MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

SYLLABUS

BACHELOR OF SCIENCE
IN
MECHANICAL ENGINEERING

REVISED ON DECEMBER 2020

DEPARTMENT OF MECHANICAL ENGINEERING (ME)
MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY(MIST)
MIRPUR CANTONMENT, DHAKA- 1216, BANGLADESH

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CHAPTER 1

GENERAL INFORMATION

1.1. Introduction to MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT) and other foreign institutions of science and technology. With a view to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) that promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. The motto of MIST is ―Technology for Advancement. Founded on 19 April 1998, MIST started its journey on 31 January 1999 by offering a four-year bachelor's degree on Civil Engineering. Bachelor’s degree on Computer Science Engineering course started on 2001**.** Bachelor courses on Electrical, Electronic & Communication Engineering and Mechanical Engineering started its journey from 2003. Bachelor of Science program on Aeronautical Engineering (AE) and Naval Architecture and Marine Engineering (NAME) program were started from 2008-2009 and 2012-2013 respectively. Besides, four new departments started their academic session from 2014-2015 i.e. Nuclear Science & Engineering (NSE), Biomedical Engineering (BME), Architecture (Arch) and Environmental, Water Resources & Coastal Engineering (EWCE).

1.2 Vision and Mission of MIST

Vision: To be a centre of excellence for providing quality education in the field of science, engineering and technology and conduct research to meet the national and global challenges.

Mission: MIST is working on following missions:

a. Provide comprehensive education and conduct research in diverse disciplines of science, engineering, technology and engineering management.

b. Produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the socio- economic development of Bangladesh and global needs.

c. Conduct collaborative research activities with national and international communities for continuous interaction with academia and industry.

d. Provide consultancy, advisory, testing and other related services to government, non-government and autonomous organization including personal for widening practical knowledge and to contribute in sustainable development of the society.

1.3 Motto and Values of MIST

Motto: As an Institution without gender biasness, MIST is steadily upholding its motto **“Technology for Advancement**” and remains committed to contributing to the wider spectrum of national educational arena, play a significant role in the development of human resources and gradually pursuing its goal to grow into a '**Centre of Excellence**'.

Values:

a. Integrity and Respect-We embrace honesty, inclusivity, and equity in all that we do.

b. Honesty and Accountability-Our actions reflect our values, and we are accountable for both.

c. Dedication to Quality and Intellectual Rigor-We strive for excellence with energy, commitment and passion.

d. Pursuit of Innovation-We cultivate creativity, adaptability and flexibility in our students, faculty and staff.

1.4 <u>Eligibility of Students for Admission in MIST</u>

The students must fulfill the following requirements:

a. **Bangladeshi Students.** Minimum qualifications to take part in the admission test are as follows:

(1) The applicant must have passed SSC/equivalent examination in Science Group obtaining GPA 4.00 (without fourth subject) in the scale of 5.0 and in HSC/Equivalent examination from Board of Intermediate and Secondary Education/Madrasa Education Board/Technical Education Board in science group the applicant must have obtained minimum 'A+' (Plus) in any TWO(2) subjects out of FIVE (5) subjects including Mathematics, Physics, Chemistry, English, and Bengali and 'A' in rest THREE (3) subjects.

(2) The applicant must have qualified in minimum five subjects including Mathematics, Physics, Chemistry and English Language with minimum 'B' in average in GCE 'O' Level and in 'A' level he/she must have obtained minimum 'A' in ONE subject out of three subjects including Mathematics, Physics, and Chemistry with and minimum 'B' in rest TWO subjects.

(3) Applicants who have passed HSC or Equivalent examination in the current year or one year before the notification for admission can apply.

(4) Sex: Male and Female.

b. **Foreign Students.** Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

(1) Educational qualifications as applicable for Bangladeshi civil students or equivalent.

(2) Must have security clearance from respective Embassy/High Commission in Bangladesh.

(3) Sex: Male and Female.

In the event of non-availability of foreign students, Bangladeshi civil candidates will fill up the vacancies.

1.5 Number of Seats

The highest number of seats for 04(Four) years bachelor's degree in engineering programs (Unit – A) and 5 (Five) years bachelor's degree of Architecture programmes at MIST are as follows:

Allocation of Seats

Ser.	Unit	Department	Seats
1	A	Civil Engineering (CE)	60
2		Computer Science and Engineering (CSE)	60
3		Electrical, Electronic & Communication Engineering (EECE)	60
4		Mechanical Engineering (ME)	60
5		Aeronautical Engineering (AE)	50
6		Naval Architecture and Marine Engineering (NAME)	40
7		Biomedical Engineering (BME)	40
8		Nuclear Science and Engineering (NSE)	40
9		Civil & Environmental Engineering	60
		Civil & Water Resources Engineering	
10		Industrial and Production Engineering (IPE)	50
11		Petroleum and Mining Engineering (PME)	25
12	**B**	Architecture (Arch)	25
	Total		570

At MIST, the total number is 570. In general, about 50% seats will be allocated to military officers. However, in case of the requirement of military students', vacancy is less in any particular year. The deficient vacancy will be filled up by civil students. MIST also maintains quota as mentioned below:

Allocation of Quota

Ser.	Quota Types	Seats
1	General Candidates	54%
2	Children of Military Personnel	40%
3	Children of Freedom Fighters	2%
4	Tribal Citizen	1%
5	International Students	3%
	Total	100%

1.6 Admission Procedure

1.6.1 Syllabus for Admission Test. Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (comprehension and functional) subjects of HSC examinations of all boards of secondary and higher secondary school certificates. Admission test will be conducted out of 200 marks and the distribution of marks is given below:

Marks Distribution in the Admission Test

Ser.	Subjects	Marks
a.	Mathematics	80
b.	Physics	60
c.	Chemistry	40
d.	English	20
		Total = 200

1.6.2 Final Selection. Students will be selected on the basis of results of the admission test. Individual choice for selection of departments will be given preference as far as possible. In case of tie in the result of admission test, difference will be judged on the basis of marks obtained in Mathematics, Physics, Chemistry and English respectively in admission test.

1.6.3 Medical Checkup. Civil candidates selected through admission test will go for medical checkup in MIST/CMH. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in medical policy of MIST will be declared unsuitable for admission.

1.7 Students Withdrawal Policy

1.7.1 For Poor Academic Performance. The undergraduate (B. Sc.) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms for Architecture program it is planned for 3 & regular levels, comprising of 10 regular terms. It is expected that all students will earn degree by clearing all the offered courses in the stipulated time. In case of failure the following policies will be adopted:

a. Students failing in any course/subject will have to clear/pass the said course/subject by appearing it in supplementary/self-study (for graduating student) examination as per examination policy.

b. Students may also retake the failed subject/course in regular term/short term as per Examination policy.

c. Maximum grading for supplementary/self-study examination etc. of failed subjects will be B+ as per examination policy.

d. One student can retake/reappear in a failed subject/course only twice. However, with the Permission of Academic Council of MIST, a student may be allowed for third time as last chance.

e. In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council, MIST. However, he/she has to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

f. Minimum credit requirement for the award of bachelor’s degree in Engineering (B. Sc. Engg) and Architecture (B. Arch) will be decide by the respective department as per existing rules. However, the minimum CGPA requirement for obtaining a bachelor’s degree in engineering and Architecture is 2.20.

g. Whatever may be the cases, students have to complete the whole undergraduate Program within 06 (six) academic years from the date of registration.

h. All other terms and condition of MIST Examination Policy remain valid.

1.7.2 Expellation on Disciplinary Ground.

a. **Unfair Means.** Adoption of unfair means may result in expulsion of a student from the program and so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

(1) Communicating with fellow students for obtaining help in the examination.

(2) Copying from another student’s script/ report /paper.

(3) Copying from desk or palm of a hand or from other incrimination documents.

(4) Possession of any incriminating document whether used or not.

b. **Influencing Grades.** Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

c. **Other Indiscipline Behaviors.** Academic Council may expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/ program or is considered detrimental to MIST’s image.

d. **Immediate Action by the Disciplinary Committee of MIST.** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the Institution. In case of withdrawal/expulsion, the matter will be referred to the Academic Council, MIST for post-facto approval.

1.7.3 Withdrawal on Own Accord.

a. **Permanent Withdrawal.** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.

b. **Leave of Absence for certain number of semesters (1-2).** A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to approval of Academic Council of MIST, but he/she has to complete the whole program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

CHAPTER 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT MIST

2.1 Introduction

MIST has started course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This policy will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

2.2 The Course System

The salient features of the Course System are as follows:

a. Number of theory courses will be generally 06 or as per syllabus in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow up to 07 courses in exceptional cases if dept can accommodate within 24 cr hr.

b. Students will not face any level repeat for failing.

c. Students will get scope to improve their grading.

d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.

e. Continuous evaluation of students' performance.

f. Promotion of student-teacher interaction and contact.

Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on the study of several subjects in humanities and social sciences.

The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science and humanities subjects; while the third and subsequent years focus on specific disciplines

2.3 Number of Terms in a Year

There will be two terms Spring Term (Jan-Jun) and Fall Term (Jul-Dec) in an academic year.

2.4 Duration of Terms

The duration of each of Spring Term and Fall Term (maximum 22 weeks) may be as under:

Ser.	Events	Durations
1.	Classes before Mid Term	7 weeks
2.	Mid Term Vacation	1 week
3.	Classes after Mid Term	7 weeks
4.	Makeup Classes and Preparatory leave	2/3 weeks
5.	Term Final Examination	2/3 weeks
6.	Term End Vacation	1/2 week

2.5 Course Pattern and Credit Structure

The undergraduate program is covered by a set of theoretical courses along with a set of laboratories (sessional) courses to support them.

2.6 Course Designation System

Each course is designated by a maximum of three/four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

a. The first digit corresponds to the year/level in which the course is normally taken by the students.

b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

c. The last digit is an odd number for theoretical courses and an even number for sessional courses.

The course designation system is illustrated as Follows:

ME 161 **Introduction to Mechanical Engineering**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1st Year/ 1st Level course
Department Identification

ME 202 **Basic Thermodynamics Sessional**

Course Title
Even digit designates a sessional course
Reserved for departmental use
Signifies 2nd Year/ 2nd Level course
Department Identification

2.7 Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. Theoretical Courses: One lecture per week per term is equivalent to one credit.

b. Sessional Courses: Credits for sessional courses is half of the class hours per week per term.

Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another

2.8 Types of Courses

The types of courses included in the undergraduate curricula are divided into the following groups:

a. Core Courses: In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete all the designated core courses of his/her discipline.

b. Prerequisite Courses: Some of the core courses are identified as prerequisite courses for a specific subject.

c. Optional Courses: Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

2.9 Course Offering and Instruction

2.9.1 The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.

2.9.2 Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e., on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

2.10 Course Instructor-Student Interaction

The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

2.11 Student Adviser

2.11.1 One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

2.11.2 However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

2.11.3 For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous term. The adviser may permit the student to drop one or more courses based on previous academic performance.

2.12 Course Registration

Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

2.12.1 Registration Procedure. At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

2.12.2 Pre-conditions for Registration.

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.

b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre- requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre- requisite course is found to be satisfactory.

2.12.3 Registration Deadline. Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

2.12.4 Penalty for Late Registration. Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

2.13 <u>Limits on the Credit Hours to be taken</u>

2.13.1 A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

2.13.2 In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Comdt, a lesser number of credit hours to suit individual requirements. Only graduating students may be allowed to register less than 15 Cr Hr without approval of Commandant. A list of all such cases to be forwarded to Register Office, ICT dte and Controller of Exam Office by the respective Department.

2.14 <u>Course Add/Drop</u>

2.14.1 A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular term. Dropping a course is permitted within the first four weeks of a regular term. Add or drop is not allowed after registration of courses for Supplementary-I and Supplementary-II Examination.

2.14.2 Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar's Office, where the required numbers of photocopies are to be made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.

2.14.3 All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

2.15 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However, application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

2.16 The Grading System

The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva- voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree.

Letter grades and corresponding grade points will be given as follows:

Grading System

Numerical Markings	Grade	Grade Points
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25
40% to below 45%	D	2.00
below 40%	F*	0.00
	AB	Absent
	DC	Dis-collegiate
	VW	Voluntary Withdrawn
	X	Project/ Thesis Continuation
	E	Expelled
	S	Satisfactory

* Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

2.17 Distribution of Marks

2.17.1 Theory. Forty percent (40%) of marks of a theoretical course shall be allotted for Continuous Assessment, i.e., assignments, class tests, pop quizzes, observations, projects and mid-term assessment. These marks must be submitted to Office of the Controller of Examinations before commencement of the final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes. Distribution of marks for a given course per credit is as follows:

Class Performance	5%
Class Attendance	5%
Class Test/Assignment	20%
Mid-Term Assessment (Exam/Project)	10%
Final Examination (Section A & B)	60%
Total	100%

Basis for awarding marks for class attendace will be as follwos:

Class Attemdace	Marks
90% and above	100%
85% to less than 90%	90%
80% to less than 85%	80%
75% to less than 70%	70%
70% to less than 75%	60%
Below 70%	00%

Note:

a. In final exam, each section can be used for achieving not more than two course outcomes (COs). The remaining COs should be attained from mid-term assessment or class tests. Course teacher has to inform the student the beginning of the terms.

b. Course teacher of a particular course has to inform the department whether he/she wants to assess mid-term through exam or project within first two weeks of beginning of a term. The duration of mid-term examination should not be more than 50 minutes which has to be conducted in between 6^{th} to 9^{th} week of a semester. If mid-term assessment is done through project, then there should be project report and presentation.

c. The weightage of class performance can be assessed through checking attentiveness during classes or arranging unnoticed pop quizzes.

d. The number of class tests shall be n for 3.0 and above credit courses and (n-1) shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3.

e. All class test will carry 20 marks each. Exam software system will finally convert these achieved marks into total class test marks as per credit hour. i.e for n=1(20), n=2 (40), n=3 (60), n=4(80) etc.

f. Irrespective of the result of the continuous assessment (class performance, class test, mid-term assessment), a student has to appear in the final examination (where applicable) for qualifying/passing the concern course/ subject.

2.17.2 Sessional/Practical Examinations. Laboratory/sessional courses are designed and conducted by the concerned departments. Examination on laboratory/sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the laboratory/sessional courses on the basis of the followings:

Conduct of Lab Tests/Class Performance	25%
Report Writing/Programming	15%
Mid-Term Evaluation (exam/project/assignment)	20%
Final Evaluation (exam/project/assignment)	30%
Viva Voce/Presentation	10%
Total	100%

Note: the above distribution of percentage is a general guideline. Department can rearrange to some extent if required.

2.17.3 Sessional Course in English. The distribution will be as under:

Class performance/observation	10%
Written Assignment	15%
Oral Performance	25%
Listening Skill	10%
Group Presentation	30%
Viva Voce	10%
Total	100%

2.17.4 Class Attendance. Class attendance may be considered as a part of continuous assessment. No mark will be allotted for attending classes.

2.18 Collegiate and Non-collegiate

Students having class attendance of 85% or above in individual subject will be treated as collegiate and less than 85% and up to 70% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear in the examination subject to payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 70% will be treated as dis-collegiate and will not be allowed to appear in the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

2.19 Calculation of CGPA

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes *n* courses in a term having credits of C1, C2, ..., Cn and his grade points in these courses are G1, G2, ...
Gn respectively, then

$$GPA = \frac{\textit{Grade points earned in the semester}}{\textit{Credits completed in the semester}}$$

$$= \frac{\textit{Summation of (Credit hours in a course} * \textit{ Grade point earned in that course)}}{\textit{Total number of credit hours completed}}$$

$$= \frac{\sum_{i=1}^{n} Ci * Gi}{\sum_{i=1}^{n} Ci}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of TC1, TC2, ..., TC n and his GPA in these terms are GPA1, GPA2, , GPA n, respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TCi * GPAi}{\sum_{i=1}^{n} TCi}$$

A Numerical Example

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credits, C_i	Grade	Grade Points, G_i	C_I*G_i
ME 160	1.50	A-	3.50	5.250
ME 165	3.00	A+	4.00	12.000
CHEM 101	3.00	A	3.75	11.250
MATH 141	3.00	B	3.00	9.000
HUM 101	3.00	B-	2.75	8.250
HUM 103	3.00	B	3.00	9.000
PHY 105	3.00	A+	4.00	12.000
CSE 102	1.50	A	3.75	5.625
Total	21.00			72.375

GPA = 72.375/21.00 = 3.45

Suppose a student has completed four terms and obtained the following GPA.

Level	Term	Credit Hours Earned, TC_I	GPA Earned, GPA_i	GPA_i*TC_i
1	1	21.00	3.73	78.330
1	2	20.50	3.93	80.565
2	1	19.75	3.96	78.210
2	2	20.25	4.00	81.000
Total		**81.50**		**318.105**

CGPA = 318.105/81.50 = 3.90

2.20 Impacts of Grade Earned

2.20.1 The courses in which a student has earned a 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an 'F' grade will not be counted towards his/her earned credits or GPA calculation. However, the 'F' grade will remain permanently on the Grade Sheet and the Transcript.

2.20.2 A student who obtains an 'F' grade in a core course will have to repeat that particular course. However, if a student gets an 'F' in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an 'F', he/she will not be eligible to get a grade better than 'B+' in that repeated course.

2.20.3 If a student obtains a grade lower than 'B+' in a particular course he/she will be allowed to repeat the course only once for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than 'B+' for an improvement course.

2.20.4 A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. program.

2.20.5 If a student obtains a 'B+' or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

2.21 Classification of Students

At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Level	Credit Hours Earned	
	Engineering/URP	Architecture
Level 1	0.0 to 36.0	0.0 to 34.0
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0
Level 4	More than 108.0	More than 110.0 to 147.0
Level 5		More than 147.0

However, before the commencement of each term all students other than new batch are classified into three categories:

Category 1: This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

Category 2: This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

Category 3: This category consists students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

2.22 Definition of Graduating Student. Graduating students are those students who will have ≤ 24 credit hour for completing the degree requirement.

2.23 Performance Evaluation

2.23.1 The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

2.23.2 Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists:

a. The term GPA falls below 2.20.

b. The Cumulative Grade Point Average (CGPA) falls below 2.20.

c. The earned number of credits falls below 15 times the number of terms attended.

2.23.3 All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and supplementary exams, if there are any, with better grades. When the minimum GPA and credit requirements are achieved the student is again returned to good standing.

2.24 Minimum Earned Credit and GPA Requirement for Obtaining Degree

2.24.1 Minimum credit hour requirements for the award of Bachelor's degree in engineering (BSc Engg) and architecture (B Arch) will be decided by the respective department (BUGS). However, the syllabus of all BSc engineering prog must be of minimum 157 credit hours or more and for architecture prog minimum 189 credit hours or more. A student must earn minimum credit hour set in the syllabus by the concerned department for qualifying Bachelor's Degree. The minimum CGPA requirement for obtaining a Bachelor's degree in engineering and architecture is 2.20.

2.24.2 A student may take additional courses with the consent of his/her Adviser in order to raise CGPA, but he/she may take a maximum of 15 such additional credits in engineering and 18 such additional credits in architecture beyond respective credit-hour requirements for Bachelor's degree during his/her entire period of study.

2.25 Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

2.26 Time Limits for Completion of Bachelor's Degree

A student must complete his/her studies within a maximum period of six years for engineering and seven years for architecture bachelor's degrees.

2.27 Attendance, Conduct and Discipline

MIST has strict rules regarding the issues of attendance in class and discipline.

2.27.1 Attendance. All students are expected to attend classes regularly. MIST believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

2.27.2 Conduct and Discipline. During their stay in MIST all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms, and drug abuse and addiction are strictly observed in the campus

2.28 Teacher-Student Interaction

The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator (CC) is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

2.29 Absence during a Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an F grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g., CMH/MIST Medical Officer).

2.30 Recognition of Performance

Following different types of final examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. Term Final Examination: At the end of each normal term (after 22wk or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. Supplementary Examination: It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) / Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.

c. Improvement Examination: It will be taken during Supplementary-I and Supplementary-II Examination. Questions will be same as the question of the regular examination of that Supplementary Examination (if any). Student can take maximum two subjects at a time (two subjects in supplementary-I and one subject in supplementary-II) and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than ‘B+’ in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better then ‘B+’ for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i,e previous to improvement examination, shall be reflected in the transcript.

2.31 <u>Rules of Different Examinations</u>

2.31.1 Term Final Examination. Following rules to be followed:

a. Registration to be completed before commencement of the Term. A student has to register his desired courses paying registration, examination fee and other related fees.

b. Late registration will be allowed without penalty within first two weeks of the term.

c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.

d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.

e. Term Final Examination to be conducted in the 18th-20th week of the term as per approved Academic Calendar.

2.31.2 Supplementary Examination. Following rules to be followed:

a. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) / Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively.

b. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.

c. No class will be conducted.

d. 40% marks will be considered from the previous exams.

e. Maximum grading in Supplementary Exam will be ‘B+’.

f. No Sessional Exam will be conducted.

g. Examination will be taken on 60% marks like Term Final Examination.

h. If a student fails in a course more than once in regular terms, then for calculating 40% marks best one of all continuous assessment marks will be counted.

i. If anyone fails in the laboratory/sessional course, that course cannot be taken in the supplementary examination.

j. If any student fails in a course, he can clear the course retaking it 2nd time or, he can clear the examination appearing at the supplementary examination as well. Any one fails twice in a course, can only retake it in the regular term for appearing third time. But anyone fails even after appearing third time. He/she has to take approval of Academic Council of MIST for appearing 4th (last) time in a course and need to pay extra financial penalty. If any student fails even 4th time in a course, will not be allowed to appear anymore in this same course

k. Registration of Supplementary-I Exam to be done within 5th wk after completion of Fall Term (July to Dec) and registration of Supplementary-II exam to be done during the Mid-Term break of Spring Term (Jan to Jun), paying all the required fees.

l. There will be no provision for add/drop courses after registration.

m. Question Setting, Moderation, and Result Publication to be done following the same rules of Spring (Jan to Jun) / Fall (July to Dec) Term Final Exam as per existing Examination Policy.

n. Moderation of the questions for Supplementary-I will be done in the 5th week after completion of Fall Term (July to Dec) Final Exam and Supplementary- II with the moderation of the questions of Spring Term (Jan to Jun).

o. Separate Tabulation sheet to be made.

p. Thesis: if a student cannot complete thesis in two consecutive terms, with the recommendation of the supervisor, he/she may continue for next one/two term within six academic years.

2.31.3 Improvement Examination. Following rules to be followed:

a. Improvement examination is to be taken during the Supplementary-I and Supplementary-II examinations.

b. For Improvement examination, registration is to be done during the registration of Supplementary-I and Supplementary-II examinations by paying all the fees.

c. Question Setting, Moderation and Result Publication to be done with courses of Supplementary-I and Supplementary-II examinations.

d. Any student gets a grading below ‘B+’ and desires to improve that course, he will be allowed to appear the improvement examination for that particular course.

e. Highest grade of Improvement examination will be ‘B+’.

f. One student is allowed to appear at Improvement exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time (two courses at supplementary-I and one course at supplementary-II).

2.32 Irregular Graduation

If any graduating student clears his/her failed course in Spring Term/Fall Term/ Supplementary examinations and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Spring Term/Fall Term/Supplementary examinations and that student will be allowed to apply for provisional certificate.

CHAPTER 3

DEPARTMENT OF MECHANICAL ENGINEERING

3.1 Introduction to the program

Department of ME commenced undergraduate programs from January 2003 with 45 students. Mechanical Engineers apply the principles of mechanics and energy to the design of machines and devices. They must be able to control mechanical systems and usually work with other professionals in designing these systems. Automobiles, engines, heating and air-conditioning system, gas and steam turbines, air and space vehicles, trains, ships, servomechanisms, transmission mechanisms, machine tools, material handling systems, elevators and escalators, and robots used in industry are a few of the systems and devices requiring mechanical engineering knowledge.

The Department of Mechanical Engineering offers dynamic educational programs and a faculty poised to deliver quality engineering education. The department also offers studies leading to the Bachelor of Science in Mechanical Engineering (BSc in ME), Master of Science in Mechanical Engineering (MSc in ME) and Doctor of Philosophy in Mechanical Engineering (PhD in ME). With its excellent professional views and capabilities of teaching, BSc in Mechanical Engineering (BSc in ME) degree program has received accreditation from BAETE, IEB with a grade as “Good”.

3.2 Vision and Mission of the Program

Vision: To be nationally and internationally recognized in providing world class mechanical engineering education, producing qualified engineers who are innovative, immediate contributors to their profession and society and successful in advanced studies and research.

Mission:

1. To educate and motivate the students through well designed curriculum for knowing the fundamental and technical knowledge in Mechanical Engineering discipline.

2. To produce skilled human resources capable of investigation, analysis and design solutions for relevant technical problems while also adhering to social values.

3. To enhance technical as well as entrepreneurship skills with ethical values through collaborations with various academic institutions, research organizations and industries.

4. To promote Research and Development (R&D) for technological innovations in the emerging areas of mechanical engineering

3.3 Program Outcomes

Based on the suggestion of Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Bachelor in Mechanical Engineering program will have following learning outcomes:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.

4. **Investigation:** Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

5. **Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

7. **Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.

9. **Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.

10. **Communication:** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multi-disciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

3.4 Generic Skills

1. Apply the principles and theory of mechanical engineering knowledge to the requirements, design and development of different mechanical systems with appropriate understanding.

2. Define and use appropriate research methods and modern tools to conduct a specific project.

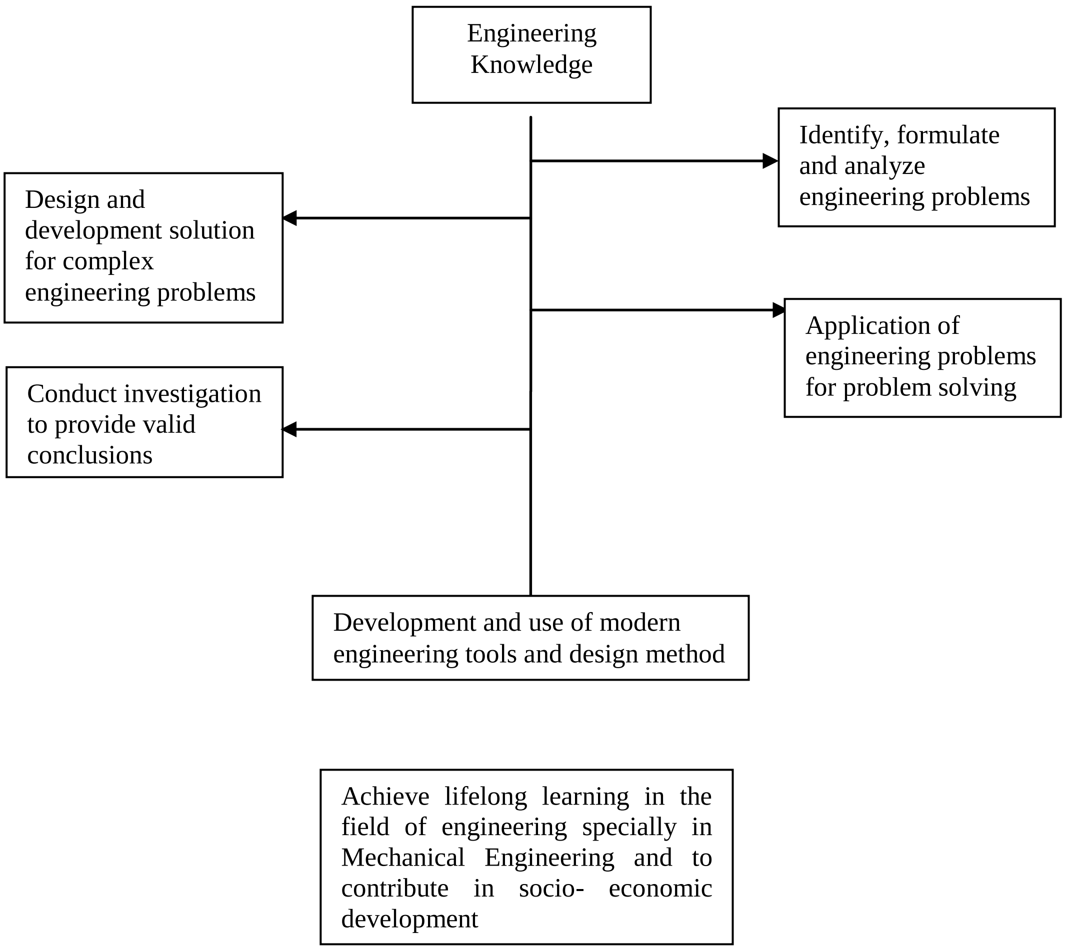
3. Learn independently, be self- aware and self- manage their time and workload.

4. Apply critical thinking to solve complex engineering problems

5. Analyze real time problems and justify the appropriate use of technology

6. Work effectively with others and exhibit social responsibility

3.5 Curriculum/Skill mapping



CHAPTER 4

COURSE CURRICULUM FOR BACHELOR DEGREE IN ME

4.1 Course Schedule

Keeping the above-mentioned program outcome, the course schedule for the undergraduate students of the Department of Mechanical Engineering is given below:

Table: Summary of Course Curriculum

Level-Term	General Education Cr Hr	Math Cr Hr	Basic Science Cr Hr	Dept Engg Cr Hr	Allied Engg Cr Hr	Optional Courses Cr Hr	Total Cr Hr
1-I	2.0+0.0	3.0+0.0	3.0+1.5	5.0+3.0	3.0+0.0	-	20.50
1-II	0.0+1.5	3.0+0.0	3.0+1.5	3.0+1.5	3.0+1.5	-	18.00
2-I	0.0+1.5	3.0+0.0	-	6.0+3.0	3.0+1.5	-	18.00
2-II	2.0+0.0	3.0+0.0	-	12.0+4.5	-	-	21.50
3-I	2.0+2.0	-	-	13.0+4.5	-	-	21.50
3-II	2.0+0.0	-	-	11.0+6.5	-	-	19.50
4-I	2.0+0.0	-	-	9.0+4.5	-	6.0**+0.0	21.50
4-II	4.0+0.0	-	-	3.0+3.0	2+1.5	6.0**+0.0	19.50
Total	14.0+5.0 =19.0	12.0+0.0 =12.0	6.0+3.0 =9.0	62.0+30.50 = 92.50	11+4.5 =15.5	12+0 =12.0	160.00
% of total theory course	11.97%	10.26%	5.13%	52.99%	9.40%	10.25%	
% of total course	11.88%	7.5%	5.63%	57.81%	9.68%	7.5%	

**To be selected from the List of Elective Courses

4.2 Contact Hours and Credit Hours Distribution in Eight Terms

Level Term	**Contact hours for theory courses**	**Contact hours for sessional courses**	**Cumulative contact hours**	**Cumulative credit hours**
1-I	16.0	9.0	25.0	20.50
1-II	12.0	12.0	49.0	38.5
2-I	12.0	12.0	73.0	56.5
2-II	17.0	9.0	99.0	78.0
3-I	15.0	13.0	127.0	99.5
3-II	13.0	11 + 04 Weeks	151+ 04 Weeks	119

4-I	17.0	9.0	175+ 04 Weeks	140.5
4-II	15.0	9.0	199+ 04Weeks	160.00
Total	119.0	79.5+ 04 Weeks	**199 + 04 Weeks**	**160.00**

4.3 Term-wise Distribution of Courses

LEVEL- 1 TERM-I

Course No	Course Name	Type of Course	Contact hours	Credit Hours
ME 161	Introduction to Mechanical Engineering	Theory	2.00	2.00
ME 103	Thermodynamics	Theory	3.00	3.00
EECE 159	Fundamentals of Electrical Engineering	Theory	3.00	3.00
PHY 101	Waves and Oscillations, Optics and Modern Physics	Theory	3.00	3.00
MATH 101	Differential and Integral Calculus	Theory	3.00	3.00
GEBS 101	Bangladesh Studies	Theory	2.00	2.00
			16.00	**16.00**
PHY 102	Physics Sessional	Sessional	3.00	1.50
ME 104	Thermodynamics Sessional	Sessional	3.00	1.50
SHOP 162	Workshop Practice Sessional	Sessional	3.00	1.50
			9.00	**4.50**
Contact hours: **25.00**; Credit hours: **20.50**				

LEVEL-1 TERM-II

Course No	Course Name	Type of Course	Contact hours	Credit Hours
ME 193	Engineering Materials	Theory	3.00	3.00
CHEM 101	Fundamentals of Chemistry	Theory	3.00	3.00
MATH 103	Differential Equations and Matrix	Theory	3.00	3.00
EECE 173	Electrical and Electronics Technology	Theory	3.00	3.00
			12.00	**12.00**
CHEM 102	Chemistry Sessional	Sessional	3.00	1.50
LANG102	Communicative English I	Sessional	3.00	1.50
ME 194	Engineering Materials Sessional	Sessional	3.00	1.50
EECE 174	Electrical and Electronics Technology Sessional	Sessional	3.00	1.50
			12.00	**6.00**
Contact hours: **24.00**; Credit hours: **18.00**				

LEVEL –2, TERM – I

Course No	Course Name	Type of course	Contact hours	Credit hours
CSE 275	Computer Programming Language	Theory	3.00	3.00
ME 245	Engineering Mechanics-I	Theory	3.00	3.00
MATH 201	Vector Analysis, Laplace Transform& Co-ordinate Geometry	Theory	3.00	3.00
ME 205	Heat and Mass Transfer	Theory	3.00	3.00
			12.00	**12.00**
CSE 276	Computer Programming Language Sessional	Sessional	3.00	1.50
ME 258	Mechanical Engineering Drawing –I	Sessional	3.00	1.50
ME 206	Heat and Mass Transfer Sessional	Sessional	3.00	1.50
LANG202	Communicative English II	Sessional	3.00	1.50
			12.00	**6.00**
Contact hours: **24.00**; Credit hours: **18.00**				

LEVEL-2, TERM –II

Course No	Course Name	Type of course	Contact hours	Credit hours
ME 247	Engineering Mechanics - II	Theory	3.00	3.00
ME 233	Manufacturing Technology	Theory	3.00	3.00
ME 207	Heat Transfer Equipment Design	Theory	3.00	3.00
MATH 215	Complex Variable, Harmonic Function and Fourier Analysis	Theory	3.00	3.00
GELM 275	Leadership and Management	Theory	2.00	2.00
ME 263	Numerical Analysis	Theory	3.00	3.00
			17.00	**17.00**
ME 234	Manufacturing Technology Sessional	Sessional	3.00	1.50
ME 264	Numerical Analysis Sessional	Sessional	3.00	1.50
ME 260	Mechanical Engineering Drawing –II	Sessional	3.00	1.50
			9.00	**4.50**
Contact hours: **26.00**; Credits hours: **21.50**				

LEVEL – 3, TERM –I

Course No	Course Name	Type of course	Contact hours	Credit hours
ME 361	Instrumentation and Measurement	Theory	2.00	2.00
ME 343	Mechanics of Solids	Theory	3.00	3.00
ME 375	Control Engineering	Theory	2.00	2.00
ME 303	Power plant Engineering	Theory	3.00	3.00
ME 321	Fluid Mechanics-I	Theory	3.00	3.00
GEE 305	Fundamentals of Economics	Theory	2.00	2.00
			15.00	**15.00**
ME 344	Mechanics of Solids Sessional	Sessional	3.00	1.50
ME 376	Control Engineering Sessional	Sessional	3.00	1.50
ME 304	Power plant Engineering Sessional	Sessional	3.00	1.50
GERM 352	Fundamentals of Research Methodology	Sessional	4.00	2.00
			13..00	**6.50**
Contact hours: **28.00;** Credit hours: **21.50**				

LEVEL –3, TERM – II

Course No	Course Name	Type of course	Contact hours	Credit hours
GES 307	Fundamentals of Sociology	Theory	2.00	2.00
ME 345	Mechanics of Machinery	Theory	3.00	3.00
ME 323	Fluid Mechanics-II	Theory	2.00	2.00
ME 341	Machine Design	Theory	3.00	3.00
ME 367	Automobile Engineering	Theory	3.00	3.00
			13.00	**13.00**
ME 324	Fluid Mechanics Sessional	Sessional	3.00	1.50
ME 346	Mechanics of Machinery Sessional	Sessional	3.00	1.50
ME 368	Automobile Engineering Sessional	Sessional	3.00	1.50
ME 366	Engineering Simulation	Sessional	2.00	1.00
ME 372*	Industrial Training	Training	4 weeks	1.00
			11 Hr + 4 weeks	**6.50**
Contact hours: **24.00 + 04** Weeks; Credit hours: **19.50**				

* Will be conducted after the completion of Level- 3, at any convenient time as can be arranged by the Department.

LEVEL – 4, TERM – I

Course No	Course Name	Type of course	Contact hours	Credit hours
GEPM 467	Project Management & Finance	Theory	2.00	2.00
ME 421	Fluid Machinery	Theory	3.00	3.00
ME 401	IC Engine	Theory	3.00	3.00
ME 405	Heating, Ventilation and Air conditioning	Theory	3.00	3.00
Optional I[1]	Selected from prescribed optional subjects	Theory	3.00	3.00
Optional II[1]	Selected from prescribed optional subjects	Theory	3.00	3.00
			17.00	**17.00**
ME 402	IC Engine Sessional	Sessional	3.00	1.50
ME 400	Final Year Design and Research Project - I	Sessional	6.00	3.00
			9.00	**4.50**
Contact hours: **26.00**; Credit hours: **21.50**				

LEVEL – 4, TERM – II

Course No	Course Name	Type of course	Contact hours	Credit hours
ME 445	Noise and vibration	Theory	3.00	3.00
GESL 407	Environment, Sustainability and Law	Theory	2.00	2.00
GEEM 437	Engineering Ethics & Moral Philosophy	Theory	2.00	2.00
IPE 463	CAD/CAM	Theory	2.00	2.00
Optional III[2]	Selected from prescribed optional subjects	Theory	3.00	3.00
Optional IV[2]	Selected from prescribed optional subjects	Theory	3.00	3.00
			15.00	**15.00**
IPE 464	CAD/CAM Simulation sessional	Sessional	3.00	1.50
ME 400	Final Year Design and Research Project - II	Sessional	6.00	3.00
			9.00	**4.50**
Contact hours: **24.00;** Credit hours: **19.50**				

4.4 <u>List of Elective Courses</u>

Course No	Course Name	Level-Term	Contact Hours	Credit Hours
ME 407	Advanced Thermodynamics	4-I or 4-II	3.0	3.00
ME 409	Renewable Energy	4-I or 4-II	3.0	3.00
ME 411	Combustion and Pollution	4-I or 4-II	3.0	3.00
ME 413	Energy and Environment	4-I or 4-II	3.0	3.00
ME 415	Advanced Programming with MATLAB	4-I or 4-II	3.0	3.00
ME 417	Multiphase Flows	4-I or 4-II	3.0	3.00
ME 419	Introduction to Nanomaterials and Nanotechnology	4-I or 4-II	3.0	3.00
ME 423	Fluid Engineering	4-I or 4-II	3.0	3.00
ME 425	Aerodynamics	4-I or 4-II	3.0	3.00
ME 427	Applied Engineering Mathematics	4-I or 4-II	3.0	3.00
ME 429	Gas Dynamics	4-I or 4-II	3.0	3.00
ME 431	Finite Element Method	4-I or 4-II	3.0	3.00
ME 433	Fluid Power and Control	4-I or 4-II	3.0	3.00
ME 435	Introduction to CFD	4-I or 4-II	3.0	3.00
ME 437	Design of Fluid Machines	4-I or 4-II	3.0	3.00
ME 439	Biomedical Fluid Mechanics	4-I or 4-II	3.0	3.00
ME 441	Theory of Structures	4-I or 4-II	3.0	3.00
ME 447	Robotics	4-I or 4-II	3.0	3.00
ME 449	Composite Materials	4-I or 4-II	3.0	3.00
ME 451	Aircraft & Aero-engine Structure	4-I or 4-II	3.0	3.00

ME 453	Applied Aerodynamics	4-I or 4-II	3.0	3.00
ME 455	Fire Safety and Engineering	4-I or 4-II	3.0	3.00
ME 459	Preventive Maintenance	4-I or 4-II	3.0	3.00
ME 463	Petroleum Engineering	4-I or 4-II	3.0	3.00
ME 465	Automotive Chassis Engineering	4-I or 4-II	3.0	3.00
ME 467	Autotronics	4-I or 4-II	3.0	3.00
ME 469	Vehicle Dynamics	4-I or 4-II	3.0	3.00
ME 471	Bio-Engineering	4-I or 4-II	3.0	3.00
ME 473	Plastic Process Technology	4-I or 4-II	3.0	3.00
ME 475	Modern Manufacturing Technology	4-I or 4-II	3.0	3.00
ME 477	Metal Cutting Processes	4-I or 4-II	3.0	3.00
ME 479	Occupational Health and safety engineering	4-I or 4-II	3.0	3.00
ME 483	Standards and inspection	4-I or 4-II	3.0	3.00
ME 485	Introduction to Nuclear Engineering	4-I or 4-II	3.0	3.00
ME 487	Tools Engineering	4-I or 4-II	3.0	3.00
ME 489	Automobile Maintenance Engineering	4-I or 4-II	3.0	3.00
ME 491	Mems Devices - Design and Fabrication	4-I or 4-II	3.0	3.00
ME 493	Material Handling	4-I or 4-II	3.0	3.00
ME 495	Mechatronics	4-I or 4-II	3.0	3.00
ME 497	Textile Technology	4-I or 4-II	3.0	3.00
ME 499	Weapon Engineering	4-I or 4-II	3.0	3.00

CHAPTER 5

COURSE DESCRIPTION

5.1 CORE COURSES OFFERED

Spring Semester L-1, T-1

COURSE INFORMATION			
CourseCode Course Title	**ME 103** **Thermodynamics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
An understudy is acclimated with the fundamental concepts and standards of thermodynamics, as well as the application of mathematical constructs to understand energy flow and conservation. The idea of entropy, and the relationship between work and heat are emphasized with pertinent problems solving approach. The standards and concepts discussed and learned are applied in ensuing courses to address real life related problems in the field of steam cycles, internal combustion engines, air compressors, refrigeration and combustion modelling.			
OBJECTIVE			
1. Introduce to one of the most powerful engineering principles - Thermodynamics: the science of transferring energy from one place or form to another place or form. 2. Familiarize with the zeroth, first and second laws of thermodynamics and show how to apply these laws. 3. Instruct in analysing air standard cycles, such as reciprocating piston engines, gas turbine engines, vapour power cyclesand other cycles used in power plants and refrigeration units.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the Zeroth, First, Second and Third Laws of thermodynamics, and use the laws of	1, 2, 12	C1, C2, C3	1, 2, 3,	1		Q, ASG, F

	thermodynamics to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines						
CO2	Analyse the efficiency and properties of thermodynamic cycles for heat engines, refrigerators, heat pumps and other important mechanical devices.	1, 2	C1, C2, C3	1, 2, 3,	1		Q, ASG, F
CO3	Distinguish the interfaces between the ideal thermodynamic cycles and real cycles used in various applications.	1, 2	C1, C2, C3	3, 4			Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a) **Main Contents:**

I. Introduction and Basic Concepts

II. Thermodynamic Laws

III. Power Cycles

b) **Detail Contents:**

I. Basic properties — State, Process, Path, Cycle — Definitions — Pure Substance.

II. Energy — Zeroth Law — Energy transfer and first law of thermodynamics — Energy analysis of control mass and control volume system — Second law of thermodynamics — Entropy and Exergy Analysis — Third Law of Thermodynamics

III. Ideal Cycles - Carnot Cycle — Gas Power Cycle — Vapour Power Cycles — Analysis of Otto Cycle, Diesel Cycle, Brayton Cycle, Rankine Cycle— Mixture of Gases and vap

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the Zeroth, First, Second and Third Laws of thermodynamics, and use the laws of thermodynamics to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines	3	3										3
CO2	Analyse the efficiency and properties of thermodynamic cycles for heat engines, refrigerators, heat pumps and other important mechanical devices.	3	3										
CO3	Distinguish the interfaces between the ideal thermodynamic cycles and real cycles used in various applications.	1	1										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Developing solutions for thermodynamic law problems will provide knowledge from physics and mathematics.
CO1-PO2	3	Students will be able to analyse basic to complex level problems on thermodynamic laws.
CO1-PO12	3	Thermodynamic laws will be ingratiated into the students' knowledge profile.
CO2-PO1	3	Developing solutions for efficiency in various thermodynamic cycle problems will provide knowledge from physics and mathematics.
CO2-PO2	3	Students will be able to analyse basic to complex level problemson various ideal thermodynamics cycles.
CO3-PO1	1	Students will have basic knowledge of the dissimilarities between the ideal and the real thermodynamic cycles.
CO3-PO2	1	Students will also be able to analyse basic problems on real cycles.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1 – 6	**Introduction and Basic Concepts** Basic properties — State, Process, Path, Cycle — Definitions — Pure Substance.		
Class 7 – 27	**Thermodynamic Laws** Energy — Zeroth Law — Energy transfer and first law of thermodynamics — Energy analysis of control mass and control volume system — Second law of thermodynamics — Entropy and Exergy Analysis — Third Law of Thermodynamics		
Class 28 - 42	**Power Cycles** Ideal Cycles - Carnot Cycle — Gas Power Cycle — Vapour Power Cycles — Analysis of Otto Cycle, Diesel Cycle, Brayton Cycle, Rankine Cycle— Mixture of Gases and vapours		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	

REFERENCE BOOKS
1. Çengel, YunusA.;Boles, Michael A - Thermodynamics : an engineering approach 2. Michael J. Moran, Howard N. Shapiro-Fundamentals of engineering thermodynamics_ SI version-Wiley 3. Thermal-Engineering-by-Mahesh-Rathore

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code	**ME 104**	Lecture Contact Hours	**:3.00**
Course Title	**Thermodynamics Sessional**	Credit Hours	**: 1.50**
PRE-REQUISITE			
ME 103			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Thermodynamics sessional deals with the relations between heat and other forms of energy such as mechanical, electrical, or chemical energy. Given that mechanical engineering systems are based on energy exchange, students will be well familiar withrelationships that determine these exchanges. In this course, students will learn and apply a range of thermodynamic laws and principles so that they can analyze a given thermodynamic problem (such as the combustion of fuels to release heat and energy, and the translation of this release of energy into movement) and discuss operational features of various thermodynamic systems and components.			
OBJECTIVE			
1. Students will be able to apply thermodynamic laws and principles to the analysis of processes, cycles and thermodynamic hardware 2. They will explain and investigate the laws and principles of thermodynamics and use them to solve problems. 3. They can solve thermodynamics problems by appraising given information, determining which conceptstoapply, and then provide and verify an appropriate solution 4. They can communicate results through reports, sketching, and modelling			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Apply** thermodynamic laws and principles to the analysis of processes, cycles and thermodynamic hardware	1	P3			1	R, Q, LT
CO2	**Analyze** and investigate the laws and principles of thermodynamics and use them to solve problems.	2	C4			1	R, Q, LT
CO3	**Solve** thermodynamics problems by appraising given information, determining which concepts to apply, and then provide and verify an appropriate solution	3	C5			5	R, Q, LT
CO4	**Compare** results through reports, sketching, and modeling	4	P2			8	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam

COURSE CONTENT

Experiments:

1) **(a) Determination of flash point of liquid fuel**

   (b) Study of sling psychometry

2) **Viscosity test of liquid substance**
3) **Study of Vapor Compression Refrigeration Cycle (refrigeration and air conditioning unit)**
4) **Study and calibration of pressure gauge by dead weight tester**
5) **(a)Concept of pressure and pressure sensor behavior**

   (b) Study of different Speed Measuring devices

6) **Study of Split and window Air Conditioner**
7) **Study of Compressor, condenser, evaporator**
8) **Study of IC Engine**
9) **Study of industrial boilers**
10) **Study of Mechanical Heat Pump**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Apply** thermodynamic laws and principles to the analysis of processes, cycles and thermodynamic hardware	3											
CO2	**Analyze** and investigate the laws and principles of thermodynamics and use them to solve problems.		3										
CO3	**Solve** thermodynamics problems by appraising given information,			3									

	determining which concepts apply, and then provide and verify an appropriate solution												
CO4	**Compare** results through reports, sketching, and modelling				2								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	In order to identify the basics of thermodynamic tools and equipment, a fundamental knowledge of engineering would be required.
CO2-PO2	**3**	In order to perform the experiments, analyzing the problem would be necessary.
CO3-PO3	**3**	In order to solve the thermodynamics problems, the process of solution is needed to develop.
CO4-PO4	**2**	For performing experiments, data analysis and comparison of reports is needed in this laboratory.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
Total	42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation forthe Lab Test	10
Preparation for presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20

Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method
COURSE SCHEDULE

Week-1	Expt-01: (a) Determination of flash point of liquid fuel (b) Study of sling psychometry
Week-2	Expt-02: Viscosity test of liquid substance
Week-3	Expt-03: Study of Vapour Compression Refrigeration Cycle (refrigeration and air conditioning unit)
Week-4	Expt-04: Study and calibration of pressure gauge by dead weight tester
Week-5	Expt-05: (a)Concept of pressure and pressure sensor behaviour (b) Study of different Speed Measuring devices
Week-6	Expt-06: Study of Split and window Air Conditioner
Week-7	Expt-07: Study of Compressor, condenser, evaporator
Week-8	Expt-08: Study of IC Engine
Week-9	Expt-09: Study of industrial boiler
Week-10	Expt-10: Study of Mechanical Heat Pump
Week-11	Expt-11: Revision Class
Week-12	Final Lab Report Submission
Week-13	Viva

Week-14	Quiz Test

Component		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. Thermodynamics: An Engineering Approach - Yunus A. Cengel, Michael A. Boles 2. Fundamentals of Engineering Thermodynamics- Michael J. Moran &Howard N. Shapiro. 3. Fundamentals of Thermodynamics – R E Sonntag, C. Borgnakke, G J. Van Wylen.

Spring Semester L-1, T-1

COURSE INFORMATION			
Course Code **Course Title**	**ME 161** **Introduction to Mechanical Engineering**	**Lecture Contact Hours** **Credit Hours**	**: 2.00** **: 2.00**
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE
To introduce the students to different branches of mechanical engineering and their relation to various disciplines of natural science like physics, mathematics etc.

OBJECTIVE
1. Introduction to various energy sources available in the world 2. Introduction to internal combustion engines, gas turbines and their applications 3. Brief introduction to psychrometry, refrigeration and air-conditioning 4. Brief introduction to fluid machinery 5. Brief introduction to automobiles, robotics, electromechanical systems and relevant cutting-edge branches

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify the core areas of mechanical engineering	1	C1	2			Q, F
CO2	Demonstrate introductory knowledge of various engines and processes like internal combustion engines, turbines, pumps, psychrometry etc. as well as advanced areas like automobile technology, robotics, MEMS etc.	1	C1, C2	2			Q, F
CO3	Employ engineering measurements, units, and conversions to solve basic problems of mechanical engineering discipline	1	C1, C2	2,3			Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Various Energy Sources
2. Major Mechanical Applications
3. Fluid Machinery
4. Steam Generators
5. Electromechanical Systems
6. Machien Elements and Materials for Engineers

b. Detail Contents

1. Scope of mechanical engineering; Study of sources of energy conventional and renewable;
2. Major mechanical applications: Automobiles and I.C. engines; Gas turbine and jet engines
3. Fluid machinery-Fan, blower, compressor, pump
4. Steam generators and turbines; Refrigeration and air-conditioning systems
5. Electromechanical systems- Robotics, Mechatronics, MEMS, Bioengineering
6. Machine elements: Gears, bearings, spring, beam, column; Materials for mechanical engineers

(Classes will be preferably conducted in lab)

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify the core areas of mechanical engineering	1											
CO2	Demonstrate introductory knowledge of various engines and processes like internal combustion engines, turbines, pumps, psychrometry etc. as well as advanced areas like automobile technology, robotics, MEMS etc.	3											

CO3	Employ engineering measurements, units, and conversions to solve basic problems of mechanical engineering discipline	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**1**	**Students will have basic knowledge of various core areas of mechanical engineering discipline**
CO2-PO1	**3**	**Students will learn to systematically formulate various fundamental and applied concepts of engineering devices based on pure science.**
CO3-PO1	**3**	**Students will learn to perform basic calculations to solve simple engineering problems.**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Lecture	Topic	CT
Class 1 – 4	Scope of mechanical engineering; Study of sources of energy conventional and renewable	CT 1
Class 5 – 12	Automobile and Hybrid Technology — Operating principle of IC (both SI and CI) engine, Valve timing diagram, cycle diagram, relevant mathematics, Hybrid technology – Various hybrid vehicles, Types, Applications, Gas Turbine and Application—Gas turbine components, Application in aviation and power industry	
Class 13 - 18	Refrigeration and Psychrometry –Vapor compression and Absorption refrigeration, COP, Cycle, Psychrometric chart, Basic applications of psychrometric chart.	CT 02
Class 19 - 22	Steam generators and turbines; Machine elements: Gears, bearings, spring, beam, column; Materials for mechanical engineers	CT 03 and Mid Term
Class 23 - 28	Fluid Machines – Various types of pump, Operation of centrifugal pump, pump series and parallel connection, submersible pump, MEMS, NEMS, PLC introduction	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	

REFERENCE BOOKS

1. A Text Book of Thermal Engineering - R S Khurmi& J K Gupta

2. Heat Engines – D. A. Low

3. Thermal Engineering- Mahesh M Rathor

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code	**Shop 162**	LectureContact Hours	**: 3.00**
Course Title	**Workshop Technology Sessional**	Credit Hours	**: 1.50**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various welding techniques and put theory into practice. Our mission is to expose students to the construction of different mechanical machines and analyze their performance. This course is targeted to verify the working principle of types of welding, casting, molding and also to gain knowledge of different manufacturing parts from lathe, drilling, milling and drilling machine etc. and relate them with their theoretical knowledge.

OBJECTIVE

1. The student will be able to use different manufacturing (machining, welding, foundry, sheet metal working, etc.) processes required to manufacture a product from the raw materials.

2. He will be able to use different measuring, marking, cutting tools used in workshops.

3. He will be aware of safety precautions while working in a workshop.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding.	1	P3			1	R, Q, LT
CO2	Be able to **compare** different types of manufacturing processes and **select** proper fabrication tools for specific machining processes.	2, 5	P1, P3			6	R, Q, LT

CO3	**Find** out about the importance of general safety precautions on different shop floors	1	C4			1	R, Q, LT
CO4	**Develop** practical skills by performing the experiments in different sections of workshops for safety and applying later in society.	6	P3			7	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1) **Design and makingpatterns for casting**
2) **Mold making, casting and assembly of final project**
3) **Study of electric arc welding**
4) **Study of Resistance Welding/Spot Welding**
5) **Study of Welding joints and welding positions**
6) **Study of Gas Welding/cutting**
7) **Study of TIG and MIG Welding**
8) **Manufacturing machine components by using a Lathe machine**
9) **Manufacturing machine components by using a Shaper machine**
10) **Manufacturingmachinecomponents by using a Milling Machine**
11) **Manufacturingmachinecomponents by using a Drilling Machine**

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding.	3											
CO2	Be able to **compare** different types of welding and machining processes and **select** proper cutting tools for specific machining processes.		2			3							
CO3	**Find** out about the importance of general safety precautions on differentshop floors	3											
CO4	**Develop** practical skills by performing the experiments in different sections of workshops for safety and applying later in society.						2						

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to identify the basics of tools and equipment, a fundamental knowledge of engineering would be required.
CO2-PO2	**2**	In order to perform the experiments, the different manufacturing processesneed to understand and analyze.
CO2-PO5	**3**	In order to perform the experiments, knowledge selecting manufacturing tools used in modern industry is required.
CO3-PO1	**3**	For performing the experiments, safety precautions are very essential in this laboratory.
CO4-PO6	**2**	Students will acquire knowledge of how to select and apply

		appropriate techniques, resources, and modern engineering tools later in society.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation forthe Lab Test	10
Preparation fora presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Expt-01: Design and makingpatterns for casting
Week-2	Expt-02: Mold making, casting and assembly of final project
Week-3	Expt-03: Study of electric arc welding
Week-4	Expt-04: Study of Resistance Welding/Spot Welding
Week-5	Expt-05: Study of Welding joints and welding positions
Week-6	Expt-06: Study of Gas Welding/cutting

Week-7	Expt-07: Study of TIG and MIG Welding
Week-8	Expt-08: Manufacturing machine components by using a Lathe machine
Week-9	Expt-09: Manufacturing machine components by using a Shaper machine
Week-10	Expt-10: Manufacturing machine components by using a Milling Machine
Week-11	Expt-11: Manufacturing machine components by using a Drilling Machine
Week-12	Final Lab Report Submission
Week-13	Viva
Week-14	Quiz Test

Component		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Machine Shop Practice – James Anderson, W. A. Chapman.

2. Callister W. D., Material Science & Engineering, John Wiley & Sons.

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code **Course Title**	**ME 193** **Engineering Materials**	**Lecture Contact Hours** **Credit Hours**	**: 3.00** **: 3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course introduces various engineering materials including metals, composites, plastics, adhesives and recognizing the process used to construct objects from these materials and the external factors that can change the effectiveness of these materials. The course aims to equip the students with basic tools and methodologies for carrying out materials for engineering systems.			
OBJECTIVE			
1. This course introduces various engineering materials including metals, composites, plastics, adhesives and recognizing the process used to construct objects from these materials and the external factors that can change the effectiveness of these materials. 2. The course aims to equip students with basic tools and methodologies for carrying out materials for engineering systems.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	1,7	C2	1,4,7			Q, ASG, F
CO2	In-depth understanding of specialist bodies of knowledge within the engineering discipline.	1,2	C2	2,3	1		Q, ASG, F

CO3	Fluent application of engineering techniques, tools and resources.	3,6	C6	4,6	1,2		Q, F, CS
CO4	Analysis engineering materials in terms of their basic mechanical properties.	1,2	C4	4	1		Q, F, CS

CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

Concept of malleability, ductility, toughness, fatigue resistance and other properties; Mechanical and non-destructive tests of metals; Crystal structure of metals, Pig iron; Cast iron; Steels; Plain carbon and different types of allow steels; Bearing metals; Light alloys; Common metals and their alloys; Phase diagram including the Fe-FeC equilibrium diagram; Types of heat treatment; Case carburizing and nitriding.

b. Detail Contents:

Concept of malleability, ductility, toughness, fatigue resistance and other properties; Mechanical and non-destructive tests of metals; Crystal structure of metals, Pig iron: production and uses; Cast iron: production, types, uses and effects of impurities; Steels: Bessemer and open-hearth steels, production and uses; Plain carbon and different types of allow steels; Bearing metals; Light alloys; Common metals and their alloys; Phase diagram including the Fe-FeC equilibrium diagram; Types of heat treatment; Case carburizing and nitriding.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering	3						2					

	discipline.												
CO2	In-depth understanding of specialist bodies of knowledge within the engineering discipline.	3	3										
CO3	Fluent application of engineering techniques, tools and resources.			2			1						
CO4	Analysis engineering materials in terms of their basic mechanical properties.	3	3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to understand comprehensive, theory-based understanding of the underpinning natural and physical sciences**
CO1-PO7	**2**	**Application of engineering fundamentals applicable to the engineering discipline**
CO2-PO1	**3**	**Students can understand specialist bodies of knowledge to develop solutions of related case studies**
CO2-PO2	**3**	**Students will have knowledge of special bodies and will observe how this knowledge relates to engineering**
CO3-PO3	**2**	**Students will be apt in the application of engineering techniques, tools and resources**
CO3-PO6	**1**	**Students will have knowledge of application of engineering techniques, tools and resources and will observe how this knowledge relates to engineering**
CO4-PO1	**3**	**Students will be able to identify engineering materials**

CO4-PO2	**3**	**Students can apply properties of engineering materials and learn how to utilise them**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	Concept of malleability, ductility, toughness, fatigue resistance and other properties	CT 01	
Class 7-12	Mechanical and non-destructive tests of metals; Crystal structure of metals, Pig iron: production and uses	CT 02	
Class 13-21	Cast iron: production, types, uses and effects of impurities; Steels: Bessemer and open-hearth steels, production and uses; Plain carbon and different types of alloy steels	CT 03	
Class 22-27	Bearing metals; Light alloys; Common metals and their alloys	MT	
Class 28-36	Phase diagram including the Fe-FeC equilibrium diagram	MT	
Class 37-42	Types of heat treatment; Case carburizing and nitriding, Introduction to composite materials		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**20**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	MID, Final Exam	**70**	
3	MID, Final Exam	**80**	
4	Final Exam	**70**	

REFERENCE BOOKS

1. Chemistry of Engineering Materials (4th edition) – Robert B. Leighou, Publisher – Mc Graw-Hill Inc.

2. Introduction to Physical Metallurgy (2nd edition) Sidney H Avner, Publisher –Tata Mc Graw – Hill Edition.

3. Engineering Metallurgy (Part I & II) (6th edition) – Raymond A. Huggins, Publisher – Viva Books Private Ltd.

4. Materials Science and Engineering: An Introduction – W D Callister, Jr. Publisher – John Wiley and Sons, Inc (4th edition) 1997.

5. Introduction to Materials Science for Engineering – Shackleford.

6. Introduction to Physical Metallurgy – S F Avner, Publisher – Mc Graw Hill (2nd edition).

7. Physical Metallurgy for Engineers – D S Clarke and W B Verney.

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code	**ME 194**	LectureContact Hours	: **3.00**
Course Title	**Engineering Materials Sessional**	Credit Hours	: **1.50**

PRE-REQUISITE
ME 193
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
Introduction to metallographic and Metallographic sample specimen preparation, Study of Phase diagrams, Microstudy of steel, Heat treatment of steels, Micro study of cast irons.
OBJECTIVE
1. To develop an understanding among students about the basic concepts of Metallic Materials. 2. To provide initial Training in the Metallurgical Microscope. 3. The course aims to develop the basic concepts of study of phase diagrams and micro study of cast iron.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the differences in the mechanical behaviour of engineering materials based upon bond type, structure, composition, and processing.	1	P1			1	R, Q, LT
CO2	**Describe** the basic structures and repeat units for common thermoplastics and relate the distribution of molecular	2	P2			3	R, Q, LT

	weights, degree of polymerization, percent crystallinity, and glass transition temperature to properties in service.						
CO3	**Apply** ethical principles, engineering codes of ethics, and professional responsibilities in the selection of materials in engineering design.	5	P3			6	R, Q, LT
CO4	**Use** binary phase diagrams to **predict** microstructures and also to **understand** precipitation hardening.	5	P3			6	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1. **Introduction to metallographicsample specimen preparation**
2. **Study of phase diagrams**
3. **Microstructure study of Steels**
4. **Heat Treatment of steel-1**
5. **Heat Treatments of steel-2**
6. **Microstructure study of cast irons -1**
7. **Microstructure study of cast irons-2**
8. **Testing of magnetic particles**
9. **Experimental study of the laser beam cutting on acrylic sheet**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain the differences in the mechanical behaviour of engineering materials based upon	3											

	bond type, structure, composition, and processing.												
CO2	Describe the basic structures and repeat units for common thermoplastics and relate the distribution of molecular weights, degree of polymerization, percentcrystallinity, and glass transition temperature to properties in service.		2										
CO3	Apply ethical principles, engineering codes of ethics, and professional responsibilities in the selection of materials in engineering design.					3							
CO4	Use binary phase diagrams to predict microstructures and also to understand precipitation hardening.					3							

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	In order to know the mechanical properties of material, the sound knowledge of material structure is important.
CO2-PO2	**2**	In order to describe basic structures and composition of materials, knowledge of identification and formulation of engineering systems would be required
CO3-PO5	**3**	In order to apply ethical principles in material selection, knowledge of application in the proper field is also required.

CO4-PO5	**3**	Using a specific way to predict and work accordingly by understanding.It requires a good knowledge of application of materials engineering.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation forthe Lab Test	10
Preparation fora presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Introduction class
Week-2	Exp 1: Introduction to Metallographic Sample Specimen Preparation
Week-3	Exp 2: Study of phase diagrams.
Week-4	Exp 3:Microstudy of Steels.
Week-5	Exp 4:Heat Treatment of steel-1
Week-6	Exp 5: Heat Treatments of stel-2
Week-7	Exp 6: Microstudy of cast irons -1
Week-8	Exp 7: Microstudy of cast irons-2
Week-9	Exp 8: Testing of magnetic particles
Week-10	Exp 9: Experimental study of the laser beam cutting on acrylic sheet
Week-11	Final Lab Report Submission
Week-12	Lab Test
Week-13	Viva
Week-14	Quiz Tes

ASSESSMENT STRATEGY		
Component		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Chemistry of Engineering Materials (4th edition) – Robert B. Leighou, Publisher – McGraw-Hill Inc.

2. Introduction to Physical Metallurgy (2nd edition) Sidney H Avner, Publisher –Tata McGraw –Hill Edition.

3. Engineering Metallurgy (Part I & II) (6th edition) – Raymond A. Huggins, Publisher – Viva Books Private Ltd.

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code	**ME 205**	**LectureContact Hours**	**3.00**
Course Title	**Heat and Mass Transfer**	**Credit Hours**	**3.00**

PRE-REQUISITE

ME-103, Thermodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course examines the different modes of heat transfer with detailed treatment of each mode. Analysis of different heat transfer devices is carried out and associated mathematical concepts emphasized. Analogy is drawn between heat and mass transfer with the prevalent mathematical models and theories discussed. Applications of the concepts developed in practical cases involving cooling towers, heat exchangers, heat pipes etc. further cement the students' understanding.

OBJECTIVE

1. The course provides an introduction to heat and mass transfer and introduces practical applications in industry.
2. Familiarize basic tools to design process operations involving heat transfer and mass transfer
3. Extensive use of industrial examples and analogies between the various transport mechanisms to encourage lateral thinking.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Students will have a clear understanding of different modes of heat transfer and mass transfer used in engineering systems.	1	C1, C2	1			Q, ASG,F
CO2	Students will be able to analyzethe performance of various engineering systems like heat exchangers, and various heat transferring surfaces.	1,2	C3, C4	3	1,2		Q, ASG,F

CO3	Students will have a fundamental understanding of two-phase heat transfer and mass transfer and their applications in engineering systems.	1	C1, C2	2, 3			Q, ASG,F
CO4	Students will be able to analyzethe performance of various engineering systems using two phase heat transfer.	1,2	C3, C4	3, 4	1,2		Q, ASG,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

Details of three heat transfer methods (conduction, convection and radiation) and mass transfer.

b. Detail Contents:

Conduction
Basic concepts — Conduction — Fourier's Law of Heat conduction — Concept of Thermal Conductivity — Generalized conduction equation in Cartesian, cylindrical and spherical systems; Steady State Conduction —Heat transfer composite systems — Critical thickness of insulation —Conduction with heat Generation.

Convection
Fundamentals of Convection — Thermal boundary layer & Convective heat transfer coefficients —Convection correlations through Dimensional analysis; Laminar flow over a flat plate — Turbulent flow over a flat plate — Flow over cylinders — Internal flow through pipes — annular spaces —Natural convection in vertical - inclined and horizontal surface.

Radiation
Radiation heat transfer — Thermal radiation — Laws of radiation — Black body concepts— Emissive power — Radiation shape factor — Gray bodies — Radiation shields

MASS TRANSFER
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will have a clear understanding of different modes of heat transfer and mass transfer used in engineering systems.	3											
CO2	Students will be able to analyzethe performance of various engineering systems like heat exchangers, and various heat transferring surfaces.	3	3										
CO3	Students will have a fundamental understanding of two-phase heat transfer and mass transfer and their applications in engineering systems.	3											
CO4	Students will be able to analyzethe performance of various engineering systems using two phase heat transfer.	3	3										

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	3	Understanding different modes of heat and mass transfer will require knowledge of natural science and engineering fundamentals
CO2-PO1	3	To analysethe performance of various engineering systems like heat exchanger, knowledge of mathematics, natural science and engineering fundamentals will be required.
CO2-PO2	3	Students will be able to analyse heat exchangers and various heat transferring surfaces.
CO3-PO1	3	To understand two-phase heat transfer and mass transfer and their applications in engineering systems, knowledge of mathematics, natural science and engineering fundamentals will be required.
CO4-PO1	3	To analyze the performance of various engineering systems using two phase heat transfer, knowledge of mathematics, natural science and engineering fundamentals will be required.
CO4-PO2	3	Students will be able to analyze the performance of various engineering systems using two phase heat transfer using the first principles of mathematics, natural sciences and engineering sciences.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Lec 1-10	Basic concepts — Conduction — Fourier's Law of Heat conduction — Concept of Thermal Conductivity — Generalized conduction equation in Cartesian, cylindrical and spherical systems; Steady State Conduction —Heat transfer composite systems — Critical thickness of insulation — Conduction with heat Generation.	CT-1	Lecture 01-10 Theory: 60% Problem: 30% Practical Application:10% CT 01 will cover these sections.
Lec 10-30	Fundamentals of Convection — Thermal boundary layer & Convective heat transfer coefficients —Convection correlations through Dimensional analysis; Laminar flow over a flat plate — Turbulent flow over a flat plate — Flow over cylinders — Internal flow through pipes — annular spaces —Natural convection in vertical - inclined and horizontal surface.	CT-2	Lecture 10-30 Theory: 30% Problem: 50% Practical Application: 20% CT02 / Mid-Term will cover this section

Lec 30-36	Radiation heat transfer — Thermal radiation — Laws of radiation — Black body concepts—Emissive power — Radiation shape factor — Gray bodies — Radiation shields	Mid Term	Lecture 30-36 Theory: 40% Problem: 50% Practical Application: 10% CT03 will cover this section
Lec 36-42	Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations	CT-3	Lecture 36-42 Theory: 40% Problem: 40% Practical Application: 20%

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO 1	Class Observations/Assignments	**20**	
CO 2		**20**	
CO 3		**20**	
CO 4		**20**	
	Exam		
CO 1	CT/Mid/Final Exam	**80**	
CO 2		**80**	
CO 3		**80**	
CO 4		**80**	

REFERENCE BOOKS

1. Heat and Mass Transfer, Fundamentals & Applications – Yunus A. Cengel, Afshin J. Ghajar.

2. Fundamental of Heat & Mass Transfer – Frank P. Incropera.

3. Heat Transfer – J. P. Holman

REFERENCE SITE

Online Content:

Heat Transfer: Dr. John Biddle's Lecture Series

(https://www.youtube.com/playlist?list=PLZOZfX_TaWAE6nTX50dJl0Jia8iQTIhrG)

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**ME-206** **Heat Transfer Sessional**	Lecture Contact Hours Credit Hours	**3.00** **1.50**

PRE-REQUISITE

ME 205

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course enables students to apply the understanding of heat transfer mechanisms such as conduction, convection and radiation for understanding the performance of various heat transfer equipment such as heat exchangers, condensers, boilers, evaporators etc. used in almost all industries.

OBJECTIVE

1. The course provides an introduction to heat and mass transfer and introduces practical applications in industry.
2. Basic tools to design process operations involving heat transfer and mass transfer are covered.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Correspondin g PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Apply** principles of heat and mass transfer to basic engineering systems.	1	P3			3	R, Q, LT
CO2	**Analyze** heat transfer by conduction, convection and radiation.	1	C4			4	R, Q, LT
CO3	**Explain** analytical and numerical methods commonly used to **analyze** two-dimensional, steady state heat conduction.	4	P1, C4			8	R, Q, LT
CO4	**Analyze** and calculate heat and mass transfer in complex systems involving several heat transfer mechanisms	2,3	C4			5	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1. Forced convection heat transfer in a circular tube.
2. Forced convection over a flat plate
3. Study of heat exchanger
4. Study of forced convection of fin/flat plate/pipe bundle
5. Study of free convection of fin/flat plate/pipe bundle.
6. Determination of thermal conductivity of a metal by steady state method
7. Study of thermal radiation unit
8. (a) Inverse square law for light radiation.
   (b) Lamberts cosine law for light
   (c) Lamberts law of absorption for light.
9. Study of heat transfer by radiation and convection
10. Determination of thermal contact conductance

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply principles of heat and mass transfer to basic engineering systems.	3											
CO2	Analyze heat transfer by conduction, convection and radiation.	3											
CO3	Describe analytical and numerical methods commonly used to analyze two-dimensional, steady state heat conduction.				2								
CO4	Analyze and calculate heat and mass transfer in complex systems involving several heat transfer mechanisms		3	2									

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justification**
CO1PO1	**3**	In order to apply principles of heat and mass transfer to basic engineering systems, engineering knowledge is required.
CO2PO1	**3**	Engineering knowledge is a must in order to analyse heat transfer by conduction, convection and radiation.
CO3PO4	**2**	Investigations are required to describe analytical and numerical methods used to analyse heat transfer.
CO4PO2	**3**	In order to analyze heat and mass transfer in complex systems, problem analysis skills are required.
CO4PO3	**2**	To analyze and calculate heat and mass transfer in complex systems involving several heat transfer mechanisms, design and development of solutions is required.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation forthe Lab Test Preparation fora presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Introduction and short briefs regarding lab proceedings and experiments
Week-2	Expt-01: Forced convection heat transfer in a circular tube.
Week-3	Expt-02: Forced convection over a flat plate
Week-4	Expt-03: Study of heat exchanger
Week-5	Expt-04: Study of forced convection of fin/flat plate/pipe bundle

Week-6	Expt-05: Study of free convection of fin/flat plate/pipe bundle.
Week-7	Expt-06: Determination of thermal conductivity of a metal by a steady state method.
Week-8	Expt-07: Study of thermal radiation unit
Week-9	Expt-08: (a) Inverse square law for lightradiation. (b) Lamberts cosine law for light (c) Lamberts law of absorption for light.
Week-10	Expt-09: Study of heat transfer by radiation and convection
Week-11	Expt-10: Determination of thermal contact conductance
Week-12	
Week-13	Viva
Week-14	Lab Quiz

ASSESSMENT STRATEGY

Component		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Fundamental of Heat & Mass Transfer -Incropera.

2. Principles of Heat Transfer –F. Kreith, (7^{th} edition), M. S. Bohn.

3. Heat Transfer –J. P. Holman 7e.

4. Heat and Mass Transfer, Fundamentals & Applications –Yunus A. Cengel, Afshin J. Ghajar.

5. Heat Transfer Laboratory Practice-A.C. Mandal & M.Q. Islam

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code **Course Title**	**ME 207** **Heat Transfer Equipment Design**	Lecture Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

1. ME-103 Thermodynamics, 2. ME-205 Heat and Mass Transfer

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides an introduction to the essential theoretical basis of heat transfer equipment design and its application to a range of problems of relevance to practical engineering. The course aims to equip students with basic tools and methodologies for carrying out heat transfer analysis in many engineering devices.

OBJECTIVE

a. Design, inspect, maintain and operate heat exchangers and analyze their performance.

b. Carry out heat exchanger analysis for counter flow, cross flow and multi-pass heat exchangers and to apply the relevant correction factors.

c. Choose the correct heat exchanger for a given application and its costing in line with the advantages and disadvantages of its type and scope of its applications.

d. Determine the cooling performance of a range of heat exchangers and establish insights on the effectiveness/ NTU method for heat exchanger analysis in terms of heat capacity ratios.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Students will have a clear understanding of various types of heat transfer processes and associated devices.	1	C1, C2	1,2			T, ASG, F
CO2	Students will be able to analyze and select the heat transfer device.	2,3	C3	3,5	1		T, ASG, F
CO3	Students will have a fundamental understanding of interpretation of design parameters, cost estimation and optimization from the engineeringpoint of view.	3,4	C5, C6	5,8	1		T, ASG, F

CO4	Students will be able to analyze the applications of multiphase heat transfer equipment design.	3	C5,C6	5	1,2		T, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, CS- Case Study)

COURSE CONTENT

a. Main Contents:

1) Concept of thermal system design;
2) Heat transfer from finned surface;
3) Basic thermal design methods of heat exchangers;
4) Fouling of heat exchangers;
5) Heat transfer mechanism with change of phase;
6) Two phase heat transfer equipment;
7) Thermo-electric cooling, direct liquid cooling;
8) Thermal systems with internal heat source.

b. Detail Contents:

Concept of thermal system design: Heat transfer requirements: Mechanical design: Design parameters: Materials, cost and economics: Safety and reliability: Choice and availability; Optimization: Cyclic service.

Heat transfer from finned surface: Basic fin design, Types of fins: Fin performance, Efficiency of fins, Equation of heat transfer from fins, Analysis of unsteady heat conduction.

Basic thermal design methods of heat exchangers: Types of heat exchangers; Parallel flow, counter flow, cross flow, shell-and-tube, mixed and unmixed, single and multiple pass, compact heat exchangers: Thermo fluid characteristics: Sizing of heat exchangers. Basic application of nanofluid in heat transfer.

Fouling of heat exchangers: Performance of heat transfer equipment; Log mean temperature difference, Effectiveness-NTU; F correction factor.

Heat transfer mechanism with change of phase: Boiling and condensation;mechanism and heat transfer correlations; Heat Pipe-basic design and operation.

Two phase heat transfer equipment: Boiler, Evaporator, Condenser, Cooling tower.

Thermo-electric cooling, direct liquid cooling.

Thermal systems with internal heat source: Modeling of thermal equipment

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will have a clear understanding of various types of heat transfer processes and associated devices.	3											
CO2	Students will be able to analyze and select the heat transfer device.		3	3									
CO3	Students will have a fundamental understanding of interpretation of design parameters, cost estimation and optimization from the engineering point of view.			3	2								
CO4	Students will be able to analyze the applications of multiphase heat transfer equipment design.			3									

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	The student will learn about heat transfer requirements and design parameters that will provide engineering knowledge.
CO2-PO2	**3**	Students will be able to analyze complex engineering problems related to fin design.
CO2-PO3	**3**	They will be able to determine fin performance, Efficiency of fins, heat transfer from fins according to requirement.

CO3-PO3	**3**	Design solution of heat exchanger by using different system parameters
CO3-PO4	**2**	Conduct investigation of the sizing of heat exchangers and fouling of heat exchangers.
CO4-PO3	**3**	Students will acquire knowledge of modeling thermal equipment to meet specific requirements.

TEACHING LEARNING STRATEGY

Type and No.	Activity	Engagement Hour
Face-to-Face Learning		
1	Lecture	40
2	Introduction to different manufacturing devices operated in Industry	2
Self-Directed Learning		
3	Non face to face learning	75
Formal Assessments		
4	Class test and Mid-term Exam	2.5
5	Final Exam	3
Total		**122.5**

TEACHING METHODOLOGY

Class lecture, Assignment, Group discussion for problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
1-2	**Concept of thermal system design:** Heat transfer requirements: Mechanical design: Design parameters: Materials, cost and economics: Safety and reliability: Choice and availability; Optimization: Cyclic service.		
3-5	**Heat transfer from finned surface:** Basic fin design, Types of fins: Fin performance, Efficiency of fins, Equation of heat transfer from fins, Analysis of unsteady heat conduction.	CT 01	
6-8	**Basic thermal design methods of heat exchangers:** Types of heat exchangers; Parallel	Mid Term Exam	

	flow, counter flow, cross flow, shell-and-tube, mixed and unmixed, single and multiple pass, compact heat exchangers: Thermo fluid characteristics: Sizing of heat exchangers. Basic application of nanofluid in heat transfer.		
9-10	**Fouling of heat exchangers:** Performance of heat transfer equipment; Log mean temperature difference, Effectiveness-NTU; F correction factor.	CT 02	
11	**Heat transfer mechanism with change of phase:** Boiling and condensation; mechanism and heat transfer correlations;Heat Pipe-basic design and operation.	CT 03	
12	**Two phase heat transfer equipment**: Boiler, Evaporator, Condenser, Cooling tower.		
13-14	**Thermo-electric cooling, Direct liquid cooling.** **Thermal systems with internal heat source:**Modeling of thermal equipment.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	Homework/ Assignment	**5**	
CO2	Homework/ Assignment, Case study of various heat transferring equipment, Class test	**10**	
CO3	Homework/ Assignment Online content regarding application of two phase heat transfer equipment. Class test, Mid-term.	**20**	
CO4	Assignment, Case study, Online content.	**5**	
	Exam		
CO2 CO3 CO4	Final Exam	**60**	

REFERENCE BOOKS
1. Fundamental of Heat & Mass Transfer-by Incropera. 2. Principles of Heat Transfer – F. Kreith, (7th edition), M. S. Bohn, Publisher – Harper Int. Edition 1999. 3. Heat Transfer – J. P. Holman 7e, Publisher - Mc Graw-Hill Inter. Edition. 4. Heat Transfer: A Basic Approach – OZISIK, Publisher – McGraw-Hill Int. Edition 1985. 5. Advanced Convective Heat Transfer – Adrian Bejan
REFERENCE SITE
N/A

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 233** **Manufacturing Technology**	Lecture Contact Hours Credit Hours	3.00 3.00
PRE-REQUISITE			
NA			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students to different types of manufacturing machineries and components, their production process and industrial structure, operating principle and design.			
OBJECTIVE			
1. Introduction to Manufacturing Process and machine Overview 2. Introduction to Plastic, Ceramic and Glass product manufacturing processes 3. Introduction to Concept of Quality circle, TQM and TQC.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Demonstrate knowledge of manufacturing processes with set of functional requirements and product development.	1,7	C1, C3			1,4,6,7	Q, ASG, F

CO2	Analyze various machines and machining operations of manufacturing products.	1,2	C3			2,3,5	Q, ASG, F
CO3	Clear understanding of economic performance and quality manufacturing products.	1,2	C1, C3			4,6,7	Q, F, CS
CO4	Design theoretical impacts of materials in product and their failure analysis.	3,12	C1, C3			5,6,8	Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents: Basic manufacturing process overview, Methods of manufacture and process, Metal cutting and operation, Introduction to Plastic, ceramic and glass product manufacturing processes, Quality control, Machine Tools and operations

b. Detail Contents: Basic manufacturing process overview: Conventional and non-conventional (Mechanical, Thermal, Chemical) machining process.Methods of manufacture and process– metal casting, metal forming and metal joining, welding. Metal cutting and operation: Cutting Tool Materials, Geometry and Surface Finish, Effect of machining parameters on surface finish. Machining equations for cutting operations. Mechanics of Machining Processes, Tool Wear, Tool Life. Types of motions in machining, turning and Boring, Shaping, Planning and Slotting, Thread cutting, Drilling, Milling, Gear tooth cutting. Machining parameters and related quantities. Introduction to Plastic, ceramic and glass product manufacturing processes. Quality control: Concept of quality circle, TQM and TQC.

Machine Tools and operations: Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine.

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge of manufacturing processes with set of functional requirements and product development.	3						3					
CO2	Analyze various machines and machining operations of manufacturing products.	3	3										
CO3	Clear understanding of economic performance and quality manufacturing products.	3	3										
CO4	Design theoretical impacts of materials in product and their failure analysis.			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	Understanding the knowledge associated with manufacturing and product development.
CO1-PO7	**3**	Students will be able to get Understand about product manufacturing and associated feature and apply their knowledge by ensuring environment and sustainability.
CO2-PO1	**3**	Students will be able to conduct different machining operation by gaining knowledge about machining processes.
CO2-PO2	**3**	Students will apply appropriate techniques, resources, and modern engineering of machining to improve productivity of industry.
CO3-PO1	3	Students will be able to evaluate the quality of manufacturing keeping mind its economic point of view
CO3-PO2	**3**	Students will be able to analyze efficiency by selecting method of production.
CO4-PO3	**3**	Students will be able to analyze material at design point of view.
CO4-PO12	**3**	Students will be able to conduct investigation, design the product which will prepare them to take challenges in upcoming future.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE			
Week	**Topic**	**CT**	**Remarks**
Class (1-4)	1.Basic manufacturing process overview: Conventional and non-conventional (Mechanical, Thermal, Chemical) machining process.	CT 01	
Class (5-16)	2.Methods of manufacture and process– metal casting, metal forming and metal joining, welding.		
Class (17-26)	3.Metal cutting and operation: Cutting Tool Materials, Geometry and Surface Finish, Effect of machining parameters on surface finish. Machining equations for cutting operations. Mechanics of Machining Processes, Tool Wear, Tool Life. Types of motions in machining, turning and Boring, Shaping, Planning and Slotting, Thread cutting, Drilling, Milling, Gear tooth cutting. Machining parameters and related quantities.	CT 02 MT	
Class (27-31)	4. Introduction to Plastic, ceramic and glass product manufacturing processes		
Class (32-33)	5. Quality control: Concept of quality circle, TQM and TQC.		
Class (34-42)	6. Machine Tools and operations: Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine.	CT 03	

ASSESSMENT STRATEGY			
COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Manufacturing Engineering and Technology – SeropeKalpakjiannStevenR. Schmid

2. Manufacturing processes and materials for engineeerings – Doyle Morris.

3. Introduction to Manufacturing process – Jhon A Schey.

Fall Semester L-2, T-2

COURSE INFORMATION			
Course Code Course Title	**ME-234** **Manufacturing Technology Sessional**	Lecture Contact Hours Credit Hours	**3.00** **1.50**

PRE-REQUISITE

ME 233

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The focus of this curriculum is the development of students' practical knowledge regarding process and tools used in manufacturing. Students will observe different types of chip, determine chip reduction coefficient and get familiarized with CNC milling machine, bending machine, column & knee type milling machine. They will also manufacture an industrial part by using lathe & shaper machine. Thus allowing them to relate theoretical knowledge with practical.

OBJECTIVE

1. Manufacturing Process Overview: Product concepts, Market feasibility, Engineering design, Prototyping.
2. Production Processes: Machine and process overviews, Finishing, Assembly. Production Machine Operations: Presses, Molding/Casting, Drilling/Boring, Machining, Welding, Finishing, Advanced Intelligence Automation, Programmable Logic Controllers.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **recommend** appropriate part manufacturing processes when provided a set of functional requirements and product development constraints	3	C5			5	R, Q, LT
CO2	**Develop** engineering knowledge of manufacturing process of various materials	1	P5			3	R, Q, LT
CO3	**Develop** thorough engineering sense of various machines and machining operations related to manufacturing products	1	P5			3	R, Q, LT
CO4	Be able to understand and **assess** economic performance and quality analysis of various manufactured products.	11	P3			8	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1) Study of Different Types of Chip and Determination of Chip Reduction Coefficient.
2) Study and Determination of Tool Wear.
3) Study of a CNC milling machine.
4) Gear Cutting on a Column & Knee Type Milling Machine.
5) Manufacturing of an Industrial Part by Using Lathe & Shaper Machine

6) Study of Injection Molding Machine

7) Study of EDM (Electric Discharge Machining)

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **recommend** appropriate part manufacturing processes when provided a set of functional requirements and product development constraints			3									
CO2	**Develop** engineering knowledge of manufacturing process of various materials	3											
CO3	**Develop** thorough engineering sense of various machines and machining operations related to manufacturing products	3											
CO4	Be able to understand and **assess** economic performance and quality analysis of various manufacturing products								3				

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO3	**3**	In order to manufacture part design analysis is important and then process development for manufacturing part is analyzed.
CO2-PO1	**3**	Engineering knowledge is required to develop complete understanding of manufacturing process of various materials .
CO3-PO1	**3**	In order to develop thorough engineering sense of various machines and machining operations related to manufacturing products engineering knowledge is a must.
CO4-PO11	**3**	Knowledge regarding economic decision-making, project management and finance is essential to be able to understand and assess economic performance and quality analysis of various manufacturing products.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Introduction and short brief regarding lab proceedings and experiments
Week-2	Study of Different Types of Chip and Determination of Chip Reduction Coefficient.
Week-3	Study and Determination of Tool Wear.
Week-4	Study of a CNC milling machine.
Week-5	Gear Cutting on a Column & Knee Type Milling Machine.
Week-6	Mid Term Lab Viva
Week-7	Mid Term Lab Quiz
Week-8	Manufacturing of an Industrial Part by Using Lathe & Shaper Machine
Week-9	Study of Injection Molding Machine
Week-10	Study of EDM (Electric Discharge Machining)
Week-11	Review Class
Week-12	Lab Report Submission
Week-13	Final Lab Viva
Week-14	Final Lab Quiz

ASSESSMENT STRATEGY		
Components		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1.ManufacturingEngineeringandTechnology(4th edition)–SeropeKalpakjiannStevenR. Schmid,
2.“Principles of Modern Manufacturing, 5th Edition, SI Version 2013”, Authors: Mikell P. Groover,
3.Manufacturing Processes and Materials for Engineers –Doyle Morris
4.Education Quality Control and Management-Dr. M.A.A Hasin

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 245** **EngineeringMechanics I**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To familiarize students with the principles of static equilibrium by applying Newton’s laws of motion to solve engineering problems. Accentuation is set on drawing free body diagrams. Topics incorporate introduction to forces; 2D equilibrium of particles and rigid bodies; center of gravity and centroids; friction; analysis of truss structures; and moments of inertia.

OBJECTIVE

1. Introduction to the construction of "Free Body Diagrams" of real-world problems and apply Newton's Laws of motion and vector operations to assess equilibrium of particles and bodies

2. To apply the principles of equilibrium of particles and bodies to analyze the forces in planar truss members and structures.

3. Understanding the theory of dry friction and analysing the equilibrium of rigid bodies subjected to this force

4. To discuss the concepts of center of gravity, centroids and moment of inertia and apply the concepts to compute their location for bodies of arbitrary shape

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Determine the equilibrium of a particle and rigid bodies in space using principle of laws of mechanics	1,2	C1, C2, C3	1,2, 3			Q, ASG, F
CO2	Understanding of force systems of planar truss member, structures	1,2	C2, C3	1,2, 3			Q, ASG, F
CO3	Analyse and design systems that include frictional forces	2,3	C2, C3, C4	1,2, 3,4	1,2		Q, F, CS
CO4	Determine location of center of gravity, centroids and moment of inertia of bodies of arbitrary shape.	1,2	C2, C3	1,2, 3	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Basic concepts of mechanics
2. Centroids
3. Moments of inertia
4. Truss, frames, and machines
5. Friction
6. Cables
7. Problems solving using software

b. Detail Contents:

Basic concepts of mechanics: Free body diagrams; statics of particles and rigid bodies; centroids of lines, areas (planar areas, composite areas) and volumes; Properties of forces: Concurrent / coplanar / non-coplanar force systems, resultant of forces, resolution of forces, rectangular and polar components of forces in plane and 3-D space; Analysis of structures: Forces in trusses, frames and machines, zero force members; forces in cables; friction; Equilibrium of rigid bodies: Conditions for maintaining equilibrium in 2 and 3-D; Statical determinacy: Identification of known forces and solution of unknown reactions for a structure, combined loads, application of equilibrium equations for statical determinacy; Moments of inertia: Of areas and masses; moments of force in vector notation; equivalent force system; parallel-axis theorem for determination of rotational inertia about a different axis; polar moments; of inertia; couples and resultant of force-couple systems; principal axes and principal moments of inertia; Analysis: Of two and three dimensional problems; simulation using MATLAB

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Determine the equilibrium of a particle and rigid bodies in space using principle of laws of mechanics	3	3										
CO2	Understanding of force systems of planar truss members, structures	3	2										
CO3	Analyze and design systems that include frictional forces		3	2									
CO4	Determine location of center of gravity, centroids and moment of inertia of bodies of arbitrary shape.	3	2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to draw Free Body diagrams of particles and rigid bodies and will be able to know the concepts of Newton's laws of motion.**
CO1-PO2	**3**	**Application of Newton's law of motion and vectors to real word engineering problems.**
CO2-PO1	**3**	**Understanding of force systems of planar truss members, structures will enhance their engineering knowledge**
CO2-PO2	**2**	**Students will have an ability to examine forces in trusses and structures**
CO3-PO2	**3**	**Students will be able to identify, formulate and analyze complex engineering problems by applying principles of dry friction**

CO3-PO3	**2**	**They will be competent enough to design simple systems including friction**
CO4-PO1	**3**	**Students will have knowledge of centroids, moment of inertia and will observe how this knowledge relates to engineering**
CO4-PO2	**2**	**Student will be apt in determining centroids, center of gravity and moment of Inertia of 2D and 3D bodies**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-12	Basic concepts of mechanics; Statics of particles and rigid bodies	CT 01	
Class 13-21	Centroids of lines, areas and volumes; Moments of inertia of areas and masses	CT 02	
Class 22- 27	Forces in truss, frames, and machines	MT	
Class 28- 36	Friction	CT 03	
Class 37-39	Forces in cables		
Class 40-42	Solving basic problems using software		

ASSESSMENT STRATEGY			
COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	CT	**20**	
3	CT	**30**	
4	CT	**20**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	Final Exam	**80**	
4	MID, Final Exam	**70**	

REFERENCE BOOKS

1. Vector Mechanics for Engineers: Statics– Ferdinand P. Beer, E Russell Johnston, Jr; Publisher – McGraw-Hill Companies, 5th edition 1988.

2. Engineering Mechanics Statics (10th Edition)– R.C. Hibbeler

Fall Semester L-2, T-II

COURSE INFORMATION

CourseCode CourseTitle	**ME 247** **EngineeringMechanics II**	LectureContactHours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME-245

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course teaches students how to apply Newtonian physics to analyse relatively simple physical mechanisms with some emphasis on commonly encountered engineering applications. It follows on from the Statics course, but considers systems that are not in equilibrium i.e. with velocity and acceleration. Some of the topics covered are pure kinematics (a mathematical description of motion only), while others are kinetic (determine motion in problems involving the concepts of force and energy). The course is restricted to 2-D (planar) mechanisms

OBJECTIVE

1. Explain basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).

2. Explain and be able to apply Newton's laws of motion.

3. Explain and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution

4. To teach planar kinematics of rigid bodies, systems of rigid bodies and particles

5. To teach problem formulation and solution methods for the dynamic equations of motions for planar motion of rigid bodies.

6. Introduction to velocity and acceleration diagram.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	General knowledge about mathematics, physics and engineering to solve real world problems	1,2	C1, C2, C3	1,5, 6			Q, ASG, F
CO2	Apply fundamental concepts of kinematics and kinetics of particles and rigid bodies to the analysis of simple, practical problems.	1,2	C2, C3	1,3			Q, ASG, F
CO3	An ability to apply this knowledge for desired analysis or methods to solve engineering problems.	1,2	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	To develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering	2,3	C3, C4	1,3	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Kinematics of particles
2. Plane motion of rigid bodies: forces and acceleration
3. Energy and momentum method
4. System of particles
5. Kinematics of rigid bodies -3-D properties of sections

b. Detail Contents:

Kinematics of particles; Kinetics of particles: Newton's second law; energy and momentum method; System of particles; Kinematics of rigid bodies; Plane motion of rigid bodies: forces and acceleration; Energy and momentum methods; Kinematics of rigid bodies -3-D properties of sections

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	General knowledge about mathematics, physics and engineering to solve real world problems	3	3										
CO2	Apply fundamental concepts of kinematics and kinetics of particles and rigid bodies to the analysis of simple, practical problems	3	2										
CO3	An ability to apply this knowledge for desired analysis or methods to solve engineering problems	1	2										
CO4	To develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering		2	1									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	**Developing dynamic equations of motion will provide knowledge from physics and mathematics to build up engineering fundamental equations.**
CO1-PO2	**3**	**Application of dynamics equation of motion will enable the students to analyse problems arise in various engineering problems**
CO2-PO1	**3**	**Students will develop an ability to understand the kinematics and kinetics of particles and rigid bodies using force and acceleration, work and energy, and impulse and momentum principles.**
CO2-PO2	**2**	**Students will be apt in analysing kinetics and kinematics of dynamic system**
CO3-PO1	**1**	**Students will have knowledge on power and energy losses of dynamically loaded objects**
CO3-PO2	**2**	**Students will have an ability to calculate required power and energy losses of dynamically loaded objects and to apply the laws of motion to relate forces obtained from free body diagrams and accelerations from kinematics to derive the equations of motion for particles and rigid bodies in planar motion.**
CO4-PO2	**2**	**Students will have examining knowledge on various types of dynamics system and their applications**
CO4-PO3	**1**	**Students will develop an ability to solve dynamic problems with respect to linear and angular position, acceleration and velocity using the resulting forces and moments and principles of work and energy**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	Kinematics of particles – Basic Concepts and problems	CT 01	
Class 7-12	Kinetics of particles: Newton's second law	CT 02	
Class 13- 21	Plane motion of rigid bodies: forces and acceleration	MT	
Class 22- 27	Energy and momentum method	MT	
Class 28-36	System of particles	CT 03	
Class 37-42	Kinematics of rigid bodies -3-D properties of sections		

ASSESSMENT STRATEGY			
COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**20**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	MID, Final Exam	**70**	
3	MID, Final Exam	**80**	
4	Final Exam	**70**	

REFERENCE BOOKS

1. Vector Mechanics for Engineers: Dynamics – Ferdinand P. Beer, E Russell Jr. Johnston

Engineering Mechanics, Statics and Dynamics – Joseph F Shelley

2. Engineering Mechanics Dynamics – R.C. Hibbeler.

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code	**ME 258**	Lecture Contact Hours	**3.00**
Course Title	**Mechanical Engineering Drawing-1**	Credit Hours	**1.50**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The rationale for this course is to motivate students by fostering creativity and introducing conceptual design, sustainable design in engineering, industrial design, computer aided design and drafting early in the course. Early training and practice in the engineering design method, the introduction to engineering handbooks. Engineers need skills in graphical communication and spatial vision in the practice of their profession.

OBJECTIVE

1. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.

2.To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Ability to **create** simple engineering drawing and sketches based on current practice.	3	C4			5	T,ASG,Q
CO2	To **develop** the skills to read manufacturing and construction drawings used in industry.	10	P5			5	T,ASG,Q
CO3	Students should be able to **make use of** and **interpret** standard conventions used in engineering drawing.	1	P2,P3			5	T,ASG,Q
CO4	Learn basic AutoCad skills and be able to **make use of** AutoCAD for 2-D representations.	5	C3			6	T,ASG,Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Manual Drawing (50%): Introduction; Instruments and their uses; First and third angle projections; Orthographic drawings; Isometric views; Missing lines and views; sectional views and conventional practices; Auxiliary views. Reading Civil Drawing for Mechanical Design of HVAC System.

CAD (50%): Importance to design and drafting, Setting up a drawing: starting SolidWorks, menu, planning for a drawing, basic commands, making a simple 2-D drawing, layers, object snap, poly lines and other features, file handling and display control, editing and dimensioning.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To develop the ability to produce simple engineering drawing and sketches based on current practice.			3									
CO2	To develop the skills to read manufacturing and construction drawings used in industry.										3		
CO3	To develop a working knowledge of the layout of plant and equipment.	1											
CO4	Capability to use AutoCAD for 2-D representations.					3							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1PO3	**3**	To design system and components ability to create simple engineering drawing and sketches is required.
CO2PO10	**3**	To communicate with other engineering professionals and manufacturers of mechanical systems, the skill to read manufacturing and construction drawings is a must.
CO3PO1	**1**	To interpret and understand standard engineering conventions knowledge of engineering fundamentals will be required.
CO4PO5	**3**	To operate AutoCad and make use of it, knowledge regarding modern engineering and IT tools will be required.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Assignments	10
Preparation of Mid Quiz	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Introduction; Instruments and their uses; First and third angle projections;
Week-2	Orthographic drawings;
Week-3	Orthographic drawings;
Week-4	sectional views and conventional practices;
Week-5	sectional views and conventional practices;
Week-6	Auxiliary views
Week-7	Isometric views
Week-8	Isometric views
Week-9	Reading Civil Drawing for Mechanical Design of HVAC System.
Week-10	Importance to design and drafting, Setting up a drawing: starting SolidWorks, menu, planning for a drawing
Week-11	Basic commands, making a simple 2-D drawing.
Week-12	Layers, object snap, poly lines and other features.
Week-13	File handling and display control, editing and dimensioning.
Week-14	Viva and Quiz Test

ASSESSMENT STRATEGY		
Assessment Method		**Grading**
Continuous Assessment (60%)	Class Performance	20%
	Attendance	10%
	Assignment	10%
Final Lab Quiz		50%
Viva		10%
Total Marks		100%

REFERENCE BOOKS

1.Metric Drafting –Paul Wallah, Publisher –GlenceoPublishing Co, Inc; 1979.

2. Drafting Technology and Practice –William P. Spence, Publisher –Chas A. Bennett Co, Inc, 1973.

3.Technical Drawing –Frederick E Giesecke, Alva Mitchell, Henry C. Spencer

4.Mechanical Engineering Drawing-AC Mandal& M.Q. Islam

Fall Semester L-2, T-2

COURSE INFORMATION			
Course Code	**ME-260**	Lecture Contact Hours	**3.00**
Course Title	**Mechanical Engineering Drawing-2**	Credit Hours	**1.50**

PRE-REQUISITE

ME 258

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

An introduction course which dives into the 3D and solid modelling design concepts in computer assisted design techniques. The student will learn how to make the software work for them while gaining experience in solving drafting problems utilizing an interactive CAD system. Students will extend their CAD competency by solving sophisticated drafting problems utilizing an interactive

CAD system, applications, course description and lecture with an opportunity to test for third party credentials via Solid Works.

OBJECTIVE

1. Gaining a working knowledge of CAD solid modelling (SolidWorks).
2.Theoretical concepts of engineering graphics, including orthographic projection, auxiliary views and sectioning, general dimensioning and tolerance, and geometric dimensioning and tolerance.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Develop** competency with multiple drawing and modification commands in SolidWorks.	5	P3			6	T,ASG,Q
CO2	Be able to **design** three-dimensional solid models.	3	C6			5	T,ASG,Q
CO3	Capability to **design** three-dimensional assemblies incorporating multiple solid models	3	C6			5	T,ASG,Q
CO4	This knowledge will be **applied** during the whole engineering career.	6	P5			12	T,ASG,Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1. Introduction, Similarities and differences between conventional drawing and computer aided drawing (CAD)
2. Planes, sketching on planes, sketches (Line tool, rectangle tool, circle tool), dimensions
3. Smart dimensions, sketch relations
4. Extrude boss/base, extrude cut, revolve boss/base, revolve cut, sketching on surfaces
5. Filet, rib, draft, shell, sectional view
6. Sketches (Arc tool, spline tool, slot tool, ellipse tool, polygon tool, filet tool), convert entities, mirror entities
7. Linear pattern, circular pattern, sketch driven pattern, curve driven pattern
8. Reference geometry swept boss/base, swept cut, mirror
9. 3D sketches, lofted boss/base, lofted cut
10. Boundary boss/base, boundary cut, curve through XYZ points, Aerofoil

11. Helix and spiral, Assembly
12. Assembly
13. Toolbox, Drawing from part, Appearance

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Develop** competency with multiple drawing and modification commands in SolidWorks.					3							
CO2	Be able to **create** three-dimensional solid models.			3									
CO3	Capability to **design**three-dimensional assemblies incorporating multiple solid models			3									
CO4	This knowledge will be **applied** during the whole engineering career.												3

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	Knowledge regarding modern tool usage is required to develop competency in creating engineering drawing with SolidWorks.
CO2-PO3	**3**	Knowledge of system and component design enhances the ability to create three-dimensional solid models.
CO3-PO3	**3**	Capability to **design**three-dimensional assemblies incorporating multiple solid models requires knowledge of system and component design.
CO4-PO6	**2**	In order to apply industry standards in the preparation of technical mechanical drawings acknowledging the consequent responsibilities relevant to professional engineering and public safety is a must.
CO4-PO10	**2**	To communicate with other mechanical engineering professionals and manufacturers of mechanical systems, being able to apply industry standards in the preparation of technical mechanical drawings is required.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Assignment Preparation of Mid Quiz Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Introduction, Similarities and differences between conventional drawing and computer aided drawing (CAD)
Week-2	Planes, sketching on planes, sketches (Line tool, rectangle tool, circle tool), dimensions
Week-3	Smart dimensions, sketch relations
Week-4	Extrude boss/base, extrude cut, revolve boss/base, revolve cut, sketching on surfaces
Week-5	Filet, rib, draft, shell, sectional view
Week-6	Sketches (Arc tool, spline tool, slot tool, ellipse tool, polygon tool, filet tool), convert entities, mirror entities
Week-7	Linear pattern, circular pattern, sketch driven pattern, curve driven pattern
Week-8	Reference geometry swept boss/base, swept cut, mirror
Week-9	3D sketches, lofted boss/base, lofted cut
Week-10	Boundary boss/base, boundary cut, curve through XYZ points, Aerofoil
Week-11	Helix and spiral, Assembly
Week-12	Assembly
Week-13	Toolbox, Drawing from part, Appearances
Week-14	Lab Quiz

ASSESSMENT STRATEGY		
Assessment Method		**Grading**
Continuous Assessment (40%)	Class Performance	20%
	Attendance	10%
	Assignment	10%
Final Lab Quiz		50%
Viva		10%
Total Marks		100%

REFERENCE BOOKS

1.Metric Drafting –Paul Wallah,

2.Drafting Technology and Practice –William P. Spence

3.Technical Drawing –Frederick E Giesecke, Alva Mitchell, Henry C. Spencer

Fall Semester L-2, T-2

COURSE INFORMATION			
Course Code Course Title	**ME 263** **Numerical Analysis**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Engineering applicationsrequire many mathematical models that cannot be solved exactly using conventional mathematics such as algebra and calculus. Therefore, this course will offer students the ability to apply different principles of numerical methods to solve engineering problems to obtain approximate solutions. The numerical method is a very powerful method but very simple to apply in solving many complex problems in Engineering. Some of the examples could be Heat Transfer, Fluid Dynamics, Structural Analysis, and Vibrations. This course makes a mathematical problem more interesting and makes Engineering problems fun to solve. This course will help students later to solve engineering problems in professional life or in academia.
OBJECTIVE
a. This course will emphasize the development of numerical algorithms to provide solutions to common problems formulated in science and engineering. **b.** The primary objective of the course is to develop the basic understanding of the construction of numerical algorithms, and perhaps more importantly, the applicability and limits of their appropriate use.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge of different engineering problems and difficulties by analytical methods.	1	C1, C3	2	1,2		Q, ASG, F
CO2	Analyzing different types of mathematical equations and their solving method by applying the numerical algorithm.	2	C3,C5	1,2	1		Q, ASG, F
CO3	Understanding different algorithms to of the same mathematical problem.	3	C2,C3	1,2	1,2		Q, F, CS

CO4	Connecting the theoretical problems and solving them numerically for an approximate real solution.	1,4	C4,C5	1,2	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Linear, Quadratic, Newton's Divide Difference Interpolating Polynomials

ii. Integral Metods

iii. Engineering Applications of Roots of Equations;

iv. Engineering Applications for Linear Algebraic Equations.

b. Detail Contents:

Approximations, Taylor's Series, and Errors. Linear, Quadratic, Newton's Divide Difference Interpolating Polynomials, ad Lagrange Interpolating Polynomials. Graphical Method, Bisection Method, False-Position Method. The trapezoidal rule, Simpson's Rule, and Integration with Unequal Segments. Simple Fixed-Point Iteration, Newton-Raphson Method, Secant Method, System of Nonlinear Equations. Numerical Differentiation, Richardson's extrapolation, Forward, backward, and central divide difference formula. Muller's Method, Bairstow's Method. Solving ODE, Euler's Method, Heun's Method, Runge-Kutta Methods for lower and higher order, and Adaptive RK Method, Engineering Applications of Roots of Equations. Boundary Value Problems, Eigen Value Problems, Shooting method. Gauss Elimination, Gauss-Jordan, LU Decomposition, Matrix Inverse, Gauss-Seidel.)derivation of Laplace Equation, Laplacian Difference Equation, Liebmann Method. Engineering Applications of Linear Algebraic Equations. Solving PDE for Derivative Boundary Conditions, Solution of first-order differential equations and 2nd order Partial Differential Equation (Elliptic equations, Parabolic equations, Hyperbolic equations)

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge of different engineering problems and difficulties with analytical methods.	3											
CO2	Analyzing different types of mathematical equations and their solving method by applying the numerical algorithm.		3										
CO3	Understanding different algorithms to of the same mathematical problem.			3									
CO4	Connecting the theoretical problems and solving them numerically for an approximate real solution	2			3								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will learn how to solve different engineering problems by applying analytical methods.
CO2-PO2	3	Students by analysing different mathematical equation and applying numerical algorithm will be able to solve complex Engineering problems
CO3-PO3	3	Students will learn about the different algorithms of same mathematical problems
CO4-PO1	2	Students will gain knowledge about approximate real solutions
CO4-PO4	3	Students will be able to connect theories with approximate real solution and thus apply this knowledge to investigate

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Approximations, Taylor's Series, and Errors. Linear, Quadratic, Newton's Divide Difference Interpolating Polynomials, ad Lagrange Interpolating Polynomials	CT 01	
Class 10-15	Graphical Method, Bisection Method, False-Position Method. The trapezoidal rule, Simpson's Rule, and Integration with Unequal Segments.		
Class 16- 25	Simple Fixed-Point Iteration, Newton-Raphson Method, Secant Method, System of Nonlinear Equations. Numerical Differentiation, Richardson's extrapolation, Forward, backward, and central divide difference formula.	CT 02	
Class 26- 29	Muller's Method, Bairstow's Method. Solving ODE, Euler's Method, Heun's Method, Runge-Kutta Methods for lower and higher order, and Adaptive RK Method,		
Class 30-34	Engineering Applications of Roots of Equations. Boundary Value Problems, Eigen Value Problems, Shooting method.	MT	
Class 35-36	Gauss Elimination, Gauss-Jordan, LU Decomposition, Matrix Inverse, Gauss-Seidel.)derivation of Laplace Equation, Laplacian Difference Equation, Liebmann Method.	CT 03	
Class 37-42	Engineering Applications of Linear Algebraic	CT 04	

	Equations. Solving PDE for Derivative Boundary Conditions, Solution of first-order differential equations and 2nd order Partial Differential Equation (Elliptic equations, Parabolic equations, Hyperbolic equations)		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. Numerical Methods for Engineers (4th edition) - Steven C. Chapra, Raymond P. Carale
2. Applied Numerical Analysis (5th edition) - Curtis F. Gerald, Patrick O. wheatley
3. Numerical Methods: Using Matlab, Fourth Edition, 2004 John H. Mathews and Kurtis D. Fink
4. Numerical Methods - E. Balagurusamy

Fall Semester L-2, T-2

COURSE INFORMATION

Course Code Course Title	**ME-264** **Numerical Analysis Sessional**	Lecture Contact Hours Credit Hours	**3.00** **1.50**

PRE-REQUISITE

ME 263

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This module provides in-depth coverage of key numerical methods to solve practical mathematical problems that occur throughout engineering. It demonstrates the use of numerical analysis as a powerful problem-solving tool in engineering. The course encompasses Numerical Analysis, Numerical Integration, and Solutions to Ordinary Differential Equations, with applications to engineering problems through computational simulations using MATLAB.

OBJECTIVE

1. Understand the implications of digital number representation and digital arithmetic for computational science and engineering.
2. Develop and implement numerically stable and accurate algorithms for all the basic tasks of computational science and engineering.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **interpret** the fundamental principles of digital computing, including number representation and arithmetic operations.	1	P2			2	T,ASG,Q
CO2	**Examine** the linkage between accuracy, stability and convergence	1	P4			2	T,ASG,Q
CO3	To be able to **demonstrate** error analysis for arithmetic operations.	1	C6			2	T,ASG,Q
CO4	**Perceive** the propagation of errors through complex numerical algorithms.	5	C2			6	T,ASG,Q
CO5	Enable students to learn Matlab coding, a powerful Engineering tool which will help them to in their future carrier.	12	P3			8	T,ASG,Q
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)							

COURSE CONTENT

Roots of polynomials and transcendental equations; Determinants and matrices; Eigen values and eigen vectors; Solution of linear and non-linear algebraic equations; Solution of first-order differential equations. Interpolation methods; Numerical differentiation and integration; Solving equations by finite differences; Curve fitting

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **interpret**the fundamental principles of digital computing, including number representation and arithmetic operations.	3											
CO2	**Examine**the linkage between accuracy, stability and convergence	3											
CO3	To be able to **demonstrate** error analysis for arithmetic operations.	2											
CO4	**Perceive**the propagation of errors through complex numerical algorithms.					3							
CO5	To be able to **test**numerical stability												3

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Engineering knowledge is required to understand the fundamental principles of digital computing, including number representation and arithmetic operations.
CO2-PO1	**3**	In order to be able to examine the linkage between accuracy, stability and convergence, engineering knowledge is a must.
CO3-PO1	**2**	Engineering knowledge is required to be able to demonstrate error analysis of arithmetic operations.
CO4-PO5	**3**	Modern tool usage is required to perceive the propagation of errors through complex numerical algorithms.
CO5-PO12	**3**	To be able to test fornumerical stability analysis modern tool usage is compulsory. This is a lifelong lesson which, students will be able to apply later in their carrier.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Assignment Preparation of Mid Quiz Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Introduction to MATLAB and short brief regarding the activities and contents of the sessional
Week-2	Linear, Quadratic, Newton's Divide Difference Interpolating Polynomials
Week-3	Graphical Method, Bisection Method, False-Position Method.
Week-4	The trapezoidal rule, Simpson's Rule, and Integration with Unequal Segments.
Week-5	Simple Fixed Point Iteration, Newton-Raphson Method, Secant Method, System of Nonlinear Equations.
Week-6	Numerical Differentiation, Richardson's extrapolation
Week-7:	Forward, backward, and central divide difference formula.
Week-8	Solving ODE, Euler's Method, Heun's Method
Week-9	Runge-Kutta Methods for lower and higher order, and Adaptive RK Method
Week-10	Boundary Value Problems, Eigen Value Problems
Week-11	Gauss Elimination, Gauss-Jordan, LU Decomposition, Matrix Inverse, Gauss-Seidel
Week-12	Solving Partial Differential Equations

Week-13	Viva
Week-14	Lab Quiz

ASSESSMENT STRATEGY		
Assessment Method		**Grading**
Continuous Assessment (40%)	Class Performance	20%
	Attendance	10%
	Assignment	10%
Final Lab Quiz		50%
Viva		10%
Total Marks		100%

REFERENCE BOOKS
1. Applied Numerical Analysis (5th edition) – Curtis F. Gerald, Patrick O. wheatley. 2. Numerical Methods for Engineers (4th edition) – Steven C. Chapra, Raymond P. Carale 2. Numerical Method : Using Matlab, Fourth Edition, 2004John H. Mathews and Kurtis D. Fink

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 303** **Power Plant Engineering**	Lecture Contact Hours Credit Hours	**3.00** **3.00**
PRE-REQUISITE			
ME-103, Thermodynamics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE
Apply knowledge of mechanical engineering related to power generation systems, their control and economics in different types of power plants for their operation and maintenance.

OBJECTIVE
1. To introduce students to different aspects of power plant engineering. 2. To familiarize the students with the working of power plants based on different fuels. 3. To expose the students to the principles of safety and environmental issues.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Analyze economics of power plants, list factors affecting the power plants, interpret the performance of power plants based on load variations and global energy situation.	1,2	C1,C2	2			Q, ASG, F
CO2	Apply the basic thermodynamics and fluid flow principles to different power generation methods.	1	C3	3			Q, ASG, F
CO3	Analyze thermodynamic cycles, construction, working and significance of, Hydro power plants, Steam power plants, Nuclear power plants, Gas Turbine power plants, and Diesel power plants.	2,12	C2, C4	3,	1,2		Q, ASG, F
CO4	Comprehend different solutions to improve the energy efficiency of power plants, pollution problems from thermal power plants and its control methods.	2,7	C2, C4	4,7			Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

Economics of Power Generation, Thermal Power Plant, High Pressure Boilers, Coal and Ash Handling Systems, Draught System, Steam turbine, Feed Water Treatment, Gas turbine, Nuclear Power Plant, Hydro-electric power plant, Alternative Power Plant Technologies.

b. Detail Contents:

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant. Power plant economics and selection: Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plants, heat balance and efficiency, Site selection of a steam power.

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant.

Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. Hydro-electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

Non-Conventional Power Plants: Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.

Plant safety and environmental impact of power plant: Social and Economic issues of power plant- Oxides of sulphur- oxides of carbon-oxides of nitrogen, air and water pollution from thermal power plants and its control, Thermal pollution from thermal power plants, noise pollution and its control, natural and artificial radio activity nuclear power and environment-radiations from nuclear power plant effluents- high level wastes- methods to reduce pollution, global warming- its effects and control, standardization for environmental pollution

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Analyze economics of power plants, list factors affecting the power plants, interpret the performance of power plants based on load variations and global energy situation.	3	3										
CO2	Apply the basic thermodynamics and fluid flow principles to different power generation methods.	3											
CO3	Analyze thermodynamic cycles, construction, working and significance of, Hydro power plants, Steam power plants, Nuclear power plants, Gas Turbine power plants, and Diesel power plants.		3										3
CO4	Comprehend different solutions to improve the energy efficiency of power plants, pollution problems from thermal power plants and its control methods.		3					2					

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	3	Analyzing economics of power plants will require knowledge of mathematics and engineering fundamentals
CO1-PO2	3	Students will be able to analyze the economics of power plants and interpret the performance of power plants based on load variations and global energy situation.
CO2-PO1	3	To apply the basic thermodynamics, students will require knowledge of mathematics, natural science and engineering fundamentals.
CO3-PO2	3	Students will be able to analyse different thermodynamic cycles and different kinds of power plant problems.
CO3-PO12	3	Students will gain knowledge about various design parameters of various power plants that support engineering design in a practice area.
CO4-PO2	3	Students will be able to analyse power plant efficiency.
CO4-PO7	2	Students will learn about pollutionproblems from thermal power plants and their control methods.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Lec 1-5	Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant. Power plant economics and selection: Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.	CT-1	
Lec 6-18	Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plants, heat balance and efficiency, Site selection of a steam power plant.		
Lec 19-22	Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust		

	system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.	CT-2	
Lec 23-30	Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant.	CT-3	
Lec 31-36	Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. Hydro-electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.		
Lec 37-42	Non-Conventional Power Plants: Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc. Plant safety and environmental impact of power plant: Social and Economic issues of power plant-Oxides of sulphur- oxides of carbon-oxides of nitrogen, air and water pollution from thermal power plants and its control, Thermal pollution from thermal power plants, noise pollution and its control, natural and artificial radio activity nuclear power and environment- radiations from nuclear power plant effluents- high level wastes- methods to reduce pollution, global warming- its effects and control, standardization for environmental pollution.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO 1	Class Observations/Assignments	**20**	
CO 2		**20**	
CO 3		**20**	
CO 4		**20**	
	Exam		
CO 1	CT/Mid/Final Exam	**80**	
CO 2		**80**	
CO 3		**80**	
CO 4		**80**	

REFERENCE BOOKS
1. Power Plant Technology – M M. El-Wakil 2. Power Plant Engineering –by Nag P K 3. Power Plant Engineering – Frederick T. Morse
REFERENCE SITE
N/A

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code	**ME 304**	Lecture Contact Hours	**: 3.00**
Course Title	**Power Plant Sessional**	Credit Hours	**: 1.50**
PRE-REQUISITE			
ME 303			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This is the foundation unit in the study of power plants. The students are introduced to fundamental theories and techniques required to analyze the safety and usage of power plants along with their working principles. This knowledge will allow students to perform the engineering calculations required in the power plant field.			
OBJECTIVE			
1. To comprise a wide range of power engineering subjects 2. To focus on theoretical and practical training. 3. To equip with quality to design, operate and maintain the various parts of a power plant along with environmental safety associated with it.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Relate** between advanced knowledge of thermodynamics and the key features of a power plant.	1	P5			1	R, Q, LT
CO2	**Illustrate** thermodynamic cycles in practical and to investigate theoretical and actual efficiencies.	1	P3			1	R, Q, LT
CO3	**Construct** and **know** the solutions to improve the energy efficiency of power plants.	7,8	C4, C5			7	R, Q, LT
CO4	**Develop** knowledge of power plant equipment's and Environmental safety.	4	P1			3	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1) **Study of Boiler**
2) **Performance Test of Cooling Tower**
3) **Study of Steam Turbine**
4) **Study of Gas Turbine (Jet) Engine**
5) **Determination of carbon residue of a given fuel**
6) **Proximate Analysis of coal**
7) **Determination of the calorific value of fuel**
8) **Determination of calorific value of gaseous fuel by gas calorimeter**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Relate** between advanced knowledge of thermodynamics and the key features of a power plant.	3											
CO2	**Illustrate** thermodynamic cycles in practical and to investigate theoretical and actual efficiencies.	3											
CO3	**Construct** and **know** the solutions to improve the energy efficiency of power plants.						2	3					
CO4	**Develop** knowledge of power plant equipment's and Environmental safety.				3								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	In order to identify the basics of power plants, a fundamental knowledge of engineeringwould be required.
CO2-PO1	**3**	In order to perform the experiments, a fundamental knowledge of diagrams and efficiencies would be required
CO3-PO7	**2**	In order to solve the power plant problems, the knowledge of energy efficiency, pollution.

CO3-PO8	**3**	Studying different areas of power plants, the students will have enough ethical knowledge about the decisions making of different types of power plants.
CO4-PO4	**3**	For performing the experiments, safety is needed in this laboratory

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Introduction class
Week-2	Exp 1: Study of Boiler
Week-3	Exp 2: Performance Test of Cooling Tower
Week-4	Exp 3: Study of Steam Turbine
Week-5	Exp 4: Study of Gas Turbine (Jet) Engine
Week-6	Mid Term Quiz
Week-7	Exp 5: Determination of carbon residue of a given fuel (proposed)
Week-8	Exp 6: Proximate Analysis of coal (proposed)
Week-9	Exp 7: Determination of the calorific value of fuel (proposed)
Week-10	Exp 8: Determination of calorific value of gaseous fuel by gas calorimeter (proposed)
Week-10	Revision Class
Week-11	Final Lab Report Submission
Week-12	Lab Test
Week-13	Viva
Week-14	Quiz Test

Component		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. "Power Plant Engineering" by Derbal L F and Boston P G 2. "Power Plant Performance" by Gill A B 3. "Power Plant Engineering" by Nag

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	: **ME 321** : **Fluid Mechanics-I**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts and standards of fluid mechanics of mechanical systems and to introduce the students to different Fluid flow patterns and the fundamental flow cases such as free shear flows, Specific applications of these flow cases are then given through the study of internal flow systems and external flows around air, ground and sea-going vehicles. The focus is to illustrate practical engineering applications of these principles comparable to simple fluid systems. The learning approach is to apply engineering principles to performance analysis and forecast of simple fluid systems. Students will achieve comprehension of the fundamental hypothetical premise of the fluid mechanic sciences and their application to a scope of issues of pertinence to practical engineering			
OBJECTIVE			
1. To familiarize students with the essential ideas of fluid mechanics. 2. To make students acquainted with the numerical depiction of fluid flow. 3. To familiarize students with the conservation principles governing fluid streams. 4. Ability to solve inviscid flow problems using stream functions and velocity potentials 5. Be able to compute forces on bodies in liquid flows. 6. To solve (analytical and numerical) viscous flow problems.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify how properties of fluids change with temperature and their effect on pressure and fluid flow and define the relationship between pressure and elevation as it relates to manometers, barometers and other pressure measuring devices	1,2	C1, C2, C3	1,4, 6			Q, ASG, F
CO2	Calculate forces on a plane and buoyancy on a body submerged in a static fluid and analyze performance and frictional losses in pipe system	2,3	C2, C3	2,5, 6			Q, ASG, F
CO3	Clear understanding of general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids and demonstrate knowledge on different types of flows and determine sonic velocity in a fluid	1,2	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	Use the general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids	2,3	C3, C4	4,6	1,2		Q, F, CS
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)							

COURSE CONTENT

a. Main Contents:

1. Fundamental concept

2. Fluid statics: basic hydrostatic equation

3. Incompressible and compressible fluids

4. Manometers

5. Momentum and energy equations

6. Velocity and flow measurement devices

b. Detail Contents:

Fundamental concept of fluid as a continuum; Fluid statics: basic hydrostatic equation, pressure variation in static incompressible and compressible fluids; Manometers; Forces on plane and curved surfaces, Buoyant force; control volume approach; Continuity, momentum and energy equations (Bernoulli's and Euler's Equation); Special forms of energy and momentum equations and their applications; Pressure, velocity and flow measurement devices.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify how properties of fluids change with temperature and their effect on pressure and fluid flow and define the relationship between pressure and elevation as it relates to manometers, barometers and other pressure measuring devices	3	3										
CO2	Calculate forces on a plane and buoyancy on a body submerged in a static fluid and analyze performance and frictional losses in pipe system	2	3										

CO3	Clear understanding of general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids and demonstrate knowledge on different types of flows and determine sonic velocity in a fluid	3	2										
CO4	Use the general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids		2	1									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to know about the properties of fluids. Students will get clear theoretical knowledge about pressure measuring devices and by using these devices they can measure the fluid pressure.**
CO1-PO2	**3**	**Students will develop the ability to illustrate a relationship between pressure and elevation. The relationship relates to manometers, barometers and other pressure measuring devices which are essential in fluid mechanics.**
CO2-PO1	**2**	**Students get definition of buoyancy, buoyant force, submerged body, metacentre, metacentric height and other terms of fluid mechanics.**
CO2-PO2	**3**	**Students will be able to determine forces on a plane and buoyancy on a body submerged in a static fluid.**
CO3-PO1	**3**	**The students will attain the knowledge to understand energy equation**
CO3-PO2	**2**	**Students will have an ability to calculate the change in different dimensional flow in pipes**
CO4-PO2	**2**	**Students will learn the Bernoulli's Equation and Continuity**

		Equation.
CO4-PO3	**1**	**They will be able to use the Bernoulli's equation (energy equation) to compute and analyse the changes in fluid flow for circular and non-circular pipes for in-compressible fluids.**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-12	Fundamental concept of fluid as a continuum; Fluid statics: basic hydrostatic equation, pressure variation in static incompressible and compressible fluids;	CT 01	
Class 13-21	Buoyant force; control volume approach; Continuity, momentum Equation, Energy equations (Bernoulli's and Euler's Equation);	CT 02	
Class 22- 27	Energy equations (Bernoulli's and Euler's Equation);	MT	
Class 28- 36	Manometers; Forces on plane and curved surfaces	MT	
Class 37-39	Special forms of energy and momentum equations and their applications	CT 03	

Class 40-42	Pressure,Velocity and flow measurement devices.;		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
3	CT	**30**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	MID, Final Exam	**70**	
4	Final Exam	**70**	

REFERENCE BOOKS

1.Fluid Mechanics: Fundamentals and Applications- JohnCimbala, Yungus A. Cengel

2. Fluid Mechanics and Hydraulic Machines- R.K. Rajput
3. Fluid mechanics through worked out problems -Md. Quamrul Islam and Amalesh Chandra Mandal.

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME-323** **Fluid Mechanics-II**	Lecture Contact Hours Credit Hours	**2.00** **2.00**

PRE-REQUISITE

ME-321

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This curriculum is designed to give all students in the program proficiency in fluid mechanics as well as the mathematical, experimental and computational tools needed to work in these disciplines. It is also designed to provide students with the opportunity to pursue in-depth study in each of these broad disciplines.

OBJECTIVE

1. To explain the concepts and definitions used in fluid mechanics.
2. To apply fundamental concepts and equations to practical problems.
3. To apply analytical cognitive skills and problem-solving skills in fluid mechanics

1. LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the fundamental relations of compressible flow.	1		4			Q, ASG, F
CO2	Solve complex problems using the theory of converging and diverging nozzles.	2		2,4			Q, ASG, F
CO3	Understand and Estimation of Boundary Layer and Momentum Thickness	3		4			Q, F, CS
CO4	Demonstrate Knowledge on open channel flows	7		6	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Dimensional analysis and similitude

ii. Fundamental relations of compressible flow

iii. Speed of sound wave

iv. Flow through converging-diverging nozzles

v. Normal shock; Real fluid flow; Frictional losses in pipes and fittings

vi. Introduction to boundary layer theory; Estimation of boundary layer and momentum thickness

vii. Skin friction and drag of a flat plate. Introduction to open channel flow

viii. Best hydraulic channel cross-sections; Hydraulic jump; Specific energy; Critical depth.

b. Detail Contents:

Dimensional analysis and similitude; Fundamental relations of compressible flow; Speed of sound wave; Stagnation states for the flow of and ideal gas; Flow through converging-diverging nozzles; Normal shock; Real fluid flow; Frictional losses in pipes and fittings. Introduction to boundary layer theory; Estimation of boundary layer and momentum thickness; Skin friction and drag of a flat plate. Introduction to open channel flow; Best hydraulic channel cross-sections; Hydraulic jump; Specific energy; Critical depth.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the fundamental relations of compressible flow.	3											
CO2	Solve complex problems using the theory of converging and diverging nozzles		3										
CO3	Understand and Estimation of Boundary Layer and Momentum Thickness			3									
CO4	Demonstrate Knowledge on open channel flows							3					

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	Students will be able to understand the fundamental relations of compressible flow.
CO2-PO2	**2**	Students will be able to solve complex problems using the theory of converging and diverging nozzles
CO3-PO3	**3**	Students will learn about Boundary Layer and Momentum Thickness
CO4-PO7	**3**	Students will gather knowledge on open channel flows

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28

Self-Directed Learning	70
Formal Assessment	6
Total	**104**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-5	Dimensional analysis and similitude; Fundamental relations of compressible flow; Speed of sound wave	CT 01	
Class 6-10	Stagnation states for the flow of and ideal gas; Flow through converging-diverging nozzles; Normal shock	CT 02	
Class 11-14	Real fluid flow; Frictional losses in pipes and fittings. Introduction to boundary layer theory	CT 03	
Class 15-19	Estimation of boundary layer and momentum thickness	MT	
Class 20-23	Skin friction and drag of a flat plate. Introduction to open channel flow		
Class 24-28	Best hydraulic channel cross-sections; Hydraulic jump; Specific energy; Critical depth		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	CT	**20**	
CO2	CT	**30**	
CO3	CT	**20**	
CO4	CT	**30**	
	Exam		
CO1	Mid, Final	**80**	
CO2	Mid, Final	**70**	
CO3	Mid, Final	**80**	
CO4	Mid, Final	**70**	

REFERENCE BOOKS

i. Fluid Mechanics with Engineering Applications–Robert L. Daugherty, Joseph B. Franzini, E. John

ii. Fluid Mechanics –Frank M. White.

iii. Fluid Mechanics Through Worked out Problems- A.C. Mandal& M.Q. Islam

REFERENCE SITE

N/A

Fall Semester L-3, T-II

COURSE INFORMATION

Course Code	**ME 324**	Contact Hours	**: 3.00**
Course Title	**Fluid Mechanics Sessional**	Credit Hours	**: 1.50**

PRE-REQUISITE

ME 321, ME 323

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The course is designed to illustrate practical engineering applications of fluid mechanics principles in relation to simple fluid systems.The learning approach is to apply engineering principles to performance analysis and prediction of simple fluid systems. This will provide a basis for understanding how performance can be improved.

OBJECTIVE
1. This course provides an introduction to the principles of fluid mechanics of mechanical systems. 2. The focus is to illustrate practical engineering applications of these principles in relation to simple fluid systems. 3. By the end of this course students should be able to understand the basic principles and analysis of both static and dynamic fluid systems.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow.	1	P3			1	R, Q, LT
CO2	**Illustrate** practical engineering applications of these principles in relation to simple fluid systems.	1	P2			1	R, Q, LT
CO3	**Evaluate** and design fluid engineering systems	2	P5			5	R, Q, LT
CO4	**Build** simple solutions to a range of problems in basic fluid flows.	4	C6			3	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Experiments: **Expt-01: Verification of Bernoulli's Equation** **Expt-02: (a) Calibration of rectangular notch** **(b) Calibration of triangular notch (V notch)** **Expt-03: Study of flow through an Orifice meter and Venturi Meter (Combined)** **Expt-04: Study of Pipe friction (Merged with below two)** **(b) Determination of Pressure losses in different types of elbows (Different types of pipe bent)** **Expt-05: (a) Introduction to Centrifugal Pump Characteristics (Merged with below three)** **(b) Performance test of a single centrifugal pump** **© Performance test of centrifugal pumps connected in series** **(d) Performance test of centrifugal pumps connected in parallel** **Expt-06: (a) Study of Propeller Turbine Characteristics** **(b) Performance test of a Pelton wheel and Francis Turbine.** **Expt-07: Study of Wind Tunnel** **Expt-08: Study of the Pump Test Bench Arrangement** **Expt-09: Study ofcompressors (Single Stage and Multistage) and Blowers** **Exp-10: Study of various pumps used in automotive engines.** **Expt-11: Study of Pneumatic and Hydraulic control system** **Exp-12: Case Study of the Hydraulic Circuit Diagram for Injection molding and Fatigue testing.** **Exp-13: Study of Pumps and attachments used in Firefighting systems**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow.	3											
CO2	**Illustrate** practical engineering applications of these principles in relation to simple fluid systems.	3											
CO3	**Evaluate** and design fluid engineering systems		3										
CO4	**Build** simple solutions to a range of problems in basic fluid flows.				3								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	In order to identify the basics of fluid mechanics, knowledge of fluid dynamics principles would be required.
CO2-PO1	**3**	In order to perform the experiments, practical engineering applications of these principles in relation to simple fluid systems knowledge would be required
CO3-PO2	**2**	In order to solve and design a fluid engineering system, the knowledge of fluid machinery is required.
CO4-PO4	**3**	For performing the experiments, basic simple solutions to a range of problems investigation of fluid dynamics principles and the machinery required to implement the solution is necessary.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Expt-01: Verification of Bernoulli's Equation
Week-2	Expt-02: (a) Calibration of rectangular notch (b) Calibration of triangular notch(V notch)
Week-3	Expt-03: Study of flow through an Orifice meter and Venturi Meter (Combined)
Week-4	Expt-04: Study of Pipe friction (Merged with below two) (b) Determination of Pressure losses in different types of elbows (Different types of pipe bent)
Week-5	Expt-05: (a) Introduction to Centrifugal Pump Characteristics (Merged with below three) (b) Performance test of a single centrifugal pump © Performance test of centrifugal pumps connected in series

	(d) Performance test of centrifugal pumps connected in parallel
Week-6	Expt-06: (a) Study of Propeller Turbine Characteristics (b) Performance test of a Pelton wheel and Francis Turbine.
Week-7	Expt-07:Study of Wind Tunnel
Week-8	Expt-08: Study of the Pump Test Bench Arrangement
Week-9	Expt-09: Study about, compressor (Single Stage and Multistage) and Blowers
Week-10	Exp-10: Study of different pumps used in automotive engines.
Week-11	Expt-11:Study of Pneumatic and Hydraulic Fluid Power
Week-12	Exp-12: Case Study of the Hydraulic Circuit Diagram for Injection molding and Fatigue testing.
Week-13	Exp-13: Study of Firefighting Pumps and attachments
Week-14	Quiz Test

Assessment Strategy		
Component		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	]30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. Fluid Mechanics-1 by Victor, L. Streeter. 2. Fluid Mechanics: Fundamentals and Applications by Yunus A. Cengel, John Cimbala. 3. Fluid Mechanics Through Worked out Problems- A.C. Mandal & M.Q. Islam

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME-341** **Machine Design**	Contact Hours Credit Hours	**3.00** **3.00**
PRE-REQUISITE			
ME 343, ME 247			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course aims to analyze the stresses and deflections due to various loading. It also investigates specific design problems through the application of the theory of elasticity, failure criteria, energy approach, and numerical methods. This course also intends to incorporate the information that the student has gained earlier in their program and to focus the student's analytical skills towards amalgamation of arrangements by working through the design of several simple, commonly used devices .			
OBJECTIVE			
2. To analyze the failure resulting from static and variable loading 3. To apply the fundamentals of the theory of failure and stress analysis to design machine components 4. To introduce the design modifications to be considered for ease of manufacturing 5. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge of selecting factor of safety for various materials and under different loading type**.**	2,3	C3	2,4			Q, ASG, F

CO2	Analyze failure resulting from static loading and fatigue failure due to variable load.	1,2	C4	4			Q, F, CS
CO3	Apply the fundamentals of the theory of failure and stress analysis to design machine components.	1,3	C3	6	1,2		Q, F, CS
CO4	Design mechanical springs, couplings, gears, belts, springs, brakes, clutches and engine parts.	2,3	C5,C6	2,4,5	1,2		Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

Introduction to design: Beam design, Column design; Statistical considerations; Types of fits;Design for static strength; Design for fatigue strength; Fracture mechanics in design; Design of mechanical springs; Bearings; Gears, shafts,Rope, belt, and chain drives; Brakes; Design for Stability; Finite element analysis

b. Detail Contents:

Introduction to design; Stress analyses, Stress concentration analysis; Deflection and stiffness considerations;Shock and impact; Beam design, Column design; Statistical considerations; Types of fits;Design for static strength; Design for fatigue strength; Fracture mechanics in design; Design of screws and welded joints; Design of mechanical springs; Rolling contact bearings,lubrication and journal bearings; Spur, helical, worm and bevel gears, shafts,Rope, belt and chain drives; Brakes; Design for Stability; Some FEA analysis of designs.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge of selecting factor of safety for various materials and under different loading type.		3	3									
CO2	Analyze failure resulting from static loading and fatigue failure due to variable load.	2	3										
CO3	Apply the fundamentals of the theory of failure and stress analysis to design machine components.	2		3									
CO4	Design mechanical springs, couplings, gears, belts, springs, bearings, brakes, clutches and engine parts.			2	3								

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO2	**3**	**Student can understand factor of safety for different cases.**
CO1-PO3	**3**	**Understanding factor of safety under different loading types will enhance their engineering knowledge**
CO2-PO1	**2**	**Students will have an ability to analyse failure from static loading**
CO2-PO2	**3**	**Students will be able to identify, formulate complex engineering problems with the analysis of static loading and fatigue failure from variable load**
CO3-PO1	**2**	**They will be competent enough to design simple systems from stress and failure analysis**
CO3-PO3	**3**	**Students will have knowledge of how to design machine components**
CO4-PO3	**2**	**Student will be apt in designing different engineering systems**
CO4-PO4	**3**	**Students will be able to design mechanical springs, couplings, gears, belts, springs, bearings, brakes, clutches to solve engineering problems**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE			
Lectures	**Topic**	**CT**	**Remarks**
Class 1-6	Introduction to design; Stress analyses, Stress concentration analysis; Deflection and stiffness considerations;	CT 01	
Class 7-12	Shock and impact; Beam design, Column design; Statistical considerations; Types of fits;	CT 02	
Class 13-21	Design for static strength; Design for fatigue strength; Fracture mechanics in design; Design of screws and welded joints.	CT 03	
Class 22-27	Design of mechanical springs; Rolling contact bearings,	MT	
Class 28-36	lubrication and journal bearings; Spur, helical, worm and bevel gears, shafts,		
Class 37-42	Rope, belt and chain drives; Brakes; Design for Stability; Some FEA analysis of designs		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	CT	**20**	
CO2	CT	**30**	
CO3	CT	**20**	
CO4	CT	**30**	
	Exam		
CO1	Mid, Final	**80**	
CO2	Mid, Final	**70**	
CO3	Mid, Final	**80**	
CO4	Mid, Final	**70**	

REFERENCE BOOKS

1. Shigley, JE &Mischke, CR, Mechanical Engineering Design, McGraw-Hill, 1989.
2. Khurmi, R. S., A Textbook of Machine Design, S Chand, 2005.
3. Mott, RL, Machine Elements in Mechanical Design, Maxwell Macmillan, 1992.
4. Pahl, G &Beitz, W, Engineering Design, Springer-Verlag, 1988.
5. Singh, K, Mechanical Design Principles, Nantel Publications, Melbourne, 1996.

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 343** **Mechanics of Solid**	Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
ME-245			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course will familiarize students with different kinds of loads and the internal reactions in materials (ductile, brittle, composite) due to the loads. the concept of stress as a tensor quantity is introduced along with the relevant materials properties which relate it to strain. In addition, various loading conditions, i.e. axial, tensile, compressive, bending, shear, torsion etc. are explored with pertinent discussions on associated stress and strain distributions. Thermal and centrifugal stresses are also discussed. The importance of shear force and bending moment diagrams in structural analysis along with the use of Mohr's Circle for principal stress/plane determination are elaborated on. An applied component involving computer modelling of common loading problems in engineering concludes the course.			
OBJECTIVE			
1. Introduction to the calculations concerned with the mechanical properties of materials. 2. To characterize and calculate the magnitude of combined stresses in individual members and complete structures. 3. To analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress. 4. To calculate and analyse the deflection at any point on a beam subjected to a combination of loads.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the types of loads and stress in different loaded members and development of skills to determine them	1,2	C1, C2	1,3			Q, ASG, F

CO2	Define the characteristics and calculate the magnitude of minimum safe load and stresses to operate individual members and structures without failure	1,3	C2, C3	2,3			Q, ASG, F
CO3	Calculate the deflection at any point on a beam subjected to a combination of loads and clear understanding of shear force and bending moment diagram	1,2	C1, C2, C3	2,3, 4	1,2		Q, F, CS
CO4	Analysis various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress	3,4	C3, C4	2,3, 4	1,2		Q, F, CS
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam							

COURSE CONTENT

a. Main Contents:

1. Stress analysis
2. Strain Analysis
3. Beams
4. Columns
5. Various Failure Theories

b. Detail Contents:

Stress analysis: statically indeterminate axially loaded member, axially loaded member, Thermal and centrifugal stresses; Stresses in thin and thick-walled cylinders and spheres, Beams: Shear force and bending moment diagrams; various types of stresses in beams, Flexural formula; Deflection of beams: integration and area moment methods; Introduction to reinforced concrete beams and slabs, Composite beams, Torsion formula; Angle of twist; Modulus of rupture; Helical springs, Combined stresses: principal stress, Mohr’s Circle; Columns: Euler’s formula, intermediate column formulas, the Secant formula, Flexure formula of curved beams. Introduction to experimental stress analysis techniques; Strain energy; Failure theories, Failure prediction for impact loading, Computational modelling of mathematical problem using software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the types of loads and stress in different loaded members and development of skills to determine them	3	2										
CO2	Define the characteristics and calculate the magnitude of minimum safe load and stresses to operate individual members and structures without failure	3		2									
CO3	Calculate the deflection at any point on a beam subjected to a combination of loads and clear understanding of shear force and bending moment diagram	3	2										
CO4	Analysis various situations involving structural members subjected to combined stresses by application of Mohr’s circle of stress	3	2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**The students will learn to identify different types of loads and stresses in loaded members that will enhance their knowledge domain in engineering**

CO1-PO2	**2**	**Application of concept of stress and strain will enable the students to analyse problems arise in various engineering problems**
CO2-PO1	**3**	**Students will know how to calculate permissible load, stresses and**
CO2-PO3	**2**	**Students will be able to design individual members and structures without failures**
CO3-PO1	**3**	**Students will be able to point out the deflection at any point in a beam**
CO3-PO2	**2**	**Students will be able to draw and analyse shear force and bending moment diagram**
CO4-PO1	**3**	**The knowledge Mohr's circle will enable students to visualize the relationships between the normal and shear stresses acting on various inclined planes at a point in a stressed body**
CO4-PO2	**2**	**Students will be able to analyse and calculate the combined stresses induced in structural members by using Mohr's circle of stresses**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activitie	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessent	5.5
Total	**122.5**
TEACHING METHODOLOGY	
Class Lecture, Pop quiz, Case study, Problem solving	

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	Stress analysis: statically indeterminate axially	CT 01	

	loaded member, axially loaded member		
Class 7-12	Thermal and centrifugal stresses; Stresses in thin and thick-walled cylinders and spheres.	CT 02	
Class 13- 18	Beams: Shear force and bending moment diagrams; various types of stresses in beams		
Class 19- 24	Flexural formula; Deflection of beams: integration and area moment methods; Introduction to reinforced concrete beams and slabs, Composite beams	MT	
Class 25-30	Torsion formula; Angle of twist; Modulus of rupture; Helical springs	MT	
Class 31-36	Combined stresses: principal stress, Mohr's Circle; Columns: Euler's formula, intermediate column formulas, the Secant formula	CT 03	
Class 37-42	Flexure formula of curved beams. Introduction to experimental stress analysis techniques; Strain energy; Failure theories, Failure prediction for impact loading, Computational modelling of mathematical problem using software		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
3	CT	**20**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	MID, Final Exam	**80**	
4	Final Exam	**70**	

REFERENCE BOOKS

1. Strength of materials (4th edition) William Nash, Publisher Mcgraw-hill International Editions, Schaum's Outline Series

2. Mechanics of material with solved problems A C Mandal & M. Quamrul Islam, published by IUT, OIC, 2011

3. Strength of Materials (4th edition) – Andrew Pytel, Ferdinand L. Singer. 4. Strength of Materials – Beer and Johnston. 5. Mechanics of Materials (10th edition) - R. C. Hibbeler

Spring Semester L-3, T-I

COURSE INFORMATION			
CourseCode	**ME 344**	Contact Hours	**: 3.00**
Course Title	**Mechanics of Solids Sessional**	Credit Hours	**: 1.50**
PRE-REQUISITE			
ME 343			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE							
This is the foundation unit in the study of structures. By applying the knowledge gained in Statics and combining it with the concepts gained in Materials Technology the students are introduced to fundamental theories and techniques required to analyze the state of stress and strain in structural members subjected to external loads.This knowledge will allow students to perform the engineering calculations required to ensure that a structural member meets strength, stiffness and stability requirements.							
OBJECTIVE							
1. Students will be able to instill a basic knowledge of the statistical aspects of mechanics of materials. 2. Develop the formal theory of solid mechanics: the equilibrium, kinematic, and constitutive equations. 3. Introduce the atomistic mechanisms underlying the mechanical behavior of materials. 4. Establish process - structure - property - performance relationships in materials engineering.							
LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Meth

							ods
CO1	**Apply** the fundamentals of Solid Mechanics.	1	C3			4	R, Q, LT
CO2	**Analyze** the fundamentals of stresses and strains.	2,3	C4			1	R, Q, LT
CO3	**Investigate** and express the principles of Solid Mechanics in obtaining the solutions for applications in real life engineering problems.	4,5	P5			5	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1) **a. Study and calibration of Universal Testing Machine (UTM)**

   b. Tensile Test of mild steel specimens.
2) **Hardness test of metal specimen.**
3) **Impact test of metal specimen.**
4) **Support reaction of a point loaded for a simple supported beam.**
5) **Column test of a mild steel specimen.**
6) **Test of a Helical Spring (Proposed)**
7) **Bending test on Cantilever beam (Proposed)**
8) **Torsion Test (Proposed, we do not have Equipment for This)**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Apply** the fundamentals of Solid Mechanics	3											
CO2	**Analyze** the fundamentals of stresses and strains.		3	3									
CO3	**Identify** and express the principles of Solid Mechanics in obtaining the solutions for applications in real life engineering problems.				3	3							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to identify the basics of solid mechanics, the knowledge of engineering fundamental would be required.
CO2-PO1	**3**	In order to perform the experiments, the fundamentalknowledge of stress strainwould be required
CO3-PO2	**2**	In order to solve the solid mechanics problems, the knowledge of engineering fundamentals is also required.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10

Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Introduction class
Week-2	Exp 1: a. Study and calibration of Universal Testing Machine (UTM) b. Tensile Test of mild steel specimens.
Week-3	Exp 2: Hardness test of metal specimen.
Week-4	Exp 3:Impact test of metal specimen.
Week-5	Exp 4:Support reaction of a point loaded for a simple supported beam.
Week-6	Exp 5:Column test of a mild steel specimen.
Week-7	Exp 6:Test of a Helical Spring (Proposed)
Week-8	Exp 7:Bending test on Cantilever beam (Proposed)
Week-9	Exp 8: Torsion Test (Proposed, we do not have Equipment for This)
Week-10	Revision Class
Week-11	Final Lab Report Submission
Week-12	Lab Test
Week-13	Viva
Week-14	Quiz Test

ASSESSMENT STATEGY		
Components		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Strength of materials (4^{th} edition) William Nash, Publisher Mcgraw-hill International Editions, Schaum's Outline Series.

2. Mechanics of material with solved problems A C Mandal & M. Quamrul Islam 2011.

3. Strength of Materials (4^{th} edition) – Andrew Pytel, Ferdinand L. Singer.

4. Strength of Materials – Beer and Johnston.

5. Strength of Materials – E. P. Popov.

6. Mechanics of Solids Laboratory Practice- A.C. Mandal & M.Q. Islam

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 345** **Mechanics of Machinery**	Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME 245, ME 247, ME 343

CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
Understand the basic of mechanism, linkages, gears and gear trains. The knowledge accumulation for finding unbalanced forces and solving for the balanced system containing reciprocating and rotating forces. Gaining knowledge about different vibration and its principles. Getting familiarized with clutch, brake, dynamo-meter and gyroscope and its effects.
OBJECTIVE
1. To determine the balancing of masses of rotating and reciprocating machine elements 2. To understand the principles of gyroscope and the effects of gyroscopic couple 3. To determine the forces and power calculations for brakes and dynamo-meter 4. To determine the static and dynamic forces for mechanical systems 5. To understand the principles of vibrations
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand reciprocating and rotating parts of machines: turning moments and balancing of those parts	1,2,	C2	1,2, 3	1,2		R, Q, LT
CO2	Demonstrate knowledge on different types of vibrations and calculating the natural frequency of free, damped and undamped vibrations	1,7	C3	3,5	1,3		R, Q, LT
CO3	Design Cam and cam follower	1,3	C5,C6	2,3, 4,5	1,3 ,5	2	R, Q, LT
CO4	Gain knowledge of gears and gear trains and solve different problems of gear trains	1,3	C2	3,4, 5	1,2		R, Q, LT

C05	Familiarize with different mechanisms of clutch, brake and dynamo-meter	1,2	C4	3,5			R, Q, LT
C06	Study the principles and applications of gyroscopes	2,12	C1,C2	3,5, 6			R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

Mechanisms; Turning moment; Static and dynamic balancing; Balancing machines.; Study of cams and cam followers; Clutches and brakes; Dynamometers; Study of gears and gear trains; Gyroscope;

b. Detail Contents:

Mechanisms; Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Static and dynamic balancing: reciprocating and rotating parts, multi-cylinder in-line and V-engines, radial engines, and opposed-piston engines; Balancing machines.

Study of cams and cam followers; Clutches and brakes; Dynamometers; Study of gears and gear trains; Gyroscope; Principles and applications.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand reciprocating and rotating parts of machines: turning moments and balancing of those parts	3	3										
CO2	Design Cam and cam follower	3		2									
CO3	Gain knowledge of gears and gear trains and solve different problems of gear trains	3		3									
C04	Familiarize with different mechanisms of clutch, brake and	3	3										

	dynamo-meter												
C05	Study the principles and applications of gyroscopes		3										1

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to understand reciprocating and rotating parts of machines: turning moments and balancing of those parts.**
CO1-PO2	**3**	**Application of turning moments and balancing of parts**
CO2-PO1	**3**	**Students will have an ability to examine forces in trusses and structures**
CO2-PO3	**2**	**Students will be able to design cam and cam follower**
CO3-PO1	**3**	**They will be competent enough to design simple systems of cams**
CO3-PO3	**3**	**Students will have knowledge of cam and cam follower and will observe how this knowledge relates to engineering**
CO4-PO1	**3**	**Student will be apt in different mechanisms of clutch, brake and dynamo-meter**
CO4-PO2	**3**	**Students will have an ability to examine mechanisms of clutch, brake and dynamo-meter**
CO5-PO2	**3**	**Student will be apt in understanding gyroscope**
CO5-PO12	**1**	**Application of gyroscope**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75

Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	Mechanism: Simple mechanism, link, pairs and joints Gyroscope: Principle, effect of gyroscopic couples and application	CT 01	
Class 7-12	Turning moment: Inertia and kinetic energy of reciprocating and rotating parts Static and dynamic balancing: Reciprocating and rotating parts	CT 02	
Class 13- 27	Study of Gear and Gear Trains	CT 03	
Class 28-36	Study of Clutch, Brake and Dynamo-meter	MT	
Class 37-42	Study of Cam and Cam follower and design of Cam profile		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**20**	
4,5	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	MID, Final Exam	**70**	
3	MID, Final Exam	**80**	
4,5	Final Exam	**70**	

REFERENCE BOOKS
1. Theory of Machines (S. I. Units) – R. S. Khurmi, J. K. Gupta, Publisher – Eurasia Publishing house (Pvt) Ltd. 2. Mechanics of Machines (Advanced theory and examples) 2nd edition (SI units) – John Hannah and R. C. Stephens. 3. Theory of Machines – Thomas Bevan 4. Mechanical Vibration- K. G. Grover

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 346** **Mechanics of Machinery Sessional**	Lecture Contact Hours Credit Hours	**: 3.00** **: 1.50**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course student will study advanced concepts of kinematic and dynamic modeling and analysis of mechanisms and machines, including linkage mechanisms and cam mechanisms, reciprocating and rotating machinery.The course enables student to explore in depth core mechanical engineering concepts by integrating and applying contemporary analytical, computational and experimental methods. It relates kinematics and dynamics of mechanisms and machines to their design and allows to relate theory and practice using a problem-based approach in which you develop project management skills.			
OBJECTIVE			
1. This course will make one capable of applying the advanced concepts of kinematics and dynamics in real life problems including linkage mechanisms and cam mechanisms, reciprocating and rotating machinery etc. 2. This course will provide students with the skills, knowledge required to describe and analyse the effects of forces on the motion of particles, rigid bodies and vibrating systems, in order to predict dynamic behaviour as a basis for engineering design. 3. This will provide students with in depth practical knowledge and skills within specialist sub-disciplines of the practice area.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Correspon ding PO	Bloom's Taxonomy	CP	CA	KP	Assess ment Metho ds
CO1	**Relate** basic concepts/principles of work-energy methods and impulse and momentum principles to the solving of engineering problems.	1	P1			1	R, Q, LT
CO2	Explain the kinetics of particles or rigid bodies moving with planar motion.	1	P3			1	R, Q, LT
CO3	**Analyze** and solve engineering problems relating to the dynamic behavior of vibrating single-degree and two-degrees of freedom, undamped and damped systems.	2	C4			5	R, Q, LT
CO4	**Relate** basic principles to applications of vibration transducers / accelerometers.	4	P1			3	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1. **Study of Moment of Inertia and radius of gyration of a body with bifilar suspension.**
2. **Study of Compound Pendulum.**
3. **Determining Mass moment of inertia of Flywheel.**
4. **Static and Dynamic Balancing of Shaft.**
5. **Study of free vibration Apparatus.**
6. **Study of forced vibration apparatus.**
7. **Determining Critical Speed of shaft by using whirling shaft apparatus.**

8. Study of Critical speed investigation by using critical speed investigation apparatus.

9. Study of Gear and Gear Trains (Proposed)

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Relate** basic concepts/principles of work-energy methods and impulse and momentum principles to the solving of engineering problems	3											
CO2	**Explain** the kinetics of particles or rigid bodies moving with planar motion.	3											
CO3	**Analyze** and solve engineering problems relating to the dynamic behaviour of vibrating single-degree and two-degrees of freedom, undamped and damped systems.		3										
CO4	**Relate** basic principles to applications of vibration transducers / accelerometers.				3								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to dynamics problem, understanding of different vibration principle is required.
CO2-PO1	**3**	In order to perform the experiments, kinetics of particles or rigid bodies moving with planar motion knowledge would be required
CO3-PO2	**2**	In order to solve dynamic behavior of vibrating single-degree and two-degrees of freedom, undamped and damped systems, the knowledge of engineering fundamentals is also required.

CO4-PO4	**3**	For performing the experiments, applications of vibration accelerometers are needed.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112
TEACHING METHODOLOGY	
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method	

COURSE SCHEDULE	
Week-1	Expt-01: Study of Moment of Inertia and radius of gyration of a body with bifilar suspension.
Week-2	Expt-02: Study of Compound Pendulum.
Week-3	Expt-03: Determining Mass moment of inertia of Flywheel.
Week-4	Expt-04: Static and Dynamic Balancing of Shaft.
Week-5	Expt-05: Study of free vibration Apparatus.
Week-6	Expt-06: Study of forced vibration apparatus.

Week-7	Expt-07: Determining Critical Speed of shaft by using whirling shaft apparatus.
Week-8	Expt-08: Study of Critical speed investigation by using critical speed investigation apparatus.
Week-9	Expt-09: Study of Gear and Gear Trains (Proposed)
Week-10	Lab Test
Week-11	Expt-11:Revision Class
Week-12	Final Lab Report Submission
Week-13,14	Viva, Quiz

Components		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Theory of Machines (S. I. Units) – R. S. Khurmi, J. K. Gupta, Publisher – Eurasia Publishing house (Pvt) Ltd.

2. Mechanics of Machines (Advanced theory and examples) 2nd edition (SI units) – John Hannah and R. C. Stephens.

3. Theory of Machines – Thomas Bevan

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 361** **Instrumentation and Measurement**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students to different electrical and mechanical instruments and components of different types of measurement systems, their circuit components, structure, operating principle and design.			
OBJECTIVE			
1. To introduce the students with the principles, techniques, equipment and engineering practice of electronic testing as well as underlying instrumentation and measurement technology and tools. 2. To familiarize with current industrial needs. 3. To develop the idea of the modern test technology that plays key role in ensuring quality and functionality of the modern high complexity devices and systems. 4. To build up important skills in the area of practical instrumentation in industrial and research settings with the use of modern modular hardware for measurement.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Students will have clear understanding of different types of measurement systems used in engineering systems.	1,5	C2	3			Q, ASG, F

CO2	Students will be able to analyse various measuring devices like fluid flow measurement, temperature and pressure measurement etc.	1, 3	C3	1, 3, 5			Q, ASG, F
CO3	Students will have fundamental understanding of signal processing, filtering, amplification and their applications in engineering system.	1, 2	C2	3, 5			Q, F, CS
CO4	Students will be able to analyze different types of sensors related to mechatronics.	1,3	C5	1, 5	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Basic principles of measurement
2. Different types of sensing elements
3. Different types of measurement systems
4. Measurement, transmission and recording methods
5. Data acquisition and processing
6. Oscilloscopes
7. Signal Amplification and Processing

b. Detail Contents:

Basic principles and terminologies of measurement and instrumentation, Characterization and behavior of typical measuring systems, Different types of sensing elements such as ultrasonic transducer, pressure sensor, proximity sensor, thermocouple, thermistor, photodetector, hall effect sensor etc., Measurements of displacement, pressure, temperature, heat flux, flow, motion and vibrations, force, torque and strain, ADC and DAC and their Circuits, analysis of oscillography, graphitization of signal through oscilloscopes, operational amplifiers, filters, bipolar junction transistors, digital signal

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will have clear understanding of different types of measurement systems used in engineering systems.	3				1							
CO2	Students will be able to analyse various measuring devices like fluid flow measurement, temperature and pressure measurement etc.	3		3									
CO3	Students will have fundamental understanding of signal processing, filtering, amplification and their applications in engineering system.	3	3										
CO4	Students will be able to analyze different types of sensors related to mechatronics.	3		2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	Students will gather knowledge derived from physics and engineering fundamentals as well as common engineering practice

CO1-PO5	**1**	Students will be able to utilize different types of measurement systems and modern tools
CO2-PO1	**3**	Students will learn the common engineering practice prevailing in the field
CO2-PO3	**3**	Students will gain in-depth knowledge of various types of measuring devices
CO3-PO1	**3**	Student will gather knowledge on various important engineering systems
CO3-PO2	**3**	Student will be able to demonstrate knowledge on various electronics topics like signal processing, amplification etc.
CO4-PO1	**3**	Students will gain knowledge on various types of sensor and measuring elements
CO4-PO3	**3**	Students will gain in-depth knowledge on different topics pertinent to mechatronic

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
1-2	Basic principles and terminologies of measurement and instrumentation, Characterization and behavior of typical measuring systems	CT-1	
3-5	Different types of sensing elements such as ultrasonic transducer, pressure sensor, proximity sensor, thermocouple, thermistor, photodetector, hall effect sensor etc.	CT-2	
6-10	Measurements of displacement, pressure, temperature, heat flux, flow, motion and vibrations, force, torque and strain	Mid-Term	
11	Data acquisition and processing, ADC and DAC and their Circuits		
12-13	Operational amplifiers, Filters, Bipolar junction transistors, Digital signal	CT-3	
14	Analysis of oscillography, Graphitization of signal through oscilloscopes		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

COURSE SCHEDULE

Week	Topic	CT	Remarks
1-2	Basic principles and terminologies of measurement and instrumentation, Characterization and behavior of typical measuring systems	CT-1	
3-5	Different types of sensing elements such as ultrasonic transducer, pressure sensor, proximity sensor, thermocouple, thermistor, photodetector, hall effect sensor etc.	CT-2	
6-10	Measurements of displacement, pressure, temperature, heat flux, flow, motion and vibrations, force, torque and strain	Mid-Term	
11	Data acquisition and processing, ADC and DAC and their Circuits		
12-13	Operational amplifiers, Filters, Bipolar junction transistors, Digital signal	CT-3	
14	Analysis of oscillography, Graphitization of signal through oscilloscopes		

REFERENCE BOOKS

1. Introduction to Mechatronics and Measurement Systems – David G. Alciatore, Michael B. Histand.

2. Experimental Methods for Engineers – J. P. Holman, Publisher – Mc Graw – Hill Inc.

3. Mechanical Measurements – Thomas G. Beckwith, Roy D. Marangoni, John H. Lientard.

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code	**ME 366**	Lecture Contact Hours	**: 3.00**
Course Title	**Engineering Simulation Sessional**	Credit Hours	**: 1.50**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course examines a variety of engineering system modelling and simulation methods, as well as numerical and computer based solution techniques utilized in industrial and engineering environments. Techniques for finding solutions to these systems include: graphical, algebraic, numerical, state space, simulation and computational processes. Case studies in industry and engineering applications are used to illustrate the techniques and modelling concepts. Examples of simulation and analysis methods will be related to the linear and non-linear, deterministic and non-deterministic systems.

OBJECTIVE

1. Characterize engineering systems in terms of their essential elements, purpose, parameters, constraints, performance requirements, sub-systems, interconnections and environmental context.

2. Engineering problem modelling and solving through the relationship between theoretical, mathematical, and computational modelling for predicting and optimizing performance and objective.

3. Mathematical modelling real world situations related to engineering systems development, prediction and evaluation of outcomes against design criteria.

4. Develop solutions and extract results from the information generated in the context of the engineering domain to assist engineering decision making.

5. Interpret the model and apply the results to resolve critical issues in a real world environment.

6. Develop different models to suit special characteristics of the system being modelled.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Model** deterministic systems and **differentiate** between		P1		2	3	R, Q,

	nonlinear and linear models.	1					LT
CO2	**Simulate** linear and non-linear ordinary differential equations and deterministic systems.	2	P3			2	R, Q, LT
CO3	**Estimate** and **validate** a model based upon input and output data.	4	C4	2		4	R, Q, LT
CO4	**Create** a model prediction based upon new input and validate the output data.	3	P5	3	3,5	5	R, Q, LT
CO5	**Comprehend** and **apply** advanced theory-based understanding of engineering fundamentals and specialist bodies of knowledge in the selected discipline area to predict the effect of engineering activities.	5	P4			6	R, Q, LT
CO6	**Apply** underpinning natural, physical and engineering sciences, mathematics, statistics, computer and information sciences to engineering applications.	6	C3	3,4, 5	2,3	7	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1. **Combustion control (jet engine in aero lab) and/or heating control for boiler with simulation using MATLAB toolbox (CAD and Automotive lab)**
2. **Car control with ECU (Automotive Lab)**
3. **Generator inertia and RLC circuit, such as operational amplifiers (Electrical circuit lab)**
4. **Projectile control with fin stabilization (Aeronautical Lab, aileron controls and software can be used)**

5. **PLC control demonstration with ladder logic programming (Mechanical thermo lab and/or IPE lab)**
6. **Pneumatic and hydraulic circuits (Mechanical lab, 1st floor)**
7. **Modeling and demonstration of 4 post car lift for electro-hydro-pneumatic control (Automotive MAHA car lift, automotive lab)**
8. **Pump test bench (Hydraulic pump testing building)**
9. **Solenoid, its structure and function (Needs the setup)**
10. **PID controller (Electrical circuit lab: temperature control and water level control equipment)**
11. **Car suspension system with spring-mass damper model and MATLAB simulation (Automotive lab)**
12. **Heat transfer, 2 phase flow (Thermo lab, setup needs to be prepared)**
13. **Gyroscope control (Instrumentation lab, setup needs to be assembled and prepared)**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Model deterministic systems and differentiate between nonlinear and linear models.	3											
CO2	Simulate linear and non-linear ordinary differential equations and deterministic systems.		2										
CO3	Estimate and validate a model based upon input and output data.				2								
CO4	Create a model prediction based upon new input and validate the output data.			3									

CO5	Comprehend and apply advanced theory-based understanding of engineering fundamentals and specialist bodies of knowledge in the selected discipline area to predict the effect of engineering activities.					3							
CO6	Apply underpinning natural, physical and engineering sciences, mathematics, statistics, computer and information sciences to engineering applications.						1						

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to differentiate between the linear and non linear model, the knowledge of engineering mathematics would be required.
CO2-PO2	**2**	In order to simulate differential equations, the knowledge of identification and formulae would be required
CO3-PO4	**2**	In order estimate and validate a model, the knowledge of investigation, analysis and interpretation of data are also required.
CO4-PO3	**3**	For creating a model, design problems are needed in this laboratory.
CO5-PO5	**3**	In order to comprehend and apply theory based understanding one need to know the techniques of appropriate application of theory.
CO6-PO6	**1**	In order to apply computer and information sciences to engineering area, the knowledge of reasoning application and contextual knowledge

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Exp 1:Combustion control (jet engine in aero lab) and/or heating control for boiler with simulation using MATLAB toolbox (CAD and Automotive lab)
Week-2	Exp 2: Car control with ECU (Automotive Lab)
Week-3	Exp 3: Generator inertia and RLC circuit, such as operational amplifiers (Electrical circuit lab)
Week-4	Exp 4:Projectile control with fin stabilization (Aeronautical Lab, aileron controls and software can be used)
Week-5	Exp 5:PLC control demonstration with ladder logic programming (Mechanical thermo lab and/or IPE lab)

Week-6	Exp 6: Pneumatic and hydraulic circuits (Mechanical lab, 1^{st} floor)
Week-7	Exp 7:Modeling and demonstration of 4 post car lift for electro-hydro-pneumatic control (Automotive MAHA car lift, automotive lab)
Week-8	Exp 8:Pump test bench (Hydraulic pump testing building)
Week-9	Exp 9: Solenoid, its structure and function (Needs the setup)
Week-10	Exp 10:PID controller (Electrical circuit lab: temperature control and water level control equipment)
Week-11	Exp 11:Car suspension system with spring-mass damper model and MATLAB simulation (Automotive lab)
Week-12	Exp 12:Heat transfer, 2 phase flow (Thermo lab, setup needs to be prepared)
Week-13	Viva, Lab Report Submission
Week-14	Quiz Test

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Numerical Methods for Engineers (4^{th} edition) – Steven C. Chapra, Raymond P. Carale

2. Numerical Method : Using Matlab, Fourth Edition, 2004 John H. Mathews and Kurtis D. Fink

3. “Computer Integrated Design and Manufacturing” by David Bedworth and Philip Wolfe

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 367** **Automobile Engineering**	Lecture Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides an introduction to the essential theoretical basis of Automobile Engineering and its application to a range of problems of relevance to practical engineering. It enables you to explore new areas, create new avenues in the fields of research and development of technologies in the field of automobile engineering.

OBJECTIVE

The student will be able to understand the fundamental principles and technologies involved in automobile engineering, learn the main components and systems, introduce themselves to the most recent innovation taking place in the industry and how the industry will shape facing challenges of sustainable development and human safety

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Understand the anatomy of the automobile in general	1	C1, C3			1,4	Q, ASG, F
CO2	Understand the working principles of various parts of the automotive vehicle	1	C3			1,4	Q, ASG, F
CO3	Know about the various systems inherent in an automotive vehicle	1	C1, C3			1,4	Q, F, CS
CO4	Develop a strong base for understanding future developments in the automobile industry and understand the environmental implications of automobile emissions.	6,7	C1, C3			6,7	Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
a. Main Contents:: History and development of automobile in modern century, Transmission system, Powertrain system, Subsystem of automobile, Automotive electronics, Vehicle dynamics and chassis **b. Detail Contents:** History and development of automobile in modern century. The latest examples of energy-saving vehicles (hybrid, electric and fuel cell vehicles). Hybrid electric vehicles: electronic motor control, battery pack build, practical electronics, synergy drive. Transmission system: Introduction of manual gear transmission, clutches, automatic gears, torque converters, CVT transmission, Powertrain system: Differentials, propeller shaft, axles, other components. All-wheel drive, Real wheel drive, Front wheel drive, Four-wheel drive systems. Subsystem of automobile: Starting and charging systems, steering and suspension systems, braking systems, lubrication systems. exhaust emission systems. Automotive electronics: engine ECU, sensors and actuator for safety and stability of modern automotive vehicle. Vehicle dynamics and chassis. Self-driving Car. Crash Safety. Introduction of tire.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the anatomy of the automobile in general	3											
CO2	Understand the working principles of various parts of the automotive vehicle	3											
CO3	Know about the various systems inherent in an automotive vehicle	3											
CO4	Develop a strong base for understanding future developments in the automobile industry and understand the environmental implications of automobile emissions.						3	3					

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	**Understanding the basic anatomy of modern automobile, their market and engineering fundamentals.**
CO2-PO1	**3**	**Students will be able to analyze the working principle of various automobile parts.**
CO3-PO1	**3**	**Students will be able to know about various integral system and sub system such as mechanical and electrical features attached with modern automobile.**
CO4-PO6	3	**Students will apply appropriate techniques, resources, and modern engineering to assess societal, health, safety and the consequent responsibilities relevant to professional engineering practice.**
CO4-PO7	**3**	**Students will be able to Understand different environmental impact of emission and find out professional engineering solutions for sustainable development**.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE			
Week	**Topic**	**CT**	**Remarks**
Class (1-5)	History and development of automobile in modern century. The latest examples of energy-saving vehicles (hybrid, electric and fuel cell vehicles). Hybrid electric vehicles: electronic motor control, battery pack build, practical electronics, synergy drive.		

Class (6-16)	Transmission system: Introduction of manual gear transmission, clutches, automatic gears, torque converters, CVT transmission,	CT01 will over this section	
Class (17-25)	Powertrain system: Differentials, propeller shaft, axles, other components. All-wheel drive, Real wheel drive, Front wheel drive, Four-wheel drive systems.	CT02 will over this section Mid-Term will cover this section	
Class (26-32)	Subsystem of automobile: Starting and charging systems, steering and suspension systems, braking systems, lubrication systems. exhaust emission systems.	Mid-Term will cover this section	
Class (33-38)	Automotive electronics: engine ECU, sensors and actuator for safety and stability of modern automotive vehicle.	CT03 will over this section	
Class (39-42)	Vehicle dynamics and chassis. Self-driving Car. Crash Safety. Introduction of tire.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS
1. Automotive Mechanics – W. H. Crouse, Donald L Anglin 2. Automotive Technology – Jack Erjavec 3. Automobile Engineering Vol 1 and VoI 2 – Dr.Kirpal Singh

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	: ME 372 : Industrial Training	Lecture Contact Hours Credit Hours	: 4 weeks : 1.50
PRE-REQUISITE			
Student should complete all courses up to 3rd Year, 2nd Semester			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To provide the experience for the students regarding industrial environment and organization as well as the functionality of the engineers in industries.			
OBJECTIVE			
1. To be able to practice the responsibility of becoming an engineer in the profession of engineering. 2. To be able to involve and experience the true working environment of the engineer. 3. To be able to work in a team and manage a project within a given time frame. 4. To be able to effectively communicate solution to problems (oral, visual, written).			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Develop** practical experience. in the industrial sector of maintenance, planning, engineering service and aircraft inspection.	3	C4			K5	Pr , R

CO2	**Recognize** the structure and management of an industry/organization to apply this knowledge in the individual's professional life.	9	A1	4			Pr , R
CO3	**Internalize** the industrial training knowledge further in project or research work.	12	A5	1 &2	1 &2		Pr , R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam; Bloom's Taxonomy: C-Cognitive, P- Psychomotor and A-Affective)

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Develop** practical experience. in the industrial sector of maintenance,planning, engineering service and aircraft inspection			2									
CO2	**Recognize** the structure and management of an industry/organization to apply this knowledge in the individual's professional life.									3			
CO3	**Internalize** the industrial training knowledge further in project or research work.												3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO3	**2**	Students will develop practical experience. in the industrial sector of maintenance, planning, engineering service and aircraft inspection

CO2-PO9	**3**	Students can recognize the structure and management of an industry/organization to apply this knowledge in the individual's professional life.
CO3-PO12	**3**	Students will be adroit at the industrial training knowledge which can be used for further project or research work.

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	Industrial Visit & Training
Week 2	Industrial Visit & Training
Week 3	Industrial Visit & Training
Week 4	Test for Industrial Performance, Presentation & Viva

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
	Attendance	**10**	
1	Industrial Performance, Observation and Presentation	**90**	
2			
3			

TEXT AND REFERENCE BOOKS
As per the type of core work of the assigned industry.

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 368** **Automobile Engineering Sessional**	Lecture Contact Hours Credit Hours	: **3.00** **: 1.50**
PRE-REQUISITE			
ME 367			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Students need to experiment based on various types of vehicles, working principle and mechanism of vehicles, different parts and their functions of a vehicle.			

OBJECTIVE

1. Penetrate deep into engine classification, construction and operation of IC engine

2. Understand the performance parameters and testing methodology

3. Understand the necessity of ignition system SI engines

4. Understand the individual systems of Automobile.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Students learn different mechanism used in automobile.	1	C3			1	R, Q, LT
CO2	Different application of principles learned in machine design, control engineering, combustion,		P5		3	5	R, Q, LT

	and others.	3,4					
CO3	Deep and insightful knowledge on automobile internal systems and their testing.	12	P4			4	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1. **Study of Automotive Manual transmission system (Expt setup)**
2. **Study of Automotive Automatic transmission system (have a AT X sectioned)**
3. **Study of steering geometry and determine related parameters (Experiment setup)**
4. **Study of Automotive powertrain (3 ton Truck body) (Proposed)**
5. **Study of Automotive Chassis (Nissan Xtrail) (Proposed)**
6. **Study of Wheel alignment (have setup, not functional)**
7. **Study of Wheel balancing (have setup, not functional)**
8. **Study Testing of CNG/LPG (Proposed, Head Sir) Engine**
9. **Study of Electrical and Hybrid Vehicle (Head Sir)**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students learn different mechanism used in automobile.	3											
CO2	Different application of principles learned in machine design, control engineering, combustion, and others.			3	3								
CO3	Deep and insightful knowledge on automobile internal systems and their testing. The lesson learned will be helpful in the future.												3

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to understand Automobile system, the knowledge of engineering fundamental would be required.
CO2-PO3	**3**	In order to understand the design of different automobile systems, engineering knowledge is important so that it could be used for greater good of the society.
CO2-PO4	**3**	The study will enable students to investigate different mechanism hands on, test them and gather results for analyzing.
CO3-PO12	**3**	Studying different systems in the automotive will enable the students about understanding complex systems and their working principles later in their career.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Introduction class
Week-2	Exp 1: Study of Automotive Manual transmission system (Expt setup)
Week-3	Exp 2: Study of Automotive Automatic transmission system (have a AT X sectioned)
Week-4	Exp 3:Study of steering geometry and determine related parameters (Expt setup)
Week-5	Exp 4:Study of Automotive powertrain (3 ton Truck body) (Proposed)
Week-6	Exp 5: Study of Automotive Chassis (Nissan Xtrail) (Proposed)
Week-7	Exp 6:Study of Wheel alignment (have setup, not functional)
Week-8	Exp 7:Study of Wheel balancing (have setup, not functional)
Week-9	Exp 8: Study Testing of CNG/LPG (Proposed, Head Sir) Engine
Week-10	Exp 9: Study of Electrical and Hybrid Vehicle (Head Sir)
Week-11	Final Lab Report Submission
Week-12	Lab Test
Week-13	Viva
Week-14	Quiz Test

ASSESSMENT STRATEGY		
Components		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%

Lab Quiz	40%
Total Marks	100%

REFERENCE BOOKS

1. Ganesan.V.Internal Combustion Engines, Tata-McGraw Hill Publishing Co., New Delhi, 1994.

2. Heldt.P.M.,High Speed Combustion Engines, Oxford IBH Publishing Co.,1985.

3. Maleev.V.M, Diesel Engine Operation and Maintenance, McGraw Hill, 1974.

4. Dicksee.C.B, Diesel Engines, Blackie & Son Ltd., London, 1964.

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 375** **Control Engineering**	Lecture Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

CSE 171 - Computer Programming Language
ME 103 - Thermodynamics
ME 247 - Engineering Mechanics II
ME 321 - Fluid Mechanics I
ME 361 - Instrumentation and Measurement

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This final year course requires basic knowledge of mechanics, fluids, thermodynamics and electrical circuits with orientation in computer programming (C and MATLAB). It comprises theory and mathematical modeling, some physical demonstrations, visualization of system responses and simulation. Initially, the understudy is introduced to dynamic systems and their mathematical modeling using differential equations, linear approximations, Fourier and Laplace Transforms. Block diagrams and transfer functions are emphasized for system's response analysis. Analytical solutions of simplified control systems using state variables and basics for the development of control architectures are introduced. Standard inputs, response, control action, and system types are critically evaluated for stability and performance using Time and Frequency domain plots of single and multi-body or multi-component systems. In addition, analogues of control systems and equivalence of mechanical, thermal, fluids and electrical systems are elaborated. Design of Lead-Lag controllers for real life hydraulic and pneumatic control systems are carried out along with discussion of elements of electro-mechanical controls. Finally, the course is concluded with detailed study of digital computer control and robust systems.

OBJECTIVE
1. To understand the application of physical laws and differential equations in order to create mathematical models of dynamic systems 2. To apply concepts of transfer function and Laplace transforms in order to analyze system response 3. To analyze control system stability and to evaluate robustness of comparable systems under standard inputs 4. To apply PLC and PID based control protocols to design simulated control systems of real world applications 5. To evaluate the performance of digital and robust systems using time and frequency domain outputs and simulation in MATLAB

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Students will be able to create mathematical models of dynamic real world systems	PO 1	C6	P1		K3	ASG, F
CO2	Students will be able to analyze responses of real dynamic systems to different types of inputs	PO 2	C4	P3		K2 K3	T, ASG, Mid Term, F
CO3	Students will be able to analyze control system's stability and evaluate robustness of different ones.	PO 2	C4	P2, P3		K2	Mid Term, F

CO4	Students will be able to design control systems for the control of practical dynamic systems.	PO 3	C6	P1, P3		K2 K5	PR, R, F
CO5	Students will be able to evaluate different control systems' stability and robustness using analytical methods and computer software	PO 5	C5	P2, P3		K6	ASG, Mid Term & F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1. Control Systems: Open and closed loop control systems; Feedback and feed-forward control architectures, their basics and performance evaluation, limitations, robustness and stability; Fundamentals of modeling dynamic systems using the laws of physics and differential equations, linear approximation using Taylor series.

2. Block Diagrams: Fundamentals of block diagram representations of control systems, their simplifications and applications in designing control system architecture; Signal Flow graph models; Simulation of control systems using MATLAB.

3. Mass-Spring-Damper Systems: Analogies of single and multi-body systems, natural and forced responses, damping ratios, resonant peaks and band widths; Applications in real world including active vehicle suspension system control with demonstration, and simulation via MATLAB.

4. RLC Circuit based Control: Concept, mathematical models and control applications of RLC circuits including Operational Amplifiers, Demonstration, MATLAB simulation.

5. State Variable Approach: State variables of a dynamic system, state differential equation, system response using state transition matrix, simulation of state variable models of control systems using MATLAB.

6. Inputs and Responses of Control Systems: Standard inputs (unit impulse, rectangular, step, ramp, parabolic etc.); Responses of dynamic systems (natural, forced, transient, steady-state etc.); Percentage overshoot, Lead-Lag.

7. Stability Analysis: Basic concept for linear systems using the Routh array test, marginal stability, control design constraints, applications in feedback systems.

8. Evans Root Locus techniques: Mathematical basis and application in control design for real world systems.

9. Gain and Phase margins: Basic concept, polar plots, computation from Bode diagrams and Nyquist plots, implications in terms of robust stability of control systems.

10. Actuator Control: Pneumatic, hydro-pneumatic, electro-hydro-pneumatic actutators, study of pneumatic circuits with physical demonstration, electro-hydro-pneumatic control system demonstration and mathematical modeling for 4 post car lift, simulation using MATLAB; D.C. and servo motors control methods and mathematical models, their analysis using block diagrams and transfer functions.

11. Design of Feedback Control Systems: Phase Lead and Lag-Design using Bode diagrams and root locus; Lead-Lag compensators based on frequency data for open-loop linear systems; PLC based control fundamentals, physical demonstration using trainer and MATLAB simulation; PID controller basics, algorithms for control including ladder diagrams, designing PID controllers based on empirical tuning rules, physical demonstration and modeling of water level control in water reservoir and temperature control in heating set-ups.

12. Automotive control systems: Integration of engine management and transmission control systems, power train control systems, automatic clutch and throttle system, chassis control systems: Antilock Braking systems (ABS), electronic damping control systems, power assisted steering systems, traction systems. Cruise control.

13. Electromechanical system: mathematical modelling and designing of electromechanical systems. Air bag and seat pre-tensioner systems. Servo-mechanism.

14. Thermostatic control systems, electromechanical, hydraulic and pneumatic positioner systems.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will be able to create mathematical models of dynamic real world systems	3											
CO2	Students will be able to analyze responses of real dynamic systems to different types of inputs		3										
CO3	Students will be able to analyze control system's stability and evaluate robustness of different ones.		3										
CO4	Students will be able to design control systems for the control of practical dynamic systems.			2									
CO5	Students will be able to evaluate different control systems' stability and robustness using analytical methods and computer software					3							

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Creation of mathematical models of physical systems will involve significant depth of engineering knowledge; often with application of first principles.
CO2-PO2	3	Considerable analytical ability will be exercised in analyzing control systems.
CO3-PO2	3	Evaluation of different control approaches for a designated problem and constraints demands identification, formulation and complex problems analysis and evaluation.
CO4-PO3	2	Design of control systems in using calculations and MATLAB emphasizes designing skills and developing solutions to engineering problems.
CO5-PO5	3	Assessment of different control strategies using analytical means and computer software will fortify students skills in using modern computation tools and analysis.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face	42
Self- Learning & Reports	58
Preparation & Exams	20
Total	120

TEACHING METHODOLOGY

1. Feedback on submitted assignments
2. Feedback on submitted group projects
3. Feedback on submitted computer programs in MATLAB (for visualization)
4. Review of class tests and mid-term exam scripts
5. Open group discussion on projects and materials learnt from open courseware

COURSE SCHEDULE	
Week-1	Dynamic systems introduction and their modeling using ODEs
Week-2	Control systems introduction and types: feedback and feed forward, open and closed loop control; their importance, demonstration using automobile ECU.
Week-3	Mass-spring-damper systems for single and multi-body, ODEs, Laplace transforms, demonstration via vehicle active suspension, visualization using MATLAB
Week-4	Resistor, Inductor and Capacitor (RLC) circuit basics, analogy with mechanical systems, RLC control, visualization using MATLAB
Week-5	State Variable Approach to control engineering, state differential equation, system response using state transition matrix, simulation in MATLAB

Week-6	Inputs of Control Systems: Standard inputs (unit impulse, rectangular, step, ramp, parabolic etc.); Responses of dynamic systems (natural, forced, transient, steady-state etc.); Lead-Lag.
Week-7	Stability Analysis of linear systems, concept of marginal stability, control design constraints, applications in feedback systems; Review for mid-term exam
Week-8	Root Locus: Mathematical basis, plots and application in control system design
Week-9	Gain and Phase margins: Basic concept, polar plots,
Week-10	Bode diagrams and Nyquist plots, robust stability of control systems, MATLAB simulations
Week-11	Actuator Control for pneumatic, hydro-pneumatic, electro-hydro-pneumatic actutators, demonstrations using pneumatic circuits and 4 post car lift, simulations in MATLAB; D.C. and servo motors control, block diagrams and transfer functions methods
Week-12	Design of Feedback Control Systems for Phase Lead and Lag-Design using Bode diagrams and root locus; Lead-Lag compensators, MATLAB visualization
Week-13	PLC based control systems, physical demonstration using PLC trainer, and MATLAB simulation
Week-14	Control system design and evaluation using MATLAB; Review for final examination

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
	Class Participation/Observation	**5%**	
CO1	Assignment 1, CT 1	**7.5%**	
CO2	Assignment 2, CT 2	**7.5%**	
	Exam		
CO2, 3, 5	Mid Term	**20**	
CO 1-5	Final Exam	**60**	

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Modern Control Systems, 12th Edition, by Dorf and Bishop (Text Book)
2. Control System Engineering, 6th Edition, by Norman Nise (Reference Book & Further Reading)
3. Introduction to Automatic Controls, 2nd Edition, by Howard L. Harrison and John G. Bollinger (Reference)

REFERENCE SITE
N/A

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code	**ME 376**	Lecture Contact Hours	**: 3.00**
Course Title	**Control Engineering Sessional**	Credit Hours	**: 1.50**
PRE-REQUISITE			
ME 375			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Introduction to control systems and their representation by different equations and Laplace transforms; Block diagrams and transfer functions; Analog computer solution of system equations; System response, control action and system types, Frequency response; System analysis; System compensation; Analogues of control systems; Hydraulic and pneumatic control systems; Elements of electromechanical controls; Introduction to digital computer control.			
OBJECTIVE			
1. To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis. 2.To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system			

3.Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Categorize** different types of system and **identify** a set of algebraic equations to represent and model a complicated system into a more simplified form.	2	P2			1	R, Q, LT
CO2	**Characterize** any system in time, frequency and laplace domain to illustrate different specification of the system using. Transfer function concept.	1	P4			2	R, Q, LT
CO3	**Interpret** different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.	3	P3			3	R, Q, LT
CO4	**Employ** time domain analysis to **predict** and **diagnose** transient performance parameters of the system for standard input functions.	6	C4			7	R, Q, LT
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)							

COURSE CONTENT
Experiments: **1.Combustion control and heating for boiler and simulation using MATLAB toolbox** **2.Car control with ECU** **3.Generator inertia and RLC circuit, such as operational amplifiers** **4.Projectile control with fin stabilization** **5.PLC control demonstration with ladder logic programming** **6.Pneumatic and hydraulic circuits** **7.Pump test bench** **8.Solenoid, its structure and function** **9.PID controller** **10.Car suspension system with spring-mass damper model and MATLAB simulation** **11.Modeling and demonstration of 4 post car lift for electro-hydro-pneumatic control** **12.Heat transfer, 2 phase flow (may not be possible)** **13.Gyroscope control**
CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Categorize** different types of system and **identify** a set of algebraic equations to represent andmodel a complicated system into a more simplified form.		3										
CO2	**Characterize** any system in time, frequency and laplace domain to illustrate different specification of the system using. Transfer function concept.	2											
CO3	**Interpret** different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for			3									

	analysis												
CO4	**Employ** time domain analysis to **predict** and **diagnose** transient performance parameters of the system for standard input functions.						2						

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO2	**3**	In order to identify the different types of systems, the knowledge of non-linear complex engineering problem analysis would be required.
CO2-PO1	**2**	In order to characterize and illustrate the system, the fundamental knowledge of mathematics would be required
CO3-PO3	**3**	In order to interpret the systems, the knowledge interpretation of Engineering data is important.
CO4-PO6	**2**	Solving complex engineering problem for analyzing and applying for greater good of the society.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20

Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Exp 1: Combustion control and heating for boiler and simulation using MATLAB toolbox
Week-2	Exp 2:Car control with ECU
Week-3	Exp 3: Generator inertia and RLC circuit, such as operational amplifiers
Week-4	Exp 4:Projectile control with fin stabilization
Week-5	Exp 5:PLC control demonstration with ladder logic programming
Week-6	Exp 6: Pneumatic and hydraulic circuits
Week-7	Exp 7: Pump test bench
Week-8	Exp 8: Solenoid, its structure and function
Week-9	Exp 9: PID controller
Week-10	Exp 10: Car suspension system with spring-mass damper model and MATLAB simulation
Week-11	Exp 11: Modelling and demonstration of 4 post car lift for electro-hydro-pneumatic control
Week-12	Exp 12: Heat transfer, 2 phase flow (may not be possible)
Week-13	Exp 13: Gyroscope control
Week-14	Lab report Submission, LabViva,Quiz Test

ASSESSMENT STRATEGY		
Components		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. Introduction to Automatic Controls (2^{nd} edition) – Howard L. Harrison, John G. Bollinger.
2. Control System Engineering – N. S. Nise, Modern control System – R. C. Dorf, R. C.Bishop.

Spring/Fall Semester L-4, T-I & II

COURSE INFORMATION			
Course Code Course Title	: **ME 400** :Final Year Design and Research Project	Lecture Contact Hours Credit Hours	: **12.00** : **6.00**
PRE-REQUISITE			
GERM-352 Research Methodology			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The Final Year Design and Research Project (FYDRP) aims to synergies all the previous engineering knowledge to solve real Mechanical Engineering problems in an integrated and comprehensive manner. It provides the students opportunity to apply the knowledge and skills gathered through previous course works. Student will take the primary responsibility to identify, organize, plan and execute different tasks assigned with the analysing or designing Mechanical systems or components. Thereby the students will also learn to develop hardware solution a real-time industry related problem by working in a team of two, three or more members.			

OBJECTIVE
1. To learn more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work. **2.** To identify an appropriate topic that can be designed and verified. **3.** To investigate in order to evaluate performance of the proposed system. **4.** To provide design experience to the students through teamwork and familiarize them with the project management methodology **5**. To plan a project and perform different tasks of project management. **6.** To provide the ability to understand and redefine a given engineering problem and to develop a conceptual design through teamwork. **7.** To assess professional, ethical, environmental and social impacts and responsibilities of the design project. **8.** To provide students the ability to present the design project results through written technical documents and oral presentation.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify and analyse appropriate problem or topic related to Mechanical Engineering	PO2	C4	3,4	1	1	APW,R,AS G
CO2	Investigate to evaluate performance of the system.	PO4	C5	8	1	2	PW, APW

CO3	Design a solution that meets the required specification.	PO3	C6,P6	5	2,3,4	1	PW,APW
CO4	Incorporate the use of modern engineering tools in the design, development and verification process.	PO5	PA,A4	6	1	5	Mid Term Exam
CO5	Value ethical and professional responsibilities during the course of the Final Year Design and Research Project.	PO8	A4	7	5	2	PR, R, ASG, F
CO6	Demonstrate the understanding of the impact of the project on environment and sustainability.	PO7	C2,P2,A3	7	6		PR, Pr, R
CO7	Assess social, health, safety, legal and cultural issue related to the final year design and research.	PO6	C5,P4	7			PR, Pr, R
CO8	Work Effectively in a Team.	PO9	A5	4	1	1	PW, Pr
CO9	Write professional technical document related to the topic or project and orally present the results.	PO10	A2	4	1		FPr, FR
C010	Conduct the economic analysis and estimate the cost of the final year design and research project.	PO11	C6	6			FR, FPr
C011	Verify the problem in the broadest context of technological change.	PO12	A5	7	2	3	FR, FPr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT
Course Contents: Students may choose to write alone or in groups of up to 4 students. **Types of thesis:** Students can choose topics containing theoretical, empirical and/or practical aspects. For Military student officer, as per the requirement of Svc HQ, diff design project may be introduced. But irrespective of the topic chosen, the use of relevant theory and literature is fundamental to the thesis. **An empirical paper**: The idea is to gather knowledge on a specific topic and to relate theory to empirical observations, e.g. by using existing data, by using questionnaires or experiments. **A case study**: A case study approach involves an analysis of a specific occurrence or process in an actual company or another type of organization. The purpose of a case study is to provide descriptions, analyses and suggested solutions to problems in relation to the case in hand. Case studies will involve the use of quantitative and/or qualitative methods for data collection. **A theoretical paper :** This type of thesis builds on a theoretical model or a generic problem. Often a theoretical thesis is based on existing literature studies in which a theoretical problem is analysed. This type of thesis is the least common. **Presenting a technical report** A technical report will be presented by the students based on their work and activities in this course

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify and analyse appropriate problem or topic related to Mechanical Engineering		3										
CO2	Investigate to evaluate performance of the system.				3								
CO3	Design a solution that meets the required specification.			3									
CO4	Incorporate the use of modern engineering tools in the design, development and verification process.					3							
CO5	Value ethical and professional responsibilities during the course of the Final Year Design and Research Project.								3				
CO6	Demonstrate the understanding of the impact of the project on environment and sustainability.							3					
CO7	Assess social, health, safety, legal and cultural issue related to the final year design and research.						3						
CO8	Work Effectively in a Team.									3			
CO9	Write professional technical document related to the topic or project and orally present the results.										3		
CO10	Conduct the economic analysis and estimate the cost of the final year design and research project.											3	
CO11	Verify the problem in the broadest context of technological change.												3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO2	**3**	Students will learn to identify and analyse appropriate problems related to Mechanical Engineering
CO2-PO4	**3**	Ability to investigate and Evaluate performance of the system
CO3-PO3	**3**	Students will be able to design a solution that meets the required specification.
CO4-PO5	**3**	Incorporating the use of modern engineering tools in the design, development and verification process
CO5-PO8	**3**	Students will learn to value ethical and professional responsibilities during the course of the Final Year Design and Research Project.
CO6-PO7	**3**	Students will learn to demonstrate the impact of the project on environment and sustainability
CO7-PO6	**3**	Students will be able to assess social, health, safety, legal and cultural issue related to the final year design and research.
CO8-PO9	**3**	Ability to work effectively in a Team
CO9-PO10	**3**	Students will be able to write professional technical document related to the topic or project and orally present the results.
CO10-PO11	**3**	Ability to conduct the economic analysis and estimate the cost of the final year design and research project
CO11-PO12	**3**	Students will learn to verify the problem in the broadest context of technological change

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	84
Self-Directed Learning	168
Formal Assessment	11
Total	**263**

ASSESSMENT STRATEGY
As per the guidance of the supervisor

Spring Semester L-4, T-1

COURSE INFORMATION			
Course Code	**ME 401**	Lecture Contact Hours	**3.00**
Course Title	**Internal Combustion Engine**	Credit Hours	**3.00**
PRE-REQUISITE			
ME 103- Thermodynamics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course will provide the students with advanced knowledge regarding Internal Combustion Engine operation, design, thermodynamic analysis etc			
OBJECTIVE			
a)To analyze the approach to the engineering problem and performance analysis of internal combustion engine b)To study of thermodynamics, combustion, heat transfer, friction, and other factors affecting engine power, efficiency, and emissions c)To design and operate the characteristics of different types of engines			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Design modern internal combustion engines and differentiate among different kinds of them	1	C2,C3	1,3			ASG, T, F
CO2	Apply analytical techniques to the engineering problems and performance analysis of internal combustion engines	1, 2	C2,C3	2,3,4	1	5	ASG, T, F

CO3	Identify the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions	3, 5	C4,C5	2,3,5	2,6,		CS, T, F
CO4	Introduce environmental and fuel economy challenges facing the internal combustion engine along with future internal combustion engine technology and market trends	3,5,7	C4,C5	4,6	2,6	4	PR, T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam; CS – Case Study)

COURSE CONTENT

a. Main Contents:

1. Introduction
2. Fuels
3. Combustion
4. Fuel metering
5. Air capacity of engines
6. Performance and design
7. Compressors and turbines

b. Detail Contents:

Introduction: basic engine types, their operation and testing; Idealized cycles and processes; Fuels: IC engine fuels, their properties and tests; Combustion: SI engine, CI engine and gas turbine; Equilibrium charts; Exhaust gas analysis and air pollution; Fuel metering: SI engines, CI engines; Air capacity of engines: two and four stroke cycles, naturally aspirated and supercharged; Performance and design: performance of supercharged engines and un-supercharged engines, design considerations, application of principle of similitude of similitude in engine design. Compressors and turbines: compression processes, volumetric efficiency, multistage compression, intercooling; various types of compressors and gas turbines.

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Design modern internal combustion engines and differentiate among different kinds of them	3											
CO2	Apply analytical techniques to the engineering problems and performance analysis of internal combustion engines	3	3										
CO3	Identify the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions			3			3						
CO4	Introduce environmental and fuel economy challenges facing the internal combustion engine along with future internal combustion engine technology and market trends			3		3		3					

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**3**	Apply engineering fundamental and engineering specification to design modern internal combustion engines.
CO2-PO1	**3**	Students will get the knowledge about the performance analysis of internal combustion engine
CO2-PO2	**3**	Students will be enable to analyze engine performance using principles of mathematics and engineering sciences
CO3-PO3	**3**	Students will develop solution for factors affecting engine power, efficiency and emissions with appropriate consideration for health safety and environmental consideration.
CO3-PO6	**3**	Students will apply knowledge to access health and safety issues.
CO4-PO3	**3**	They will be able to design solutions for internal combustion engines with appropriate considerations.
CO4-PO5	**3**	Students will select and apply techniques to withstand the environmental and economic challenges.
CO4-PO7	**3**	They will understand and evaluate sustainability of future internal combustion engine technology and market trends

TEACHING LEARNING STRATEGY		
Type and No.	**Activity**	**Engagement Hour**
Face-to-Face Learning		
1	Lecture	40
2	Introduction to different manufacturing devices operated in Industry	2
Self-Directed Learning		
3	Non face to face learning	75
Formal Assessments		
4	Class test and Mid-term Exam	2.5
5	Final Exam	3
Total		**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE			
Week	**Topic**	**CT**	**Remarks**
1-2	Introduction: basic engine types, their operation and testing; Idealized cycles and processes;		
3-4	Fuels: IC engine fuels, their properties and tests	CT1	
5-6	Combustion: SI engine, CI engine and gas turbine; Equilibrium charts; Exhaust gas analysis and air pollution;		
7-8	Fuel metering: SI engines, CI engines	CT2	
9-10	Air capacity of engines: two and four stroke cycles, naturally aspirated and supercharged;	MID TERM	
11-12	Performance and design: performance of supercharged engines and un-supercharged engines, design considerations, application of principle of similitude of similitude in engine design.	CT3	
13-14	Compressors and turbines: compression processes, volumetric efficiency, multistage compression, intercooling; various types of compressors and gas turbines.		

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
CO1	Homework/ Assignment	**50**	

	CO2	Homework/ Assignment, Class test	**40**	
	CO3	Homework/ Assignment Class test, Mid-term.	**70**	
	CO4	Assignment	**30**	
		Exam		
	CO1	Final Exam	**50**	
	CO2		**60**	
	CO3		**30**	
	CO4		**70**	

REFERENCE BOOKS

1. Internal combustion Engine Fundamentals – John B. Heywood
2. Internal Combustion Engines (3rd edition) – Edward F. Obert
3. The Internal Combustion Engine Theory and Practice - C. F. Taylor

REFERENCE SITE

N/A

Spring Semester L-4, T-I

COURSE INFORMATION

Course Code Course Title	**ME 402** **IC Engine Sessional**	Lecture Contact Hours Credit Hours	**: 3.00** **: 1.50**

PRE-REQUISITE

ME 401

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONAL
Introduction: basic engine types, their operation and testing; Idealized cycles and processes; Fuels: IC engine fuels, their properties and tests; Combustion: SI engine, CI engine and gas turbine; Equilibrium charts; Exhaust gas analysis and air pollution; Fuel metering: SI engines, CI engines; Air capacity of engines: two and four stroke cycles, naturally aspirated and supercharged; Performance and design: performance of supercharged engines and un-supercharged engines, design considerations, application of principle of similitude of similitude in engine design. Compressors and turbines: compression processes, volumetric efficiency, multistage compression, intercooling; various types of compressors and gas turbines.

OBJECTIVE
1. To understand the operation of internal combustion engines. 2. To perform theoretical calculations to obtain thermodynamic efficiencies and then assess operating losses. 3. To calculate engine operating parameters. 4. To understand the implications of a trade off between performance, efficiency, emissions.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Students will be able to **identify** the properties of substances on property diagrams and **obtain** the data from property tables.	2	P3			1	R, Q, LT
CO2	Students will be able to **define** energy transfer through mass, heat and work for closed and control volume system.	1	P1			2	R, Q, LT
CO3	Students will be able to **understand** the basic concepts of heat engine such as temperature, pressure system, properties, process, state, cycles, thermal equilibrium, emission and engine efficiency	6,7	C2			7	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Experiments: **1.Study of an Automotive SI Engine Components** **2.Study of Engine subsystems.** **3.Dismantling and assembling a Diesel (CI) Engine** **4.Performance test of a high speed Diesel Engine** **5.Study of Diesel power plant of MIST** **6.Study of a Gray marine Engine** **7.Study of CATS Dynamometer (Proposed)** **8.Study of VVT-i Technology of Toyota Engine** **9.Study of Turbocharged Engine (Proposed)**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will be able to identify the properties of substances on property diagrams and obtain the data from property tables.		3										
CO2	Students will be able to define energy transfer through mass, heat and work for closed and control volume system.	3											
CO3	Students will be able to understand the basic concepts of heat engine such as temperature, pressure system, properties, process, state, cycles and equilibrium.						3	2					

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO2	**3**	In order to identify the properties of a substance mechanics, the knowledge of problem analysis would be required.
CO2-PO1	**3**	In order to define energy transfer, the fundamental knowledge of mathematics would be required
CO3-PO6	**3**	The engineering efficiency, power, torque, and turbo charger will provide the students proper knowledge how those study could impact the society.
CO3-PO7	**2**	Efficient IC engines will decrease the emission of toxic gases which provides knowledge students about the sustainability.

Page Break

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Introduction class
Week-2	Exp 1: Study of an Automotive SI Engine Components
Week-3	Exp 2: Study of Engine subsystems.
Week-4	Exp 3:Dismantling and assembling a Diesel (CI) Engine
Week-5	Exp 4:Performance test of a high speed Diesel Engine
Week-6	Exp 5: Study of Diesel power plant of MIST
Week-7	Exp 6:Study of a Gray marine Engine
Week-8	Exp 7:Study of CATS Dynamometer (Proposed)
Week-9	Exp 8: Study of VVT-i Technology of Toyota Engine
Week-10	Exp 9: Study of Turbocharged Engine (Proposed)
Week-11	Final Lab Report Submission
Week-12	Lab Test
Week-13	Viva
Week-14	Quiz Test

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Internal combustion Engine Fundamentals – John B. Heywood
2. Internal Combustion Engines (3rd edition) – Edward F. Obert
3. The Internal Combustion Engine Theory and Practice - C. F. Taylor

Spring Semester L-4, T-1

COURSE INFORMATION			
CourseCode Course Title	ME **405** **Heating, Ventilation and Air Conditioning**	Lecture Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students with various types of refrigeration and air-conditioning systems, their components, and make the students capable of calculating cooling load of any type of room.

OBJECTIVE

1) Introduction to refrigeration, its application and different refrigeration methods

2) Introduction to different components of refrigeration and air-conditioning system

3) Delineate the principles of air conditioning design, and consideration that influence the design including human comfort, weather and environmental parameters and building structure

4) Demonstrate load estimation and analysis, psychometric analysis of a system and climate data and its us

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on different refrigeration and air conditioning systems and their components.	1,7	C1,C2	1,4,6,7			ASG, F
CO2	Explain the principles of air conditioning design and consideration that influence the design including human comfort, weather and environmental parameters and building structure.	1,2	C3,C4	2,5,6	1		T, ASG, F

CO3	Fundamental understanding of load estimation and analysis, psychometric analysis of a system and climate data and its use.	1,2,10,12	C5,C6	4,5,6	1,2		T, ASG, F
CO4	Knowledge on air conditioning systems, duct design methods and application criteria.	1,3,7,12	C5,C6	5,6,7	1		T, ASG, CS, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation

COURSE CONTENT

a. Main Contents:

- **i.** Concept of refrigeration and its applications
- **ii.** Different refrigeration methods
- **iii.** Refrigeration equipment
- **iv.** Concept of air conditioning and its uses
- **v.** Cooling load calculation
- **vi.** Air distribution systems
- **vii.** Air management system
- **viii.** Air conditioning equipment

b. Detail Contents:

Concept of refrigeration and its applications. Different refrigeration methods. Analysis of vapor compression refrigeration, absorption refrigeration and air-cycle refrigeration systems. Refrigerants; Refrigeration equipment: compressors, condensers, evaporators, expansion devices, other control and safety devices. Multi-evaporator, multi-compressor systems; Low temperature refrigeration. Concept of air conditioning and its uses. Cooling load calculation;

Psychrometric analysis. Air conditioning systems; Air distribution systems; Air management system; Duct design methods, Duct layout, mechanical machinery in buildings. HVAC software. Air conditioning equipment; Application criteria; Control systems.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on different refrigeration and air conditioning systems and their components.	3						3					
CO2	Explain the principles of air conditioning design and consideration that influence the design including human comfort, weather and environmental parameters and building structure.	3	3										
CO3	Fundamental understanding of load estimation and analysis, psychometric analysis of a system and climate data and its use.	3	3								2		3
CO4	Knowledge on air conditioning systems, duct design methods and application criteria.	3		3				3					2

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Students will acquire knowledge on different refrigeration and air conditioning systems and their components.
CO1-PO7	**3**	Demonstrate the knowledge of different refrigeration and air conditioning systems for sustainable development.
CO2-PO1	**3**	Students can be able to have a thought on principles of air conditioning designing parameters.
CO2-PO2	**3**	They will identify design considerations that influence human comfort, using the principles of mathematics and sciences,

CO3-PO1	**3**	Achieve the knowledge of engineering fundamentals of cooling loads and psychometry.
CO3-PO2	**3**	reach substantiated conclusions using principles of engineering sciences on load estimation and psychometric analysis.
CO3-PO10	**2**	Communicate effectively about complex engineering activities with the engineering community
CO3-PO12	**3**	Students will be able to engage in independent data analysis of cooling load.
CO4-PO1	**3**	Students will have knowledge on duct and duct design methods and application criteria.
CO4-PO3	**3**	Students will be able to develop solutions by appropriate duct design considerations.
CO4-PO7	**3**	They will understand the impact of applications and solutions of air conditioning systems in societal and environmental contexts.
CO4-PO12	**2**	Duct design and analysis will lead to life-long learning in the broadest context of technological change.

TEACHING LEARNING STRATEGY

Type and No.	Activity	Engagement Hour
Face-to-Face Learning		
1	Lecture	40
2	Introduction to different manufacturing devices operated in Industry	2
Self-Directed Learning		
3	Non face to face learning	75
Formal Assessments		
4	Class test and Mid-term Exam	2.5
5	Final Exam	3
Total		**122.5**

TEACHING METHODOLOGY

Class lecture, Assignment, Case study, Group discussion for problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
1-2	Concept of refrigeration and its applications		

3-4	Different refrigeration methods and Refrigerants	CT1	
5-6	Refrigeration equipment: compressors, condensers, evaporators, expansion devices, other control and safety devices	CT2	
7-8	Concept of air conditioning and its uses, Air conditioning systems		
9-10	Cooling Load Calculation	MID TERM	
11-12	Air distribution systems and Duct design methods	CT3	
13-14	Air conditioning equipment; Application criteria; Control systems.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	Homework/ Assignment	**40**	
CO2	Homework/ Assignment, Case study, Class test	**50**	
CO3	Homework/ Assignment. Class test, Mid-term.	**60**	
CO4	Assignment, Case study, Online content.	**30**	
	Exam		
CO1	Final Exam	**60**	
CO2		**50**	
CO3		**40**	
CO4		**70**	

REFERENCE BOOKS

1. Refrigeration and Air conditioning – AhmadulAmeen

2. Refrigeration and Air conditioning – R.S Khurmi

3. C P Arora, C. P., Refrigeration and Air Conditioning, 2nd Edition, Tata McGraw-Hill Publishing Company, New Delhi, 2000

4. ASHRAE (American Society of Heating, Refrigeration and Air Conditioning) Handbooks: Fundamentals, Refrigeration, HVAC Systems & Equipment, HVAC Application

REFERENCE SITE
N/A

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 407** **Advanced Thermodynamics**	Lecture Contact Hours Credit Hours	**3.00** **3.00**
PRE-REQUISITE			
ME-103, Thermodynamics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE

To provide the insights on the laws of thermodynamics, exergy and irreversibility of thermal systems, non-reactive and reactive mixtures and exergy-based power cycles.

OBJECTIVE

1. To impart knowledge about the concept of basic thermodynamic systems.
2. To impart knowledge of real gas behavior and introduction to exergy and statistical thermodynamics.
3. To impart knowledge on different thermodynamic property relations and their applications.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the laws of thermodynamics applied to mixture of gases and thermodynamic potentials.	1	C1	3			Q, ASG, F
CO2	Analyze and apply the thermodynamics laws for various thermal systems and to solve various numerical problems.	4,5	C2, C3, C5	4,6,8	1,2		Q, F, CS, Pr
CO3	Evaluate the thermodynamic properties of various thermal systems.	2	C2	4	1		Q, ASG, F
CO4	Synthesize I law and II law	2,3	C2, C3	4,5	1,2		Q, ASG, F

	efficiency of various thermal systems.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

Basic Concepts, Thermodynamic Relations, Kinetic Theory ofan Ideal Gas, Non-Reactive Gas Mixtures, Reactive Gas Mixtures, Exergy, Irreversibility, Advanced Power Cycles, Gas Power Cycles.

b. Detail Contents:

BASIC CONCEPTS: Thermodynamics - Temperature and Zeroth law of thermodynamics - First law of thermodynamics-Applications - Limitations of first law - Concept of internal energy - Second law of thermodynamics-Applications - concept of entropy-Third law of Thermodynamics.
THERMODYNAMIC RELATIONS: Introduction — Reciprocity and cyclic relations — The Maxwell’s relations — The Gibbs and Helmholtz relations - The Clapeyron Equation — Applications, General relations for du, dh, ds Co-efficient of volumetric expansion - Isothermal Compressibility-Applications.
KINETIC THEORY OF AN IDEAL GAS: Kinetic theory of gases- introduction, basic assumption, molecular flux, equation of state for an ideal gas, collisions with a moving wall, principle of equipartition of energy, classical theory of specific heat capacity. Transport phenomena-intermolecular forces, The Van der Waals equation of state, collision cross section, mean free path.
NON-REACTIVE GAS MIXTURES: Introduction - Basic definitions for gas mixtures - PVT relationship for mixtures of ideal gases - Properties of mixtures of ideal gases - Entropy change due to mixing - Mixtures of perfect gases at different initial pressure and temperatures -Applications.
REACTIVE GAS MIXTURES: Introduction- Fuels and Combustion-theoretical and actual combustion processes- Enthalpy of formation and Enthalpy of reaction- First and Second law analysis of reacting systems- Applications.
EXERGY: Introduction - Availability of heat - Availability of a closed system - Availability function of the closed system - Availability of steady flow system - Availability function of open system- Applications.
IRREVERSIBILITY: Introduction - Irreversibility for closed and open system - Steady flow process — Effectiveness-Applications
ADVANCED POWER CYCLES: Vapor power cycles: - Second law analysis of vapor power cycles, Cogeneration, Binary vapor cycles, combined gas vapor power cycles-Applications.
Gas power cycles: - Second law analysis of gas power cycles-Applications, Atkinson cycle, Lenoir cycle.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the laws of thermodynamics applied to mixture of gases and thermodynamic potentials.	3											
CO2	Analyze and apply the thermodynamics laws for various thermal systems and to solve various numerical problems.				3	2							
CO3	Evaluate the thermodynamic properties of various thermal systems.		3										
CO4	Synthesize I law and II law efficiency of various thermal systems.		3	3									

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Understanding the laws of thermodynamics applied to mixture of gases and thermodynamic potentials, will required knowledge of mathematics, natural science and engineering fundamentals.
CO2-PO4	2	Students will be able to conduct investigations of complex thermodynamic problems including design and analysis.
CO2-PO5	2	Students will apply appropriate techniques, resources, and modern engineering and IT tools for various thermal system analysis.
CO3-PO2	3	Students will be able to evaluate the thermodynamic properties of various thermal systems for analysis.
CO4-PO2	3	Students will be able to analyze efficiency of various thermal systems.
CO4-PO3	3	Student will practice various thermal system design related problems.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5

Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	**Topic**	**CT**	**Remarks**
Lec 1-5	Thermodynamics - Temperature and Zeroth law of thermodynamics -First law of thermodynamics-Applications - Limitations of first law - Concept of internal energy - Second law of thermodynamics-Applications - concept of entropy-Third law of Thermodynamics.	CT-1	
Lec 6-12	THERMODYNAMIC RELATIONS: Introduction — Reciprocity and cyclic relations — The Maxwell's relations — The Gibbs and Helmholtz relations - The Clapeyron Equation —Applications, General relations for du, dh, ds Co-efficient of volumetric expansion - Isothermal Compressibility-Applications.		
Lec 13-20	Kinetic theory of gases- introduction, basic assumption, molecular flux, equation of state for an ideal gas, collisions with a moving wall, principle of equipartition of energy, classical theory of specific heat capacity. Transport phenomena-intermolecular forces, The Van der Waals equation of state, collision cross section, mean free path.	CT-2	
Lec 21-30	NON-REACTIVE GAS MIXTURES: Introduction - Basic definitions for gas mixtures - PVT relationship for mixtures of ideal gases - Properties of mixtures of ideal gases - Entropy change due to mixing - Mixtures of perfect gases at different initial pressure and temperatures - Applications. REACTIVE GAS MIXTURES: Introduction-Fuels and Combustion-theoretical and actual combustion processes- Enthalpy of formation and Enthalpy of reaction- First and Second law analysis of reacting systems- Applications.	CT-3	
Lec 31-36	EXERGY: Introduction - Availability of heat - Availability of a closed system - Availability function of the closed system - Availability of steady flow system - Availability function of		

	open system- Applications. IRREVERSIBILITY: Introduction - Irreversibility for closed and open system - Steady flow process — Effectiveness-Applications		
Lec 37-42	ADVANCED POWER CYCLES: Vapor power cycles: - Second law analysis of vapor power cycles, Cogeneration, Binary vapor cycles, combined gas vapor power cycles-Applications. Gas power cycles: - Second law analysis of gas power cycles-Applications, Atkinson cycle, Lenoir cycle.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Advanced Engineering Thermodynamics by A. Bejan, John Wiley and Sons.

2. Advanced Thermodynamics for Engineers by K. Wark, McGraw Hill.

3. Fundamentals of Thermodynamics by R.E. Sonntag, C. Borgnakke and G.J. Van Wylen, Wiley.

4. Principles of engineering thermodynamics by M.J. Moran, H.N. Shapiro, Wiley.

REFERENCE SITE

N/A

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 409** : Renewable **Energy**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE

Reserves of non-renewable fuels; Prospects of renewable energy, and its sources and pattern of usage: Characteristics of renewable sources: intermittent, low power density etc.; use of renewable in small-scale systems.

Current technology: wind wave, tidal, passive and active solar, biological and examples of devices; Energy management, interaction of non-technical requirements (social, economic, political, environment) in engineering design and innovation; Case-study.

OBJECTIVE

1. To introduce renewable energy technologies and emphasize exploration of principles and concepts as well as the application of renewable energy technologies (RET).
2. To Explores topics such as energy consumption, the pros and cons of renewable energy, energy production and cons, energy conversion, environmental issues and concerns, electrical grid, biomass and bio fuels, geothermal, wind, power, solar power, nuclear power, and hydropower systems.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify the issues existing in the energy industry regarding conventional and non-conventional energy sources	6	C4	7	2		Q, ASG, F
CO2	Understanding of the theory behind various	1	C2	1			Q, ASG, F

	renewable energy sources						
CO3	Investigation of the case studies of various renewable energy projects that is shaping today's world	4	C4, C5	8	4		Q, F, CS
CO4	Apply the fundamentals of renewable energy to design various renewable energy devices	2, 3	C3	1-5			Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

b) Main Contents:

IV. Introduction to conventional and non-conventional fuel

V. Solar Energy

VI. Bio-energy

VII. Wind energy

VIII. Hydro-energy

IX. Other Sources of renewable energy

c) Detail Contents:

I. Renewable and Conventional energy sources

II. Solar radiation and its measurement — Solar thermal conversion — Solar photovoltaic devices and systems

III. Energy from bio-mass — bio-energy conversion techniques

IV. Wind energy Conversion — Wind turbine design and principles

V. Hydro-energy conversion techniques

VI. Other renewable energy sources

VII. Hybrid energy systems

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify the issues existing in the energy industry regarding conventional and non-conventional energy sources						3						
CO2	Understanding of the theory behind various renewable energy sources	3											
CO3	Investigation of the case studies of various renewable energy projects that is shaping today's world				3								
CO4	Apply the fundamentals of renewable energy to design various renewable energy devices		3	3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO6	**3**	**Identifying the issues in current energy issues will help to grow societal responsibility in the students**

CO2-PO1	**3**	**Renewable energy theories will include knowledge from mathematics, physics and chemistry.**
CO3-PO4	**3**	**Students will learn to use advanced energy knowledge to investigate on the current world energy issues with the case studies**
CO4-PO2	**2**	**Students will learn to analyse problems on the renewable energy systems**
CO4-PO3	**3**	**Students will learn to design various renewable energy devices**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	**Topic**	**CT**	**Remarks**
Class 1 – 3	**1. Introduction to conventional and non-conventional fuel** Basic properties — State, Process, Path, Cycle — Definitions — Pure Substance.	CT-1	
Class 4 – 20	**2. Solar Energy** Solar radiation and its measurement — Solar thermal conversion — Solar photovoltaic devices and systems	CT-2	

Class 21 – 26	**3. Bio-energy** Energy from bio-mass — bio-energy conversion techniques		
Class 27 – 30	**4. Wind energy** Wind energy Conversion — Wind turbine design and principles	MID	
Class 31 – 34	**5. Hydro-energy** Hydro-energy conversion techniques		
Class 35 – 42	**6. Other Sources of renewable energy** Emerging energy sources — Hybrid energy systems	CT -3	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. Energy Resources and Policy – R. C. Dorf

2. Alternative Energy Sources: A Strategy Planning guide – R. T. Sheahan

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	ME 411 **Combustion and Pollution**	Lecture Contact Hours Credit Hours	3.00 3.00

PRE-REQUISITE
ME-103:Thermodynamics **ME-205: Heat and Mass Transfer** **ME -321: Fluid Mechanics I**
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To provide the basis of thermal energy technologies that are common for combustion and fuels and equip the participant with the knowledge and skills necessary to address the challenges of transition from reliance on fossil fuel to increasing fraction of renewable energy.
OBJECTIVE
a) To introduce participants to combustion; Heat of reaction, adiabatic flame temperature, heating values, chemical composition of products of combustion; Chemistry and kinetics of reactions; Reaction rate and flame propagation; Structure of laminar premixed flames; Explosions and fuel oxidation; Detonation; Combustion in internal and external combustion engines. **b)** To analyze the production of pollutants in combustion systems, Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and Sulphur, and other pollutants. c) To develop an understanding of the basic principles and concepts of advanced fuel combustion and control process. d) To provide students with the required skills for analyzing thermal cycles. **e)** To be familiar with the fundamental physical and chemical principles regarding the formation and control of air pollutants in industrial and technological processes.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Recognize the ongoing role of combustion, both of fossil and bio-fuels, in providing a more sustainable energy source for society, and the	1,6	C1,C3	1,3, 4,7			ASG, T,F

	environmental challenges to be met to achieve this						
CO2	Explain the responsibility of engineers to the community in terms of providing a safe healthy environment.	2,3	C3	1, 5			ASG, T,F
CO3	Identify the formation mechanisms and reduction strategies of pollutant species in combustion systems and design the technology and the logic behind after-treatment of pollutants	3,7	C5,C6	5, 7			CS,T, F
CO4	Identify design trade-offs between increasing engine performance and maintaining low emission characteristics and explain the technology and the logic behind after-treatment of pollutants	2,12	C5,C6	3,4	1		PR,T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS- Case Study, F – Final Exam)

COURSE CONTENT

Introduction to combustion; Heat of reaction, adiabatic flame temperature, heatingvalues, chemical composition of products of combustion; Chemistry and kinetics of reactions; Reaction rate and flame propagation; Structure of laminar premixed flames; Explosions and fuel oxidation; Detonation; Combustion in internal and external combustion engines. Production of pollutants in combustion systems; Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants. Pollution control: post-engine exhaust treatment for emission control - thermal reactors, exhaust gas recirculation, catalysis; Pollution control by modification of combustion parameters; other pollution control strategies.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Recognize the ongoing role of combustion, both of fossil and bio-fuels, in providing a more sustainable energy source for society, and the environmental challenges to be met to achieve this	3					3						
CO2	Explain the responsibility of engineers to the community in terms of providing a safe healthy environment		3	3									
CO3	Identify the formation mechanisms and reduction strategies of pollutant species in combustion systems and design the technology and the logic behind after-treatment of pollutants			3				3					
CO4	Identify design trade-offs between increasing engine performance and maintaining low emission characteristics and explain the technology and the logic behind after-treatment of pollutants		3										3

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Students will attain knowledge to recognize the ongoing role of combustion, both of fossil and bio-fuels.
CO1-PO6	**3**	Contextual knowledge for providing a more sustainable energy source for society, and the environmental challenges with understanding of limitations.
CO2-PO2	**3**	Research literature on the responsibility of engineers to the community
CO2-PO3	**3**	Design systems in terms of providing a safe healthy environment
CO3-PO3	**3**	Develop solution for the reduction strategies of pollutant species in combustion systems.
CO3-PO7	**3**	Evaluate the technology and logic behind after-treatment of pollutants for environment and sustainability
CO4-PO2	**3**	Identification for increasing engine performance and maintaining low emission characteristics using first principles of mathematics and engineering sciences.
CO4-PO12	**3**	Explanation of the technology and the logic behind after-treatment of pollutants will be recognized for lifelong learning

TEACHING LEARNING STRATEGY

Type and No.	Activity	Engagement Hour
Face-to-Face Learning		
1	Lecture	40
2	Introduction to different manufacturing devices operated in Industry	2
Self-Directed Learning		
3	Non face to face learning	75
Formal Assessments		
4	Class test and Mid-term Exam	2.5
5	Final Exam	3
Total		**122.5**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week	Topic	CT	Remarks
1-3	Introduction to combustion; Heat of reaction, adiabatic flame temperature, heating values, chemical composition of products of combustion; Chemistry and kinetics of reactions;	CT1	
4-5	Reaction rate and flame propagation; Structure of laminar premixed flames; Explosions and fuel oxidation;		
6-7	Detonation; Combustion in internal and external combustion engines.	CT2	
8-10	Production of pollutants in combustion systems; Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and	**MID**	

	sulphur, and other pollutants		
11-12	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas recirculation, catalysis;	CT3	
13-14	Pollution control by modification of combustion parameters; other pollution control strategies		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	Assignment, CT	**60**	
CO2	CT	**30**	
CO3	MID	**40**	
CO4	Group discussion, assignment	**30**	
	Exam		
CO1	FINAL	**40**	
CO2		**70**	
CO3		**60**	
CO4		**70**	

REFERENCE BOOKS

1. Industrial Combustion Pollution and Control - Charles E. Baukal, Jr.

2. Combustion Engineering – G L Borman, K. W Ragland, Publisher – McGraw-Hill International

REFERENCE SITE

N/A

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION			
Course Code Course Title	: **ME413** : **Energy and Environment**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE
N/A

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course examines some environmental management aspects of atmospheric resources, energy, transportation, manufacturing and food production in the context of natural resources, human health, and sustainable practices.

OBJECTIVE
1. To provide a deep understanding of the issues of energy production, transmission and usage. 2. To discuss qualitatively and quantitatively, informed by a working knowledge of the physical principles governing the transformation of energy from one form to another. 3. To analyze the consequences of today's energy consumption

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge of conventional and renewable energy technologies and their applications	4,12	C2	4			Q, ASG, F
CO2	Demonstrate knowledge of Oil reserve, current status, geopolitical issue related to oil reserve	6,7	C4	7			Q, ASG, F

CO3	Environmental impact of using fossil fuel specially oil	7	C4	7			Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Various type of energy sources
2. Oil field, Geopolitics, Extraction methods
3. Environmental Impact

b. Detail Contents: The Future, Energy Myths & a Brief History of Energy,Electricity& Radiant Energy Heat engines & entropy” and “Technological Fixes Technological Fixes, The future and The Origin of Oil, Oil Reservoirs and Oil Traps, Finding It, Drilling Methods, Size and Discoverability of Oil Fields, The Future of Fossil Fuels, Alternative Energy Sources ,Wealth, Resources, and Power: The Changing Parameters of Global Security, Oil, Geography, and War: The Competitive Pursuit of Petroleum Plenty, Oil Conflict in the Persian Gulf, Environmental Impact

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge of conventional and renewable energy technologies and their applications				3								2
CO2	Demonstrate knowledge of Oil reserve, current status, geopolitical issue related to oil reserve						2	2					
CO3	Environmental impact of using fossil fuel specially oil							3					

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO4	**3**	**Students will learn about various energy sources and engineering practices related to those**
CO1-PO12	**2**	**Students will go through literature related to energy crisis and other related issues**
CO2-PO6	**2**	**Students will go through various societal issue related to oil extraction**
CO2-PO7	**2**	**Students will learn the environmental impact of fossil fuel extraction**
CO3-PO7	**3**	**Students will learn the environmental impact of using excess amount of fossil fuel**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42

Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**
TEACHING METHODOLOGY	
Class Lecture, Pop quiz, Case study, Problem solving	

COURSE SCHEDULE

Lecture	Topic	CT	Remarks
01-03	The Future of Energy	01	
04-06	Energy Myths & a Brief History of Energy," "Electricity & Radiant Energy		
07-09	Heat engines & entropy" and "Technological Fixes		
10-12	Technological Fixes," "The future revisited" and "Annotated Bibliography		
13-15	Overview" and "The Origin of Oil	02	
16-18	Oil Reservoirs and Oil Traps		
19-21	Oil Exploration		
22-24	Drilling Methods	03	
25-27	Size and Discoverability of Oil Fields		
28-30	The Future of Fossil Fuels Alternative Energy Sources	Mid	

31-33	"Wealth, Resources, and Power: The Changing Parameters of Global Security		
34-36	Oil, Geography, and War: The Competitive Pursuit of Petroleum Plenty		
37-39	Oil, Geography, and War: The Competitive Pursuit of Petroleum Plenty	04	
40-42	Energy Conflict in the Caspian Sea Basi		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1) Energy and Environment- Wiley Book Series

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION			
Course Code Course Title	**ME 415** **Advanced Programming with MATLAB**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
ME 263, CSE 171			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This module exposes students to the depth and breadth of modern programming practice, with the goal of making students better programmers. It is, however, an advanced level module in which some advanced programming concepts are taught.			
OBJECTIVE			
1. To review of basic MATLAB features, class organization and functionality 2. To study about advanced graphical features of MATLAB. Effective use of programs written in C, FORTRAN and use of SIMULINK.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand some advanced programming concepts	2	C1,C2	1,2			Q, ASG, F
CO2	Analyse a problem and determine what problem elements to represent as functions or objects	3	C3	3			Q, ASG, F

CO3	Write the simplest possible program that solves a given problem while explaining to the reader how it solves that problem using MATLAB	4	C1,C3	4	1		Q, F, CS
CO4	Develop programs with networking and multithreading	7	C3,C4	6	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam

COURSE CONTENT

a. Main Contents:

1. Advanced MATLAB syntax
2. Graphics/Graphical User Interface
3. ODE solver suite in MATLAB
4. Intro to C, CMEX interface
5. Java and Java classes in MATLAB

b. Detail Contents:

Advanced MATLAB syntax; Object Oriented Programming, Handle Graphics/Graphical User Interface. Project brainstorming, Building, ODE solver suite in MATLAB, Simulink architecture and programming, Intro to C, CMEX interface, Java and Java classes in MATLAB, XML in MATLAB.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand some advanced programming concepts		3										
CO2	Analyse a problem and determine what problem elements to represent as functions or objects			2									
CO3	Write the simplest possible program that solves a given problem while explaining to the reader how it solves that problem using MATLAB				3								
CO4	Develop programs with networking and multithreading							2					

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO4	**3**	Student will understand some advanced programming concepts
CO2-PO3	**2**	After this course students will gain an ability of analysing a problem and determine what problem elements to represent as functions or objects
CO3-PO4	**3**	Students adroit at writing the simplest possible program that solves a given problem while explaining to the reader how it solves that problem using MATLAB
CO4-PO7	**2**	Student will develop programs with networking and multithreading

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42

Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Advanced MATLAB syntax	CT 01	
Class 10-15	Object Oriented Programming, Handle Graphics/Graphical User Interface		
Class 16- 25	Project brainstorming	CT 02	
Class 26- 29	Building ODE solver suite in MATLAB		
Class 30-34	Simulink architecture and programming	MT	
Class 35-36	Intro to C, CMEX interface	CT 03	
Class 37-42	Java and Java classes in MATLAB, XML in MATLAB	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

2) Introduction to Optimum Design - Jasbir Singh Arora

3) Numerical Methods for Engineers and Scientists Using MATLAB - Ramin S. Esfandiari

4) MATLAB Programming for Engineers – Stephen J Chapman

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION

Course Code Course Title	**ME 417** **Engineering Multiphase Flow**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME 321, ME 205

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to provide students with a strong background on fundamental fluid mechanics the necessary understanding of the dynamics of multiphase flow to carry out research in their area of interest. Particular emphasis will be placed on bubble and particle dynamics, including sediment transport, cavitation, atomization and other environmental and industrial processes. Although we will cover both Eulerian-Eulerian (two fluid) models and Eulerian-Lagragian (discrete particles) models, most of the material concentrates on the study of a discrete phase (particles, droplets or bubbles) in a continuous phase. Topics will include Basset-Boussinesq-Oseen equation of motion for a particle in a non-uniform flow, particle interactions with turbulence, inertial clustering, cavitation and bubble dynamics, droplet breakup, collisions and coalescence, and surface tension effects.

OBJECTIVE

1. To covers the common background material and emphasizes the latest empirical and mechanistic modelling, computational and instrumentation aspects of multiphase flows
2.To design and operate different type of multiphase flow reactors will be introduced and their functioning, advantage and disadvantages and challenges along with future direction of research will be discussed

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Basic background of multiphase models for stratified, dispersed, and granular flow phenomena, mostly in technological context, both in 1-D and multidimensional settings.	4	C1,C2	2			Q, ASG, F
CO2	Candidates are able to work with state of the art multiphase models, and with related numerical simulations, in a wide variety of problems from mechanical, metallurgical, chemical - and petroleum engineering.	3	C1,C2,C4	1,3	4		Q, ASG, F
CO3	Understanding the basic mechanistic - and thermodynamic concepts behind typical multiphase models, and ability to apply this - along with current computational tools - to further research and development in science and technology	2	C2,C3	4	2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam

COURSE CONTENT

a. Main Contents:

1. Fundamental fluid mechanics and heat, mass, and energy transport in multiphase flows
2. Liquid/vapor/gas (LVG) flows
3. Models of LVG flows
4. Fluid/structure interactions
5. Discussion of two-phase flow problems in conventional, nuclear, and geothermal power plants marine hydrofoils, and other hydraulic systems

b. Detail Contents:

Fundamental fluid mechanics and heat, mass, and energy transport in multiphase flows. Liquid/vapor/gas (LVG) flows, nucleation, bubble dynamics, cavitation and boiling flows, models of LVG flows; instabilities, dynamics, and wave propagation; fluid/structure interactions. Discussion of two-phase flow problems in conventional, nuclear, andgeothermal power plants, marine hydrofoils, and other hydraulic systems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Basic background of multiphase models for stratified, dispersed, and granular flow phenomena, mostly in technological context, both in 1-D and multidimensional settings.				3								
CO2	Candidates are able to work with state of the art multiphase models, and with related numerical simulations, in a wide variety of			2									

	problems from mechanical, metallurgical, chemical and petroleum engineering.												
CO3	Understanding the basic mechanistic - and thermodynamic concepts behind typical multiphase models, and ability to apply this along with current computational tools to further research and development in science and technology		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO4	**3**	Student will be adroit at the background of multiphase models for stratified, dispersed, and granular flow phenomena, mostly in technological context, both in 1-D and multidimensional settings.
CO2-PO3	**2**	Candidates will be able to work with state of the art multiphase models, and with related numerical simulations, in a wide variety of problems from mechanical, metallurgical, chemical and petroleum engineering.
CO3-PO2	**3**	Student will understand the basic mechanistic - and thermodynamic concepts behind typical multiphase models, and ability to apply this along with current computational tools to further research and development in science and technology

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75

Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Fundamental fluid mechanics and heat, mass, and energy transport in multiphase flows	CT 01	
Class 10-15	Liquid/vapor/gas (LVG) flows		
Class 16- 25	nucleation, bubble dynamics, cavitation and boiling flows	CT 02	
Class 26- 29	, models of LVG flows; instabilities, dynamics, and wave propagation		
Class 30-34	fluid/structure interactions	MT	
Class 35-36	Discussion of two-phase flow problems in conventional, nuclear, andgeothermal power plants, marine hydrofoils, and other hydraulic systems.	CT 03	
Class 37-42	Discussion of two-phase flow problems in conventional, nuclear, andgeothermal power plants, marine hydrofoils, and other hydraulic systems.	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	

		Exam		
	1	Final Exam, CT	**80**	
	2	Final Exam, CT, MID	**80**	
	3	Final Exam, CT	**80**	
	4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Multiphase flow and Fluidization - DimitriGidaspow, Brennen, C.E. Fundamentals of Multiphase Flow

2. Crowe, C.T. "Multiphase Flow Handbook". Taylor & Francis, Boca Raton

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 419** **Introduction to Nanomaterials and Nanotechnology**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This introductory course in nanomaterials and nanotechnology addresses the needs of engineers to know the special phenomena and potentials of nanomaterials. The underlying physical laws, material behavior in the nanoscale, fabrication, application and analysis of properties is elaborated on. Top-down and Bottom-up processes are discussed, along with their pros and cons. This will give the student engineer the requisite knowledge to pursue work or research in the future in a related field.

Engineering applications of nanomaterials for novel products, with emphasis on eco-friendly and often biomedical use is covered. Special topics deal with synthesis, characterization techniques, thermal, optical, magnetic and electronic properties, processing and, finally, applications that are likely in the near future. The course shall also engender ethical thinking and appreciation of green technology in the students.

OBJECTIVE

a. To introduce the fundamental physical concepts and laws governing nanoscale technology and the nano-domain.

b. To elaborate on different types of Micro and Nano fabrication and processing technologies.

c. To familiarize students with various characterization and testing of nanomaterials and their associated properties.

d. To disseminate knowledge of state-of-the-art applications of nanomaterials with special emphasis to environmentally friendly and biomedical uses.

e. To develop ethical thinking and analytical abilities related to the use (of nanotechnology), recycling and disposal of nanomaterials.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Explain** the fundamental physical phenomenon and principles governing nanotechnology and nanomaterials properties	1	C2	2	1		Q, ASG, F
CO2	**Demonstrate** understanding of the various types of Fabrication processes involved in micro and nano fabrications.	2	C3,C4	3,4	1		Q, ASG, F

CO3	**Familiarize** with different characterization and mechanical tests of nanomaterials	2	C4	2,3	4		Q, F, CS
CO4	**Understand** and **Analyze** the potential of Nano-Science and Technology in Industrial, biomedical and environmentally friendly applications	6,7	C2, C4	2	1,5		Q, F, CS, Pr
CO5	**Develop** ethical thinking and judgement pertaining to use of nanomaterials and **demonstrate** ethical conduct in class.	8	C4,C5	3,5			Q,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Introduction to the multi-disciplinary field of nanotechnology

ii. MNT Materials

iii. Experimental techniques and application of this recent vastly improved sector

iv. Understanding of the Fabrication Processes, Metrology and Characterization

b. Detail Contents:

. General and Broad Introduction to the multi-disciplinary field of nanotechnology (Mirco and Nano Technology), Basic knowledge of physical phenomena, theoretical concepts, MNT Materials (Metal, Polymer, Ceramics, Quartz and Others), Experimental techniques behind the recent vastly improved sector, Fabrication Process (Micro, Nano Fabrication, Photolithography, Physical Vapor Deposition, Chemical Deposition, Packaging and Bonding, Assembly and Commercial Fabrication Process, AFM, Chemical reduction and dispersion process), Metrology and Characterization (SEM, TEM, FTiR, AFM etc.), recent scientific and technological applications with focus on industrial, biomedical and eco-friendly use. Ethical considerations, especially those pertaining to aerosol or inhalation of nanoparticles and effect on habitat.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the fundamental physical phenomenon and principles governing nanotechnology and nanomaterials properties	3											
CO2	**Demonstrate** understanding of the various types of Fabrication processes involved in micro and nano fabrications		2										
CO3	**Familiarize** with different characterization and mechanical tests of nanomaterials		3										
CO4	**Understand** and **Analyze** the potential of Nano-Science and Technology in Industrial, biomedical and environmentally friendly applications						2	2					
CO5	**Develop** ethical thinking and judgement pertaining to use of nanomaterials and **demonstrate** ethical conduct in class.								3				

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Explaining the fundamental physical phenomenon and principles governing nanotechnology and nanomaterials properties will enable the students to gain knowledge about nano-materials and nano-technology
CO2-PO2	2	Understanding of the various types of Fabrication processes will help the students to solve complex problems related to mirco and nano fabrications
CO3-PO2	3	Students will learn about mechanical testing methods of nano-materials
CO4-PO6	2	Students will learn about the potential of nanotechnology in industrial fields which will help them in professional career.
CO4-PO7	2	Students will learn about the effect of nanomaterials and nanotechnology on the environment.
CO5-PO8	3	Students will have knowledge about the use and applications of nanomaterials

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	General and Broad Introduction to the multi-disciplinary field of nanotechnology (Mirco and Nano Technology)	CT 01	
Class 7-12	Basic knowledge of physical phenomena, theoretical concepts.		
Class 13-15	MNT Materials (Metal, Polymer, Ceramics, Quartz and Others)	CT 02, MT	
Class 16-27	Experimental techniques behind the recent vastly improved sector, Fabrication Process (Micro, Nano Fabrication, Photolithography, Physical Vapor Deposition, Chemical Deposition, Packaging and Bonding, Assembly and Commercial Fabrication Process, AFM, Chemical reduction and dispersion process). **Review for Mid Term Exam**		
Class 28-34	Metrology and Characterization	CT 03	
Class 35-42	Recent scientific and technology work in the Nano world to demonstrate the potential of nanoscience and industrial applications of nanotechnology.	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	
5	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS
1. Nanomaterials: An introduction to synthesis, properties and applications-Dieter Vollath, 2nd Ed., Wiley publications, 2013. 2. Nanoparticles, nanocomposites and nanomaterials, an introduction for beginners-Dieter Vollath, 1st Ed., Wiley-VCH, 2013. 3. Nanomaterials Characterization, an introduction-RatnaTantra (Editor), Wiley publications, 2016.

Fall Semester L-4, T-1

COURSE INFORMATION			
Course Code Course Title	: **ME 421** : **Fluid Machinery**	Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
ME 321			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students to different fluid power driven machineries and components, Fluid turbo-machinery theory, performance characteristics of centrifugal and axial flow fans, compressors, pumps and turbines, fluid vibrations and sound, water hammer, introduction to fluid power controls and fluid amplifiers, operating principle and design.			
OBJECTIVE			
1. To provide students with the skills, knowledge and attitudes required to apply Fluid Mechanics theories in practice. 2. To study the principles to a variety of real-world engineering applications including simple flow networks and pump & turbine design. 3. To analyse different practical engineering machineries			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on several types of turbomachines and their principal applications	1,7	C1, C2	1,4			Q, ASG, F
CO2	Analyse performance/ efficiency of different turbo machineries.	1,2	C4	2,5	1		Q, F
CO3	Design different turbomachines for desired application.	3,12	C3, C6, A5	5,6	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Types of fluid machinery; ii. Euler pump/turbine equation; iii. Impulse and reaction turbines; iv. Centrifugal and axial flow pumps; v. Dimensional analysis applied to fluid machinery; vi. Reciprocating pump, gear, and screw pumps; vii. Fan, blower, and compressor; viii.Hydraulic transmission; ix. Wind turbines.

b. Detail Contents:

Types of fluid machinery; Rotodynamic and positive displacement machines; Velocity diagrams and Euler pump/turbine equation; Impulse and reaction turbines; Centrifugal and axial flow pumps; Deep well turbine pumps; Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge; Performance and characteristics of turbines and pumps; Cavitation; Reciprocating pump, gear and screw pumps; Fans, blowers and compressors; Hydraulic transmission: fluid coupling and torque converter; System analysis and selection of fluid machine; Wind turbines.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on various types of turbomachines and their principal applications	3						3					
CO2	Analyze performance/efficiency of different turbo machineries.	3	3										
CO3	Design different turbomachines for desired application.			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	**Student will be able to describe various aspects and components of a fluid machinery.**
CO1-PO7	**3**	**Students will be able to identify which type of system and system components should be used under different need.**
CO2-PO1	**3**	**Students will be able to determine the performance of a hydraulic or turbo machines in operation using different system parameters.**
CO2-PO2	**3**	**Students will able to analyzeturbomachines engineering science like velocity triangle and various diagrams**
CO3-PO3	**3**	**Students will acquire knowledge of designing fluid machineries to meet specific requirements**
CO3-PO12	**3**	**Students will go through various handbook for design practice**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving.

COURSE SCHEDULE

Week	Topic	CT
1-5	Types of fluid machinery; Rotodynamic and positive displacement machines; Velocity diagrams and Euler pump/turbine equation;	CT 01
6-8	Impulse and reaction turbine; Centrifugal and axial flow pump; Deep well turbine pump;	CT 02
9-12	Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge;Performance and characteristics of turbines and pumps;	CT 03
12-14	Cavitation; Reciprocating pump, gear and screw pumps; Fans, blowers and compressors, Hydraulic transmission: fluid coupling and torque converter ;system analysis and Wind turbines	MT

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
3	Assignment	**30**	
	Exam		
1	Final Exam, CT	**80**	

	2	Final Exam, CT, MID	**80**		
	3	Final Exam, CT	**70**		
	4	Final Exam, CT, Mid	**80**		

REFERENCE BOOKS

1. Fluid Mechanics – J. F. Douglas, J. M. Gaesirek, J. A. S. Waffield.

2. Fluid Mechanics (including Hydraulic Machines) by Jain A.K

3. Hydraulic Machines – Dr. Md. Quamrul Islam

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 423** **Fluid Engineering**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME-323

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students with the application of fluid mechanics knowledge in design of plumbing system, fountain design, designing various power enhancement device like hydraulic jack, intensifier etc.

OBJECTIVE

1. Introduce the student with the integral form of conservations equations.

2. To give an idea of plumbing system design.

3. To give an idea of various types of fountains and basic design principle

4. To provide elementary idea of hydraulic equipment design principle.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on integral form of conservation equations and their applications	1,2	C1, C3	3			Q, ASG, F
CO2	Demonstrate knowledge to solve simple flow problem using Navier Stokes Equation	2,12	C3	2,4			Q, ASG, F
CO3	Design of plumbing system in tall buildings and fountains	6,12	C5, C6	6,7	1,2		Q, F, CS
CO4	Design of various hydraulic machines	3,12	C5, C6, A5	4,6	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Integral form of conservation equaiton
2. Solution of Navier Stokes equation in simple flow conditions
3. Piping system design in buildings
4. Fountain design
5. Hydraulic machines design

b. Detail Contents:

Conservation of mass, momentum and energy; Solution of Navier Stokes equation in simple flow case like Couttee flow, flow in pipes, and rectangular channel, Stokes first problem, Flow in 2-D and axisymmetric ducts; Laminar jets; Stability of laminar flow; Orr-Sommerfield equation; Flow in branching pipe systems, Hardy Cross Method; Plumbing system design, Fountains and basic design principle, Unsteady flow in pipes; Water hammer; Economics of pipe systems; Hydraulic machines: press, intensifier, ram.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on integral form of conservation equations and their applications.	3	3										
CO2	Demonstrate knowledge to solve simple flow problem using Navier Stokes Equation		3										3
CO3	Design of plumbing system in tall buildings and fountains						2						3
CO4	Design of various hydraulic machines			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	**Developing integral form of conservation equation will provide knowledge from physics and mathematics to build up engineering fundamental equations.**
CO1-PO2	**3**	**Application of conservation equation will enable the students to analyse problems arise in various engineering problems**
CO2-PO2	**3**	**Applying Navier Stokes equation for various flow field will enable the students to solve flow problems**
CO2-PO12	**3**	**Students will go through some research literature to see the application of Navier Stokes equation in various flow problem**
CO3-PO6	**2**	**Students will learn various codes and practices used in plumbing design**
CO3-PO12	**3**	**Students will go through various handbook for design**

		practice
CO4-PO3	**3**	**Student will practice hydraulic jack and ram design problems**
CO4-PO12	**3**	**Students will go through various handbook for design practice**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

COURSE SCHEDULE

Week	Topic	CT
Class 1-9	Integral form of conservation equations and their applicatins	CT 01
Class 10-15	Navier Stokes equation and its application in different flow problems	
Class 16- 25	Plumbing system in tall buildings	CT 02
Class 26- 29	Piping system design and economics	
Class 30-34	Laminar jet, Instability in fluid flow, Fountain design	MT
Class 35-36	Unsteady flow in pipes, water hammer	CT 03
Class 37-42	Hydraulic Machine design	CT 04

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Foundation of Fluid Mechanics – S. W. Yuan

2. Fluid Mechanics for Engineering - Schobeiri, Meinhard T

3. Handbook for Plumbing System

4. Handbook for Fountain desing

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	: **ME 425** **: Aerodynamics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students with the fundamental principles of incompressible and compressible fluid mechanics and aerodynamics and provide them with fundamental knowledge for understanding supersonic flight, stability and control of flight and aircraft performance from the aerodynamic point of view.

OBJECTIVE
1. Introduce with the parts of an aircraft that sustain and control flight. 2. Correlate the concepts of aerodynamics and associated fluid mechanics with aircraft design and operation. 3. Describe, using basic formulas, the scientific basis for balancing the four forces of action on an aircraft in flight 4. Derive and apply the aircraft flight mechanics equations to analyze the flight performance of aircraft in different situations 5. Calculate aerodynamic loads (such as lift, induced drag, total drag, load factor) acting on an aircraft 6. Explain in detail how improvements in aerodynamic design have led to improvements in aircraft performance 7. Evaluate the performance potential of an aircraft by recognizing the inherent aerodynamic potential of the design

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on different components of an aircraft, fundamental aerodynamics and related fluid mechanics formulas	1	C2	3,4			Q, F
CO2	Explain the fundamental principles and equations of aerodynamics for analysing flight performance	2	C3, C4	3,4			Q, ASG, F
CO3	Formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic configurations	2	C3, C4	3,4			Q, F, CS

CO4	Assess the applicability of aerodynamic models to predict the forces on and performance of realistic configurations and estimate the errors resulting from their application	4,5	C5	6,8			Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Fundamental concepts of aerodynamics
2. Governing equations in aerodynamics
3. Lift and Drag over airfoils
4. Airplane performance

b. Detail Contents:

Introduction to aerodynamics, Fundamental concepts of aerodynamics, Lift and Drag, Aerodynamics forces and moments, Pressure distribution over an airfoil, Lift curve, L/D Ratio, cl from cp distribution, Lift Prediction, Different types of aerodynamic drag, Airplane design consideration, Fundamental principles of aerodynamics, Navier-Stokes Equation, Bernoulli's Equation, Angular velocity and vorticity, Stream function, Velocity potential, Laplace equation, Circulation, Uniform flow, Source and sink in potential flows, Rankine oval, Doublet and flow over a stationery circular cylinder, Vortex sheet, Vortex system and flow over a rotating circular cylinder, Thin airfoil theory, Flow over finite wings, Airplane Performance: Drag polar, Equation of motion, Thrust required, Power required, Thrust available, Power available, Vmax at a given altitude, Rate of climb, Gliding flight, Accelerated rate of climb, Endurance and Range, Takeoff performance, Landing performance, Turning flight, V-n diagram

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on different components of an aircraft, fundamental aerodynamics and related fluid mechanics formulas	3											
CO2	Explain the fundamental principles and equations of aerodynamics for analysing flight performance		3										
CO3	Formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic configurations		3										
CO4	Assess the applicability of aerodynamic models to predict the forces on and performance of realistic configurations and estimate the errors resulting from their application				2	2							

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO1	3	Students will learn about fundamental formulas and their derivation to analyse the performance of aerofoils.
CO2-PO2	3	Students will learn about analysing complex problems of aerodynamics.
CO2-PO2	3	Students will learn to analyseaerodynamic and fluid system by using engineering fundamental derived from pure science
CO3-PO2	3	Students will learn about engineering practices in the field of aerodynamics
CO4-PO4	3	Students will be able to investigateaerodynamic systems prevailing in practice as well as with conflicting requirements
CO4-PO5	2	Student will be able to select various system components

		following handbooks and design requirements

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	122.5

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	Introduction to aerodynamics, Fundamental concepts of aerodynamics, Lift and Drag, Aerodynamics forces and moments, Pressure distribution over an airfoil,	CT 01	
Class 7-12	Lift curve, L/D Ratio, cl from cp distribution, Lift Prediction, Different types of aerodynamic drag, Airplane design consideration		
Class 13-18	Fundamental principles of aerodynamics, Navier-Stokes Equation, Bernoulli's Equation, Angular velocity and vorticity, Stream function, Velocity potential,	CT 02	
Class 19-24	Laplace equation, Circulation, Uniform flow, Source and sink in potential flows, Rankine oval, Doublet and flow over a stationery circular cylinder		
Class 25-30	Vortex sheet, Vortex system and flow over a rotating circular cylinder, Thin airfoil theory, Flow over finite wings	MT	
Class 31-36	Airplane Performance: Drag polar, Equation of motion, Thrust required, Power required, Thrust available, Power available	CT 03	

Class 37-42	Vmax at a given altitude, Rate of climb, Gliding flight, Accelerated rate of climb, Endurance and Range, Takeoff performance, Landing performance, Turning flight, V-n diagram		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	20	
2	Assignment	20	
	Exam		
1	Final Exam, CT	80	
2	Final Exam, CT, MID	80	
3	Final Exam, CT	80	
4	Final Exam, CT, Mid	80	

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 427** **Applied Engineering Mathematics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To provide students with the skills, knowledge and attitudes required to perform fundamental mathematical procedures and processes for solution of engineering problems, particularly the use of calculus, vector analysis and infinite series. Also, to show the relevance of mathematics to engineering and applied science.

OBJECTIVE
1. Understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. 2. To simplify expressions and solve simple problems involving Exponential, Logarithmic, Trigonometric, Inverse Trigonometric, Hyperbolic and Inverse Hyperbolic Functions and apply the principles of Three-Dimensional Vector algebra to solve a variety of basic problems in Engineering and Applied Science. 3. Application of the principles of Analytical Geometry and vector analysis to determine the equations of and relationships between straight lines and planes in Three-Dimensional Space. 4. To show the relevance of mathematics to engineering and applied science and use various types of Series to approximate given functions and hence solve simple problems involving Linear and Quadratic approximations and evaluation of integrals.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understanding of the underpinning mathematical concepts applicable to the engineering discipline.	1,2	C1, C2, C3	1,2, 3			Q, ASG, F
CO2	To simplify expressions and solve simple problems involving Exponential, Logarithmic, Trigonometric, Inverse Trigonometric, Hyperbolic and Inverse Hyperbolic Functions and apply the principles of Three-Dimensional Vector algebra to solve a variety of basic problems in Engineering and Applied Science.	1,2	C2, C3	1,2, 3			Q, ASG, F
CO3	Application of the principles of various differential methods and	2,3	C2, C3, C4	1,2, 3,4	1,2		Q, F, CS

	theories and to determine the equations and relationships which are applicable to engineering field.						
CO4	To show the relevance of mathematics to engineering and applied science and use various types of Series to approximate given functions and hence solve simple problems involving Linear and Quadratic approximations and evaluation of integrals.	1,2	C2, C3	1,2, 3	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Non-linear differential equations
2. Finite difference method
3. Finite element method
4. Chaos theory

b. Detail Contents:

Non-linear differential equations: asymptotic method, perturbation method, Rayleigh-Ritz method, collocation method; Finite difference method; Finite element method; Boundary element method; Calculus of variations; Chaos theory.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understanding of the underpinning mathematical concepts applicable to the engineering discipline.	3	2										

CO2	To simplify expressions and solve simple problems involving Exponential, Logarithmic, Trigonometric, Inverse Trigonometric, Hyperbolic and Inverse Hyperbolic Functions and apply the principles of Three-Dimensional Vector algebra to solve a variety of basic problems in Engineering and Applied Science.	3	2										
CO3	Application of the principles of various differential methods and theories and to determine the equations and relationships which are applicable to engineering field.		3	2									
CO4	To show the relevance of mathematics to engineering and applied science and use various types of Series to approximate given functions and hence solve simple problems involving Linear and Quadratic approximations and evaluation of integrals.	2	2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to understand the mathematical relations with the practical problems of engineering.**
CO1-PO2	**2**	**This understanding will enable the students to apply the mathematical theories to solve engineering problems.**
CO2-PO1	**3**	**Understanding of nature of various functions will enhance pupil's engineering knowledge**
CO2-PO2	**2**	**Students will have an ability to solve a variety of basic problems in Engineering and Applied Science**

CO3-PO2	**3**	**Students will be able to identify, formulate and analyze complex engineering problems by applying principles of dry friction**
CO3-PO3	**2**	**They will be competent enough to develop solutions regarding engineering problems.**
CO4-PO1	**2**	**Students will have knowledge of various theories and calculus of variations.**
CO4-PO2	**2**	**Student will be apt in applying these theories to analyse practical engineering problems.**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-15	Non-linear differential equations: asymptotic method, perturbation method, Rayleigh-Ritz method, collocation method	CT 01	
Class 16-21	Finite difference method	CT 02	
Class 22- 30	Finite element method	MT	
Class 31- 36	Boundary element method	CT 03	
Class 37-39	Calculus of variations		
Class 40-42	Chaos theory		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
3	CT	**30**	
4	CT	**20**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	Final Exam	**80**	
4	MID, Final Exam	**70**	

REFERENCE BOOKS

1. Applied Engineering Mathematics – Erwin Kreyzig, Publisher – Wiley

2. Mathematical methods for physicists and Engineers – Royal Eugune Collins, Publisher – Dover Publications

3. Engineering Mathematics – K. A. Stroud, Denter J. Booth, Publisher – Industrial press

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION

Course Code Course Title	: **ME 429** : **Gas Dynamics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to introduce students to the fundamentals of compressible fluid flow, with an emphasis on a wide variety of steady, one-dimensional flow problems and a general understanding of the principles of multi-dimensional flow.

OBJECTIVE
1. To cover the basic concepts and results for the compressible flow of gases and introduction to the numerical method of characteristics. 2. To introduce the students to the numerical method of characteristics. of compressible flow of gases

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Develop the Behavior of equilibrium and frozen flows with real gas properties.	1	C3	1,4			Q, ASG, F
CO2	Analyze non-equilibrium (rate) processes and behavior for gas dynamic flows.	3	C4	2			Q, ASG, F
CO3	Formulate and solve problems in one - dimensional steady compressible flow including: isentropic nozzle flow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow).	2	C3, C4	1	1,2		Q, F, CS
CO4	Define the conditions for the change in pressure, density and temperature for flow through a normal shock and also determine the strength of oblique shock waves on wedge shaped bodies and concave corners.	3	C1	4	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

One-dimensional compressible flows including basic concepts; isentropic flow; normal and oblique shock waves; flows with heat transfer (Rayleigh line), friction (Fanno line), and mass addition; simple waves; small perturbation theory for linearized, steady flows; method of characteristics for two-dimensional, steady flow and one-dimensional, unsteady flow

b. Detail Contents:

Flow of compressible fluids; One-dimensional flows including basic concepts, isentropic flow, normal and oblique shock waves, Rayleigh line, Fanno line, and simple waves; Multidimensional flows including general concepts, small perturbation theory for linearized flows, and method of characteristics for nonlinear flows

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Develop the Behavior of equilibrium and frozen flows with real gas properties.	3											
CO2	Analyze non-equilibrium (rate) processes and behavior for gas dynamic flows.			3									
CO3	Clear understanding of general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids and demonstrate knowledge on different type of flows and determine sonic velocity in a fluid		2										

CO4	Use the general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids			1									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to know about behavior of equilibrium. Students will get clear theoretical knowledge about frozen flows with real gas properties**
CO2-PO3	**3**	**Students will develop the ability to illustrate a relationship between non-equilibrium (rate) processes and behavior for gas dynamic flows**
CO3-PO2	**2**	**Students get definition of Clear understanding of general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids and demonstrate knowledge on different type of flows and determine sonic velocity in a fluid**
CO4-PO3	**1**	**Students will be able to determine the conditions for the change in pressure, density and temperature for flow through a normal shock and also determine the strength of oblique shock waves on wedge shaped bodies and concave corners.**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-12	One-dimensional compressible flows including basic concepts; isentropic flow	CT 01	
Class 13-21	normal and oblique shock waves	CT 02	
Class 22- 27	flows with heat transfer (Rayleigh line), friction (Fanno line)	MT	
Class 28- 36	mass addition; simple waves; small perturbation theory for linearized	MT	
Class 37-39	steady flows; method of characteristics for two-dimensional	CT 03	
Class 40-42	steady flow and one-dimensional, unsteady flow		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
3	CT	**30**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	MID, Final Exam	**70**	
4	Final Exam	**70**	

REFERENCE BOOKS

1. Gas Dynamics – Oswatitsch, Klaus.

2. Gas Dynamics – Zucrow, J. Maurice.

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION			
Course Code Course Title	: **ME 431** : **Finite Element Method**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Introduction - Illustration using spring systems and simple problems - Weighted residual methods Galerkin's method- Variational approach - Rayleigh-Ritz method.			
OBJECTIVE			
1. To learn basic principles of finite element analysis procedure 2. To learn the theory and characteristics of finite elements that represent engineering structures. 3.To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others 4. Learn to model complex geometry problems and solution techniques.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on different engineering problems and difficulties by analytical methods.	1	C1, C3	2	1,2		Q, ASG, F
CO2	Analyzing different types of heat transfer, beam problems and solving them by applying finite element method.	2	C3,C5	1,2	1		Q, ASG, F

CO3	Understanding of the underpinning Finite element concepts applicable to the engineering discipline	2	C2,C3	1,2	1,2		Q, F, CS
CO4	Connecting the theoretical problems and solving them by applying finite element analysis for an approximate real solution.	4	C4,C5	1,2	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam

COURSE CONTENT

a. Main Contents:

1. One-dimensional finite element analysis
2. Two-dimensional finite element analysis
3. Applications to structural mechanics
4. Numerical integration
5. Solution of finite element equations,Fluid flow problems - Dynamic problems.

b. Detail Contents:

Weighted residual methods Galerkin's method- Variational approach - Rayleigh-Ritz method. One-dimensional finite element analysis; bar element, beam element, frame element - Heat transfer problems. Two-dimensional finite element analysis; types of elements, shape functions, natural coordinate systems. Applications to structural mechanics - Numerical integration - Solution of finite element equations.Fluid flow problems - Dynamic problems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on different engineering problems and difficulties by analytical methods.	3											
CO2	Analyzing different types of heat transfer, beam problems and solving them by applying finite element method.		2										
CO3	Understanding of the underpinning Finite element concepts applicable to the engineering discipline		3										
CO4	Connecting the theoretical problems and solving them by applying finite element analysis for an approximate real solution.				2								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will learn how to solve different engineering problems by applying Finite element method.
CO2-PO2	**2**	Students by analysing different mathematical equation and applying Finite element method will be able to solve complex Engineering problems
CO3-PO3	**3**	Students will be able to understand the Finite element problems relations with the practical problems of engineering.
CO4-PO4	**2**	Students will be able to connect Finite element theories with approximate real solution and thus apply this knowledge to investigate.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Weighted residual methods Galerkin's method-Variational approach - Rayleigh-Ritz method	CT 01	
Class 10-15	One-dimensional finite element analysis; bar element, beam element, frame element		
Class 16- 25	Heat transfer problems	CT 02	
Class 26- 29	Two-dimensional finite element analysis; types of elements		
Class 30-34	Shape functions, natural coordinate systems	MT	
Class 35-36	Applications to structural mechanics - Numerical integration	CT 03	
Class 37-42	Solution of finite element equations.Fluid flow problems - Dynamic problems.	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		

1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1.Seshu, P., Textbook of Finite Element Analysis

2. Segerlind, L.J., Applied Finite Element Analysis

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 433** **Fluid Power and Control**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students to different fluid power driven machineries and components, their fluid circuit and circuit components, structure, operating principle and design.

OBJECTIVE

1. To introduce the students with the history and development of fluid power and control.

2. To educate the students regarding various types of fluid control system and their components and their construction and use.

3. To introduce the students with various commonly used fluid power circuit

4. To make the students familiar with the design performance analysis of fluid power system.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on different hydraulic and pneumatic system and their components	1,7	C2	4,7			Q, ASG, F
CO2	Analyse performance/ efficiency of simple hydraulic system	1, 2	C3	3,4			Q, ASG, F
CO3	Clear understanding of different practical hydraulic and pneumatic system	2, 10	C2	3			Q, F, CS
CO4	Design theoretical hydraulic circuit for desired application	3,12	C5	5	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Basic of Fluid power and control
2. Fluid power circuit components
3. Design of fluid power circuit
4. Function of various common fluid power circuit

b. Detail Contents:

Fluid power and its classification, Difference, advantages and disadvantages of hydraulic and pneumatic system, Hydraulic and oil and their properties, Conductor and connector, Working pressure and burst pressure, Hydraulic pump - construction and operation, Hydraulic motor - construction and operation, efficiency calculation and cost estimation, Hydraulic actuator and related mathematical problem, Pressure control valve- construction and operation, Flow control valve - construction and operation, Direction control valve - construction and operation, Hydraulic circuit diagram for shaper machine, drill machine, Injection Molding Machine, Design of simple hydraulic circuit for desired operation, Hydraulic system maintenance, Contamination.

Introduction to pneumatic systems, Air brake system, Power steering, Air production unit, Condensation valve, ABS solenoid valve, Pneumatic relay valve, Duplex control valve, Air distributor, Air dryer, Drum valve, Pneumatic connection design for a plant, Design of pneumatic system.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on different hydraulic and pneumatic system and their components	3						1					
CO2	Analyse performance/ efficiency of simple hydraulic system	3	3										
CO3	Clear understanding of different practical hydraulic and pneumatic system		3								2		
CO4	Design theoretical hydraulic circuit for desired application			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	Students will gather knowledge derived from physics and engineering fundamentals as well as common engineering practice
CO1-PO7	**1**	Students will gain knowledge how fluid energy can be employed to solve various high power problem in industry that has high social impact
CO2-PO1	**3**	Students will learn the common engineering practice prevailing in the field
CO2-PO2	**3**	Students will learn to analyse the performance of a hydraulic system
CO3-PO2	**3**	Student will be able to demonstrate knowledge on various common hydraulic device and their hydraulic diagram
CO3-PO10	**2**	Students will be able to read and communicate using hydraulic diagrams of various commonly used hydraulic device
CO4-PO3	**3**	Students will be able to design hydraulic systems to meet specific necessity considering public health and safety
CO4-PO12	**3**	Students will be tasked to go through literature and various manuals to design a device

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

COURSE SCHEDULE
Class Lecture, Pop quiz, Case study, Problem solving

Week	Topic	CT	Remarks
Class 1-6	History of fluid power, Fluid power and its classification, Difference, advantages and disadvantages of hydraulic and pneumatic system, Hydraulic and oil and their properties, Conductor and connector, Working pressure and burst pressure, Basic components fluid power system	CT 01	
Class 7-12	Hydraulic pump- construction and operation (gear pump, vane pump, piston pump, lobe pump etc.), Hydraulic motor- construction and operation, efficiency calculation and cost estimation, Hydraulic actuator (single acting, double acting, rotary, tandem cylinder) and related mathematical problem		
Class 13-18	Different pressure control valve- construction and operation	CT 02	
Class 19-24	Flow control valve and direction control valve		
Class 25-30	Hydraulic circuit analysis for different hydraulic machineries and simple hydraulic circuit design, Contamination and maintenance.	MT	
Class 31-36	Introduction to pneumatic systems, Air brake system, Power steering, Air production unit, Condensation valve	CT 03	
Class 37-42	ABS solenoid valve, Pneumatic relay valve, Duplex control valve, Air distributor, Air dryer, Drum valve, Pneumatic connection design for a plant	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS
1. Fluid Power Circuits and Controls: Fundamentals and Applications - John S Cundiff 2. Fluid Power: Hydraulics and Pneumatics, 2nd Edition - James R Daines

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION			
Course Code Course Title	: **ME 435** : **Introduction to CFD**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
ME 321			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The use of modern computational fluid dynamics software in mechanical engineering. Build, solve, and visualize fluid-flow models to gain a deeper understanding of the principles of fluid mechanics.			
OBJECTIVE			
1.Provide the student with a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems 2.Improve the student's understanding of the basic principles of fluid mechanics 3.Improve the student's research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results in written form			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Significant level of experience in the use of modern CFD software for the analysis of complex	2,3	C1, C2	1			Q, ASG, F

	fluid-flow systems.						
CO2	Improve the understanding of the basic principles of fluid mechanics.	1,2	C1,C2	1,2			Q, ASG, F
CO3	Develop capabilty of solving some of the difficulties that one may encounter in CFD, such as geometry simplification, mesh problems, convergence problems, multiple solutions.	4,5	C4	4			Q, F, CS
CO4	Improve the research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results in written form.	3,10	C3,C4	3			Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

4. Introduction to Computational Fluid Dynamics (CFD)
5. Introduction to control volume method
6. Numerical solution of diffusion type equations: Steady one-dimensional conduction, unsteady one dimensional conduction, two and three- dimensional situations
7. Numerical solution of convection-diffusion-type equations: Steady one-dimensional

convection-diffusion, discretization equation in two and three-dimensions

8. Discretization of continuity and momentum equations for fluid flow

b. Detail Contents:

Introduction: Computational Fluid Dynamics (CFD)- a research, modelling and design tool, historical perspective, commercial CFD packages, mathematical description of physical phenomena, a brief discussion of discretization methods-finite difference, finite element.

Introduction to control volume method, Numerical solution of diffusion type equations: Steady one-dimensional conduction, unsteady one dimensional conduction, two and three- dimensional situations. Numerical solution of convection-diffusion-type equations: Steady one-dimensional convection-diffusion, discretization equation in two and three-dimensions.

Numerical solution of fluid flow equations: Discretization of continuity and momentum equations for fluid flow, pressure-based algorithms- SIMPLE & SIMPLER

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.		3	2									
CO2	Improve the understanding of the basic principles of fluid mechanics.	3	3										
CO3	Develop capabilty of solving some of the difficulties that one may encounter in CFD, such as geometry simplification, mesh problems, convergence problems, multiple solutions.				3	3							
CO4	Improve the research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results in written form.			3							3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	**3**	The student will demonstrate the ability to use modern CFD software tools to build flow geometries, generate an adequate mesh for an accurate solution, select appropriate solvers to obtain a flow solution, and visualize the resulting flow field.
CO1-PO3	**2**	The student will demonstrate the ability to analyse a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, etc., using flow visualization and analysis tools
CO2-PO1	**3**	The student will demonstrate an ability to recognize the type of fluid flow that is occurring in a particular physical system and to use the appropriate model equations to investigate the flow.
CO2-PO2	**3**	The student will demonstrate an ability to describe various flow features in terms of appropriate fluid mechanical principles and force balances.
CO3-PO4	**3**	The students will be able to conduct investigation of complex problems encounter in CFD, such as geometry simplification, mesh problems, convergence problems, multiple solutions, etc.
CO3-PO5	**3**	The student will able to select and apply appropriate technique to solve complex problems.
CO4-PO3	**3**	The student will demonstrate the ability to simplify a real fluid-flow system into a simplified model problem, to select the proper governing equations for the physics involved in the system, to solve for the flow, to investigate the fluid-flow behaviour, and to understand the results.
CO4-PO10	**3**	The student will demonstrate the ability to communicate the results of this detailed fluid-flow study in a written format.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42

Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Introduction: Computational Fluid Dynamics (CFD)- a research, modelling and design tool, historical perspective.	CT 01	
Class 10-15	Introduction of commercial CFD packages, mathematical description of physical phenomena, a brief discussion of discretization methods-finite difference, finite element.		
Class 16- 25	Introduction to control volume method.	CT 02	
Class 26- 29	Numerical solution of diffusion type equations: Steady one-dimensional conduction, unsteady one dimensional conduction, two and three-dimensional situations.		
Class 30-34	Numerical solution of convection-diffusion-type equations: Steady one-dimensional convection-diffusion, discretization equation in two and three-dimensions.	MT	
Class 35-36	Numerical solution of fluid flow equations: Discretization of continuity and momentum equations for fluid flow.	CT 03	
Class 37-42	Pressure-based algorithms- SIMPLE & SIMPLER	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	

	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

5) Computational Fluid Dynamics, J.D. Anderson

6) Computational Methods for Fluid Dynamics, J.H. Ferziger& M. Peric

7) Computational Techniques for Fluid Dynamics 1, C.A.J. Fletcher

8) Computational techniques for Fluid Dynamics 2, C.A.J. Fletcher, 2nd Edition.

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION

Course Code Course Title	: **ME 437** : **Design of Fluid Machines**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME-323

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to introduce students to the fundamentals of fluid flow and particle mechanics, fluid flow systems, equipment handling fluid-particle systems, empirical formulae, theory and some simple mathematical derivations.

OBJECTIVE

1. To analyze the fluid flow and particle mechanics with an emphasis on fundamental concepts and applications in process industries.

2. To design and analyze fluid flow systems and equipment handling fluid-particle systems.

3. To study the empirical formulae, theory and some simple mathematical derivations. Examples and applications will generally cover fluid machinery, pipe flow and fluid-particle systems.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Discuss the characteristics of centrifugal pump and reciprocating pumps	1	C6	1,4			Q, ASG, F
CO2	Find forces and work done by a jet on fixed or moving plate and curved plates	2	C1				Q, ASG, F
CO3	Find the working of turbines and select the type of turbine for an application	3	C1	1	1,2		Q, F, CS
CO4	Find the analysis of air compressors and select the suitable one for a specific application	3	C1	4	1		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

Impact of jets, Hydraulic Turbines, Rotary motion of liquids, Rotodynamic pumps, Positive displacement pumps, Compressors

b. Detail Contents:

Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve),– Series of vanes - work done and Efficiency Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles– Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features –

Velocity triangles, work done and efficiencies.

Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , Type Number–Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power.

Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps- centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q

characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and available Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based on shape numbers.

Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiency indicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.

Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)

Centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Discuss the characteristics of centrifugal pump and reciprocating pumps	3											
CO2	Calculate forces and work done by a jet on fixed or moving plate and curved plates		3										

CO3	Know the working of turbines and select the type of turbine for an application			3									
CO4	Do the analysis of air compressors and select the suitable one for a specific application			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will be able to know about behavior of characteristics of centrifugal pump and reciprocating pumps
CO2-PO2	**3**	Students will calculate forces and work done by a jet on fixed or moving plate and curved plates
CO3-PO3	**3**	Students get definition of Clear understanding of working of turbines and select the type of turbine for an application
CO4-PO3	**2**	Students will be able to determine analysis of air compressors and select the suitable one for a specific application

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-12	Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve),– Series of vanes - work done and Efficiency Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles– Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, work done and efficiencies.	CT 01	
Class 13-21	Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power	CT 02	
Class 22- 27	Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps- centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and availableType number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based on shape numbers.	MT	
Class 28- 36	Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiencyindicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air	MT	

	vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.		
Class 37-39	Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)	CT 03	
Class 40-42	Centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:-working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
3	CT	**30**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	MID, Final Exam	**70**	
4	Final Exam	**70**	

REFERENCE BOOKS
1. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013 2. Yahya S. M, Fans, Blower and Compressor, Tata McGraw Hill, 2005. 3. Shepherd D. G, Principles of Turbo Machinery, Macmillan, 1969. 4. Stepanoff A. J, Centrifugal and Axial Flow Pumps, John Wiley & Sons, 1991. 5. Rajput R. K, Fluid Mechanics and Hydraulic Machines, S. Chand & Co.,2006. 6. Subramanya, Fluid mechanics and hydraulic machines, 1e McGraw Hill Education India,2010

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	: **ME 439** : **Bio Fluid Mechanics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
ME-321			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Engineering approach to the analysis of circulatory and respiratory systems and to other problems in physiologyinvolving fluid dynamics; Review of relevant anatomy and physiology emphasizing qualitative consideration;Presentations and discussions; Simulation of physiological phenomena			
OBJECTIVE			
i. Understand physiologically relevant fluid and solid mechanic ii. Apply fluid mechanical analyses relevant to biomedical engineering problems iii. Understand and analyze velocity measurement techniques relevant to blood flow (e.g., MRI,Ultrasound, Doppler)			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Apply fundamental concepts of calculus, differential equation to solve problems related to Bio fluid mechanics	1,3	C1, C3	3			Q, ASG, F
CO2	Demonstrate knowledge to solve problems related to physiological process.	2	C3	2,4			Q, ASG, F
CO3	Clear understanding of different practical medical devices.	2,3	C5, C6	6,7	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Various approaches and solutions applied to a wide variety of fluid mechanics problems related to physiological process

ii. Problems related to medical devices

iii. Problems related to laboratory setup.

iv. Computational Fluid Dynamics (CFD)

v. MATLAB.

b. Detail Contents:

Difference between the various approaches and solutions applied to awide variety of fluid mechanics problems related to physiological processes, medical devices, and laboratory setups as used for testing and measuring. A significant objective is to reinforce the student's prior knowledge in calculus, differential equations, and engineering as it applies to fluid mechanics. Computational Fluid Dynamics (CFD) and MATLAB will be introduced to emphasize Computer Aided

Engineering (CAE).

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply fundamental concepts of calculus, differential equation to solve problems related to Bio fluid mechanics	3		3									
CO2	Demonstrate knowledge to solve problems related to physiological process.		3										
CO3	Clear understanding of different practical medical devices.		2	2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will have knowledge on calculus and differential equation necessary to solve problems related to bio fluid mechanics
CO1-PO3	**3**	Ability to apply calculus and differential equation to solve complex problems related to bio fluid mechanics
CO2-PO2	**3**	Students will be able to differentiate between various approaches and solutions applied to a wide variety of fluid mechanics problems related to physiological process
CO3-PO2	**2**	Students will be able to analyse the requirement of medical devices and can design a solution
CO3-PO3	**2**	Student will practice various Medical devices design problems

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	**Topic**	**CT**	**Remarks**
Class 1-9	Difference between the various approaches and solutions applied to a wide variety of fluid mechanics problems related to physiological processes	CT 01	
Class 10-17	Fluid mechanics problems related to Medical Devices.		
Class 18- 27	Problems related to laboratory setups as used for testing and measuring	CT 02, MT	
Class 28- 33	Calculus, differential equations, and engineering as it applies to fluid mechanics		
Class 34-38	Computational Fluid Dynamics (CFD)	CT 03	
Class 39-42	MATLAB to emphasize Computer Aided Engineering (CAE)	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Applied Biofluid Mechanics, Lee Waite and Jerry Fine
2. A Brief Introduction to Fluid Mechanics, Young, Munson, and Okiishi

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	: **ME 441** : **Theory of Structures**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students to concept of global structural stability, theory of structural analysis, and methods instructural analysis

OBJECTIVE

1. Translate a stated problem in theory of structures to an analytic form.
2. Apply appropriate solution techniques to the problem.
3. Calculate the correct answer to the given problem.
4. Interpret the meaning of the outcome.
5. Recognize limitations of the solution techniques and the outcomes.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Gain knowledge of element stiffness matrices to solves different complex problems	3	C1	3,4, 5	1,2		Q, ASG, F
CO2	Understand the design and performance of 2-D rigid joint structures.	2	C2	3			Q, ASG, F
CO3	Understand and analyse the elastic stability of 2-D rigid joint structures.	6	C2	3			Q, F, CS
CO4	Demonstrate knowledge on different on the frequency of rigid structures and finite element method.	1	C4,C5	3,5	1,3		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Preliminaries; Elements stiffness matrices

2. Pin-joint structures
3. Elastic plane elementstructures
4. Mixed element structures
5. Elastic stability of 2-D rigid-joint structures;
6. Finite element method

b. Detail Contents:

Preliminaries; Elements stiffness matrices; Pin-joint structures; 2-D rigid-joint structures; Elastic plane element structures; Mixed element structures; Elastic stability of 2-D rigid-joint structures; Frequency of rigid-joint structures; Finite element method

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Gain knowledge of element stiffness matrices to solves different complex problems			3									
CO2	Understand the design and performance of 2-D rigid joint structures.		2										
CO3	Understand and analyse the elastic stability of 2-D rigid joint structures.						3						
CO4	Demonstrate knowledge on different on the frequency of rigid structures and finite element method.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO3	**3**	Students will gain knowledge of element stiffness matrices to solve various high power problem
CO2-PO2	**2**	Students will be able to design 2-D rigid joint structures.
CO3-PO6	**3**	Students will be able to analyse the stability of 2-D rigid joint structures.
CO4-PO1	**3**	Students will gain knowledge on rigid structures and finite element method

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-6	Preliminaries; Elements stiffness matrices	CT 01	
Class 7-12	Pin-joint structures; 2-D rigid-joint structures		
Class 13-18	Elastic plane elementstructures	CT 02	
Class 19-24	Mixed element structures		
Class 25-30	Elastic stability of 2-D rigid-joint structures	MT	
Class 31-36	Frequency of rigid-jointstructures	CT 03	
Class 37-42	Finite element method	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Theory & Design of Structure – E. S. Andrews.
2. Structural Design By Computer – E. W. Wright.
3. Structural Design with Plastic – B. S. Benjamin.

Fall Semester L-4, T-2

COURSE INFORMATION			
Course Code Course Title	**ME 445** **Noise and Vibration**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The course is based on Sound waves; Sound sources; Sound transmission through walls and structures; Acoustics of large and small rooms; Mechanism of sound absorption; Design of silencers. It also focuses on Vibration isolation, machine foundation design; Vibration absorption; Random vibration; Beam and plate vibrations

OBJECTIVE
1. This course will emphasize the development of basic understanding in the field of sound transmission, sound absorption, damping in machines and experimental modal analysis. 2. The primary objective of the course is to develop the basic understanding of the construction and design of noise control device and their applications.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Students will develop understanding of sound interference, refraction, diffraction and scattering; the basic concepts of active noise and vibration control; the concepts and methods of passive noise and vibration control	1	C2	1			Q, ASG, F

CO2	Students will be able to describe, quantify, predict, measure and analyze noise and vibration signals, to describe the physiological and subjective responses of humans exposed to noise and vibration, quantify the exposure and assess the response.	2	C2, C4	2,4			Q, ASG, F
CO3	To Apply engineering and other methods for controlling exposure to noise and vibration	3	C3	6,7	2,4		Q, F, CS
CO4	Enables students to apply Noise and Vibration on human body and hand-arm vibration effect and the relevant related legislation	5	C3,C4	4,6	2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Sound source

ii. Sound transmission

iii. Machine foundation Design

iv. Vibration Absorption

v. Lagrange equations

vi. Vehicular noise and control

vii. Analysis of transient response

b. Detail Contents:

Sound waves; Sound source (Sources of Noise) Sound transmission through walls and structures, Linear vibration theory: free and forced vibration of single- and multi- degree-of-freedom systems, Engine muffler designs, Vibration isolation, Machine foundation Design, Damping in machines; experimental modal analysis, Random vibration, Beam and plate vibrations, Vibration Absorption, Laplace, Noise control through barriers and enclosures and absorbent linings, Logarithmic decrement methods to find modal parameters, Balance of rotating machinery: sources of unbalance, rigid rotors, flexible rotors, critical speeds, balancing principles. Lagrange equations, Vehicular noise and control – Environmental noise control, Solutions involving the reduction of the symptoms of vibration, Analysis of transient response: solution techniques for transient forcing including shock loading, Application to mechanical systems, Case study - worked illustration of a problem and its solution

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will develop understanding of sound interference, refraction, diffraction and scattering; the basic concepts of active noise and vibration control; the concepts and methods of passive noise and vibration control	3											
CO2	Students will be able to describe, quantify, predict, measure and analyze noise and vibration signals, to describe the physiological and subjective responses of humans exposed to noise and vibration, quantify the exposure and assess the		2										

	response.												
CO3	To Apply engineering and other methods for controlling exposure to noise and vibration			3									
CO4	Enables students to apply Noise and Vibration on human body and hand-arm vibration effect and the relevant related legislation					3							

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will have knowledge on sound interference, refraction, diffraction and scattering; the basic concepts of active noise and vibration control
CO2-PO2	**2**	Students by predicting, measuring and analysing noise and vibration signals will be able to solve complex problems
CO3-PO3	**3**	Students will learn about the methods for controlling exposure to noise and vibration
CO4-P05	**3**	Students will gain knowledge about the application of noise and vibration in human body and other relevant fields

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Sound waves; Sound source (Sources of Noise) Sound transmission through walls and structures, Linear vibration theory: free and forced vibration of single- and multi- degree-of-freedom systems	CT 01	
Class 10-15	Engine muffler designs, Vibration isolation, Machine foundation Design, Damping in machines; vibration absorbers; experimental modal analysis		
Class 16- 25	Vibration absorption, Random vibration, Beam and plate vibrations.	CT 02	
Class 26- 29	Laplace, Noise control through barriers and enclosures and absorbent linings, Logarithmic decrement methods to find modal parameters, Balance of rotating machinery: sources of unbalance, rigid rotors, flexible rotors, critical speeds, balancing principles. Lagrange equations		
Class 30-34	Vehicular noise and control – Environmental noise control, Solutions involving the reduction of the symptoms of vibration	MT	
Class 35-36	Analysis of transient response: solution techniques for transient forcing including shock loading, Application to mechanical systems	CT 03	
Class 37-42	Case study - worked illustration of a problem and its solution		

ASSESSMENT STRATEGY			

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Fundamentals of Noise and Vibration – F. J. Fahy, J. G. Walker, Publisher – Spon Press; 1998.

2. Active control of Noise and Vibration – Colin Snyder Hansen – C. H. Hansen, Scott Snyder, Publisher – Spon Press, 1st edition, 1996

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 447** **Robotics**	Lecture Contact Hours Credit Hours	**3.00** **1.50**

PRE-REQUISITE

CSE 171 - C Programming Language
ME 495 – Mechatronics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides an overview of robot mechanisms, dynamics, and intelligent controls. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots; control design, actuators, and sensors; wireless networking, task modelling, human-machine interface, and embedded software; image processing and introduction to artificial intelligence.

OBJECTIVE
1. Learn to apply the position and motion analysis of robots. 2. Learn to apply dynamic analysis and plan trajectories. 3. To know about various systems and sensors associated with robots. 4. To understand and apply image processing and artificial intelligence techniques for robots.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Understand the engineering knowledge related to the main terminologies and concepts of robotic systems.	1	C1			3	T
CO2	Apply the concepts and mathematical modeling for analyzing the position, motion, dynamics, forces and trajectory planning associated with robots.	2,3,4	C3,C4,C6	1		2,3,4	T,ASG,F
CO3	Knowledge and application of the various sensors and systems used in robots.	1,5	C1,C3			1,3	T,F
CO4	Learn various image processing techniques and artificial intelligence to understand advance robotic systems and apply them using computer programming.	1,4	C1,C3	3		2,3	ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Kinematics of Robots: Position and orientation analysis, mechanisms, transformations, forward and inverse kinematics, coordinate systems, DH representation

Differential Motions and Velocities: Differential motion, translation, rotation, differential changes, robot jacobian

Motion control systems: Transfer functions, PPI, PPD, PID controllers

Actuators and drive systems: Pneumatic devices, motors, servomotors

Dynamic Analysis and Forces: Dynamic analysis, lagrangian mechanics, kinetic energy and potential energy for multiple DoF robots

Sensors: Potentiometers, LVDT, velocity sensors, piezoelectric sensors

Trajectory planning: The world and robot, configuration space, metrics

Image Processing and Analysis with Vision Systems: Image processing techniques, image acquisition, sampling, histogram, thresholding, convolution, blurring, sharpening and edge detection filters, applications in robots

Path planning algorithms: start-goal methods, map-based approaches, cellular decompositions

Artificial Intelligence: Introduction to artificial intelligence, neural networks, backpropagation theory, applications in robots

Applications: Navigating large spaces, coverage

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the engineering knowledge related to the main terminologies and concepts of robotic systems.	3											
CO2	Apply the concepts and mathematical modelling for analyzing the position, motion, dynamics, forces and trajectory planning associated with robots.		3	3	3								
CO3	Knowledge and application of the various sensors and systems used in robots.	2				3							
CO4	Learn various image processing techniques and artificial intelligence to understand advance robotic systems and apply them using computer programming.	3			3								

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**3**	Students will have the basic and background knowledge required to get familiar with robotic systems.
CO2-PO2	**3**	Students will be able to analyze a problem related to positions,

		movements and dynamics of robots.
CO2-PO3	**3**	Students will be able to design a solution to tackle the problems they have analyzed.
CO2-PO4	**3**	Students will be able to conduct investigations on complex problems and come up with possible solutions.
CO3-PO1	**2**	Students will have the basic knowledge about the theory and working principles of sensors and various robotic systems.
CO3-PO5	**3**	Students will know how to modern technologies and tools are used to develop sensors and various robotic systems.
CO4-PO1	**3**	Students will understand various image processing techniques and how an artificial intelligence system is used with a robot.
CO4-PO4	**3**	Students will be able implement image processing and artificial intelligence models to investigate complex problems.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**
TEACHING METHODOLOGY	
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method	

COURSE SCHEDULE	
Week-1	Introduction, reference systems, degree of freedoms, robot classifications
Week-2	Position and orientation analysis, mechanisms, transformations
Week-3	Forward and inverse kinematics, coordinate systems, DH representation
Week-4	Motion control systems, transfer functions, PPI, PPD, PID controllers
Week-5	Actuators and drive systems, pneumatic devices, motors, servomotors
Week-6	Differential motion, translation, rotation, differential changes, robot jacobian
Week-7	Sensors, potentiometers, LVDT, velocity sensors, piezoelectric sensors
Week-8	Dynamic analysis, lagrangian mechanics, kinetic energy and potential energy for multiple DoF robots
Week-9	Trajectory planning, the world and robot, configuration space, metrics
Week-10	Image processing techniques, image acquisition, sampling, histogram, thresholding
Week-11	Convolution, blurring, sharpening and edge detection filters, applications in robots
Week-12	Path planning algorithms, start-goal methods, map-based approaches, cellular decompositions
Week-13	Introduction to artificial intelligence, neural networks, backpropagation theory, applications in robots
Week-14	Applications, navigating large spaces, coverage

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, MID	**100**	

REFERENCE BOOKS

1. Introduction to Robotics: Analysis, Control, Applications, Saeed B. Niku
2. Modeling and Control of Robot Manipulators - Sciavicco and Siciliano, McGraw-Hill
3. Introduction to Robotics: Mechanics and Control - John J. Craig, Pearson Prentice Hall.
4. Robot Analysis - Lung-Wen Tsai, Wiley & Sons Inc.

REFERENCE SITE

None

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 449** **Composite Materials**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course focuses on fibre-reinforced composites, especially polymer matrix composites, and covers design, manufacture, testing and through-life performance of composite structures. The topics covered in the course are: design, advanced manufacturing processes, micromechanical modelling, mechanical properties, fracture and fatigue, durability, repair and non-destructive evaluation of composites. The course enables the student to obtain knowledge, skills and attitudes needed for the optimum design and manufacture of advanced composite components. It will also engender ethical thinking and discernment pertaining to the judicious and eco-friendly use of such composites.

OBJECTIVE
a. To apply the concepts of solid mechanics to advanced manufacturing processes, micromechanical modelling, mechanical properties, fracture and fatigue, durability, repair and non-destructive evaluation of common fibre-reinforced composites. b. To gain understanding of fibre-reinforced polymer composites in terms of their design, manufacture, testing and through-life performance. c. To obtain knowledge in the current applications of advanced composites, especially glass and carbon fibre reinforced polymer matrix type. d. To develop ethical judgement in application of composites and demonstrate ethical behaviour.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Apply** the concepts of solid mechanics and **analyze** the design, manufacture and characterization of fibre-reinforced composites.	1	C3	1,2	1		Q, ASG, F
CO2	**Understand** the design, manufacture, performance and service life of fibre-reinforced polymer matrix composites	2	C2	3,4	1,2		Q, ASG, F
CO3	**Understand** the modern application of advanced composites, especially glass and carbon fibre reinforced polymer matrix types.	6,7	C2	7	1,2		Q, F, CS
CO4	**Demonstrate** ethical consideration and judgement in the eco-friendly applications of composites and towards class norms.	8	C4,C5	7			Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Introduction to composites,
2. Manufacturing processes,
3. Micromechanical analysis of a lamina,
4. Macromechanical analysis of a lamina,
5. Laminated composites,
6. Design of composite components

b. Detail Contents:

Introduction to composites (definition, types of reinforcements and matrices, types of composites, application of composites, effect on environment, recycling), Manufacturing processes, Micromechanical analysis of a lamina (volume and mass fraction, density, elastic moduli, Strength hygrothermal properties), Macromechanical analysis of a lamina (stiffness and compliance, stress-strain relation, hygrothermal stresses, failure theories of lamina), Laminated composites (stress-strain relation, stiffness and compliance, hygrothermal analysis, failure analysis), Design of composite components

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Apply** the concepts of solid mechanics and **analyze** the design, manufacture and characterization of fibre-reinforced composites	2											

CO2	**Understand** the design, manufacture, performance and service life of fibre-reinforced polymer matrix composites		3										
CO3	**Understand** the modern application of advanced composites, especially glass and carbon fibre reinforced polymer matrix types.						2	3					
CO4	**Demonstrate** ethical consideration and judgement in the eco-friendly applications of composites and towards class norms								2				

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	**2**	Analyzing the design, manufacture and characterization of fibre-reinforced composites will enable the students to gain knowledge about Reinforced composite
CO2-PO2	**3**	Understanding the design, manufacture, performance of fibre reinforced composites will allow them to solve complex problems
CO3-PO6	**2**	Students will learn about the application of advanced composite that which will help them in professional career.
CO3-PO7	**3**	Students will know about the impact of advanced composites on the environment
CO4-PO8	**2**	Students will know how to apply advanced composite for an eco-friendly environment

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
1	Composite (General definition and Discussion)	CT-1	
2	Fiber Reinforced Composites, Types and Properties and Use (Fibrous Composite), Metal Matrix, Ceramic Matrix		
3	Polymer Matrix, Discussion of Fiber, Interface and Matrix, Reinforcement.	CT-2	
4	Fiber with Thermoplastic, Property, Uses, Example		
5	Fiber with Thermoset (Glass fiber, Carbon fiber, Aramid fiber) with polymer.		
6	Ply Stiffness, Strength, Failure, **Review for Mid-Term**	Mid-term	
7	Laminate Layer, Stiffness strength, Failure Testing		
8	Composite section and Failure mode.		
9-10	Inter-Laminar Stress and Stress concentration		

	(Maximum 3 × 3 Matrix), Holes in laminates	CT-3	
11	Advanced Mechanical Testing and Characterization (Prepegs, Fiber reinforced polymer matrix, Delamination Test)		
12-13	Advanced Polymers and Application (HDPE, LCD, Conductive polymer, Organic LED, Thermoplastic Elastomers), Environmental Impacts and recycling		
14	Biomaterial, Bio-composite (Implants, Scaffolds), Nano-composites (Carbon Nano Technology, Graphene Reinforcements), Ethical considerations **Review for Finals**		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**80**	
4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. An introduction to composite materials-Derek Hull, Cambridge University Press, 1995
2. Materials science and engineering, an introduction-William D. Callister Jr. & David G. Rethwisch, 9^{th} Ed., Wiley publications, 2010
3. Mechanics of composite Materials – Autar K. Kaw, Publisher – CRC Press, 1997.
4. Mechanics of composite Materials–Robert M. Jones, Publisher–John Benjamins Publishing Co, 1975.
5. Introduction to Composite Materials – Stephen W. Tsai, Publisher–CRCpress,1980

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code	**ME 451**	Lecture Contact Hours	: **3.00**
Course Title	**Aircraft & Aero-engine Structure**	Credit Hours	: **3.00**

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To learn the various factors in analysing and designing the different components of the aircraft.

OBJECTIVE

1. To learn what an engineer should consider as a responsibility during the design phase of an aircraft.
2. To be able to explain the contemporary requirements and trends for designing various components of an aircraft.
3. To be able to evaluate the different types of loads acting on the aircraft and their possible effect in its structural integrity.
4. To evaluate the advantages and disadvantages of basic contemporary configurations of different aircraft components.
5. To be able to ensure the safety of designed components based on structural integrity.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Gain knowledge about an engineer's responsibility in relation to designing various components of an aircraft.	8	1,2,4	1,2,3	1		

CO2	Understand the basic contemporary factors for designing various components of an aircraft.	7	1,2,3	3,5			
CO3	Evaluate various types of loads acting on the aircraft	2	1,2	2,3			
CO4	Gain knowledge about various contemporary configurations of different aircraft components.	7	2,3	3,4	1,2		

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

Introduction to Aircraft Structure, Aircraft Loads Buckling and Stability of Structures; Wing Design; Empennage Design; Fuselage Design; Landing Gear; Engine

b. Detail Contents:

Introduction to Aircraft Structural Design; Design for Manufacturing: Engineer's Responsibility, Producibility, Maintainability, Tooling, Other Considerations Aircraft Loads: Review of Aero-elasticity, Flight Maneuvers, Wing Design Loads, Empennage Loads, Fuselage Loads, Propulsion Loads, Landing Gear Loads, Miscellaneous Loads, and Example of an Airplane Load Calculation Buckling and Stability of Structures: Columns and Beam Columns, Crippling Stress, Buckling of Thin Sheets, Thin Skin-Stringer Panel – Compression, Skin-Stringer Panel – General, Integrally Stiffened Panel, Wing Design: Wing Box Structure, Wing Box Design, Wing Covers, Spars, Ribs and Bulkheads, Wing Root Joints, Variable Swept Wings, Wing Fuel Tank Design, Wing Leading and Trailing Edges, Wing Control Surfaces, Fixed Leading and Trailing Edges, Design Considerations Empennage Design: Horizontal Stabilizer, Vertical Stabilizer (Fin), Elevator and Rudder Fuselage Design: Introduction, Fuselage Configuration, Fuselage Detail Design, Forward Fuselage, Wing and Fuselage Intersection, Stabilizer and Aft Fuselage Intersection, Fuselage Opening Landing Gear: Introduction, Development and Arrangements, Stowage and Retraction, Selection of Shock Absorbers, Wheels and Brakes Engine Mounts: Propeller-Driven Engine

Mounts, Inlet of Jet Engine (Fighter), Wing-Pod (Pylon) Mounts, Rear Fuselage Mount and Tail Mount, Fuselage Mount (for Fighters)

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Gain knowledge about an engineer's responsibility in relation to designing various components of an aircraft.								3				
CO2	Understand the basic contemporary factors for designing various components of an aircraft.							3					
CO3	Evaluate various types of loads acting on the aircraft		3										
CO4	Gain knowledge about various contemporary configurations of different aircraft components.							2					

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO8	**3**	Students will know their responsibility in relation to designing various components of an aircraft
CO2-PO7	**3**	Students will be adroit at basic contemporary factors for designing various components of an aircraft.
CO3-PO2	**3**	Ability to evaluate various types of loads acting on the aircraft will be achieved
CO4-PO7	**2**	Students will have knowledge about various contemporary configurations of different aircraft components.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week 1	**Introduction to Aircraft Structural Design**	CT 1
Class 1	Design for Manufacturing	
Class 2	Engineer’s Responsibility,	
Class 3	Producibility, Maintainability, Tooling, Other Considerations	
Week 2	**Aircraft Loads**	
Class 4	Review of Aero-elasticity	
Class 5	Flight Maneuvers	
Class 6	Continue	
Week 3	**Aircraft Loads (Continued)**	
Class 7	Wing Design Loads, Empennage Loads	
Class 8	Continue	
Class 9	Fuselage Loads, Propulsion Loads	
Week 4	**Aircraft Loads (Continued)**	CT 2
Class 10	Landing Gear Loads, Miscellaneous Loads	
Class 11	Continue	
Class 12	Example of an Airplane Load Calculation	
Week 5	**Buckling and Stability of Structures**	
Class 13	Columns and Beam Columns	
Class 14	Crippling Stress	
Class 15	Buckling of Thin Sheets	
Week 6	**Buckling and Stability of Structures(Continued)**	
Class 16	Thin Skin-Stringer Panel – Compression	
Class 17	Continue	

Class 18	Continue	
Week 7	**Buckling and Stability of Structures(Continued)**	CT 3
Class 19	Skin-Stringer Panel – General	
Class 20	Integrally Stiffened Panel	
Class 21	Continue	
Week 8	**Wing Design**	
Class 22	Wing Box Structure, Wing Box Design	
Class 23	Wing Covers, Spars, Ribs and Bulkheads	
Class 24	Wing Root Joints, Variable Swept Wings	
Week 9	**Wing Design(Continued)**	
Class 25	Wing Fuel Tank Design	
Class 26	Continue	
Class 27	Wing Leading and Trailing Edges	
Week 10	**Wing Design(Continued)**	MT
Class 28	Wing Control Surfaces	
Class 29	Fixed Leading and Trailing Edges	
Class 30	Design Considerations	
Week 11	**Empennage Design**	
Class 31	Horizontal Stabilizer	
Class 32	Vertical Stabilizer (Fin)	
Class 33	Elevator and Rudder	
Week 12	**Fuselage Design**	
Class 34	Introduction, Fuselage Configuration	
Class 35	FuselageDetailDesign,ForwardFuselage,WingandFuselageIntersection	
Class 36	Stabilizer and Aft Fuselage Intersection, Fuselage Opening	
Week 13	**Landing Gear**	
Class 37	Introduction, Development and Arrangements	
Class 38	Stowage and Retraction, Selection of Shock Absorbers	
Class 39	Wheels and Brakes	
Week 14	**Engine Mounts**	
Class 40	Propeller-Driven Engine Mounts, Inlet of Jet Engine (Fighter)	
Class 41	Wing-Pod (Pylon) Mounts, Rear Fuselage Mount and Tail Mount	
Class 42	Fuselage Mount (for Fighters)	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**20**	

4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	MID, Final Exam	**70**	
3	MID, Final Exam	**80**	
4	Final Exam	**70**	

REFERENCE BOOKS

1. Design of Aircraft by Thomas C. Corke; PearsonEducation.
2. Synthesis of Subsonic Airplane Design (Delft UP) –Torenbeek.
3. Airframe Structural Design: Practical Design Information and Dataon Aircraft Structures-Michael Chun-YungNiu

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 453** **Applied Aerodynamics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME-343 Mechanics of Solids

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students with the fundamental principles of aerodynamics for understanding stability and control, aircraft performance etc.

OBJECTIVE

1. To understand the fundamental principles of incompressible and compressible fluid mechanics and aerodynamics.
2. To apply these principles to real systems such as pipe flows, automobiles and aircraft.
3. To explain the sources of friction, induced, wave, and pressure drag.
4. To understand aspects of flight characteristics that relates to lift, drag, thrust and power.

5. To be able to perform calculations involving lift, drag in relation to various aspects of flight and aircraft performance.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Explain the methods of fluid flow analysis i.e. theoretical, experimental and computational	2	1,2	1			Q, ASG, F
CO2	Analyze the concept potential theory and its application to incompressible and inviscid flows	1,2	1,2,3,4	2,3			Q, ASG, F
CO3	Apply of theoretical techniques to analyze the simple viscous flows	5	1,2,4	4,6			Q, F, CS
CO4	Apply the numerical methods for solution of complex flow situations	5	1,2,3	2,3			Q, F, CS
CO5	Describe implications errors and stability analysis of numerical methods	4	1,2	1,2			Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

Inviscid flows, Theory of 2D aerofoils, Viscous Flows

b. Detail Contents:

Inviscid flows: Models of fluid flow, continuity and momentum equations applied to inviscid flows, drag momentum theory, concept of stream lines, stream tubes, streak line, path lines. Angular velocity, strain and vorticity, potential theory applied to Inviscid flows, elementary flows, their combination and applications. Solution of flows past bodies using Panel methods. Theory of 2D aerofoils: Kutta-Joukowski theorem, Kutta condition, Kelvin circulation theorem. Classical thin aerofoil theory. Types of flow separation and inviscid flow characteristics over a 2D aerofoil. Inviscid & incompressible flow over finite wings, Prandtl's lifting line theory, lift distribution over finite wings, effect of aspect ratio; Different types of drags. Viscous Flows: Qualitative aspects of viscous flows, Navier-Stokes equations, modification N-S equation for different flows, Exact solutions of N-S equations, Aerodynamic heating, Prandtl Boundary Layer theory; Boundary Layer equations and their solutions. Skin friction and skin friction drag. Laminar flow past flat plate. Concept free shear flows viz. jet, wake and mixing streams. Flow past cylinder and spheres and their applications. Boundary layer separation and its effects. Flow control techniques. Methods to reduce different types of drag. Introduction to turbulence, concept of turbulence modelling, Prandtl mixing length theory.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain the methods of fluid flow analysis i.e. theoretical, experimental and computational		2										
CO2	Analyze the concept potential theory and its application to incompressible and inviscid flows	2	3										
CO3	Apply of theoretical techniques to analyze the simple viscous flows					3							
CO4	Apply the numerical methods for solution of complex flow situations					3							

CO5	Describe implications errors and stability analysis of numerical methods				2								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	**2**	Students will be adroit at theoretical, experimental and computational methods of fluid flow analysis.
CO2-PO1	**2**	Students will gain concept about the theory of incompressible and inviscid flows
CO2-PO2	**3**	Ability for the application of incompressible and inviscid flows will be achieved
CO3-PO5	**3**	Students will be meticulous about the theoretical techniques to analyze the simple viscous flows
CO4-PO5	**3**	Adroit at the numerical methods for solution of complex flow situations
CO5-PO4	**2**	Students will be able to analyze the stability of numerical methods and also they will have an ability for error analysis

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week 1	**Introduction to Applied Aerodynamics**	
Class 1	Review of fundamental aerodynamic concepts, classification flows	
Class 2	Applied aerodynamics: aerodynamic coefficients, their magnitudes and variation	CT 1
Class 3	Review of vector relation gradient, divergence, curl, line integrals, surface integrals and volume integrals	
Week 2	**Discussion on basic topics of theoretical Aerodynamics**	
Class 4	Angular velocity, strain rate and vorticity of fluid flows	
Class 5	Classification of rotational and irrotational flows, Fluid Stressed and strain rates	
Class 6	Circulation, stream function and velocity potential	
Week 3	**Development of Potential theory**	CT 2
Class 7	Flow analysis of Inviscid and incompressible flows, review of Bernoulli's equation and its applications	
Class 8	Pressure coefficient and its variation on typical airfoils	
Class 9	Elementary fluid flows. Derivation of equations of stream function velocity potential and velocity for uniform flow.	
Week 4	**Application of potential theory for flow analysis**	
Class 10	Derivation of equations of stream function and velocity potential and velocity for doublet flow and vortex flow.	
Class 11	Analysis of flow past non-lifting cylinder	
Class 12	Analysis of flow past lifting cylinder, Derivation of Kutta-Joukowski theory of lift.	
Week 5	**Classical thin airfoil theory**	CT-3
Class 13	Discussion on airfoil nomenclature and their characteristics.	
Class 14	Kutta condition and Kelvin's circulation theorem and starting vortex.	
Class 15	Introduction to Classical thin airfoil theory.	
Week 6	**Flow separation**	
Class 16	Types of flow separation.	
Class 17	Inviscid flow characteristics over a 2D airfoil.	
Class 18	Inviscid & incompressible flow over finite wings.	
Week 7	**Lift distribution**	
Class 19	Lift distribution over finite wings.	
Class 20	Effect of aspect ratio.	
Class 21	Different types of drags.	

Week 8	**Finite wing and its Lift**	MT	
Class 22	Finite wing theory or Prandtl classical lifting line theory.		
Class 23	Elliptical lift distribution.		
Class 24	Effect of aspect ratio and physical significance.		
Week 9	**Derivation of N-S equation and its application to simple flows**		
Class 25	Derivation of Navier Stokes equations: Continuity and Momentum equation.		
Class 26	Derivation of Navier Stokes equations: Energy equations and different forms of N-S equation. Modification of N-S Equations for different types of flow.		
Class 27	Solution method of N-S equation for simple problems: Parallel flows.		
Week 10	**Boundary layer theory**		
Class 28	Introduction to Boundary layers. Properties of B-L properties.		
Class 29	Derivation of Boundary layer equations		
Class 30	Application of Boundary layer equations for laminar boundary layers and interpretation of Laminar B- L properties		
Week 11	**Boundary layer theory**		
Class 31	Modification N-S equation for different flows, Exact solutions of N-S Equations		
Class 32	Aerodynamic heating		
Class 33	Prandtl Boundary Layer theory		
Week 12	**Laminar flow**		
Class 34	Skin friction and skin friction drag.		
Class 35	Laminar flow past flat plate		
Class 36	Concept free shear flows viz. jet		
Week 13	**Flow past cylinder and spheres**		
Class 37	Flow past cylinder and spheres and their applications.		
Class 38	Boundary layer separation and its effects.		
Class 39	Flow control techniques.		
Week 14	**Introduction to turbulence**		
Class 40	Introduction to turbulence		
Class 41	Concept of turbulence modeling		
Class 42	Prandtl mixing length theory		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**20**	
4	CT	**30**	
5	CT	**0**	
	Exam		
1	MID, Final Exam	**80**	
2	MID, Final Exam	**70**	
3	MID, Final Exam	**80**	
4	Final Exam	**70**	
5	MID, Final Exam	**100**	

REFERENCE BOOKS

1. Mechanics of Fluids - Irving H.Shames
2. Mechanics of Fluids - B. S.Messy
3. Fundamentals of Aerodynamics - John D Anderson;McGrawhill.
4. Aerodynamics for Engineering Students – EHoughton,P.W. Carpenter, S.H. Collicot and D.T. Valentine;Elsevier.
5. Computational Fluid Mechanics and Heat Transfer – Anderson

Fall Semester L-4, T-I/II

COURSE INFORMATION			
Course Code Course Title	ME 455 Fire Safety and Engineering	Lecture Contact Hours Credit Hours	3.00 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE
Theoretical course based on advanced systems and equipment's used for firefighting in different areas.

OBJECTIVE
The students will learn fire safety equipment design in tall buildings.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge about the dynamics of combustion and propagation of fire.	1	C2, C3	3	1		ASG, T, F
CO2	Demonstrate knowledge about different existing firefighting technique.	1	C3	4	1		ASG, T, F
CO3	Design fire hydrant system following national standards.	3,5	C2, C3	5,6	1		ASG, T, F
CO4	Design and analyze firefighting system of tall buildings and industrial areas.	3,5	C3, C4	5,6	1		ASG, T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Theory of combustion, active and passive firefighting systems, chemical firefighting, ventilation system for firefighting, firefighting equipment and safety gears, respiratory system in firefighting, automatic fire fighting system, fire hydrant system design, firefighting system design of tall buildings and industrial areas, Fire safety standards, Fire detection methods, Inspection procedure for fire protection in buildings, Human management during fire hazard/ fire drill., BNBC Code, Fire Safety layout in industrial area, specials vechicles

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge about the dynamics of combustion and propagation of fire.	3											
CO2	Demonstrate knowledge about different existing firefighting technique.	3											
CO3	Design fire hydrant system following national standards.			3		3							
CO4	Design and analyze firefighting system of tall buildings and industrial areas.			3		3							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Apply knowledge of natural science, engineering fundamentals about the dynamics of combustion and propagation of fire.
CO2-PO1	**3**	Students will acquire knowledge about different existing firefighting technique.
CO3-PO3	**3**	Students will able to design fire hydrant system following national standards.
CO3-PO5	**3**	Students will apply appropriate techniques and select fire hydrant system following national standards.
CO4-PO3	**3**	Students will able todesign and analyze firefighting system of tall buildings and industrial areas
CO4-PO5	**3**	Students will be able to predict and model firefighting system of tall buildings and industrial areas.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Theory of combustion, active and passive firefighting systems.	CT 01	
Class 10-15	Chemical firefighting, ventilation system for firefighting.		
Class 16- 25	Firefighting equipment and safety gears, respiratory system in fire fighting.	CT 02	
Class 26- 29	Automatic fire fighting system, fire hydrant system design.		
Class 30-34	Firefighting system design of tall buildings and industrial areas.	MT	
Class 35-36	Fire safety standards, Fire detection methods, Inspection procedure for fire protection in buildings.	CT 03	
Class 37-42	Human management during fire hazard/ fire drill.	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. Fire Dynamics - Gregory E. Gorbett, James L. Pharr, and Scott Rockwell
2. Fire Suppression and Detection Systems - John L. Bryan
3. Fire Protection Systems - A. Maurice Jones
4. Engineering Guide: Fire Safety for Very Tall Buildings - Valerie Necka

Spring/Fall Semester L-4, T-I or T-II

COURSE INFORMATION			
Course Code Course Title	: **ME 459** : **Preventive Maintenance**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Preventive maintenance is the care and protection of your vehicle against potential major auto repairs. Negligence is the most common and costly way to see money wasted on repairs that could have easily been prevented through regular service intervals. Depending on your vehicle's manufacturer, avoiding preventive maintenance on certain parts and components has the potential to void warranty coverage .This is a optional course for undergraduates majoring in vehicle engineering and for students majoring in mechanical engineering as a selected course to train students to become entry level maintenance engineer. The course is focused on maintenance procedures and diesel-powered vehicle systems inspection and operations.

OBJECTIVE

1. To familiarize students with the application of preventive maintenance theory to practical engineering field.

2. To make students aquatinted with various types of maintenance procedures.

3. To familiarize students with the different preventive measures.

4. Ability to relate regular maintenance to industrial maintenance.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Apply preventive maintenance theory to practical evaluation and measurement	1,2	C1, C2, C3	1,4, 6			Q, ASG, F

CO2	Articulate various types of maintenance procedures	1,3	C2, C3	1,4			Q, ASG, F
CO3	Identify and utilize important prevention techniques used in industry to evaluate maintenance parameters.	1,2	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	Relate regular automotive maintenance to industrial maintenance of automobiles.	1,2	C3, C4	4,6	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Review Regular Maintenance

2. Automotive maintenance.

3. Vehicle Handling

4. Case Study

5. Vehicle maintenance depending on engines.

6. Preventive maintenance Characteristics

b. Detail Contents:

This course introduces students to various types of principles and practices used within industry for predictive and preventative maintenance of equipment. Topics will include: safety, housekeeping, filter replacement, oil analysis, lubricating, vibration analysis, shaft alignment, balancing, motor current analysis, infrared and ultrasonic analysis, and troubleshooting. Locating vehicle information – decoding vehicle identification number – identifying power-train configurations – identifying chassis configurations - using a shop manual – using an owners manual – using a repair manual – using computerized service information – using a parts manual – using a labor guide – recording service procedures – checking and changing engine oil and filter – checking and adjusting power train fluids – checking and changing transmission/ transaxle fluids and filters – checking and adjusting differential fluids – checking and adjusting coolant levels – checking and adjusting brake fluid – checking and adjusting power steering fluid – checking and adjusting windshield washer fluid –inspecting and adjusting engine drive belts – servicing air conditioning systems, inspecting vehicle safety features – checking exterior lighting – checking and replacing windshield wiper blades – checking and adjusting tire pressures – checking tire wear patterns- new car pre delivery inspection- lubrication service of wear points- cleaning and care of vehicle

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply preventive maintenance theory to practical evaluation and measurement	3	2										
CO2	Articulate various types of maintenance procedures	3		2									
CO3	Identify and utilize important prevention techniques used in industry to evaluate maintenance parameters.	2	2										
CO4	Relate regular automotive maintenance to industrial maintenance of automobiles.	2	1										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will be able to know about preventive maintenance theory
CO1-PO2	**2**	Students will develop the ability to apply maintenance theory to practical evaluation and measurement.
CO2-PO1	**3**	Students will have the knowledge of various vehicle maintenance procedures

CO2-PO3	**2**	Students will be able to find solution by categorizing the problems into various classifications.
CO3-PO1	**2**	The students will attain the knowledge of various preventive maintenance of engines.
CO3-PO2	**2**	Students will have an ability to techniques used in industry to evaluate maintenance parameters..
CO4-PO1	**2**	Students will learn about the automotive industrial maintenance.
CO4-PO2	**1**	They will be able to apply the knowledge of small regular maintenance to industrial automotive maintenance.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-12	Demonstration of sound safety practices, mechatronic systems corresponding to the maintenance and repair plans, exchange wear and tear parts in context with preventative maintenance.	CT 01	
Class 13-21	Demonstration of how to take out devices and assembly parts, taking into account their function, mark parts regarding to their position and function,	CT 02	

	Elimination of disturbances caused by reworking and replacement of parts and assemblies Objectives		
Class 22- 30	Using TPM (Total productive maintenance principles), evaluation of the need for and performance of maintenance on mechanical system (including exchange of components)	MT	
Class 31- 36	Demonstration of how to develop and implement a predictive maintenance plan	CT 03	
Class 37-42	Identification and explanation of various types and styles of predictive and preventive maintenance components, principles, and practices used in industrial applications.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**70**	
3	MID, Final Exam	**70**	
4	Final Exam	**100**	

REFERENCE BOOKS

1. AMTEC. (2012). AMTEC basic preventive maintenance lessons. Versailles, KY: KCTCS.

2. Quality Training Portal. (2011). The 5s's: workplace organization. Waitsfield, VT: Resource Engineering,

3. AMTEC. (2012). AMTEC advanced technologies in predictive maintenance lessons. Versailles, KY: KCTCS.

4. Kemp, A. (2011). Industrial mechanics. (3^{rd} ed.). Orland Park, IL: American Technical Publishers.

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
CourseCode	**ME 463**	Contact Hours	3.00
Course Title	**Petroleum Engineering**	Credit Hours	3.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
A degree in Petroleum Engineering leads to exciting careers in the oil and gas industry, including reservoir, production and drilling engineering, which offer the scope to work across the world, in technically challenging and financially rewarding jobs.

OBJECTIVE
To have a very high employability record and the course is recognized as a leading program by international oil companies.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Provides excellent instruction and design experiences essential for graduates to enter the practice of petroleum engineering and pursue life-long professional development.	1, 2	C1,C2	1			ASG, T, F
CO2	To conduct research that generates, communicates, and applies new knowledge for the betterment of society.	2, 6	C2,C3	1,3			ASG, T, F
CO3	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	1, 3	C4	2			ASG, T, F
CO4	Use the techniques, skills, and modern engineering tools necessary for engineering practice.	3, 12	C5	7			ASG, T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

An overview of hydrocarbon reserves in Bangladesh; Classification of rocks and hydrocarbon deposits and their genesis; Geophysical exploration of oil and gas; Physical properties and characteristics of reservoir rocks; Origin, accumulation, composition and behavior of hydrocarbon reserves; Analysis and prediction of reservoir performance.

Drilling rigs and their types; Rig moving equipment; Rig components and their auxiliaries; Drilling operations; Vertical and direction drilling; Well logging and interpretation; Cracking and steaming; Well completion and cementation.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Provides excellent instruction and design experiences essential for graduates to enter the practice of petroleum engineering and pursue life-long professional development.	2	3										
CO2	To conduct research that generates, communicates, and applies new knowledge for the betterment of society.		3				3						
CO3	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	3		3									
CO4	Use the techniques, skills, and modern engineering tools necessary for engineering practice.			3									3

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**2**	The student will learn about design essentials of petroleum engineering
CO1-PO2	**3**	Students will be able to analyze complex engineering problems related to petroleum engineering.

CO2-PO2	**3**	Students will be able to generate solutions by conducting research and applying new knowledge for the betterment of society.
CO2-PO6	**3**	They will be able to apply contextual knowledge to assess socialhealth and safety issue.
CO3-PO1	**3**	Students will have knowledge about Drilling rigs, their types and drilling operation.
CO3-PO3	**3**	Conduct investigations of complex problems on various identifying variables and measures to meet desired needs within realistic constraints
CO4-PO3	**3**	Design solution of appropriate techniques, skills necessary for engineering practice.
CO4-PO12	**3**	Choice and availability of different kind of skills, and modern engineering tools to engage in lifelong learning. .

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week-1	An overview of hydrocarbon reserves in Bangladesh; Classification of rocks and hydrocarbon deposits and their genesis;	
Week-2	Geophysical exploration of oil and gas	
Week-3	Physical properties and characteristics of reservoir rocks	CT 1
Week-4	Origin, accumulation, composition and behavior of hydrocarbon reserves	
Week-5	Analysis and prediction of reservoir performance.	
Week-6	Drilling rigs and their types	
Week-7	Rig moving equipment	Mid term
Week-8	Rig components and their auxiliaries	
Week-9	Drilling operations	
Week-10	Vertical and direction drilling	CT 2
Week-11	Well logging and interpretation	

Week-12	Cracking and steaming	CT 3
Week-13	Well completion and cementation	
Week-14	Review	

ASSESSMENT STRATEGY

COs	Assessment method	100%	Remarks
	Class Assessment		
CO1	**Class observation/ Assignments**	**20**	
CO2		**20**	
CO3		**20**	
CO4		**20**	
	Exam		
CO1	**CT/MID/Final Exam**	**80**	
CO2		**80**	
CO3		**80**	
CO4		**80**	

REFERENCE BOOKS

1. Fundamentals of Petroleum Industry – Robert O. Anderson
2. Introduction to Petroleum, Geology and Drilling – Md. AbdurRazzaqAkanda, Md. Quamrul Islam
3. Nontechnical Guide to Petroleum, Geology, Exploration, Drilling and Production – Norman J. Hyne

REFERENCE SITE

None

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
CourseCode Course Title	**ME 465** **Automobile Chassis Engineering**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
ME-367 Automobile Engineering			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students to components of automotive chassis and their role and dynamics. Also introduce the recent technologies used in Automotive chassis for safety and efficient driving.			
OBJECTIVE			
1. Introduction to Automotive Chassis and its components. 2. Introduction to dynamics in each component, their linkage, involvement in total functioning of automobile. 3. Introduction to modern technologies used in Chassis, safety, efficiency driving. 4. Analyse the complete design exercise and arrive at important dimensions of chassis components.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	To address the underlying concepts and methods behind Automobile chassis and body engineering	1,12	C1, C2	1,3, 4			Q, F
CO2	Identify, formulate and solve engineering problems related to automobile drive line components	2,3	C2, C3, C4	3,4, 5			Q, ASG, F
CO3	Learn about the performances of various axles, suspensions and steering systems and to design the same.	3,4	C2, C3, C4	3,4	1		Q, ASG, F

CO4	Learn the importance of weight reduction and its consequence on vehicle performance.	3,7	C4, C5, C6, A3	4,5	1		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam

COURSE CONTENT

a. Main Contents:

1. Introduction to Chassis components
2. Vehicle aerodynamics,
3. Design of chassis with engineering concepts
4. Forces and stress analysis inside chassis components
5. Dynamics of chassis components and linkages

b. Detail Contents:

Introduction of chassis components and their relative positioning: engine, gearbox, drivetrain, differentials, front axle & steering linkage, real axle, bearings in axle and steering.

Vehicle Aerodynamics: Vehicle drag and types, various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, principle of wind tunnel technology, flow visualization techniques, tests with scale models.

Car Body Details: Types of car bodies, visibility, regulations, driver’s visibility, methods of improving visibility, safety design, constructional details of roof, under floor, bonnet, boot, wings etc., Classification of coach work.

Design of Vehicle Bodies: Vehicle body materials, use of composites, power to weight ratio, layout of the design, preliminary design, safety, Idealized structure- structural surface, symmetric and asymmetrical vertical loads in car, testing of body.

Force and stress: study of loads-moments and stresses on frame members, loads-moments and stresses at different sections of front axle, real axle, bearing loads, determination of optimum dimensions and proportions for steering linkages and associated forces, longitudinal loads on vehicle, symmetric and asymmetrical vertical loads in car.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To address the underlying concepts and methods behind Automobile chassis and body engineering	3											3
CO2	Identify, formulate and solve engineering problems related to automobile drive line components		3	2									
CO3	Learn about the performances of various axles, suspensions and steering systems and to design the same.			3	2								
CO4	Learn the importance of weight reduction and its consequence on vehicle performance.		3					3					

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Understand the fundamental knowledge applied in automotive manufacturing and the purposes it serves.
CO1-PO12	**3**	Students willgo through the recent design of chassis from different manufacturers and will be able to identify the reasonings behind their design.
CO2-PO2	**3**	Learn some basic problems and design parameters associated with each component.
CO2-PO3	**2**	Analyse similar possible linkages which can serve the same purpose and learn the most suitable design
CO3-PO3	**3**	Analyse the forces and stresses involved in the drive-train components and how they are supported with the structure.
CO3-PO4	**2**	Students can investigate recent technologies involved from different manufacturers and their relative performance upgrades.

CO4-PO3	**3**	Learn the design related to aerodynamics body and minimization of load using composites
CO4-PO7	**3**	Students will learn the importance of reduced usage of material for global mitigation of manufactured pollutants and recyclability of the chassis components.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Laboratory visits

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-8	Introduction of chassis components and their relative positioning	CT 01	
Class 9- 18	Vehicle Aerodynamics	CT 02	
Class 19-26	Car Body Details	MT	
Class 27-34	Design of Vehicle Bodies	CT 03	
Class 35-42	Force and stress		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
2	Assignment	**20**	
3	Assignment	**20**	
	Exam		
1	Final Exam, CT	**100**	
2	Final Exam, CT, Mid	**80**	

	3	Final Exam, CT, Mid	**80**		
	4	Final Exam, CT	**100**		

REFERENCE BOOKS

1. Automotive Engineering Powertrain, Chassis System and Vehicle Body (1st Edition) - David A. Crolla – Elsevier Publications

2. Automobile Chassis Design (2nd Edition) - R. Dean-Averns - Koteliansky Press

3. Automotive Mechanics (10th Edition) - William Crouse &Donald Anglin - Career Education

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

CourseCode Course Title	: **ME 467** : **Autotronics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

ME-367 Automobile Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Impart knowledge on Basic Electrical supply and safety. Learn the working of ignition system and the electrical components in the automotive. Acquire knowledge about the electronics applications in the automobile vehicle.

OBJECTIVE

- To learn the basics of electrical and Laws.
- To study about the electrical safety and importance of the earthing.
- To study the construction and principle of DC motor and its types.
- To understand about the generator, alternator, regulator and starting motor and mechanism.

- To study about the different ignition system.
- To study about the lead acid battery and testing.
- To learn about the lighting system and its components in the automobile vehicle.
- To study the horn, wins screen wiper, lights and audio systems.
- To study the electronic devices in the automotive.
- To study about the sensors and electronic control unit.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	To address the underlying concepts and methods Identify electronic components in automobiles.	1	C1, C2	1,3, 4			Q, F
CO2	Student will learn to Create a Logic circuit by logic gates and use Programmable logic control in automobiles.	1,2	C2, C3	3,4, 5	1		Q, ASG, F
CO3	Student will able to Select right type of transducer, sensor and actuator.	3,4	C2, C3	3,4			Q, ASG, F
CO4	Student will learn to Select microprocessor for application in automobiles	1,2	C4, C5	4,5	1		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. FundamentalsofAutomotiveElectronics

2. Sensors & Actuators,

3. ElectronicFuelInjection&IgnitionSystem

4. AutomotiveElectrical
5. DigitalEngineControlSystem
6. The system approach to control &instrumentation
7. Comfort&Safety

8. Electromagnetic Interference Suppression

b. Detail Contents:

Fundamentals of Automotive Electronics: Microprocessor and micro-Computer applications in automobiles; components for engine management System; electronic management of chassis system; vehicle motion control; electronic panel meters.

Sensors & Actuators: Introduction; Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel metering/vehicle s peed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, solenoids, stepper motors, relays.

Electronic Fuel Injection & Ignition System: Introduction; feedback carburettor system; throttle body injection and multi point fuel injection System; injection system controls; advantage of electronic ignition systems; types of solid-state system and their principle of operation; electronic spark timing.

Digital Engine Control System: Open loop and closed loop control system; engine cooling and warm-up control; acceleration, deceleration and idle speed control; integrated engine control system; exhaust emission control engineering; on-board diagnostics; future automotive electronic systems.

Automotive Electrical: Batteries; starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design; dashboard instruments; horn, warning system and safety devices.

Comfort & Safety: Seats, mirrors and sun roofs; central locking and electronic Windows; cruise control; in-car multimedia; security; airbag and belt tensioners; other safety and comfort systems; new developments.

The system approach to control &instrumentation: Fundamentals, electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation and telematics, new developments.

Electromagnetic Interference Suppression: Electromagnetic compatibility Electronic dash board instruments - Onboard diagnosis system. Security and warning system.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To address the underlying concepts and methods Identify electronic components in automobiles.	3											
CO2	Student will learn to Create a Logic circuit by logic gates and use Programmable logic control in automobiles.	3	3										
CO3	Student will able to Select right type of transducer, sensor and actuator.			3	3								
CO4	Student will learn to Select microprocessor for application in automobiles	3	3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Understand the fundamental knowledge applied in automotive electronics and the purposes it serves.
CO2-PO1	**3**	Understand the purpose of logic circuit and PLC in modern automobiles
CO2-PO2	**3**	Learn some basic problems and design parameters associated with each component by applying logic circuit.

CO3-PO3	**3**	Analyse the sensor, actuator and transducers function involved in modern automobile.
CO3-PO4	**2**	Students can investigate recent technologies involved from different manufacturers and their relative performance upgrades based on sensors and actuators they are using
CO4-PO1	**2**	Student will learn the importance of microprocessor in automobiles
CO4-PO2	**3**	Analyse the engineering knowledge of microprocessor in automobile electronics.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Laboratory visits

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-8	FundamentalsofAutomotiveElectronicsSensors & Actuators	CT 01	
Class 9- 18	ElectronicFuelInjection&IgnitionSystem	CT 02	
Class 19-26	AutomotiveElectrical, DigitalEngineControlSystem	MT	
Class 27-34	The system approach to control &instrumentation	CT 03	

Class 35-42	Comfort&SafetyElectromagnetic Interference Suppression		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
2	Assignment	**20**	
3	Assignment	**20**	
	Exam		
1	Final Exam, CT	**100**	
2	Final Exam, CT, Mid	**80**	
3	Final Exam, CT, Mid	**80**	
4	Final Exam, CT	**100**	

REFERENCE BOOKS

1. AutomotiveElectronicsHandbook,RonaldK.Jurgen,McGrawHillPublishingCo.,ISBN0 - 07-034453-1.
2. AutomotiveElectricityandElectronics,AlSantini,DelmarPublishers,NY,ISBN0-8273- 6743 -0.
3. AutomobileElectrical&ElectronicEquipment's,Young,Griffitns,Butt erworthPublication,London.
4. UnderstandingAutomotiveElectronics,Bechfold,SAE1998

Spring/Fall Semester L-4*, T-I/T-II*

COURSE INFORMATION			
Course Code Course Title	: **ME 469** : **Vehicle Dynamics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Vehicle Dynamics is one of core subjects in Mechanical Engineering in universities worldwide. Although road vehicles can be classified into various types based on different purposes, such as the single vehicle, sedan, passenger car, truck and special purpose vehicle, it is the rubber single tyre, single axle, four-wheel vehicle that defines the study object of this course. Based on this case, the traction and brake, ride and handling dynamics theory, as well as theory and design of vehicle control system are presented. Students thus learn about the fundamental theory of vehicle dynamics, vehicle performance as well as related tests and regulations. It is also an important goal to instruct them in the application of the dynamic modeling and analysis approach in vehicle design. The course of Automotive system dynamics can be treated as a core course for undergraduates majoring in vehicle engineering and for students majoring in mechanical engineering as a selected course.

OBJECTIVE
1. To familiarize students with the application of vehicle dynamics theory to practical engineering field. 2. To make students aquatinted with various types of vehicle dynamics models. 3. To familiarize students with the different vehicle tests. 4. Ability to relate chassis system characteristics to vehicle dynamic performance.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Apply vehicle dynamics theory to practical evaluation and measurement	1,2	C1, C2, C3	1,4,6			Q, ASG, F

CO2	Articulate various types of vehicle dynamics models	1,3	C2, C3	1,4			Q, ASG, F
CO3	Identify and utilize important vehicle tests commonly used in industry to evaluate ride, steering and handling performance	1,2	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	Relate chassis system characteristics to vehicle dynamic performance	1,2	C3, C4	4,6	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Review Rigid Body Dynamics
2. Tire Mechanics
3. Vehicle Handling
4. Case Study
5. Vehicle Ride
6. Suspension Characteristics

b. Detail Contents:

Review of Rigid Body Dynamics. Tire Mechanics: Overview, Terminology, Definitions, Slip, Skid, Rolling Resistance, Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined, longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula. Vehicle Handling: Ackerman Steering Geometry, Steady Handling (2 DOF steady-state model), Understeer and Oversteer, Effect of Tire Camber and Vehicle Roll (3 DOF steady-state model), Transient Handling and Directional Stability (2 DOF unsteady model), Effect of Vehicle Roll on Transient Handling (3 DOF unsteady model), Steady-State and

Transient Handling of Articulated Vehicles, Case Study 1: On-Center Steering of Passenger Vehicles. Vehicle Ride: Review of Vibration Principles, Human Perception of Vibration, Road Excitation and Vehicle Ride Models (low frequency), Suspension Characteristics: Ride versus Handling, Overview of Random Vibrations, Analysis of Vehicle Ride, Case Study 2: Influence of Seat Dynamics on Vehicle Ride, Case Study 3: Computer Simulation of Ride – Tracked Vehicles

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply vehicle dynamics theory to practical evaluation and measurement	3	2										
CO2	Articulate various types of vehicle dynamics models	3		2									
CO3	Identify and utilize important vehicle tests commonly used in industry to evaluate ride, steering and handling performance	2	2										
CO4	Relate chassis system characteristics to vehicle dynamic performance	2	1										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will be able to know about vehicle dynamics theory
CO1-PO2	2	Students will develop the ability to apply dynamics theory to practical evaluation and measurement.
CO2-PO1	3	Students will have the knowledge of various vehicle dynamics models
CO2-PO3	2	Students will be able to find solution by categorizing the problems into various vehicle dynamic models.
CO3-PO1	2	The students will attain the knowledge of various vehicle performance tests
CO3-PO2	2	Students will have an ability to use specific test for evaluating ride, steering and handling performance.
CO4-PO1	2	Students will learn about the chassis characteristics
CO4-PO2	1	They will be able to apply the knowledge of chassis characteristics to evaluate vehicle dynamic performance

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE			
Week	**Topic**	**CT**	**Remarks**

Class 1-12	Review of Rigid Body Dynamics. Tire Mechanics: Overview, Terminology, Definitions, Slip, Skid, Rolling Resistance, Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined, longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula.	CT 01	
Class 13-21	Vehicle Handling: Ackerman Steering Geometry, Steady Handling (2 DOF steady-state model), Understeer and Over-steer, Effect of Tire Camber and Vehicle Roll (3 DOF steady-state model), Transient Handling and Directional Stability (2 DOF unsteady model), Effect of Vehicle Roll on Transient Handling (3 DOF unsteady model), Steady-State and Transient Handling of Articulated Vehicles	CT 02	
Class 22- 30	Case Study 1: On-Center Steering of Passenger Vehicles. Vehicle Ride: Review of Vibration Principles, Human Perception of Vibration, Road Excitation and Vehicle Ride Models (low frequency), Suspension Characteristics: Ride versus Handling, Overview of Random Vibrations, Analysis of Vehicle Ride	MT	
Class 31- 36	Case Study 2: Influence of Seat Dynamics on Vehicle Ride	CT 03	
Class 37-42	Case Study 3: Computer Simulation of Ride – Tracked Vehicles		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	**20**	
2	CT	**30**	
3	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**70**	

	3	MID, Final Exam	**70**		
	4	Final Exam	**100**		

REFERENCE BOOKS

1. Pacejka, Hans. “Tire and vehicle dynamics”.Elsevier, 2005.

2. Wong, Jo Yung. “Theory of ground vehicles”.John Wiley & Sons, 2001.

3. Moore, Desmond F. “The friction of pneumatic tires.” (1975).

4. Jazar, Reza N. “Vehicle dynamics: theory and application”. Springer, 2008

5. Gillespie, Thomas D. “Fundamentals of vehicle dynamics”, 1992.

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

CourseCode Course Title	**ME 471** **Bio-Engineering**	Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Introduction to human musculoskeletal system; Biomechanics of human movement: applications of engineering mechanics to the movements of muscles, bones and skeletal joints; Material and structural characteristics of bones, ligaments, muscle/tendons and joints - alternative materials.

Introduction to biomechanical fluid mechanics; Engineering approach to the function of circulatory and respiratory systems involving fluid dynamics.

Introduction to biomedical instrumentation; Ultrasound, x-ray, laser, microwave and ultra-violet rays - physics and technology of generation – their use in diagnostic, therapeutic, and processing applications in medicine industry.

OBJECTIVE
1. To practice biomedical engineering to serve state and regional industries, hospitals, government agencies, or national and international industries. 2. To work professionally in one or more of the following areas: biomedical electronics, medical instrumentation, medical imaging, biomedical signal processing, rehabilitation engineering, neuro engineering, and biomaterials. 3. To achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments. 4. To maintain and improve their technical competence through lifelong learning, including entering and succeeding in an advanced degree program in a field such as engineering, science, business, or medicine.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Develop knowledge on human physiology, biology and neuroscience to solve the problems at the interface of engineering and biology.	2	C4	7			Q, ASG, F
CO2	Develop the ability to identify and apply appropriate engineering techniques to address the problems associated with the interaction between living and non-living materials and systems.	3	C5	1-4			Q, ASG, F
CO3	Interpret data from living systems to facilitate the understanding of the human body through theoretical models and experimental methods.	4	C4	8			Q, F

CO4	Evaluate alternate assumptions, approaches, procedures, trade-offs, and results related to engineering and biological problems.	4	C5	8			Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

c) Main Contents:

i.Bio-mechanics

ii.Materials for musculoskeletal system

iii.Biomechanical Fluid Mechanics

iv. Biomedical instrumentation

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Develop knowledge on human physiology, biology and neuroscience to solve the problems at the interface of engineering and biology.		3										
CO2	Develop the ability to identify and apply appropriate engineering techniques to Address the problems associated with the interaction between living and non-living materials and systems.			3									

CO3	Interpret data from living systems to facilitate the understanding of the human body through theoretical models and experimental methods.				3								
CO4	Evaluate alternate assumptions, approaches, procedures, trade-offs, and results related to engineering and biological problems.				3								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	**3**	**Student will able to develop knowledge on human physiology, biology and neuroscience to solve the problems at the interface of engineering and biology.**
CO2-PO3	**3**	**Student will able to develop the ability to identify and apply appropriate engineering techniques to address the problems associated with the interaction between living and non-living materials and systems.**
CO3-PO4	**3**	**Student will be able interpret data from living systems to facilitate the understanding of the human body through theoretical models and experimental methods.**
CO4-PO3	**2**	**Student will be able to validate alternate assumptions, approaches, procedures, trade-offs, and results related to engineering and biological problems.**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42

Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1 – 15	Bio-mechanics	CT-1	
Class 16 – 22	Materials for musculoskeletal system	CT-2	
Class 23 – 33	Biomechanical Fluid Mechanics	Mid Term	
Class 34 – 42	Biomedical instrumentation	CT-3	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS
1. Review of Medical Physiology – W. F. Ganong. 2. Introduction to Biomedical Equipment Technology – J. T Carr. 3. X-Ray Repair – J. J. Parichello. 4. Biomechanics of Mascalo - Skeletal System – B. M. Nigg.

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 473** **Plastic Process Technology**	Lecture ContactHours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This unit describes the skills and knowledge required to design and produce plastic products through the exploration and application of a range of advanced techniques. It is a specialization unit and refers to a specific design form.			
OBJECTIVE			
1. To identify properties and classifications of materials for processing implications such as flow and treatment. 2. To interpret process specifications of materials. 3. To communicate pertinent technical data electronically. 4. To discuss recent technical developments in plastics affecting molds, materials, and processes			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Develop in-depth understanding of specialist bodies of knowledge within the engineering discipline	1,2	C1, C2	2			Q, ASG, F
CO2	Apply engineering techniques, tools and resources	2,5	C4	2,5	1		Q, ASG, F
CO3	Analyze the application of this unit in the workplace in an individual product designer designing and producing a plastic product from a brief. The nature of the plastic product may vary greatly but the outcome would be a complete plastic product.	4,10	C2, C6	4,7	2		Q, F, CS
CO4	Use a wide range of tools, equipment and materials and the concepts developed would convey strong conceptual and theoretical development. This work would usually be carried out independently although guidance would be available if required	9,12	C3, C5, A5	5,6	1,2		Q, F, CS
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)							

COURSE CONTENT
a. Main Contents: 1. Introduction 2. Identification of common plastics 3. Mills 4. Processing of plastic materials 5. Reinforcement of plastics **b. Detail Contents:** Introduction; Properties; Testing of properties; Identification of common plastics; Flow behavior; Processing parameters; Degradation; Fillers; Additives; Mixing and compounding; Mills: internal and continuous; Processing of plastic materials: extrusion, injection moulding, thermoforming, below moulding, film blowing, compression moulding, and transfer moulding; Reinforcement of plastics; Calendering and laminating; Instrumentation and control.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Develop in-depth understanding of specialist bodies of knowledge within the engineering discipline	3	3										
CO2	Apply engineering techniques, tools and resources		2			3							
CO3	Analyze the application of this unit in the workplace in an individual product designer designing and producing a plastic product from a brief. The nature of the plastic product may vary				3						3		

	greatly but the outcome would be a complete plastic product.												
CO4	Use a wide range of tools, equipment and materials and the concepts developed would convey strong conceptual and theoretical development. This work would usually be carried out independently although guidance would be available if required									3			3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Describing different aspects and components of plastic process technology.**
CO1-PO2	**3**	**Students will be able to** develop in-depth understanding of specialist bodies of knowledge within the engineering discipline
CO2-PO2	**2**	**Students will be able to** apply engineering techniques
CO2-PO5	**3**	**Students will also have in depth knowledge about** tools and resources
CO3-PO4	**3**	**Students will attain the knowledge to** analyze the application of this unit in the workplace in an individual product designer designing and producing a plastic product from a brief.
CO3-PO10	**3**	**Students will be able to estimate** the nature of the plastic

		product may vary greatly but the outcome would be a complete plastic product.**.**
CO4-PO9	**3**	**Students will acquire knowledge to** use a wide range of tools, equipment and materials and the concepts developed would convey strong conceptual and theoretical development.
CO4-PO12	**3**	**Students will go through various** work which usually be carried out independently although guidance would be available if required.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT
1-4	Introduction; Properties; Testing of properties; Identification of common plastics; Flow behavior;	CT 01
5-7	Processing parameters; Degradation; Fillers; Additives; Mixing and compounding;	CT 02
8-9	Mills: internal and continuous; Processing of plastic materials: extrusion, injection moulding,	CT 03
10-12	Thermoforming, below moulding, film blowing, compression moulding, and transfer moulding;.	MT
13	Reinforcement of plastics; Calendering and laminating;	
14	Instrumentation and control	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**30**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**70**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. Principles of Polymer Engineering – N. G. McCrum, P. C. Buckley, C. B Bucknall.
2. Plastic Process Engineering – James L, Throne.

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 475** **Modern Manufacturing Technology**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE
ME-233

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The modern manufacturing technologies such as computer-integrated manufacturing (CIMs), CNC, high speed machining, rapid prototyping, reverse engineering, 3D printing and robotics and automation will be covered. Some industrial components will be used as the case studies.

OBJECTIVE

1. To provide students to choose the best casting and forming process for a specific product.
2. Evaluate the better way of manufacturing and construction of mechanical parts or products by means of various manufacturing processes and the corresponding manufacturing machines.
3. To analyse and evaluate the benefits of modern manufacturing processes and discuss their limitations

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand how to use the theoretical knowledge of various manufacturing processes when a specific	1,5	C1, C3	3			Q, ASG, F

	product has to be manufactured.						
CO2	Analyze, compare and finally gain theoretical experience for the advantages and limitations of different manufacturing processes.	2,4	C3	2,4	1		Q, ASG, F
CO3	Classify manufacturing processes according to the needs of products construction.	3,4	C5, C6	7	2		Q, F, CS
CO4	Design the production of a mechanical component or a specific product using the manufacturing processes of casting, bulk deformation, sheet-metal forming, materialremoval and Joining.	3,12	C5, C6	4,6	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. General Introduction
2. Casting processes
3. Bulk deformation processes.
4. Joining Processes
5. Sheet-metal forming processes

b. Detail Contents:

Design for Manufacture, The Design Process, Selecting Materials and Manufacturing Process, Product quality, Manufacturing automation, Economics of Manufacture .Solidification of Metals, Cast Structures, Casing Alloys, Ingot Casting and Continuous Casting, Casting Processes, Expendable Mold, Permanent Mold, Processing of Casting and Casting Design , Forging, Rolling, Cold and hot Extrusion Rod, Wire and Tube Drawing Die Manufacturing Methods, Die Failures, Sheet-Metal Characteristics, Shearing, Bending of Sheet and Plate, Stretch Forming, Bulging, Deep-Drawing, Formability of Sheet Metals, Oxyfuel Gas Welding, Thermit Welding, Consumable and Nonconsumable Electrode, Resistance Welding, SolidState Welding, Electron-Beam Welding Laser Beam Welding The welded Joint, Manufacturing Systems, Computer-Integrated-Manufacturing, Computer-Aided-Design, Group Technology, Cellular manufacturing, Flexible manufacturing systems, Just-in-time production.

CO-PO MAPPING

No.	Course Outco e	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand how to use the theoretical knowledge of various manufacturing processes when a specific product has to be manufactured.	3				3							
CO2	Analyze, compare and finally gain theoretical experience for the advantages and limitations of different manufacturing processes.		3		3								

CO3	Classify manufacturing processes according to the needs of products construction.			2	3								
CO4	Design the production of a mechanical component or a specific product using the manufacturing processes of casting, bulk deformation, sheet-metal forming, materialremoval and Joining.			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students should understand how to use the theoretical knowledge of various manufacturing processes.**
CO1-PO5	**3**	**Student will know when a specific product has to be manufactured.**
CO2-PO2	**3**	**Analyze, compare and finally gain theoretical experience for the advantages.**
CO2-PO4	**3**	**Students should understand the limitations of different manufacturing processes.**
CO3-PO3	**2**	**Students should learn to classify manufacturing**

		processes according to the needs of products construction
CO3-PO4	**3**	**Students will go through various handbook for design practice**
CO4-PO3	**3**	**Student will practice to Design the production of a mechanical component or a specific product using the manufacturing processes of casting.**
CO4-PO12	**3**	**Students will go through various handbook for design practice**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT
1-4	Design for Manufacture, The Design Process, Selecting Materials and Manufacturing Process, Product quality, Manufacturing automation, Economics of Manufacture	CT 01
5-7	Solidification of Metals, Cast Structures, Casing Alloys, Ingot Casting and Continuous Casting	
8-9	Die Manufacturing Methods, Die Failures, Sheet-Metal Characteristics	CT 02
10-12	Thermit Welding, Consumable and Non-consumable Electrode, Resistance Welding	MT
13	Electron-Beam Welding Laser Beam Welding The welded Joint	CT 03
14	Computer-Integrated-Manufacturing, Computer-Aided-Design, Group Technology, Cellular manufacturing	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class As ssment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS
1. Metal Cutting and High Speed Machining by D. Dudzinski, A. Molinari, H. Schulz, Plenum Pub Corp, 2002. 2. Buffa and Sarin – Modern Production / Operations Management, 8th ed., John Wiley & Sons (Asia) Pvt. Ltd 3. Russell & Taylor – Operations Management, Wiley India Pvt. Ltd. 4. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems by Mikell P. Groover, John Wiley & Sons, 2nd edition 2001.

Spring/Fall Semester, L-4,T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 477** **Metal Cutting Processes**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This unit of competency sets out the knowledge and skills required to undertake basic cutting operations under supervision. This involves setting up and cutting components by using lathes, milling machines, cut off saws, pedestal grinders and fixed position drilling machines. Marking out skills are also included as necessary in the cutting process.			
OBJECTIVE			
1.To undertake basic cutting operations under supervision. 2. To introduce the setup and cutting components by using lathes, milling machines, cut off saws, pedestal grinders and fixed position drilling machines. Marking out skills are also included as necessary in the cutting process.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Sequence operations, identifying and clarifying application requirements	1,2	C1, C3	1			Q, ASG, F
CO2	Identify specifications and required resources, reviewing and revising outcomes against task objectives and requirements	4,5	C3	2,5	1		Q, ASG, F
CO3	Interpret information and specifications categorizing manufacturing methods, developing enterprise procedures, calculations relating to engineering processes within the scope of this unit.	1,5	C5, C6	4,6	1		Q, F, CS
CO4	Access information sources using a variety of methods, applications, features and principles of engineering processes	11,12	C5, C6	5,6	1,2		Q, F, CS
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)							

COURSE CONTENT

a. Main Contents:

1. Introduction

2. Types of chip

3. Tool materials

4. Economics of metal cutting

5. Gear and thread

b. Detail Contents:

Theory of metal cutting: mechanism of chip formation, chip breaker, chip-tool contact process, types of chip. Tool materials, tool design and manufacturing.

Theoretical and experimental determination of cutting forces; Heat phenomenon; Cutting fluid, Tool wear and tool life; Economics of metal cutting. Gear and thread manufacturing processes.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Sequence operations, identifying and clarifying application requirements	3	3										
CO2	Identify specifications and required resources, reviewing and revising outcomes against task objectives and requirements				3	2							
CO3	Interpret information and specifications categorizing manufacturing methods, developing enterprise procedures, calculations relating to engineering processes within the scope of this unit.	3				3							
CO4	Access information sources using a variety of methods, applications, features and principles of engineering processes											3	3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Student will be able to describe different** application requirements.
CO1-PO2	**3**	**Students will be able to identify** sequence operations**.**
CO2-PO4	**3**	**Students will be able to** identify specifications and required resources.
CO2-PO5	**2**	**Students will also have in depth knowledge about** reviewing and revising outcomes against task objectives and requirements.
CO3-PO1	**3**	**Students will attain the knowledge to** interpret information and specifications categorizing manufacturing methods**.**
CO3-PO5	**3**	**Students will be able to** develop enterprise procedures, calculations relating to engineering processes within the scope of this unit**.**
CO4-PO11	**3**	**Students will acquire knowledge to** access information sources using a variety of methods and applications.
CO4-PO12	**3**	**Students will gain informative knowledge using** features and principles of engineering processes

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75

Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop uiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT
1-4	Theory of metal cutting: mechanism of chip formation, chip breaker, chip-tool contact process, types of chip.	CT 01
5-7	Tool materials, tool design and manufacturing	CT 02
8-9	Theoretical and experimental determination of cutting forces;	MT CT 03
10-12	Heat phenomenon; Cutting fluid, Tool wear and tool life	
13	Economics of metal cutting.	CT 04
14	Gear and thread manufacturing processes	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS
1. Application of Metal Cutting Theory – Fryderyk E. Gorczyca, Publisher – Industrial press, 1987. 2. Machine Tools – Chernov. 3. Machine Tools Design – N. Acharkhan. 4. Machine Tool Practices – Richard R. Kibbe, Roland O. Meyer, Warren T. White, John E. Neely. 5. Machine Tool operations – Steve F. Krar, Joseph V. St, Amand, J. William Oswald.

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	: **ME 479** :**Occupational Health and Safety Engineering**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Application of human factors (ergonomics) and engineering practice in accident prevention and the reduction of health hazards in the occupational environment are presented. Special attention is devoted to the detection and correction of hazards and to contemporary laws and enforcement on occupational safety and health.			
OBJECTIVE			
To provide an understanding of the safety and health practices which fall within the responsibilities of the engineer in the occupational environment.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the basic safety and health practices in the occupational environment	11	C3	6			Q, ASG, F
CO2	Application of human factors and engineering practice in accident prevention and reduction of health hazard	11	C3, C5	6			Q, ASG, F
CO3	Investigation on the detection and correction of hazards	11	C3, C5	6			Q, F
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)							

COURSE CONTENT

Sustainability & Human-Cantered Design; Product Safety & Liability; Hazard Assessment, Prevention & Control; Safety-First Corporate Culture; Ethical Behaviour in Organizations & Company's Role; Best Practices in Safety Management; Accidents & Their Effects; Injuries & Workers' Compensation; Theories of Accident Causation; Integrated Approaches to Safety & Health; Personal Monitoring for Radiation Hazards; Noise & Vibration Hazards; Fall Protection Standards; Safety Training & A Teamwork Approach to Promoting Safety; Historical Perspectives & Community Right-to-Know Act; Risk Reduction Strategies; Human Factors & Ergonomic Hazards; Economics of Ergonomics; Industrial Hygiene & Confined Spaces; Green Chemistry & the EPA; Quality Management and Safety; OSHA Policies & European REACH Regulations for Toxic

Chemicals; Comparing ISO Processes & Standards on Environment, Risk Management, Energy Management, Quality & Ergonomics.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the basic safety and health practices in the occupational environment											3	
CO2	Application of human factors and engineering practice in accident prevention and reduction of health hazard											3	
CO3	Investigation on the detection and correction of hazards											3	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO11	**3**	**Project management skills will be achieved**
CO2-PO11	**3**	**Project management skills will be achieved**
CO3-PO11	**3**	**Project management skills will be achieved**

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75

Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	**Topic**	**CT**	**Remarks**
Class 1 – 9	Sustainability & Human-Cantered Design; Product Safety & Liability; Hazard Assessment, Prevention & Control; Safety-First Corporate Culture; Ethical Behaviour in Organizations & Company's Role	CT 1	
Class 10 – 18	Best Practices in Safety Management; Accidents & Their Effects; Injuries & Workers' Compensation; Theories of Accident Causation; Integrated Approaches to Safety & Health;	CT 2	
Class 19 – 27	Personal Monitoring for Radiation Hazards; Noise & Vibration Hazards; Fall Protection Standards; Safety Training & A Teamwork Approach to Promoting Safety;	MID	
Class 28 – 33	Historical Perspectives & Community Right-to-Know Act; Risk Reduction Strategies; Human Factors & Ergonomic Hazards; Economics of Ergonomics;	CT 3	
Class 34 – 42	Industrial Hygiene & Confined Spaces; Green Chemistry & the EPA; Quality Management and Safety; OSHA Policies & European REACH Regulations for Toxic Chemicals; Comparing ISO Processes & Standards on Environment, Risk Management, Energy Management, Quality & Ergonomics.	CT 4	

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	Assignment	**20**	

2	Assignment	**20**		
	Exam			
1	Final Exam, CT	**80**		
2	Final Exam, CT, MID	**80**		
3	Final Exam, CT	**80**		
4	Final Exam, CT, Mid	**80**		

REFERENCE BOOKS

1.D.L. Goetsch, 2019. Occupational Safety and Health, 9th Ed., Prentice-Hall

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code	: **ME 483**	Lecture Contact Hours	: **3.00**
Course Title	: **Standard and Inspection**	Credit Hours	: **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students with various types of international standard organizations and standards followed all over the world and various types of inspection procedure adopted for inspecting various fields of mechanical engineering discipline

OBJECTIVE

1. Introduce the student with various standards used all over the world
2. To give an idea about developing a standard
3. To give an idea about various types of inspections happens in industry
4. To provide elementary idea of inspecting and preparing necessary document

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge on international standard organizations and standards	1, 12	C1, C3	4			Q, ASG, F
CO2	Demonstrate knowledge to develop new standards and selection of a standard for specific purpose	6, 7	C3, C4	7			Q, ASG, F
CO3	Demonstrate knowledge of various inspection technique	1	C5, C6	4			Q, F, CS
CO4	Design of inspection procedure	6,12	C5, C6	6,7	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. International standard organizations
2. Selection of standard
3. Various types of inspections
4. Preparing for inspection

b. Detail Contents:

History of standards; Various international standards, Introduction to ASME, SAE, ANSI, ISO, ASTM standards; Role of standard organizations, Process of developing international standards, How to use various international standards, Inspection and its necessity, Inspection in automotive industry, Fire safety inspection, Building inspection, system component inspection, power plant inspection, Preparation of inspection procedure and documents.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on international standard organizations and standards	3											2
CO2	Demonstrate knowledge to develop new standards and selection of a standard for specific purpose						3	3					
CO3	Demonstrate knowledge of various inspection technique	3											
CO4	Design of inspection procedure						3						3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will gain knowledge on engineering practice in the discipline regarding various standards
CO1-PO12	2	Students will have a life-long learning regarding various standards used in the field and go through in depth literature review about those standards

CO2-PO6	3	Students will learn to select standards for specific task considering societal, economic, cultural etc. considerations
CO2-PO7	3	Students will learn to select standards for a specific task considering ethical and social considerations
CO3-PO1	3	Students will gain knowledge on engineering practice in the discipline regarding inspection procedures
CO4-PO6	3	Students will learn to select/design inspection procedure for specific task considering societal, economic, cultural etc. considerations
CO4-PO12	**3**	**Student will be able to design and compare inspection technique while doing complex literature survey**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT
Class 1-9	History of standards organizations, Various international standards	CT 01
Class 10-15	Role of standard organizations, Process of developing international standards	
Class 16- 25	How to use various international standards	CT 02
Class 26- 36	Inspection and its necessity, Inspection in automotive industry, Fire safety inspection, Building inspection, system component inspection, power plant inspection	MT & CT 03
Class 36-42	Preparation of inspection procedure and documents	CT 04

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. ASME, ANSI, SAE handbook and various manuals

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	: **ME 485** : **Introduction to Nuclear Engineering**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
World energy resources; Importance of fission energy; Atomic structure; Nuclear energy and nuclear forces; Nuclear fission and fusion processes; Nuclear fission reactors; Reactors controls; Reactor coolants; Process waste disposal and safety; Nuclear power reactor systems; Safety, Safeguard, and Security of Nuclear power plant; Introduction to nuclear medicine.			

OBJECTIVE

1. To introduce nuclear science and its engineering applications.
2. To describe basic nuclear models, radioactivity, nuclear reactions and kinematics; covers the interaction of ionizing radiation with matter, with an emphasis on radiation detection, radiation shielding, and radiation effects on human health.
3. To present energy systems based on fission and fusion nuclear reactions, as well as industrial and medical applications of nuclear science.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Apply nuclear engineering techniques, tools and resources by developing	1	C3	7			Q, ASG, F

	fluency in basic nuclear physics.						
CO2	Develop knowledge of contextual factors impacting the engineering discipline and learn about seminal radiation experiments and hypothesis.	2	C2	1-4			Q, ASG, F
CO3	Describe the origins, interactions, uses, detection and biological/chemical effects of ionizing radiations to explore systems and reactors that use radiation.	2	C2	8			Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

d) Main Contents:

I. Sources of energy, Fission energy; Atomic structure;

II. Nuclear fission and fusion processes; Nuclear fission reactors;

III. Reactors controls, Reactor coolants; Nuclear power reactor systems;

IV. Process waste disposal and safety;

V. Safety, Safeguard, and Security of Nuclear power plant.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	Apply nuclear engineering techniques, tools and resources by developing fluency in basic nuclear physics.	3											
CO2	Develop knowledge of contextual factors impacting the engineering discipline and learn about seminal radiation experiments and hypothesis.		3										
CO3	Describe the origins, interactions, uses, detection and biological/chemical effects of ionizing radiations to explore systems and reactors that use radiation.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will be able to apply nuclear engineering techniques, tools and resources by developing fluency in basic nuclear physics.
CO2-PO2	3	Students will be able to develop knowledge of contextual factors impacting the engineering discipline and learn about seminal radiation experiments and hypothesis.
CO3-PO2	3	Students will be able to describe the origins, interactions, uses, detection and biological/chemical effects of ionizing radiations to explore systems and reactors that use radiation.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE			
Week	**Topic**	**CT**	**Remarks**
Class 1 – 9	Sources of energy, Fission energy; Atomic structure;	CT 1	
Class 10 – 19	Nuclear fission and fusion processes; Nuclear fission reactors;	CT 2	
Class 20 – 30	Reactors controls, Reactor coolants; Nuclear power reactor systems;	MID	
Class 31 – 36	Process waste disposal and safety;	CT 3	
Class 36 – 42	Safety, Safeguard, and Security of Nuclear power plant.	CT 4	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1) Introduction to Nuclear Engineering Paperback – 2014-John R. &Baratta Anthony J. Lamarsh

2) Fundamentals of Nuclear Science and Engineering 1st Edition-J. Kenneth Shultis, Richard E. Faw

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 487** **Tools Engineering**	LectureContact Hours Credit Hours	3.00 3.00

PRE-REQUISITE

ME 233 – Manufacturing Technology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

After successfully completing the course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Industrial Tool Manufacturing so that he/she is properly equipped to take up gainful employment.

OBJECTIVE

1. Introduce the student to processes and equipment utilized in the manufacturing

environment.

2. Compare and contrast different tool material types and their application.

3. Introduce the concepts of tool monitoring and control processes.

4. Explain different forms of production logistics in a tool making process.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Explain working of grinding, super finishing, gear cutting, broaching, threading, non-conventional and advance machining methods with kinematics and coolant/ lubrication systems stating functions of each element.	1,5	C1, C2				Q, F
CO2	Analyse, compare and finally gain theoretical experience for the advantages and limitations of different machine tools.	1,4	C1, C3				Q,F
CO3	Reduce vibration and chatter developing on machine tools.	2,3	C2, C3, C4			3,4,5	Q, ASG, F
CO4	Design the production of a mechanical component or a specific product by Apply various design aspects of spindles and bearings.	3,4	C2, C3, C4			3,4	Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

General classification of machine tools, working and auxiliary motions, Hydraulics transmission and its elements, Mechanical transmission and its elements, General requirement of machine tools. Stepped and step less drive, Basic considerations in the design ofdrives, Variable speed range in machine tools, Graphical representation of speed, structure diagram,selection of optimum ray diagram, Design of speed and feed gear boxes, step-less regulation ofspeed and feed rates.Design criteria, materials, static and dynamic stiffness, Basic dynamic stiffness, Basic design procedure, design of beds and columns, Model technique in design of machine tool structures.Classification of guideways, material and Lubrication, design criteria and calculations for guideways, designs of guides under hydrostatic lubrication, Aerostatic slideways, Antifriction guideways, Combination guideways, classification of power screws, Design principles ofpower screws, Recirculating power screws assemblies, Elimination of backlash.: Materials of spindles, Effect of machine tool compliance on machining accuracy.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain working of grinding, super finishing, gear cutting, broaching, threading, non-conventional and advance machining methods with kinematics and coolant/ lubrication systems stating functions of each element.					3							
CO2	Analyse, compare and finally gain theoretical experience for the advantages and limitations of different machine tools.	3			2								
CO3	Reduce vibration and chatter developing on machine tools.		2	3									
CO4	Design the production of a mechanical component or a specific product by Apply various design aspects of spindles and bearings.			3	2								

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**2**	Understand the fundamental knowledge applied in tool manufacturing and the purposes it serves.
CO1-PO5	**3**	Students will apply appropriate techniques, resources, and modern engineering of machining to improve productivity of industry.
CO2-PO1	**3**	Understand the knowledge applied in manufacturing and the purposes it serves.
CO2-PO4	**2**	Students can investigate recent technologies involved from

		different manufacturers and their relative performance upgrades.
CO3-PO2	**2**	Learn some basic problems and design parameters associated with each component.
CO3-PO4	**3**	Students can investigate recent technologies involved from different manufacturers and their relative performance upgrades.
CO4-PO3	**3**	Analyse similar possible linkages which can serve the same purpose and learn the most suitable design
CO4-PO4	**4**	Students can investigate recent technologies involved from different manufacturers and their relative performance upgrades.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	122.5

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	General classification of machine tools, working and auxiliary motions
Week-2	Hydraulics transmission and its elements, Mechanical transmission and its elements
Week-3	General requirement of machine tools. Stepped and step less drive
Week-4	Basic considerations in the design of drives, Variable speed range in machine tools
Week-5	Graphical representation of speed, structure diagram
Week-6	selection of optimum ray diagram
Week-7	Design of speed and feed gear boxes
Week-8	step-less regulation of speed and feed rates. Design criteria, materials
Week-9	static and dynamic stiffness, Basic dynamic stiffness
Week-10	Basic design procedure, design of beds and columns, Model technique in design of machine tool structures
Week-11	Classification of guideways, material and Lubrication, design criteria and calculations for guideways
Week-12	designs of guides under hydrostatic lubrication, Aerostatic slideways, Antifriction guideways, Combination guideways

Week-13	Reviews
Week-14	Quiz

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	CT	**30**	
CO2	Mid	**45**	
CO3	CT	**20**	
CO4	CT	**20**	
	Exam		
CO1	Final	**70**	
CO2	Final	**55**	
CO3	Final	**80**	
CO4	Final	**80**	

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1.Computer-Aided Design and Manufacture – Prepared by Khoi Hoang for UNSW -

MacGraw-Hill Custom Publishing 2. Principles of CAD - Medland, A. J
3. “Computer Integrated Design and Manufacturing” - David Bedworth and Philip Wolfe
4. CAD/CAM: Principles and Applications - J. Srinivas 5. “Computer Aided Manufacturing” - P N Rao

REFERENCE SITE

None

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 489** **Automobile Maintenance Engineering**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE
ME-367 Introduction to Automobile Engineering
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To introduce the students to the importance of maintenance in Automobile and similar machines and how to perform them.
OBJECTIVE
1. To study the various maintenance for reconditioning of vehicle parts . 2. To train the structures in identifying the fault and rectification. 3. To impart the fundamental knowledge in evaluation and maintenance. 4. To know about the various methods of maintaining vehicles and their subsystems.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Learn the important of Maintenance in Engineering application	1,3	C1, C2, A3	1,2,3,4			Q, F
CO2	Understand the importance of Engine Maintenance	2,3	C2, C3, C4	3,4,5			Q, CS, F
CO3	Analyse all subsystem of automobile that requires maintenance	2,3	C2, C3, C4	3,4,5			Q, ASG, CS, F

CO4	Implement maintenance knowledge in real life to properly maintain automobile	1,3	C3, C4, C5, C6	4,5,6			Q, Pr, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Maintenance of records and schedules
2. Engine maintenance – repair and overhauling
3. Chassis maintenance - repair and overhauling
4. Electrical system maintenance - servicing and repairs
5. Maintenance of subsystems and vehicle body

b. Detail Contents:

Maintenance of Records and Schedules:Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance ofrecords, log sheets and other forms, safety precautions in maintenance.

Engine Maintenance – Repair and Overhauling:Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.

Chassis Maintenance - Repair and Overhauling:Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

Electrical System Maintenance - Servicing and Repairs:Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dashboard instruments.

Maintenance of Fuel System, Cooling Systems, Lubrication System and Vehicle Body:Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Learn the important of Maintenance in Engineering application	3		3									
CO2	Understand the importance of Engine Maintenance		3	3									
CO3	Analyse all subsystem of automobile that requires maintenance		3	3									
CO4	Implement maintenance knowledge in real life to properly maintain automobile	3		3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Understand the fundamental knowledge maintenance and its application.**
CO1-PO3	**3**	**Apply maintenance theory to solve the ideal time for maintenance, inspection and repairing in automobile.**
CO2-PO2	**3**	**Identify engine components which need maintenance and how their application creates constant degradation.**
CO2-PO3	**3**	**Apply knowledge of maintenance to engine components for their proper functioning and solve issue regarding**

		improper maintenance of engine.
CO3-PO2	**3**	**Identify automobile subsystems and components which need maintenance and how they constantly degrade over time.**
CO3-PO3	**3**	**Apply knowledge of maintenance to subsystems for their proper functioning as a whole system and solve issue regarding improper maintenance.**
CO4-PO1	**3**	**Students able to understand fundamentals and importance of maintenance in all engineering systems.**
CO4-PO3	**3**	**Students will come up with maintenance schedule for any system they able to work with and possible components that will require maintenance.**

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Laboratory visits, Assignments, Presentation

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-7	Maintenance of records and schedules	CT 01	
Class 8- 16	Engine maintenance – repair and overhauling	CT 02	
Class 17-24	Chassis maintenance - repair and overhauling	MT	
Class 25-33	Electrical system maintenance - servicing		

	and repairs		
Class 34-42	Maintenance of subsystems and vehicle body	CT 03	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
3	Assignment	**20**	
4	Presentation	**20**	
	Exam		
1	Final Exam, CT, Mid	**100**	
2	Final Exam, CT, Mid	**100**	
3	Final Exam, CT	**80**	
4	Final Exam, CT	**80**	

REFERENCE BOOKS

1. Jon Doke "Fleet Management", McGraw-Hill Co. 1984.
2. James D Halderman - Advanced Engine Performance Diagnosis – PHI - 1998.
3. Service Manuals from Different Vehicle Manufacturers

Spring/Fall Semester L-4, T-I or II

COURSE INFORMATION

Course Code Course Title	**ME 491** **MEMS Devices- Design and Fabrication**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

An overview of micro-electromechanical devices and technologies, and an introduction to design and modelling
Standard microelectronic fabrication technologies; bulk micromachining, surface micromachining, bonding
technologies, related fabrication methods, and creating process flows.

OBJECTIVE
1.Familiar with the fundamentals, fabrication process and applications of MEMS. 2.Understand the basic principles of MEMS sensors and actuators (mechanical, electrical,piezoresistive, piezoelectric, thermal, microfluidic). 3.Understand the design considerations of basic MEMS sensors and actuators. 4.Design a basic MEMS sensor and actuator device, such as an inertia sensor, and a pressure sensor

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	To introduce the fundamental concept of MEMS & Microsystem and their relevance to current industry/scientific needs	1,2	C1, C3	3			Q, ASG, F
CO2	Applying basic sensing principles of chem./bio systems to develop novel sensors	2,3	C1	2,4	1		Q, ASG, F
CO3	To discuss the limitations and challenges in the design and fabrication of micro sensors, sensing modalities to build the desired microsystem	1,3	C1, C2	4	1,2		Q, F, CS
CO4	To introduce students to writing and evaluating research proposals enabling them to apply general micromachining principles to build novel devices.	3,4	C3, C4	2	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Introduction to design and modelling
2. Standard microelectronic fabrication technologies
3. Introduction to lumped modelling of systems and transducers
4. An overview of system dynamics MEMS examples
5. Modelling dissipative processes, Fluids and Transport.

b. Detail Contents:

Introduction to design and modelling Standard microelectronic fabrication technologies; bulk micromachining, surface micromachining, bonding technologies, related fabrication methods, and creating process flows.

Mechanical, thermal, electrical, magnetic, optical, and chemical properties of materials Introduction to lumped modelling of systems and transducers; an overview of system dynamics MEMS examples, energy methods, the thermal energy domain; modelling dissipative processes, Fluids and Transport.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To introduce the fundamental concept of MEMS & Microsystem and their relevance to current industry/scientific needs	3	2										

CO2	Applying basic sensing principles of chem./bio systems to develop novel sensors		3		2								
CO3	To discuss the limitations and challenges in the design and fabrication of micro sensors, sensing modalities to build the desired microsystem	2	3										
CO4	To introduce students to writing and evaluating research proposals enabling them to apply general micromachining principles to build novel devices.			3	2								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Student will practice design related problems
CO1-PO2	2	Application of equation will enable the students to analyse problems arise in various engineering problems
CO2-PO2	3	Student will practice design related problems
CO2-PO3	2	Application of equation will enable the students to analyse problems arise in various engineering problems

CO3-PO1	2	Application of equation will enable the students to analyse problems arise in various engineering problems
CO3-PO2	3	Student will practice design related problems
CO4-PO3	3	Student will practice design related problems
CO4-PO4	2	Application of equation will enable the students to analyse problems arise in various engineering problems

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-9	Introduction to design and modelling Standard microelectronic fabrication technologies;	CT 01	
Class 10-15	bulk micromachining, surface micromachining, bonding technologies		
Class 16- 25	related fabrication methods, and creating process flows.	CT 02	
Class 26- 29	Mechanical, thermal, electrical, magnetic, optical, and chemical properties of materials		
Class 30-34	Introduction to lumped modelling of systems and transducers;	MT	
Class 35-36	an overview of system dynamics MEMS examples, energy methods	CT 03	
Class 37-42	the thermal energy domain; modeling dissipative processes, Fluids and Transport	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. Tai – Ran Hsu, “MEMS& Microsystems Design and Manufacturing”, Tata McGrawhill Edition, 2006\Mohamed Gad-el-Hak,

2. "MEMS: Design and Fabrication (Mechanical Engineering)", CRC; 1 edition,2005Marc J. Madou

3."Fundamentals of Microfabrication, the science of Miniaturization", CRC Press SecondEdition, 2002.

4.Sami Franssila, "Introduction to Microfabrication", John Wiley; 1 edition, 2004

5.John A. Pelesko, David H. Bernstein, "Modeling MEMS and NEMS", CRC; 1 edition, 2002

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code	**ME 493**	Lecture Contact Hours	3.00
Course Title	**Material Handling**	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Importance and scope of material handling; Classification of materials - unit load and bulk loads; Analysis of material handling problems - system concept, selection and classification of conveying equipment; Efficiency of material handling systems; General theory of conveyors; Computer controlled material handling (AGV, ASRS etc); Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors; Operation and selection of industrial truck loads. Packaging: packaging materials, layout for packaging; Testing procedure of packages - vibration test, drop test; Performance limit; Testing machines. Storage and warehousing, Sorting, Automated warehousing .			
OBJECTIVE			
1. Understand and be able to complete the following charts with regard to a specific. 2. Product, assembly chart, route sheet, operations process chart, from-to chart, and activity relationship chart. 3. Identify equipment requirements for a specific process. 4. Understand the benefit of an efficient material handling system.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Learn fundamental principles of material handling systems.	1	C1				CP,CA
CO2	Develop understanding of special concepts in material handling.	3	C3,C4				KP,CP
CO3	Learn analytical procedures for the study of different material handling equipment	1	C1,C2				CT,KP
CO4	Learn fundamental principles of packaging.	6	C4,C6				KP

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R – Report; F – Final Exam)

COURSE CONTENT

Importance and scope of material handling; Classification of materials - unit load and bulk loads; Analysis of material handling problems - system concept, selection and classification of conveying equipment; Efficiency of material handling systems; General theory of conveyors; Computer controlled material handling (AGV, ASRS etc); Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors; Operation and selection of industrial truck loads. Packaging: packaging materials, layout for packaging; Testing procedure of packages - vibration test, drop test; Performance limit; Testing machines. Storage and warehousing, Sorting, Automated warehousing

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Learn fundamental principles of material handling systems.	3											
CO2	Develop understanding of special concepts in material handling.			3									
CO3	Learn analytical procedures for the study of different material handling equipment	3											
CO4	Learn fundamental principles of packaging.						3						

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Developing integral form of Material handling system will provide knowledge from physics and mathematics
CO2-PO3	**3**	Application of the system structure will enable the students to analyse problems arise in various engineering problems
CO3-PO1	**3**	Students will have the knowledge of basic research and development principles regarding the topics
CO4-PO6	**3**	Application of theories and their industrial approach

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Importance and scope of material handling; Classification of materials - unit load and bulk loads;
Week-2	Analysis of material handling problems - system concept, selection and classification of conveying equipment;
Week-3	Efficiency of material handling systems;
Week-4	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;
Week-5	Operation and selection of industrial truck loads.
Week-6	Testing procedure of packages - vibration test, drop test;
Week-7	Performance limit; T
Week-8	Testing machines.
Week-9	Storage and warehousing, Sorting,
Week-10	General theory of conveyors;
Week-11	Computer controlled material handling (AGV, ASRS etc);
Week-12	Automated warehousing.
Week-13	Packaging: packaging materials, layout for packaging;
Week-14	Overview

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, MID	**100**	

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Material Handling Systems Design – J. M. Apple.
2. MATERIAL HANDLING,Raymond A. Kulwiec, (1985), John Wiley, New Jersey.
3. FUNDAMENTALS OF PACKAGING TECHNOLOGY, KlalterSoroka, Richard Warrington, (1995)

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 495** **Mechatronics**	Lecture Contact Hours Credit Hours	**3.00** **3.00**
PRE-REQUISITE			
ME 321 - Fluid Mechanics I **ME 361 - Instrumentation and Measurement**			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students with the application of Mechatronics system introduction, Input sensors &Control, Electrical actuating systems, Hydraulic system			
OBJECTIVE			
1. Understand key elements of Mechatronics system, representation into block diagram 2. Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller 3. Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application 4. To know about electrical actuation system			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Advanced knowledge of a broad range of modelling methodologies, and underlying Mechanical science, commonly used in the development and analysis of mechatronic engineering systems.	1,2	C1,C3	3			Q,T
CO2	Knowledge of fundamental design issues relevant to mechatronic engineering, and an understanding of how to formulate and analyse design solutions in various engineering contexts relevant to sensors and input methods for the control system	1	C3,C5	2,3,4			Q,CA, KP
CO3	Knowledge of basic research and development principles and practices relevant to mainstream engineering industry related with electrical actuator and their functionality in case of practical approach.	1,6	C5,C6	3,4,7			T,PR, ASG

CO4	Apply systems engineering perspective in designing mechatronic systems Investigate further evolvement of mechatronics in new directions with the advancement of constituent technologies	1,12	C5,C6	3,4			Q,Pr,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and Design. Comparison between Traditional and Mechatronics approach.

Input sensors & Controller: Review of fundamentals of electronics. Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs.

Electrical actuating systems: solid-state switches, solenoids valves, solenoid actuator, voice coil; DC motor control, AC motor control, motor controller, power supply. Single phase motor; 3-phase motor; induction motor; synchronous motor; stepper motors, piezoelectric actuator and sensor (characterization, operation, and fabrication).

Hydraulic systems: Intrinsic circuit its application and necessity, Flow control, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, hydraulic pumps, hydraulic motor, understanding of hydraulic circuits. Pneumatic System: Engineered air production, distribution and conditioning of compressed air, system components and graphic representations, Pneumatic actuators and valves, connectors.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Advanced knowledge of a broad range of modelling methodologies, and underlying Mechanical science, commonly used in the development and analysis of mechatronic engineering systems.	3	3										
CO2	Knowledge of fundamental design issues relevant to mechatronic engineering, and an	3											

	understanding of how to formulate and analyse design solutions in various engineering contexts relevant to sensors and input methods for the control system												
CO3	Knowledge of basic research and development principles and practices relevant to mainstream engineering industry related with electrical actuator and their functionality in case of practical approach.	2					3						
CO4	Apply systems engineering perspective in designing mechatronic systems Investigate further evolvement of mechatronics in new directions with the advancement of constituent technologies	3											3

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Developing integral form of Mechatronics system will provide knowledge from physics and mathematics to build up engineering fundamental equations & applications.
CO1-PO2	**3**	Application of the system structure will enable the students to analyse problems arise in various engineering problems
CO2-PO1	**3**	Students will have the knowledge on various types of mechatronics system
CO3-PO1	**3**	Students will have the knowledge of basic research and development principles and practices relevant to mainstream engineering industry
CO3-PO6	**3**	Students will learn various codes and practices used in actuators
CO4-PO1	**3**	Will learn to apply systems engineering perspective in designing mechatronic control system
CO4-PO12	**3**	Application of controller and their industrial approach in case of use

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	

	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week	Topics	
1-2	Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach, Block diagram, System model and history, Practical example and traditional use of mechatronics	CT-1
3-4	Review of fundamentals of electronics. Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers.	
5-6	Electrical actuating systems: solid-state switches, solenoids, voice coil; electric motors; DC motors, AC motors, Single phase motor; 3-phase motor; induction motor	CT-2
7-8	Synchronous motor; stepper motors. Piezoelectric actuator: characterization, operation, and fabrication	
9-10	Definition of servo motor ,difference between servo and stepper motor, classification, construction ,control drive or servo drive ,applications	
11-12	Pressure and direction control valves, actuators, and supporting elements, hydraulic power packs and pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. And integrating with controller.	CT-3
13-14	Overall projection of industrial automation, controller ,PLC ,SCADA,DC	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	

		Exam			
	1	Final Exam, CT	**80**		
	2	Final Exam, CT, MID	**80**		
	3	Final Exam, CT	**100**		
	4	Final Exam, CT, Mid	**100**		

REFERENCE BOOKS

1. Mechatronis, Eelectronics Control System in Mechanical And Electrical Engineering – W. Botton, Publisher – Pearson Education.

2. Mechatronics – D Necsulescu.

3. Mechatronics – N. P. Mahalik.

4. The Mechatronics Hand Book-Mechatronic Systems, Sensors And Actuators—Robert H. Bishop

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 497** **Textile Technology**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Textile Technology plays a vital role in the development of the diverse economy of Bangladesh. The syllabus will enable learners to develop skills related to self-reliance, enterprising and sustainability in textile related aspects of the economy. It promotes an understanding of cultural diversity, moral and cultural values throughout human history. The needs of a society are therefore satisfied.

OBJECTIVE
1. To understand the importance of textiles **2.** To know the basic principles of fibres and fabrics **3.** Learning to use manufacturing equipments and construction techniques to construct an artefact following health and safety procedures.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand fibre forming polymer , essential and desirable properties of textile fibres and classification of textile fibres.	1	C1, C2	3			Q, ASG, F
CO2	Describe the manufacturing process of different man-made fibres.	2,5	C3	1,2	1		Q, ASG, F
CO3	Enunciate physical and chemical properties of natural and manmade fibres and their uses.	1,4	C5, C6	4	1		Q, F, CS
CO4	Demonstrate the identification of different natural and man-made fibres.	3,12	C4, C6	5,6	1,2		Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Introduction
2. Yarn Manufacturing
3. Fabric Manufacturing
4. Garments Manufacturing

b. Detail Contents:

Introduction: Different terms and definition of textiles, Textile sector in Bangladesh, Textile Fibers& mention it‘s important properties, feature of textile fibre, Ginning, Lint & linters, Mixing and Blending . Yarn Manufacturing: Flow chart of different spinning processes (carded, combed, rotor), different terms related to cotton and jute spinning, Flow-chart for modern blow room line, Basic idea on cotton and Jute spinning machineries and their function, Batch & Batching, Emulsion & emulsion making process. Fabric Manufacturing: Different basic terms of weaving process, preparatory of weaving and its functional effects. Flow chart of weaving process, Basic operation of weaving. Classification of looms, motions of loom, difference between weaving and knitting, Definition and Flow process of knitting, Types of knitting machine, non-woven fabric formation. Garments Manufacturing: Chronological development of garments industry in the world. Nomenclature of different types of garments, Flow-chart of sample garment making. Flow-chart of garments manufacturing process, Types of pattern, objectives of pattern making. Objectives of pattern grading, marker making, spreading, cutting, sewing, and garments finishing. Marker efficiency and fundamental of Trimmings.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand fibre forming polymer , essential and desirable properties of textile fibres and classification of textile fibres.	3											

CO2	Describe the manufacturing process of different man-made fibres.		3			3							
CO3	Enunciate physical and chemical properties of natural and manmade fibres and their uses.	3			2								
CO4	Demonstrate the identification of different natural and man-made fibres.			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students should understand fibre forming polymer, essential and desirable properties of textile fibres and classification of textile fibres.
CO2-PO2	**3**	Students should know about the manufacturing process
CO2-PO5	**3**	Student will have the knowledge of different man-made fibres.
CO3-PO1	**3**	Student should enunciate physical and chemical properties of natural and manmade fibres
CO3-PO4	**2**	Students should gain the knowledge of using man-made fibres

CO4-PO3	**3**	Students will know the identification of different man-made fibres.
CO4-PO12	**3**	Students will know the identification of different natural fibres.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT
1-4	Introduction: Different terms and definition of textiles, Textile sector in Bangladesh, Textile Fibers& mention it's important properties, feature of textile fibre, Ginning, Lint & linters, Mixing and Blending .	CT 01
5-7	Yarn Manufacturing: Flow chart of different spinning processes (carded, combed, rotor), different terms related to cotton and jute spinning,	

	Flow-chart for modern blow room line, Basic idea on cotton and Jute spinning machineries and their function, Batch & Batching, Emulsion & emulsion making process.	
8-9	Fabric Manufacturing: Different basic terms of weaving process, preparatory of weaving and its functional effects. Flow chart of weaving process, Basic operation of weaving.	CT 02
10-12	Classification of looms, motions of loom, difference between weaving and knitting, Definition and Flow process of knitting, Types of knitting machine, non-woven fabric formation. Garments Manufacturing: Chronological development of garments industry in the world.	MT
13	Nomenclature of different types of garments, Flow-chart of sample garment making. Flow-chart of garments manufacturing process,	CT 03
14	Types of pattern, objectives of pattern making. Objectives of pattern grading, marker making, spreading, cutting, sewing, and garments finishing. Marker efficiency and fundamental of Trimmings.	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	

	3	Final Exam, CT	**100**		
	4	Final Exam, CT, Mid	**100**		

REFERENCE BOOKS

1 . Textile Terms and Definition by Melintyre, J.E.

2. Dyeing and Chemical Technology of Textile Fibres by ER. Trotman

3. Modern Techniques of Textile Dyeing, Bleaching & Finishing by S.M. Arora

4. Textile Fibers, Dyes & Processes by Howard L. Needles

5. Textiles: Fiber to Fabric by Corbman, Bernard P

6. General Technology of Cotton Manufacturing (Mir Publisher) by PT. Bukayer

7. General Textile Processing by Abu sina Md. RuknulQuader

Spring/Fall Semester L-4, T- I or II

COURSE INFORMATION

Course Code Course Title	**ME 499** **Weapon Engineering**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Present and future trends in weapon technologies; Ballistic and ammunition fundamentals; Effect of blast; fragmentation and shaped charged warheads; blast analysis and structural design; Kinetic energy of penetrations;

Dynamics of unguided weapons; fin and spin stabilization; Principle of missile flight and propulsion; Missile guidance techniques. Technology of small arms; Cycle of operation; Classification of small arms; Method of operation; classification of firing mechanism; safety mechanism. Technology of ordinance and carriage assembly; build-up of a gun; barrel design and stresses on barrel; gun control; breech mechanism; elevating and traversing mechanism; recoil mechanism; gun dynamics; balancing mechanism

OBJECTIVE

1. The course is designed to offer equally a broad and in-depth coverage of technologies used in the design, development, test and evaluation of weapon systems and military vehicles.
2. Special attention will be given to recent advances in defence technology; and to educating students in the analysis and evaluation of systems against changes and developments in the threat.
3. The course also offers a critical depth to undertake engineering analysis or the evaluation of relevant sub systems.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Correspo nding PO	Bloom's Taxonomy	KP	CP	CA	Assess ment Method s
CO1	Describe and identify the elements that make up a gun system	1	C1, C2	1			Q, ASG, F
CO2	Demonstrate an understanding of the current technology applied to gun barrels and breeches	6	C2, C4	7			Q, ASG, F
CO3	Undertake analysis of gun recoil systems, barrel vibration and other aspects of gun dynamics	2	C2, C3, C4	1			Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

Main Contents:

a. Small arms

b. Heavy arms

Detail Contents:

Definition related to ammunition, Types of small arms, Theory of small arms. Principles of small arms, Various mechanism of small arms – breach block mechanism, trigger mechanism, recoil mechanism, firing mechanism, sign of small arms – heating, muzzle attachment, explosives, optical sight, Future trends and developments of small arms & ammunition, Inspection of small arms, Maintenance of small arms, Cycle operation of small arms, Fire power characteristics of mortar, Principle of anti-tank weapon, Definition related to armament, Ordnance – gun mechanism, distribution of energy, barrel, Breach and recoil mechanism heavy weapons, Superstructure, Inspection

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understanding the elements that make up a gun system	3											
CO2	Demonstrate an understanding of the current technology applied to gun barrels and breeches						3						
CO3	Undertake analysis of gun recoil systems, barrel vibration and other aspects of gun dynamics		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Knowledge of material properties will be needed
CO2-PO6	3	Investigation on the current weapon technologies will be needed
CO3-PO2	3	Analysis on the weapon mechanism will be needed

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1 – 3	Definition related to ammunition Types of small arms Theory of small arms	CT 1	
Class 4 – 16	Principles of small arms Various mechanism of small arms – breach block mechanism, trigger mechanism, recoil mechanism, firing mechanism Cycle operation of small arms	CT 2	
Class 17 – 23	Design of small arms – heating, muzzle attachment, explosives, optical sight	MID	
Class 24 – 27	Inspection of small arms. Maintenance of small arms	CT 3	
Class 28 –	Definition related to armament	CT 4	

42	Ordnance – gun mechanism, distribution of energy, barrel Breach and recoil mechanism heavy weapons Fire power characteristics of mortar Principle of anti-tank weapon Superstructure Inspection		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1.Charles E Balliesen, 'Principle of Firearms"
2.Brassey's Land Warfare "Guided Weapons", Into the 21st Century, 3rd Edition
3.Donald E Carlucci and Sidney S. Jacobson Ballistics "Theory and Design of Guns and Ammunition"

CHAPTER 6
COURSE OFFERED BY OTHER DEPARTMENTS TO STUDENTS OF ME DEPARTMENT

6.1 List of courses offered by other Departments to Students of ME Department

Course No	Course Name	Level - Term	Dept	Contact Hours	Credit Hours
CHEM-101	Fundamentals of Chemistry	1-2	Sci & Hum	3.00	3.00
CHEM 102	CHEMISTRY Sessional	1-2	Sci & Hum	3.00	1.50
PHY 101	Waves and Oscillations, Optics and Modern Physics	1-1	Sci & Hum	3.00	3.00
PHY 102	Physics Sessional	1-1	Sci & Hum	3.00	1.50
MATH 101	Differential and Integral Calculus	1-1	Sci & Hum	3.00	3.00
MATH 103	Differential equation and Matrix	1-2	Sci & Hum	3.00	3.00
MATH 201	Vector Analysis, Laplace Transformation and Coordinate Geometry	2-1	Sci & Hum	3.00	3.00
Math 215	Complex Variable, Harmonic Function and Fourier Analysis	2-2	Sci & Hum	3.00	3.00
LANG 102	Communicative English-1	1-2	Sci & Hum	3.00	1.50
LANG 202	Communicative English II	2-1	Sci & Hum	3.00	1.50
GERM 352	Fundamentals of Research Methodology	3-2	Sci & Hum	4.00	2.00
GEBS 101	Bangladesh Studies	1-1	Sci & Hum	2.00	2.00
GEE 305	Fundamentals of Economics	3-1	Sci & Hum	2.00	2.00
GES 307	Fundamentals of Sociology	3-2	Sci & Hum	2.00	2.00
CSE 275	Computer Programming Language	2-1	CSE	3.00	3.00
CSE 276	Computer Programming Language Sessional	2-1	CSE	3.00	1.50
EECE 159	Fundamentals of Electrical Engineering	1-1	EECE	3.00	3.00
EECE 173	Electrical and Electronics Engineering	1-2	EECE	3.00	3.00
EECE 174	Electrical and Electronics Engineering	1-2	EECE	3.00	1.50
IPE 463	CAD/CAM	4-2	IPE	2.00	2.00
IPE 464	CAD/CAM Simulation sessional	4-2	IPE	3.00	1.50
GEPM 467	Project Management and Finance	4-1	Sci & Hum	2.00	2.00
GEEM 437	Engineering Ethics and Moral Philosophy	4-1	Sci & Hum	2.00	2.00
GELM 275	Leadership and Management	2-2	IPE	2.00	2.00

GESL 407	Environment, Sustainability and Law	4-2	Sci & Hum	2.00	2.00

6.2 Proforma of Course Offered by Other Departments to Students of ME Department

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	**CHEM 101** **Fundamentals of Chemistry**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic concepts of inorganic, organic and physical chemistry.

OBJECTIVE

4. To define the different parameter and concepts of inorganic chemistry.
5. To apply different chemical theory to evaluate structure of molecules.
6. To explain the basic concepts of physical chemistry.
7. To describe basic reaction mechanism of selective organic reactions.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Be able to **define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	1	C1	1			T, F
CO2	Be able to **apply** different theory on chemical bonding and hybridization to **evaluate** structure of molecules.	1	C3, C5	1,2			T, F, ASG
CO3	Be able to classify hydrocarbons and **explain** the mechanism of selective organic reactions.	1	C2	1,2			T, F, ASG
CO4	**Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.	1	C2	1,2			ASG ,Mid Term Exam, F

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)
COURSE CONTENT
Atomic Structure: Concepts of atomic structure, Different atom models, Quantum theory and electronic configurations, Heisenberg's uncertainty principle **Periodic Table:** Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases **Chemical Bonding:** Types and properties, Lewis theory, VBT, MOT, Hybridization and shapes of molecules **Basic Concepts of Organic Chemistry**: History, Physical and chemical properties, Classification **Hydrocarbon:** Chemistry of hydrocarbon, Nomenclature, Properties **Selective Organic Reactions:** Oxidation-reduction, Substitution, Addition, Polymerization, Alkylation reactions **Acids-Bases/Buffer Solution:** Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water **Solutions:** Solutions and their classification, Unit expressing concentration, Colligative properties and dilute solutions, Raoult's law, Van't Hoff's law of osmotic pressure **Thermochemistry:** Laws of thermochemistry, Enthalpy, Hess's law, Heat of formation, Kirchoff's equations, Heat of neutralization, Heat of reaction **Electrochemistry:** Conductors & nonconductors, Difference between electrolytic and metallic conduction, Electrolytic conductance, Factors influencing the conductivity of electrolytes, Kohlrausch Law & conductometric titrations **Chemical Equilibria:** Equilibrium law/constant, Kp and Kc, Homogeneous and heterogeneous equilibrium, Van't Hoff's reaction isotherm, Le Chatelier's principle **Phase Rule:** Basic terms and phase rule derivation, Phase diagram of water and carbon dioxide **Chemical Kinetics:** Order and rate of reaction, Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	3											
CO2	Be able to **apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.	3											
CO3	Be able to **classify** hydrocarbon and **explain** the mechanism of selective organic reactions.	3											
CO4	**Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to know about the properties of particles. Students will get clear theoretical knowledge about particle's structure and know how to use this knowledge.
CO2-PO1	3	Students will get definition of chemical bonding and hybridization.
CO3-PO1	3	The students will attain the knowledge to understand hydrocarbon and explain the mechanism of selective organic reactions.
CO4-PO1	3	Students will learn the phase diagram, chemical equilibrium, thermochemistry, chemical and ionic equilibrium, electrochemical cells etc.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE		
Week 1	**Atomic Structure**	**CT**
Class 1	Concepts of atomic structure, Different atom models	**CT-1**
Class 2	Concepts of atomic structure, Different atom models	
Class 3	Quantum numbers, Electronic configuration	
Week 2	**Atomic Structure/Periodic Table**	
Class 4	Hydrogen spectral lines, Heisenberg's uncertainty principle	
Class 5	Classification of elements according to electronic configurations	
Class 6	Periodic classification of elements	
Week 3	**Periodic Table/Chemical Bonding**	
Class 7	Periodic properties of elements, Properties and uses of noble gases	
Class 8	Alkali metals: Chemical properties and uses	
Class 9	Chemical bonding (types, properties, Lewis theory, VBT)	
Week 4	**Chemical Bonding**	**CT-2**
Class 10	Molecular orbital theory (MOT)	
Class 11	Molecular orbital theory (MOT)	
Class 12	Hybridization and shapes of molecules	
Week 5	**Chemical Bonding/Organic Chemistry**	
Class 13	Hybridization and shapes of molecules	
Class 14	Hybridization and shapes of molecules	
Class 15	Basic concepts of organic chemistry: History, Physical & chemical properties, Classification	
Week 6	**Organic Chemistry**	
Class 16	Chemistry of hydrocarbon, Nomenclature, Properties	
Class 17	Selective organic reactions: Oxidation-reduction, Substitution	
Class 18	Selective organic reactions: Addition, Polymerization, Alkylation	
Week 7	**Acids-Bases**	**CT-3/Mid Term**
Class 19	Different concepts of acids-bases	
Class 20	Buffer solution, Mechanism of buffer solution	
Class 21	Henderson-Hasselbalch equation	
Week 8	**Acids-Bases/Solutions**	
Class 22	Water chemistry and pH of water	
Class 23	Solutions and their classification, Unit expressing concentration	
Class 24	Effect of temperature and pressure on solubility, Validity and limitations of Henry's law	
Week 9	**Solutions/Thermochemistry**	
Class 25	Colligative properties and dilute solutions, Raoult's law, deviation from Raoult's law, Elevation of boiling point	
Class 26	Freezing point depression, Van't Hoff's law of osmotic pressure	
Class 27	Thermochemistry: Laws of thermochemistry, Enthalpy	
Week 10	**Thermochemistry/Electrochemistry**	
Class 28	Hess's law, Kirchoff's equations	
Class 29	Heat of formation, Heat of neutralization, Heat of reaction	
Class 30	Electrolytic conduction and its mechanism	
Week 11	**Electrochemistry**	**CT-4**
Class 31	Faraday's law, Kohlrausch Law, Debye-Huckel-Onsagar theory	
Class 32	Conductrometric titrations	

Class 33	Different types of cells	
Week 12	**Chemical Equilibrium**	
Class 34	Reversible reactions, Characteristics of chemical equilibrium, Law of mass action, Equilibrium constant, Units of equilibrium constant	
Class 35	Relation between Kp & Kc,Van't Hoff's reaction isotherm	
Class 36	Free energy and its significance Heterogeneous equilibrium, Le Chatelier's principle	
Week 13	**Phase Rule/Chemical Kinetics**	
Class 37	Phase Rule: Basic terms and phase rule derivation	
Class 38	Phase Diagram of water and carbon dioxide	
Class 39	Pseudo and zero order reaction, Half-life	
Week 14	**Chemical Kinetics**	
Class 40	Determination and factors affecting the rate of a reaction	
Class 41	First order reaction, Second order reaction	
Class 42	Collision theory, Transition state theory	

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
2	Final Exam, CT	**80**	
3	Final Exam, CT, MID	**80**	
4	Final Exam, CT	**100**	

REFERENCE BOOKS

4. Modern Inorganic Chemistry – S. Z. Haider
5. Concise Inorganic Chemistry – J. D. Lee
6. A Textbook of Organic Chemistry – Arun Bahl And B. S. Bahl
7. Organic Chemistry – Morrison and Boyd
8. Principles of Physical Chemistry – Haque and Nawab
9. Essentials of Physical Chemistry – Bahl and Tuli

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	**CHEM 102** **Chemistry Sessional**	Lecture Contact Hours Credit Hours	: **3.00** : **1.50**

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To implement the basic concepts of inorganic and physical chemistry in a laboratory environment.

OBJECTIVE

1. To familiarize the students with experimentation of acid and base neutralization, titration and quantitative analysis of metals etc.
2. To make students proficient in iodimetric and iodometric analysis and complexometric titration etc.
3. To develop students' ability in estimating zinc, ferrous content in water sample by using various titrimetric methods.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	1	C1	1,2			R,Q,T
CO2	Be able to **explain** the different phenomena and **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.	2	C2,C3	1,2			R,Q,T
CO3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.	3	C4,C5	1,2			R,Q,T, Pr

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT

Quantitative chemical analysis in the field of inorganic and physical chemistry such as:
Acid-base titration, Redox titration, Iodometric and Iodimetric titration, Complexometric titration.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	3											
CO2	Be able to **explain** the different phenomena and **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.		3										
CO3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	In order to understand different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc., the knowledge of natural science would be required.
CO2-PO2	3	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO3	3	In order to perform the laboratory task, an ability to design complex process is required.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28

	Total 42
Self-Directed Learning Preparation of Lab Reports Preparation for the Lab Test Preparation for a presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	**112**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Introduction
Week-2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard
Week-3	Oxalic Acid dihydrate (C2H2O4.2H2 O) Solution.
Week-4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.
Week-5	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na2 CO3) Solution.
Week-6	Standardization of Sodium ThiosulphatePentahydrate (Na2S2O3.5H2 O) Solution with Standard Potassium Dichromate (K2Cr2O7) Solution.
Week-7	Estimation of Copper (Cu) Content in a Copper SulphatePentahydrate
Week-8	(CuSO4 .5H2 O) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium ThiosulphatePentahydrate (Na2S2O3 .5H2 O) Solution.
Week-9	Standardization of Potassium Permanganate (KMnO4) Solution with Standard Oxalic Acid dihydrate (C2 H2 O4 .2H2 O) Solution.
Week-10	Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr‘s Salt) [FeSO4.(NH4)2SO4.6H2O] Solution with Standard Potassium Permanganate (KMnO4)) Solution.
Week-11	Determination of Zinc (Zn) Content in a Zinc SulphateHeptahydrate (ZnSO4.7H2O) Solution with Standard Di-Sodium EthyleneDiamineTetraAcetic acid (Na2-EDTA) (Na2-EDTA) Solution by using Eriochrome black T indicator.
Week-12	Practice Lab
Week-13	Lab Test
Week-14	Quiz Test

ASSESSMENT STRATEGY				
Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	15%	CO 1	P1
			CO 2	P2,P3,P4,P5
			CO 3	P3,P4,P5
	Labtest-1, Labtest-1, Labtest-2, Labtest-2	25%	CO 1	P1
			CO 2	P2,P3,P4,P5
			CO 3	P3,P4,P5
	Presentation	20%	CO3	P3,P4,P5
Lab Quiz		30%	CO 1	P1
			CO 2	P2,P3,P4,P5
			CO 3	P3,P4,P5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition, Longman Scientific & Technical, 1989
2. G. D. Christian., Analytical Chemistry, 6th Edition, Wiley India Pvt. Limited, 2007
3. A. Jabbar Mian and M. Mahbubul Haque-Practical Chemistry

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	**PHY 101** **Waves and Oscillations, Optics and Modern Physics**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is the basic physics in the field of Waves and Oscillations, Optics and Modern physics. The course will be emphasized the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.

OBJECTIVE
1. To define the different parameter and concepts of Waves and Oscillations, Optics and Modern physics. 2. To explain the basic theories of Waves and Oscillations, Optics and Modern physics. 3. To solve numerical problems regarding Waves and Oscillations, Optics and Modern physics.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Be able to Define different basic parameters in the field of Waves and Oscillations, Optics and Modern physics such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	1	C1	1			T, F
CO2	Be capable to Explain different basic theories in the field of Waves and Oscillations, Optics and Modern physics such as the wave motion for different systems along with energy, different formula for interference, diffraction, polarization special theory of relativity, Compton theory, nuclear transformation, and nuclear reaction etc.	1	C1	1			T, F, ASG
CO3	Be skilled to Solve quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, photon energy, Compton shift, nuclear binding energy etc.	1	C2	1,2			T, F, ASG

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT

Waves and Oscillations: Simple Harmonic Motion (SHM) and its properties, Differential equation of a SHM and its solution, total energy of a body executing SHM, average kinetic and potential energy of a body executing SHM, LC oscillatory circuit, Pendulum: simple, compound and torsional pendulum, spring-mass system, two body oscillation and reduced mass, damped harmonic motion and its different condition, forced oscillation and its different condition, resonance, equation of a progressive wave, differential equation of a progressive wave, energy density of wave motion, average kinetic and potential energy of a body executing SHM, Stationary wave

Optics: Lens, equivalent lens and power, defects of images and different aberrations, Interference of light, Young's double slit experiment, Interference in thin film and Newton's ring method, diffraction of light, diffraction by single slit, diffraction by double slits, Fraunhofer and Fresnel bi-prism, diffraction gratings, polarization of light, Brewster's law, Malus law, polarization by double refraction Nicole prism, optical activity and polarimeters, optical instruments, resolving power of optical instrument, Laser: spontaneous and stimulated emission

Modern physics: Galilean relativity & Reference frame, Special theory of relativity postulates, Galilean transformation, Lorentz Transformation, Length contraction, Time dilation, Velocity addition, relativity of mass, mass energy relation, Momentum energy relation, Photoelectric effect, Compton effect, de Broglie matter wave, Bohr atom model and explanation, atomic orbital and energy equation, classification of nucleus, nuclear binding energy, radioactivity, radioactive decay law, half-life, mean life, nuclear reaction, introduction to nuclear reactor.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to Define different basic parameters in the field of Waves and Oscillations, Optics and Modern physics such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	3											
CO2	Be capable to Explain different basic theories in the field of Waves and Oscillations, Optics and Modern physics such as the wave motion for different systems along with energy, different formula for interference, diffraction, polarization special theory of	3											

	relativity, Compton theory, nuclear transformation, and nuclear reaction etc.												
CO3	Be skilled to Solve quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	The conceptual knowledge of the natural sciences applicable to the engineering discipline
CO2-PO1	3	The theory-based knowledge of the natural sciences applicable to the engineering discipline
CO3-PO1	3	The numerical analysis based knowledge of the natural sciences applicable to the engineering

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE		
Weeks	**Topics**	**Remarks**
Week-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	CT-1
	Simple harmonic motion (SHM) and its differential equations, graphical representation of SHM	
	Average K.E and total energy	
Week-2	Spring-mass system , electric oscillatory circuit	
	Simple, compound and torsional pendulum	
	Combination of two SHM	
Week-3	Combination of two SHM	
	Two body oscillations, reduced mass	
	Damped oscillations and its differential equation	
Week-4	Displacement equation of damped oscillation, electric damped oscillatory circuit	CT-2
	Forced oscillation and its differential equation	
	Displacement equation of forced oscillation, resonance	
Week-5	Plane progressive wave, energy density of wave	
	Stationary wave	
	Lens and combination of lenses, power of lens	
Week-6	defects of images and different aberrations	
	defects of images and different aberrations	
	Interference of light, young's double slit experiment	
Week-7	Interference in Thin films, Newton's ring	
	Diffraction : Fresnel & Fraunhofer diffraction	
	Diffraction by single slit	
Week-8	Diffraction by double slit, Diffraction gratings	MT
	Polarization and Production and analysis of polarized light	
	Optics of crystals, Nicole prism	
Week-9	Brewster's and Malus law	
	Optical activity and polarimeter	
	Laser & its applications	
Week-10	Theory of relativity: Frame of Reference, Postulates of special relativity, Galilean Transformation	
	Theory of relativity: Lorentz Transformations, Length Contraction and Time dilation	
	Velocity addition, Relativistic mass: Concept of relativistic mass and its expression	
Week-11	Theory of relativity: Mass and Energy equivalence equation and concept of Massless particle and its expression. Related numerical problems	CT-3
	Photoelectric Effect, photocurrent and work function, kinetic energy, stopping potential	
	photoelectric equation, characteristics of photoelectric effect	
Week-12	Compton effect: Definition, Compton wavelength shift, limitation	
	De Broglie Concept, Condition for wave and particle behavior, Bohr atomic model	

	Expression for Bohr radii and orbital energy for hydrogen atom	
Week-13	Classification of Nucleus, nuclear binding energy	
	Radioactivity and its transformation, Radioactive Decay Law,	
	half- life, Mean life, nuclear reaction	
Week-14	Concept of Fusion, Fission and nuclear chain reaction	
	General idea on nuclear reactor and nuclear power plant	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	

REFERENCE BOOKS

1. Fundamentals of Physics : Halliday, Resnick and Walker
2. Physics for Scientists and Engineers: Serway and Jewett
3. Concept of Modern Physics: Arthur Beiser
4. University Physics with Modern Physics: Hugh D. Young and Roger A. Freedman
5. Modern Physics for Science and Engineering: Marshall L. Burns
6. Waves and Oscillations: Walter Fox Smith
7. The Physics of Vibrations and Waves: H. J. Pain
8. Waves and Oscillations : BrijLal and Subramannyam
9. Fundamental of Optics: Francis A. Jenkins and Harvey E.White
10. Introduction to Modern Optics: Grant R. Fowles
11. Fundamental Optical Design: Michael J. Kidger

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	**PHY 102** **Physics Sessional**	Lecture Contact Hours Credit Hours	: **3.00** : **1.50**

PRE-REQUISITE
N/A
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course is a laboratory course for the basic physics in the field of Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics. The course will be emphasized the fundamental experiments on different fields of physics which can be applicable in a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as do work with team or individual.
OBJECTIVE
1. To develop basic physics knowledge practically 2. To practice use of basic scientific instrument.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Be able to Define the different parameters regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	1	C1	K1			Q
CO2	Be capable to Describe the different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	1	C1	K1			T, F
CO3	Be skilled to Construct Experiments by an individual or by a group to determine different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	9	C2	K2			F
CO4	Be able to Prepare a report for an experimental work.	10	C2	K2			R

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT

Quantitative measurement of different parameters in the field of Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics such as:
Specific resistance of materials, high resistance, Electrochemical equivalent (ECE) of copper, wavelength of light, focal length of lens, specific rotation of sugar, conductivity of a bad conductor, acceleration due to gravity, spring constant, the rigidity modulus, conservation of linear momentum, Young's modulus, Planck's constant, specific heat of a liquid.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to Define the different parameters regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	3											
CO2	Be capable to Describe the different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	3											
CO3	Be skilled to Construct Experiments by an individual or by a group to determine different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.									2			
CO4	Be able to Prepare a report for an experimental work.										1		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	The conceptual knowledge of the natural sciences applicable to the engineering discipline
CO2-PO1	3	The descriptive knowledge of the natural sciences applicable to the engineering discipline
CO3-PO9	2	Able to do work or complete a task as an individual and as a team

CO4-PO10	1	Capable to write a report on an experimental work

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation for the Lab Test Preparation for a presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	**112**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Weeks	**Topics**	**Remarks**
Week-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, evaluation system of the course, grouping, visit different section of the laboratory, introduction to different basic equipment's	
Week-2	Determination of specific resistance of materials of a wire by using Meter Bridge / Determination of focal length of a concave lens by auxiliary lens method	
Week-3	Determination of a high resistance by the method of deflection/ Determination of specific heat of a liquid by the method of cooling	
Week-4	Determination of ECE of copper by using copper voltameter / Determination of the Young's modulus of bar by bending method	
Week-5	Determination of the wavelength of light by using diffraction grating	
Week-6	Determination of the focal length of a plano-convex lens by Newton's ring method	
Week-7	Determination of the specific rotation of sugar by poralimeter	
Week-8	Determination of the conductivity of a bad conductor by Lee's method / Verification of the law of conservation of linear momentum	
Week-9	Determination of the acceleration due to gravity by means of compound pendulum	
Week-10	Determination of the spring constant and the rigidity modulus of a spiral spring	
Week-11	Determination of the Planck's constant using photoelectric effect	
Week-12	Viva & experimental exam	

Week-13	Viva & experimental exam	
Week-14	Quiz exam	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class performance/ Assignment	10%	CO1	C1
	Report Writing/ Assignment	30%	C01, CO4	C1, C2
Final Exam (60%)	Lab test	30%	CO1, CO2, CO3	C1, C2
	Viva	10%		
	Quiz	20%		
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Practical Physics: G. L. Squires
2. Practical Physics: Dr Giasuddin and Md. Sahabuddin.
3. B.Sc. Practical Physics: C. L Arora
4. Practical Physics: S.L. Gupta and V. Kumar

Spring Semester L-1, T-I

COURSE INFORMATION

Course Code Course Title	**MATH 101** **Mathematics-1 (Differential and Integral Calculus)**	Lecture Contact Hours Credit Hours	3.00 3.00

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Purpose of this course is to introduce basic knowledge of Differential Calculus and use it in engineering study.

OBJECTIVE
1. Be able to impart basic knowledge on differential and Integral Calculus to solve engineering problems and other applied problems. 2. Developing understanding some of the important aspects of rate of change, area, tangent, normal and volume. 3. Be expert in imparting in depth knowledge of functional analysis such as increasing, decreasing, maximum and minimum values of a function

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Define the limit, continuity and differentiability of functions, identify the rate of change of a function with respect to independent variables and describe the different techniques of evaluating indefinite and definite integrals.	1	C1,C2	1		3	T, F, ASG
CO2	Apply the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	1	C3	1		3	T, Mid Term Exam, F
CO3	Calculate the length, area, volume, center of gravity and average value related to engineering study	1	C3	1		3	Mid Term Exam, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Differential Calculus: Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability, Successive Differentiation, Leibnittz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions differentiation and integration, Indeterminate form, Cartesian differentiation, Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes, Partial differentiation.

Integral Calculus: Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its use, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, beta and gamma function, multiple integral and its application, Area, volume of solid revolution, Area under a plain curve, Area of the region enclosed by two curves, Arc lengths of curves.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Define the limit, continuity and differentiability of functions, identify the rate of change of a function with respect to independent variables and describe the different techniques of evaluating indefinite and definite integrals	3											
CO2	Apply the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	3											
CO3	Calculate the length, area, volume, center of Gravity and average value related to engineering study.	3											

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1- PO1	3	Knowledge of mathematics, science and engineering sciences h to be applied to describe the complete concept of differential ar integral calculus.
CO2- PO1	3	To apply proper and improper integral in the field of Engineerin study, knowledge of mathematics, science and engineering sciences are required.
CO3- PO1	3	In order to calculate volume, average, center of gravity and area of any solid revolution object, the knowledge of Mathematics and engineering sciences are needed.

COURSE SCHEDULE

Week 1		CT 1
Class 1	Introduction to Differential Calculus for Engineering study, Limit of a function and its properties.	
Class 2	Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems.	
Class 3	Concept of Differentiation, definition, classification of discontinuity and solving problems	
Week 2		

	Class 4	Basic concept of Differentiability, definition, derivative of a function, differentiable function.	
	Class 5	Differentiability – one sided derivatives (R.H.D and L.H.D), solving problems	
	Class 6	Successive differentiation – Concept and problem solving	
	Week 3		
	Class 7	Leibnitz's theorem and its applications	
	Class 8	Determination of $(y_n)_0$	
	Class 9	Mean Value theorem, Taylor theorem	
	Week 4		CT 2
	Class 10	Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder.	
	Class 11	Indeterminate forms – concept and problem solving,	
	Class 12	L'Hospital's rules with application	
	Week 5		
	Class 13	Partial differentiation - partial derivatives of a function of two variables and problems	
	Class 14	Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems	
	Class 15	Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving	
	Week 6		
	Class 16	Tangents and Normals – Tangents and Normals in Cartesian, equation of tangent at the origin, equation of normal of functions of explicit and implicit forms, Angle between two intersection of two curves; problem solving	
	Class 17	Tangents and Normals – Tangents and Normals in polar, Angle between two intersection of two curves; problem solving	
	Class 18	Tangents and Normals – Subtangent and subnormals in Cartesian and polar coordinate; problem solving	
	Week 7		Mid Term
	Class 19	maxima and minima of functions of single variables – concept,Increasing and decreasing function, Concave up and down with problems	
	Class 20	Curvature	
	Class 21	Asymptotes	
	Week 8		
	Class 22	Introduction to integral calculus	
	Class 23	Standard integrals – concept of definite and indefinite integrals, applications.	
	Class 24	Indefinite integrals – Method of substitution, Techniques of integration	
	Week 9		
	Class 25	Indefinite integrals – Integration by parts, Special types of integration, integration by partial fraction,	

	Class 26	Integration by the method of successive reduction	
	Class 27	Definite integrals – definite integrals with properties and problems	
	Week 10		CT 4
	Class 28	Definite integrals – Reduction formula, Walli's formula	
	Class 29	Definite integrals – definite integral as the limit of the sum	
	Class 30	Beta function – concept and problem solving	
	Week 11		
	Class 31	Gamma function - concept and problem solving	
	Class 32	Relation between beta and gamma function, Legendre duplication formula, problems and applications	
	Class 33	Multiple integrals – double integrals	
	Week 12		
	Class 34	Multiple integrals – triple integrals	
	Class 35	Multiple integrals – successive integration for two and three variables	
	Class 36	Area in Cartesian	
	Week 13		
	Class 37	Area in polar	
	Class 38	Volume of solid revolution	
	Class 39	Area under a plain curve in Cartesian and polar coordinates	
	Week 14		
	Class 40	Area of a region enclosed by two curves in Cartesian and polar coordinates	
	Class 41	Arc lengths of curves in Cartesian coordinates	
	Class 42	Arc lengths of curves in polar coordinates	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assesment (40%)	**Class test/ Assignment 1-3**	20%	CO1 CO2 CO2	C1, C2 C3
	Class Participation	5%	CO3	C3
	Mid term	15%	CO2, CO3	C3
Final Exam		**60%**	**CO1**	**CO1**
			CO2	**CO2**
			CO3	**CO3**
Total Marks		**100%**		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS
1. Calculus (9th Edition) by Howard Anton (Author), Irl C. Bivens (Author), Stephen Davis. 2. Calculus: An Intuitive and Physical Approach By Morris Kline.

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	**MATH 103** **Mathematics-2 (Differential Equation and Matrix)**	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Purpose of this course is to introduce basic knowledge to identify and solve differential equations and concept of matrix.			
OBJECTIVE			
1. Be able to impart basic knowledge on ordinary and partial differential equations. 2. Developing understanding some of the important aspects of ordinary and partial differential equations. 3. Be able to provide knowledge on using concept of Differential equations and matrix in engineering problems and solve other applied problems. 4. Be expert in imparting in depth knowledge on inverse matrix.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Define** various types of differential equations and **identify** the classifications of partial differential equations.	1	C1, C2, C3	3	1		T,F,ASG
CO2	**Apply** the knowledge and **solve** ordinary and partial differential equations.	1	C1, C2, C3	3	1		T, Mid Term Exam, F

CO3	**Apply** the technique to obtain the inverse matrix that **solve** the system of linear equations.	1	C1, C2, C3	3	1		Mid Term Exam, F, ASG

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT

Differential Equations: Introduction & Formulation of DE in Engg, Degree and order of ODE, solution of first order but higher degree DE by various methods, solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs, Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial, linear first order PDE, Non linear first order PDE, Standard form DEs of higher order and wave equation, particular solutions with boundary and initial condition, Non-linear PDE of order one, Charpit's method, Linear PDE with constant coefficients, Applications of DE

Matrix: Definition of Matrix, different types of matrices, Algebra of Matrices, Transpose and adjoint of a matrix and inverse matrix, rank and elementary transformation, solution of linear equation or System of Linear Equation, Matrix polynomials determination characteristic roots and vectors, characteristic subspace of matrix and Eigen values and Eigen Vectors, Cayley Hamilton

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** various types of differential equations and **identify** the classifications of partial differential equations.	3											
CO2	**Apply** the knowledge and **solve** ordinary and partial differential equations.	3											
CO3	**Apply** the technique to obtain the inverse matrix that **solve** the system of linear equations.	3											

theorem.of Gases and vapours

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	The knowledge of mathematics, science and engineering sciences has to be applied to describe for the physical explanation of differential equations.
CO2- PO1	3	The application of differential equations need the knowledge of mathematics, science and engineering for describing

		exponential growth and decay, the population growth of species or change in investment return over time.
CO3- PO1	3	In order to establish for finding the technique to obtain the inverse matrix of mathematics and natural science is required.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week 1		CT 1
Class 1-3	Introduction & Formulation of DE in Engg, Degree and order of ODE	
Week 2		
Class 4-6	Solution of first order but higher degree DE by various methods	
Week 3		
Class 7-9	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Week 4		CT 2
Class 10-12	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Week 5		
Class 13-15	Linear first order PDE, Non linear first order PDE	
Week 6		
Class 16-18	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
Week 7		Mid Ter m
Class 19-21	Linear PDE with constant coefficients, Applications of DE	
Week 8		
Class 22-24	Wave equations, Particular solutions with boundary and initial conditions	
Week 9		
Class 25-27	Second order PDE and classifications to canonical (standard)- parabolic, elliptic, hyperbolic solution by separation of variables.	
Week 10		CT 3
Class 28	Application of OD and PDE in Eng study	
Class 29	Definition of Matrix, different types of matrices, Algebra of Matrices,	

Class 30	Transpose and adjoint of a matrix and inverse matrix
Week 11	
Class 31-33	Solution of linear equation or System of Linear Equation
Week 12	
Class 34-36	Solution of linear equation using Inverse Matrix, Rank, Nullity and elementary transformation
Week 13	
Class 37-39	Dependent and independent of vectors, Matrix polynomials determination characteristic roots and vectors
Week 14	
Class 40-42	Characteristic subspace of matrix and Eigen values and Eigen Vectors, Cayley Hamilton theorem and its application. Finding inverse matrix using this theorem.

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	

REFERENCE BOOKS

1. Elementary Linear Algebra 10th Edition by Howard Anton (Author).
2. Ordinary and Partial Differential Equations By Dr. M.D. Raisinghania , S. Chand Publishing version) – Wiley

Spring Semester L-2, T-I

COURSE INFORMATION

Course Code Course Title	**MATH 201** **Mathematics-3 (Vector Analysis, Laplace Transformation and Coordinate Geometry)**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

MATH 101 and MATH 103

CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
Purpose of this course is to introduce basic knowledge to identify and solve vector mathematical problems, to demonstrate practical applications of Laplace Transform and analyze co-ordinate geometry.
OBJECTIVE
1. Be able to impart basic knowledge on ordinary and partial differential equations. 2. Developing understanding some of the important aspects of ordinary and partial differential equations. 3. Be able to provide knowledge on using concept of Differential equations and matrix in engineering problems and solve other applied problems. 4. Be expert in imparting in depth knowledge on inverse matrix.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Know** the physical explanation of different vector notation and **Define** Laplace transform, inverse Laplace transform, different types of matrices, and their properties.	1	C1 - C2	3			T,F,ASG
CO2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	1	C2	3			T, Mid Term Exam, F
CO3	**Calculate** length, volume and area of objects related to engineering study by using vector, **Apply** Laplace transform to ODE and PDEs and the knowledge of geometry in engineering study. **Solve** the problems of the pair of straight lines, circles, system of circles,	1	C3	3			Mid Term Exam, F, ASG

	parabola, ellipse etc.						

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT

Vector Analysis: Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors, Gradient of scaler functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and its application, Stoke's theorem and its application, Gauss theorem and its application in Engineering.

Laplace Transform: Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT, Sufficient condition for existence of LT, Inverse LT, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Partial fraction, Solution of DEs by LT, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Application of LT.

Co-ordinate Geometry: Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid straight lines, standard equation of coincides, sphere and ellipsoid.

SKILL MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Learn** the physical explanation of different vector notation and **Define** Laplace transform, inverse Laplace transform, different types of matrices, and their properties.	3											
CO2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	3											
CO3	**Calculate** length, volume and area of objects related to engineering study by using vector, **Apply** Laplace transform to ODE and PDEs and the knowledge of geometry in engineering study. **Solve** the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1- PO1	3	The knowledge of mathematics, science and engineering sciences has to be applied to describe the operation of being able to identify the physical explanation of different vector notation, explain the complete concept about Laplace transform, 2D and 3D geometry.
CO2- PO1	3	To explain the differentiation and integration of a vector valued functions in Cartesian, cylindrical and spherical geometry and to solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc. The concept of mathematics and engineering sciences is required.
CO3- PO1	3	In order to construct and calculate the area and volume of objects related to engineering study by using vector, solve the differential equations by Laplace transform is needed the concept of mathematics, physics and engineering sciences.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42

Practical / Tutorial / Studio Student-Centred Learning	- -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1		CT 1
Class 1-3	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Week 2		
Class 4	Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors	
Class 5	Gradient of scaler functions, Divergence and curl of point functions	
Class 6	Physical significance of gradient, divergence and curl	
Week 3		
Class 7-9	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
Week 4		CT 2
Class 10	Gauss theorem and application in Engineering	
Class 11	Stoke's theorem and it's application.	
Class 12	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates	
Week 5		
Class 13-15	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Week 6		
Class 16-18	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Week 7		

	Class 19-21	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	Mid Term
	Week 8		
	Class 22-24	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
	Week 9		
	Class 25-24	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
	Week 10		CT 3
	Class 28	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
	Class 29-30	Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT	
	Week 11		
	Class 31-33	Sufficient condition for existence of LT, LT of derivatives and it's application, LT of Integration with application, LT of sine and cosine integral	
	Week 12		
	Class 34	Unit step function and it's application	
	Class 35	Periodic function with examples, LT of some special function.	
	Class 36	Definition of inverse Laplace Transform and it's properties	
	Week 13		
	Class 37	Partial fraction and it's application in inverse Laplace Transform	
	Class 38	Heaviside formula and it's application	
	Class 39	Convoulution theorem, Evaluation of improper integral, Application of LT	
	Week 14		
	Class 40-42	Solve ODE s by Laplace transform	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	

REFERENCE BOOKS

1. Vector Analysis, 2nd Edition 2nd Edition by Murray Spiegel, Seymour Lipschutz, Dennis Spellman
2. Schaum's Outline of Laplace Transforms by Murray R. Spiegel.
3. Engineering Mathematics, Volume Two 2 II: Containing Coordinate Geometry of Two Dimensions, Co-ordinate Geometry of Three Dimensions, Matrices.
4. Theory of Equations and Vector Calculus by K. Kandasamy, P.; Thilagavathy, K.; Gunavathy
5. A Text Book on Co-ordinate Geometry with Vector Analysis - Rahman & Bhattacharjee.

Fall Semester L-2, T-II

COURSE INFORMATION

Course Code Course Title	**MATH 215** **Complex Variable, Harmonic Function and Fourier Analysis**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**

PRE-REQUISITE

Math 101, Math 103

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach the students the concepts, principles and working field of Complex Variable, Harmonic property of a function which is a special property and Fourier Analysis of different types of function. It is targeted to provide a basic foundation and applications of Fourier Series, Fourier Integrals, complex variable and to develop the concept of harmonic functions. Finally, this course is designed to demonstrate practical applications of Complex Variable, Harmonic Function and Fourier Transform.

OBJECTIVE

1. Be able to impart basic knowledge about Complex Variable, Harmonic Function and Fourier Analysis for different types of function.
2. Be able to familiarize the students with the characteristics of Complex number, Complex Integrals and Harmonic Function.
3. Be proficient to familiarize the students with the characteristics of Fourier Series, Fourier Integrals.
4. Be able to impart knowledge on Fourier Analysis, Complex Variable, Harmonic Function and thereby students able to solve engineering problems to give physical interpretation.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Recall** the basic idea about Complex Variable, Harmonic Function and Fourier Analysis.	1	C1	1	1		Q, ASG, F
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	1	C2	2	1		Q, ASG, F
CO3	**Apply** Fourier Transform to solve boundary value problems.	1	C3	2	1,3		Q, ASG, F
CO4	**Solve** different coordinate system of engineering problems by Harmonic function.	1	C3	5	1		Q, ASG, F

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT
Complex Variable: Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Differentiation and the Cauchy-Riemann equations, Mapping by elementary functions, Line integral of a complex function, Cauchy's Integral formula, Complex function, Convergence and Uniform convergence, Liouville's theorem, Taylor's and Laurent's theorem, Singular residues, Cauchy's residue theorem. **Harmonic Function:** Definitions of Harmonics function, Laplace's equation in Cartesian, Polar, cylindrical and spherical co-ordinates, Solution of these equations with applications, Gravitational potential due to a ring, Steady state temperature, Properties of harmonic functions, Potential inside and outside of a sphere. **Fourier Analysis**: Real and Complex form of Fourier Series, Definition and expansion of a function of x in a Fourier Series, Physical application of Fourier Series, Finite Fourier Transform, Fourier Integral Inverse Fourier transform, Fourier transform and their uses in solving boundary value problems, Diffusion, wave, Laplace Equation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recall** the basic idea about Complex Variable, Harmonic Function and Fourier Analysis.	3											
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	3											
CO3	**Apply** Fourier Transform to solve boundary value problems.	3											
CO4	**Solve** different coordinate system of engineering problems by Harmonic function.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	The knowledge of mathematics has to be applied to Fourier Analysis and Complex Variable in the field of engineering study.
CO2-PO1	3	In order to explain the characteristics of various components of EECE, the knowledge of mathematics regarding Complex Variable is needed.
CO3-PO1	3	In order to describe physical phenomena of different BVPs, using the knowledge of mathematics and sciences is required.
CO4-PO1	3	The concept of Mathematics and sciences is required to solve engineering problems of different coordinate system.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE		
Week 1	**COMPLEX VARIABLE (MUST KNOW)**	**CT-1**
Class-1	Complex number system	
Class-2	General functions of a complex variable	
Class-3	Graphical representation of complex number and complex variable	
Week 2	**COMPLEX VARIABLE (MUST KNOW)**	
Class-4	Roots of Complex number	
Class-5	Limits of a function of complex variable.	
Class-6	Continuity of a function of complex variable and related theorems	
Week 3	**COMPLEX VARIABLE (MUST KNOW)**	
Class-7	Differentiation and the cauchy Riemann equations	
Class-8	Mapping by elementary functions	
Class-9	Line integral of a complex function	
Week 4	**COMPLEX VARIABLE (MUST KNOW)**	**CT-2**
Class-10	Green’s theorem in complex form	
Class-11	Cauchy’s Integral formula	
Class-12	Convergence and Uniform convergence	
Week 5	**COMPLEX VARIABLE (MUST KNOW)**	
Class-13	Liouville’s theorem	
Class-14	Taylor’s and Laurents theorem	
Class-15	Singular residues, Cauchy’s residue theorem	
Week 6	**HARMONIC FUNCTION (MUST KNOW)**	
Class-16	Definitions of Harmonics function	
Class-17	Properties of harmonic functions	
Class-18	Laplace’s equation in cartesian co-ordinates	
Week 7	**HARMONIC FUNCTION (MUST KNOW)**	
Class-19	Laplace’s equation in polar co-ordinates	
Class-20	Laplace’s equation in cylindrical co-ordinates	
Class-21	Laplace’s equation in spherical co-ordinates	
Week 8	**HARMONIC FUNCTION (MUST KNOW)**	
Class-22	Solution of these equations with applications	
Class-23	Gravitational potential due to a ring, Steady state temperature	
Class-24	Potential inside and outside of a sphere	
Week 9	**FOURIER ANALYSIS (MUST KNOW)**	
Class-25	Real and complex form of Fourier series	
Class-26	Definition and expansion of a function of x in a Fourier Series	
Class-27	Physical application of Fourier Seires	

Week 10	**FOURIER ANALYSIS (MUST KNOW)**	**Mid Term**
Class-28	Physical application of Fourier Seires	
Class-29	Finite Fourier sine Transform	
Class-30	Finite Fourier cosine Transform	
Week 11	**FOURIER ANALYSIS (MUST KNOW)**	**CT-4**
Class-31	Infinite Fourier Transform	
Class-32	Inverse Fourier Transform	
Class-33	Inverse Fourier Transform	
Week 12	**FOURIER ANALYSIS (MUST KNOW)**	
Class-34	Fourier Integral	
Class-35	Fourier Integral	
Class-36	Convolution Theorem for Fourier Transform	
Week 13	**FOURIER ANALYSIS (MUST KNOW)**	
Class-37	Parseval's identity for Fourier Transform	
Class-38	Fourier Transform and their uses in solving BVP	
Class-39	Fourier Transform and their uses in solving BVP (with physical interpretation)	
Week 14	**FOURIER ANALYSIS (MUST KNOW)**	
Class-40	Solution of Diffusion Equation by using Fourier Transform	
Class-41	Solution of Wave Equation by using Fourier Transform	
Class-42	Solution of Laplace Equation by using Fourier Transform	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C3
			CO4	C3
	Class Participation	5%	CO4	C3
	Mid term	15%	CO2, CO3	C2,C3
Final Exam		60%	CO 1,CO2	C1,C2
			CO 2, CO 3	C2,C3
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Complex Variables by - Murray R. Spiegel, Schaum's Outline Series.
2. Theory and functions of complex variables, Shanti Narayan.
3. Harmonic Function Theory by - Sheldon Axler.
4. Fourier series, Schaum's outlines series, Murray R. Spiegel.

Spring Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	**: LANG 102** **: Communicative English I**	Lecture Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course has mainly been designed to improve speaking and oral communication skills of the students. The course includes instructions and experience in speech preparation and speech delivery within various real life situations, formal and informal. Emphasis will be given on various speeches, such as informative, persuasive and interactive. This course will help students progress in real life both personally and professionally. Students will be able to understand class lectures and can comfortably continue the Engineering course, and also to compete in the global job market and increase career skills.

OBJECTIVE

1. To develop the four basics skills of English language, i.e. listening, speaking, reading and writing.
2. To develop student's interpersonal skills engaging them in various group interactions and activities.
3. To improve student's pronunciation in order to improve their level of comprehensibility in both speaking and listening.
4. To give the students exposure to different types of texts in English in order to make them informed using different techniques of reading.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Listen, understand and speak English quickly and smartly using the Technics learnt in the class.	1	C1, C2	1,3			Q, F
CO2	Understand the techniques	1	C2, C3	1			Q, ASG, F
CO3	Communicate effectively within the shortest possible time to present ideas and opinions	10	C2, C3	1			Q, ASG, F
CO4	Develop competency in oral, written communication/presentatio n	10	C4, C5	1			Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT
a. Main Contents: 1.Speaking 2.Listening 3.Reading 4.Writing **b. Detail Contents** **Speaking:** Introduction to Language: Introducing basic skills of language. English for Science and Technology Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc. Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions Discussing everyday routines and habits, Making requests /offers /invitations /excuses /apologies/complaints Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event Practicing storytelling, Narrating personal experiences/Anecdotes Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation) **Listening:** Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand Listening to short conversations between two persons/more than two **Reading:** Reading techniques: scanning, skimming, predicting, inference; Reading Techniques: analysis, summarizing and interpretation of texts **Writing:** Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event Paragraph writing, Compare-contrast and cause- effect paragraph

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Listen, understand and speak English quickly and smartly using the Technics learnt in the class.	3											
CO2	Understand the techniques of academic reading and academic writing.	3											

CO3	Communicate effectively within the shortest possible time to present ideas and opinions.										3		
CO4	Develop competency in oral, written Communication/presentation.										3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Apply the knowledge of speaking English fundamentals to the solution of complex engineering problems.
CO2-PO1	3	Apply the knowledge of reading and writing of English fundamentals to the solution of complex engineering problems.
CO3-PO10	3	Communicate effectively about complex engineering activities with the engineering community and with society at large by developing their communication skill
CO4-PO10	3	Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions by developing their communication and writing skill.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Laboratory visits

COURSE SCHEDULE

Week	Class	Topic	CT
Week 1	Class 1-3	Introduction to Language: Introducing basic skills of language. English for Science and Technology	
Week 2	Class 4-6	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
Week 3	Class 7-9	Discussing every day routines and habits, Making requests/offers/invitations/excuses/apologies/complaints	
Week 4	Class 10-12	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event	
Week 5	Class 13-15	Practicing storytelling, Narrating personal experiences/Anecdotes	

Week 6	Class 16-18	Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher – student conversation)	
Week 7	Class 19-21	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions	
Week 8	Class 22-24	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand	
Week 9	Class 25-27	Listening to short conversations between two persons/more than two	Mid Term
Week 10	Class 28	Reading techniques: scanning, skimming, predicting, inference;	
	Class 29-30	Reading techniques: scanning, skimming, predicting, inference;	
Week 11	Class 31-33	Reading Techniques: analysis, summarizing and interpretation of texts	
Week 12	Class 34-36	Introductory discussion on writing, prewriting, drafting;	CT 3
Week 13	Class 37-39	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event	
Week 14	Class 40-42	Paragraph writing, Compare-contrast and cause- effect paragraph	

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	Listening Test	15%	
2	Descriptive writing	25%	
3	Public Speaking	30%	
4	Presentation	30%	

REFERENCE BOOKS

1. **Text and Ref Books:**

   a. Langan, J. (2005). College Writing Skills with Readings (6^{th} Ed). McGraw-Hill Publication

   b. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication

   c. Jones, L. (1981). Functions of English. (Student's Book, 2^{nd} Ed.) Melbourne, Australia: Cambridge University Press.

   d. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice

Hall of India. (For book presentation) e. From Paragraph to Essay - Maurice Imhoof and Herman Hudson f. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd. g. Speak like Churchill stand like Lincoln - James C. Humes h. Cambridge IELTS Practice Book i. Selected Sample Reports and Selected Research Articles.

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	LANG 202 Communicative English II	Lecture Contact Hours Credit Hours	3.00 1.50
PRE-REQUISITE			
ENG 102			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The English language course is designed for the students to develop their competence in communication skills for academic purposes especially in reading and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to different types of texts to develop efficient reading skill. Reading will also involve activities and discussions leading to effective writing. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Emphasis is particularly put on the various forms of essay writing such as descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, students are expected to be able to communicate at various situations, participate in group activities and prepare formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills. In addition, the course emphasizes on providing constructive feedback on students' oral performances.			
OBJECTIVE			
1. To develop English language skills to communicate effectively and professionally. 2. To strengthen students' presentation skills. 3. To develop competency in academic reading and writing.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CA	CP	Assessment Methods
CO1	Understand the techniques of academic reading and become acquainted with technical vocabularies	1	C2				F, ASG, Pr
CO2	Understand the techniques of effective academic writing such as research	1	C2				F, ASG, Pr

	article/report writing						
CO3	Communicate effectively within the shortest possible time to present any report and research work	10	C3				F, ASG, Pr
CO4	Analyze any problem critically, analyze and interpret data and synthesize information to provide valid conclusions	10	C3				F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Main Content	Detail Contents
Reading	Reading Comprehension: Practice using different techniques
	Academic reading: comprehension from departmental or subject related passages
	Vocabulary for Engineers (some common Engineering terms for both general and dept specific)
	Reading subject specific text to develop vocabulary
Writing	Writing semi-formal, Formal/official letters, Official E-mail
	Applying for a job: Writing Cover Letter and Curriculum Vitae
	Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;
	Narrative and descriptive writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;
	Analyzing and describing graphs or charts
	Practicing analytical and argumentative writing
Speaking	Public Speaking: Basic elements and qualities of a good public speaker
	Set Speech and Extempore Speech: How to get ready for any speech – set or extempore.
	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.
Listening	Listening to long lecture on some topics
	Listening and understanding speeches/lectures of different accent

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the techniques of academic reading and become acquainted with technical vocabularies	3											
CO2	Understand the techniques of effective academic writing such as research article/report writing	3											
CO3	Communicate effectively within the shortest possible time to present any report and research work										3		
CO4	Analyze any problem critically, analyze and interpret data and synthesize information to provide valid conclusions										3		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	3	By understanding techniques of academic reading students will be able to apply knowledge of mathematics, natural science, engineering to the solution of complex engineering problems
CO2-PO2	3	By understanding techniques of academic writing students will be able to apply knowledge of mathematics, natural science, engineering to the solution of complex engineering problems
CO3-PO10	3	Students will be able to Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
CO4-PO10	3	Students will be able to Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY
This course is mostly activity based. Students will often be engaged in interactive discussion. The tasks and activities include pair work, group work, brainstorming, guesswork, describing picture/graph/diagrams, word puzzle, making jokes, storytelling, role play, responding to reading, writing and listening texts.

COURSE SCHEDULE

Week	Class	**Topic**	CT
Week 1	Class 1-3	Reading Comprehension: Practice using different techniques	
Week 2	Class 4-6	Academic reading: comprehension from departmental or subject related passages	
Week -3	Class 7-9	Vocabulary for Engineers (some common Engineering terms for both general and dept specific), Reading subject specific text to develop vocabulary	
Week -4	Class 10-13	Writing semi-formal, Formal/official letters, Official E-mai1	
Week -5	Class 13-15	Applying for a job: Writing Cover Letter and Curriculum Vitae	
Week -6	Class 16-18	Essay writing: writing steps, principles and techniques, outlining revising, editing, proofreading;	
Week -7	Class 19-21	Narrative and descriptive writing: comparison-contrast and cause — effect, argumentative and opinion expression, assignment writing	
Week -8	Class 22-24	Analyzing and describing graphs or charts	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Testing vocabulary level	20%	
2	Argumentative/analytical writing	25%	
3	Individual Presentation	25%	
4	Group Presentation	30%	
	EXAM		

REFERENCE BOOKS

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)
3. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication
4. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
5. Headway Series — Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Cambridge IELTS Practice Book

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**: GERM 352** **: Fundamentals of Research Methodology**	Lecture Contact Hours Credit Hours	: 4.00 : 2.00

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The Fundamentals of Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in Science and Engineering context. UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments

OBJECTIVE

The primary objective of this course is to develop a research orientation among the UG students and to acquaint them with fundamentals of research methods. Some other objectives of the course are:

1. To evaluate/review related extant literature, form a variety of sources, pertinent to the research objectives/questions.
2. To expose students to various research methodologies (design), relevant to the research problem needing to be addressed.
3. To explain and justify how researchers will collect and analyze research data.
4. To educate students in the common mistakes, research misconduct, and ethical considerations in the field of research methodology.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.	2	C2	-			ASG, Q
CO2	**Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.	3, 12	C3			4,6	R, Pr, ASG, Q

CO3	**Develop** writing and presentation skill, and **demonstrate** ethical considerations in conducting research	8, 10	C3			4	R, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)
C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create)

COURSE CONTENT

1. **Foundations of Research:** Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.
2. **Problem Identification and Formulation:** Meaning and need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.
3. **Research Design:** Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental/Computational Design: Concept of Independent & Dependent variables.
4. **Data Analysis:** Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
5. **Research Misconduct and Ethics:** Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
6. **Use of Tools / Techniques for Research:** Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.		3										
CO2	**Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.			1									2
CO3	**Develop** writing and presentation skill, and **demonstrate** ethical considerations in conducting research								1		3		

(3 – High, 2- Medium, 1-low)

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO2	3	Student will understand research fundamentals
CO2-PO2	1	Student will find out research problems and formulate research statements
CO2-PO12	2	Students will be able to use gained knowledge in research throughout the life
CO3-PO8	1	Student will develop writing and presentation skill
CO3-PO10	3	Student will demonstrate ethical considerations in conducting research

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	48
Practical / Tutorial / Studio	24
Student-Centred Learning	12
Self-Directed Learning	30
Non-face-to-face learning	12
Report Preparation	18
Formal Assessment	
Continuous Assessment	1.5
Report Submission (2)	-
Presentation (2)	0.5
Total	80

TEACHING METHODOLOGY
Lecture and Discussion, Mini-Seminars by Experts, Co-operative and Collaborative Method, Problem Based Method
COURSE SCHEDULE

Weeks	Topics	Remarks
1	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.	
2	Practice session on Foundations of Research	
3	Problem Identification & Formulation: Meaning & need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance	**Continuous Assessment** (presentation/ quiz/other assignment)
4	Practice session on Problem Identification & Formulation	
5	Practice session on Research Design	
6	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	**Assignment 1** Assignment has to provide before, here students will submit report and give PPT
7	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	
8	Practice session on Data Analysis	
9	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.	
10	Practice session on Research misconduct and Ethics	**Continuous Assessment** (presentation/ quiz/other assignment)
11	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.	
12	Practice session on Use of tools / techniques for Research	

13	Review Session (Theory) – I /Final Presentation	**Assignment 2** Assignment has to provide before, here students will submit report and give PPT
14	Review Session (Practice) – II /Final Presentation	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
1, 3	Assignment I	**20**	
2, 3	Assignment II	**50**	
1, 2	Continuous Assessment	**30**	

(CO = Course Outcome)

REFERENCE BOOKS

1. Engineering Research Methodology: A Practical Insight for Researchers. Springer, by Deb, Dipankar, Dey, Rajeeb, Balas, Valentina E.
2. Research Methods for Engineers, 1st Edition, by David V. Thiel.
3. Handbook of Research Methodology by Talati, J.K.
4. Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project by Uwe Flick
5. DRM, a Design Research Methodology by Lucienne T.M. Blessing and Amaresh Chakrabarti
6. Research Methods: Information, Systems, and Contexts by Kirsty Williamson, Graeme Johanson
7. Zelkowitz, M. V. and Wallace, D. R. (1998), Experimental models for validating technology, Computer, vol. 31, no. 5, pp. 23-31.
8. Internet, mail, and mixed-mode surveys : the tailored design method (3rd ed.) by Dillman, D. A., Smyth, J. D., & Christian, L. M.
9. Improving survey questions: design and evaluation. Sage Publications, by Fowler, F. J.
10. Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.).
11. Mahwah, NJ: Lawrence Erlbaum Associates, by Cohen, J., Cohen, P., West, S., & Aiken, L.
12. Experimental and Quasi-Experimental Design for Generalized Causal Inference. Boston, Mass: Houghton Mifflin, by Shadish W.R., Cook T.D. & Campbell P.T.
13. Computational handbook of statistics (4th ed.). New York: Longman, by Bruning, J. L. & Kintz, B. L.

Fall Semester L-1, T-I

<table>
<tr><th colspan="4">COURSE INFORMATION</th></tr>
<tr><td>Course Code
Course Title</td><td>: GEBS 101
: Bangladesh Studies</td><td>Lecture Contact Hours
Credit Hours</td><td>: 2.00
: 2.00</td></tr>
<tr><th colspan="4">PRE-REQUISITE</th></tr>
<tr><td colspan="4">N/A</td></tr>
<tr><th colspan="4">CURRICULUM STRUCTURE</th></tr>
<tr><td colspan="4">Outcome Based Education (OBE)</td></tr>
<tr><th colspan="4">SYNOPSIS/RATIONALE</th></tr>
<tr><td colspan="4">This course has been designed for undergraduate engineering students to help them learn the rich history of Bangladesh, to understand present Bangladesh in the light of history and to provide them with basic knowledge of historical events which eventually led to the formation of Bangladesh and constitution of Bangladesh, current trends in economic development and thereby to enhance their understanding of present phenomena in the light of history which will make them responsible citizen.</td></tr>
<tr><th colspan="4">OBJECTIVE</th></tr>
<tr><td colspan="4">1. To equip students with factual knowledge that will enable them to learn and critically appreciate the history, culture, and economy of Bangladesh.
2. To trace the historical roots of Bangladesh as an independent state focusing on the social, cultural and economic developments that have taken place since its independence.
3. To promote an understanding of the development of Bangladesh and its culture from ancient time.
4. To create an awareness among the students about the History, Geography, Economics, Politics and Culture of Bangladesh.</td></tr>
</table>

<table>
<tr><th colspan="8">LEARNING OUTCOMES & GENERIC SKILLS</th></tr>
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<tr><td>CO1</td><td>Identify specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and critically analyse plurality of cultural identities of Bangladesh.</td><td>6</td><td>C1, C2</td><td>7</td><td></td><td></td><td>Q, ASG, F</td></tr>
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<tr><td colspan="8">(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)</td></tr>
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COURSE CONTENT
a. Main Contents: 1. Geography 2. History 3. Environment, Economy and Culture of Bangladesh **b. Detail Contents:** Bangladesh Geography: Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones. History: Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal; Bengal under the East India Company; religious and social reform movements; nationalist movements, division of the Indian sub-continent; language movement 1948-1952; education movement of 1962; six-point movement of 1966; mass uprising of 1969; war of independence and emergence of Bangladesh in 1971, Constitution of Bangladesh, Political Development and Democratic Transition (1971-1990), Political Development (1991- Present), Bangladesh's contribution to world peace and its security. Environment, Economy and Culture: Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health, Education, Agriculture, Industries, NGOs, Population, Sociological and Cultural aspects of Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Art and Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and critically analyse plurality of cultural identities of Bangladesh.						3						
CO2	Explain the economy and patterns of economic changes through qualitative and quantitative analysis.						3						

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO6	3	The students will have a good overall knowledge of historical, social, cultural aspects of Bangladesh.

CO2-PO6	3	Students will build attitude of ethical and the professional responsibility. They will have an understanding of economy related to engineering.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	75
Formal Assessment	5.5
Total	**108.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week-1	**Topic**	**CT**
Class-1	Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course	CT-1
Class-2	Bangladesh Geography: Location, Area, Boundary, Physiography, River System, Forest and Climate, Demography of Bangladesh.	
Week-2		
Class-3	Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal	
Class-4	Bengal under the East India Company, ;	
Week-3		
Class-5	Religious and Social reform movements	
Class-6	Nationalist movements, division of the Indian sub-continent	
Week-4		
Class-7	Language movement 1948-1952, Education movement of 1962	Mid exam
Class-8	Language movement 1948-1952, Education movement of 1962	
Week-5		
Class-9	Six-point movement of 1966; Mass uprising of 1969;	
Class-10	War of Independence and Emergence of Bangladesh in 1971	
Week-6		
Class-11-12	Constitution of Bangladesh, Political Development and Democratic Transition (1971-1990)	
Week-7		
Class-13-14	Political Development (1991- Present), Bangladesh's contribution to world peace and security.	
Week-8		
Class-15	Land, Characteristics of tropical Monsoon climate,	
Class-16	Forests and biomass, Fish	
Week-9		
Class-17	Minerals, Health and Education,	
Class-18	Agriculture, Industries	
Week-10		
Class-19	NGOs, Population, Sociological and Cultural aspects of Bangladesh	
Class-20	Economy and national development,	
Week-11		

Class-21	Development and Progress of the Millennium Development Goals (MDGs)	CT-2
Class-22	Public Administration in Bangladesh, State of Good Governance in Bangladesh	
Week-12		
Class-23	Art and Literature	
Class-24	Traditional cultural events	
Week-13		CT-3
Class-25	Vision-2021, Digitalization	
Class-26	Tourism and Natural Resources	
Week-14		
Class-27	Bangladesh and International Relations	
Class-28	Revision of the course	

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	CT	**20**	
1	Class Performance	**5**	
	Exam		
1 &2	MID Term	**15**	
1&2	Final Exam	**60**	

REFERENCE BOOKS

1. Bangladesh Studies: Md. Shamsul Kabir Khan and Daulatunnahar Khanam
2. The Constitution of the People's Republic of Bangladesh
3. Discovery of Bangladesh: Akbar Ali Khan
4. History of Bangladesh, Vols, 1-3: Sirajul Islam
5. History of Modern Bengal, Vol, 1: R C Majumdar
6. Dynastic History of Bengal: Dr. Abdul Mumin Chowdhury
7. A History of Bangladesh: William Van Schendel
8. A History of Sufism in Bengal: Dr. Enamul Huq
9. Geography of Bangladesh: Harun Er Rashid
10. Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10: Sirajul Islam
11. History of Bengal: (Mughal Period 1526-1765): R. A. Chandra
12. Land of Two Rivers: Nitesh Sengupta

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code	: **GEE 305**	Lecture Contact Hours	: **2:00**
Course Title	: **Fundamentals of Economics**	Credit Hours	: **2:00**

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic theories of economics in critical thinking and problem solving. To introduce the students to identify the basic features of economic development and regarding planning for the economy of the country.

OBJECTIVE

1. Students will demonstrate their knowledge of the fundamental and technical concepts of economics.
2. To work effectively in the organizations with honesty and integrity.
3. Students will be able to understand consumer behavior, elasticity and different market structure.
4. Students will be able to identify the determinants of various macroeconomic aggregates such as national income, full employment, unemployment, consumption and savings function, inflation, productivity and the major challenges associated with the measurement of these aggregates.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Realise the basic concepts and principles of Micro and Macro Economics.	1,2	C1	2			Q, ASG, F
CO2	Identify and apply the indifference curve theory and market equilibrium in real life situation	2,5	C2	2			Q, ASG, F
CO3	Explain time-value of money concept and apply the knowledge of inflation, investment and cost benefit analysis	4,10	C2	2			Q, F, CS

CO4	Realise the Economic Development and Planning for the country. To get idea of international economy.	9,12	C1	2			Q, F, CS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

Main Contents	Detail Contents
Fundamental of Economics	Definition
Production Possibility Frontier and Engineering Decision	1. PPF Curve. 2. Applying the PPF to Society's Choices by the Engineers.
Utility Theory	Law of diminishing marginal utility.
Demand	1. Definition. 2. Law of Demand. 3. Market Demand. 4. Reason for demand curve downward slopping. Mathematical Analysis
Supply	1. Definition. 2. Supply curve. 3. Market Equilibrium.
Elasticity of Demand	1. Different types of elasticity. 2. Different types of price elasticity. 3. Relation between AR, MR and elasticity 4. Mathematical Analysis
Indifference Curve Analysis and Consumers Equilibrium	Budget Line, MRS, Consumer Choice
Production Function from Engineering point of view	1. TP, AP, MP. 2. Law of Variable proportion. 3. Law of returns
Cost Analysis and Engineering Economics	1. TC, AC, MC. 2. Short run cost analysis
Analysis of Market Structure and Engineering Decision	1. Perfectly Competitive Market 2. Monopoly and Monopolistic Market
Key concept of Macroeconomics	Definition
National Income	GDP, GNP, NNP, NI
Circular Flow of National Income and Engineering Resources	Two, Three and Four sector Economy

Savings	Savings Function, APS, MPS. Derive the savings function from consumption functions; Mathematically and Graphically.
Consumptions	Consumption functions, APC, MPC
Investment	Investment Theories, Investment Multiplier
Engineering Plan considering the Inflation Rate of the Country	Demand-Pull and Cost-Push Inflation
The Effect of Monetary policy on Engineering Plan	Impact and Use
The Effect of Fiscal Policy on Engineering Plan	Impact and Use
Theories of Developments	1 or 2 Theories of Economic Development.
Economic Problems in Developing Countries especially in Bangladesh.	

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the basic concepts and principles of Micro and Macro Economics.	3											
CO2	Identify and apply the indifference curve theory and market equilibrium in real life situation		2										
CO3	Explain time-value of money concept and apply the knowledge of inflation, investment and cost benefit analysis	3											
CO4	Understand the Economic Development and Planning for the country. To get idea of international economy.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will be able to understand consumer behavior, elasticity and different market structure.
CO2-PO2	2	Applying the basic theories of economics in critical thinking and problem solving.
CO3-PO1	3	Students will be able to explain time-value of money concept
CO4-PO1	3	Student will understand the Economic Development and

		Planning for the country

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	75
Formal Assessment	5.5
Total	**108.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
1-4	Introduction to Engineering Economics, Importance of Economics in Engineering., Demand and determinants of Demand, Demand curve related basic idea and Mathematical Application, Supply and Determinants. Market Mechanism., Consumer Choice (Indifference Curve and Budget Line), Indifference Curve, Properties of IC, MRS, Theory of production in the point of view of Engineers	CT-1	
5-7	Theory of cost, Short run and long run cost curve Firms Equilibrium (Concepts), Different types of Market, How the Engineers will act in perfectly competitive market. How the Engineers will act in Monopoly Market, National Income analysis	CT-2	
8-9	Aggregate Demand and Aggregate Supply Determination of Level of Income and Employment Keynes Full Employment. Theory Circular flow of Income and Expenditure (How engineers will utilize the resources and decision-making process of project plan)	MID	
10-12	Consumption Function, Saving Function, Inflation, Type of Inflation, Impact of Inflation, Unemployment problem and its impact on society, Cost benefit analysis		
13	Theories of Economic Development, Economic Problems in Developing Countries		
14	Contribution of the Engineers in the Economic Development of Bangladesh. How the Engineers compare their development projects in the context of World Economy.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	

	Exam		
2	Final Exam, CT	**80**	
3	Final Exam, CT, MID	**80**	
4	Final Exam, CT	**100**	

REFERENCE BOOKS

1. Economics by P. A. Samuelson and W. D. Nordhaus (7th Edition)
2. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Edition)
3. Macroeconomics by N. Gregory Mankiw (8th Edition)
4. Principle of Economics by N. Gregory Mankiw (8th Edition)
5. Engineering Economics by Niall M. Fraser and Elizabeth M. Jewkes. (5th Edition)

Fall Semester L-3, T-II

COURSE INFORMATION

Course Code	**GES 307**	Lecture Contact Hours	2.00
Course Title	**Fundamentals of Sociology**	Credit Hours	2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

OBJECTIVE

Understanding social phenomena

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the basic nature, scope and perspectives of sociology.	1, 2	C1	1			ASG, T ,F
CO2	Apply sociological imagination to the context of social problems of BD society.	3	C2,C3	1,2			ASG, T ,F
CO3	Understand the stages of social research process and methodologies	7	C1,C2	1,2			ASG, T ,F
CO4	Analyze different cultures, civilizations and different social problems and design solutions for those.	11	C1,C2	1,2			ASG, T ,F
CO5	Understand and analyze social stratification, different social systems, socialism, capitalism and relate them to BD society	7	C2	1,2			ASG, T ,F

CO6	Apply contextual knowledge to assess societal and cultural issues in environmental context for sustainable development	7	C3	2			ASG, T ,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents: Understanding society, social phenomena and social change
b. Detail Contents: Nature and scope Sociological imagination, Perspectives of sociology, Stages of social research and research method, Culture and civilization, Socialization and self - development, Globalization and social changes, Media and individual, Social organizations and social problems, social stratification; industrial revolution, Capitalism and socialism, Work and economic life, Environment and human activities, Climate change and global risk, Population and human society, Urbanization and city development, Social changes and technology.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand the basic nature, scope and perspectives of sociology.	3	3										
CO2	Apply sociological imagination to the context of social problems of BD society.			3									
CO3	Understand the stages of social research process and methodologies							3					
CO4	Analyze different cultures, civilizations and different social problems and design solutions for those.											3	
CO5	Understand and analyze social stratification, different social systems, socialism, capitalism and relate them to BD society							3					
CO6	Apply contextual knowledge to assess societal and cultural issues in environmental context for sustainable development							3					

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Students will have the knowledge about nature, scope and perspectives of sociology.
CO1-PO2	3	They will identify and research literature on various sociological perspectives.
CO2-PO3	3	Design systems, components of social research process and methodologies
CO3-PO7	3	Understand and evaluate the sustainability and impact of professional work of social methodology
CO4-PO11	3	Students will demonstrate knowledge of different cultures, civilizations and different social problems management and economic decision making.
CO5-PO7	3	Students will analyze social stratification, different social systems, socialism, and capitalism and relate them to BD society for sustainability.
CO6-PO7	3	Students will be able to apply contextual knowledge to assess societal and cultural issues in environmental context

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	75
Formal Assessment	5.5
Total	**108.5**

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE			
Week-1	Class 1-2	Definition, nature and scope of sociology, Sociological imagination	CT 1
Week-2	Class 3-4	Perspectives of sociology, Orientation of sociological theories	
Week-3	Class 5-6	Social research and its process, Research designs and techniques.	
Week-4	Class 7-8	Introducing culture and its variations, civilization	
Week-5	Class 9-10	Defining family and its changes, Socialization process and development of self	
Week-6	Class 11-12	Introducing globalization and its impact on human life, Factors responsible to globalization	MID
Week-7	Class	Media and its impact in modern society, Addressing social	

	13-14	problems of Bangladesh	
Week-8	Class 15-16	Introducing social groups and Introducing bureaucracy and good governance	
Week-9	Class 17-18	Introducing social stratifications and social inequality, Poverty and its types and dimensions	
Week-10	Class 19-20	Industrial revolution and aftermath, Urbanization and city development	CT 2
Week-11	Class 21-22	Capitalism: features and influence , Socialism: features and influence	
Week-12	Class 23-24	Environment and human activities , Climate change and global risk	
Week-13	Class 25-26	Population of Bangladesh: problem or prospect , Crime and deviance: a brief analysis	
Week-14	Class 27-28	Review	

ASSESSMENT STRATEGY

COs	Assessment Method	100%	Remarks
	Class assessment		
1-3	Class performance	05	
4-6	Class tests/ assignment	20	
1-6	Mid term exam	15	
	Exam		
1-6	Final exam	60	

REFERENCE BOOKS

1. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
2. Sociology - Primary Principles: by CN Shankar Rao
3. Anthony Giddens- 5th edition
4. Relevant journal

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**CSE 275** **Computer Programming Language**	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to design and develop computer programs. Apart from these, this course will also introduce the important topics related to Arduino programming.

OBJECTIVE

1. The course is designed to provide fundamental knowledge of C language.
2. Students will be able to develop logics which will help them to create programs, applications in C.
3. Learning the basic programming constructions they can easily switch over to any other language (like C++ and Arduino programming) in future.

LEARNING OUTCOMES& GENERIC SKILLS

No.	Course Learning Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Describe the fundamentals and concepts of procedural programming language.	C1-C3	1	-	1	T
CO2	Analyse the fundamental principles, typical characteristics and mechanisms of computer programming language.	C4	3	-	6	T, F, MT
CO3	Develop programming skills with respect to program design and development.	C6	1,3	-	5	F
CO4	Able to develop the communication skill by presenting topics on Computer Programming Language.	A2	1	-	5	Q, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

COURSE CONTENT

a. **Main Contents:** Introduction to computer programming; Number System; Basic programming Structures; Control Structure; Array; Function; Pointer; Dynamic Memory Allocation; User defined data types; Bitwise Operations; File I/O, header files, preprocessors, error handling; Introduction to C++; Fundamentals on Arduino programming.

b. Detailed Contents:

- Introduction to computer programming: Programming Concepts, Program Development Stages, Structured Programming Language
- Number System: binary, octal, decimal and hexadecimal systems
- Basic programming Structures: Data types and their memory allocation, operators, expressions, basic input/ output
- Control Structure: if-else, switch case, nested if-else, loop, nested loop
- Array: one-dimensional array, multi-dimensional array, character array/ string
- Function: Function definition, function declaration, function call
- Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference
- Dynamic Memory Allocation: Malloc, calloc, free, realloc
- User defined data types: Structure, union, enumeration
- Bitwise operations: AND, OR, NOT, XOR, Left shift, Right Shift
- File I/O, header files, preprocessors, error handling
- Introduction to C++: Basic Ideas of OOP- encapsulation, inheritance and polymorphism, Classes and objects
- Fundamentals on Arduino Programming: Setup the Arduino software and start outputting code

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Describe the fundamentals and concepts of procedural language.	3											
CO2	Analyse the fundamental principles, typical characteristics and mechanisms of a computer programming language.		3										
CO3	Develop basic programming skills with respect to program design and development.			3									
CO4	Able to develop the communication skill by presenting topics on Computer Programming Language.										1		

(3 – High, 2- Medium, 1-low)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level	Justifications
CO1-PO1	3	In order to solve complex engineering problems using computer engineering knowledge, the knowledge and concepts of procedural language is very important.
CO2-PO2	3	To identify and analyse the complex engineering problems regarding computer science, one needs to have the knowledge of analysing the fundamental principles, typical characteristics and mechanisms of a computer programming language.
CO3-PO3	3	To design and develop solutions for complex computer engineering problems, one needs to develop basic programming skills.
CO4-PO10	1	In order to give a presentation on the selective topics from the course taught, one needs to have strong communication skills.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio	 42 -
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY		
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method		
COURSE SCHEDULE		
Week	**Topics**	**Assessment Methods**
1	Introduction to computer programming: Programming Concepts, Program Development Stages, Structured Programming Language; Basic programming Structures: Data types and their memory allocation, operators, expressions, basic input/ output	Class Test – 1
2	Number System: binary, octal, decimal and hexadecimal systems	
3	Control Structure: if-else, switch case, nested if-else, loop, nested loop	
4	Control Structure: loop, nested loop	Class Test – 2
5	Array: one-dimensional array, multi-dimensional array, character array/ string	
6	Function: Function definition, function declaration, function call	
7	Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference	
8	Dynamic Memory Allocation: Malloc, calloc, free, realloc	Mid Term
9	User defined data types: Structure, union, enumeration	
10	Bitwise operations: AND, OR, NOT, XOR, Left shift, Right Shift	
11	File I/O, header files, preprocessors, error handling	Class Test – 3
12	Introduction to C++: Basic Ideas of OOP- encapsulation, inheritance and polymorphism	
13	Introduction to C++: Classes and objects	
14	Introduction to Arduino: Setup the Arduino software and start outputting code	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
2	Final Exam, CT	**80**	
3	Final Exam, CT, MID	**80**	
4	Final Exam, CT	**100**	

REFERENCE BOOKS

1. Teach Yourself C (3rd Edition) by Herbert Schidlt
2. Programming in Ansi C (6th Edition) by E Balagurusamy
3. C: The Complete Reference (4th Edition) by Herbert Schildt
4. C++: The Complete Reference (4th Edition) by Herbert Schildt
5. C Programming Language (2nd Edition) by Dennis M. Ritche

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**CSE 276** **Computer Programming Language Sessional**	Lecture Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

CSE 275

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to practically introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to design and develop computer programs. Apart from these, this course will also introduce the important topics related to Arduino programming.

OBJECTIVE

1. The course is designed to provide practical knowledge of C language.
2. Students will be able to develop logics which will help them to create programs, applications in C.
3. Learning the basic programming constructs using other languages like C++ and Arduino Programming in future.

LEARNING OUTCOMES& GENERIC SKILLS

No.	Course Learning Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Solve problems systematically using a structured logic approach, OOP and Arduino programming.	C1-C3	1	-	4	T, ASG
CO2	Practically analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.	C4	3	-	4, 5	T, ASG, Q
CO3	Construct or develop complete programs for simple to moderate problems individually.	C6	1, 3	2	5,7	T, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

COURSE CONTENT

Main Contents: Introduction to computer programming; Number System; Basic programming Structures; Control Structure; Array; Function; Pointer; Dynamic Memory Allocation; User defined data types; Bitwise Operations; File I/O, header files, preprocessors, error handling; Introduction to C++; Introduction to MATLAB; Introduction to Arduino

Detailed Contents:

- Introduction to computer programming: Programming Concepts, Mathematical problems using printf, scanf
- Basic programming Structures: Data types and their memory allocation, operators, expressions, basic input/ output
- Control Structure: if-else, switch case, nested if-else, loop, nested loop
- Array: one-dimensional array, multi-dimensional array, character array/ string
- Function: Function definition, function declaration, function call
- Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference
- Dynamic Memory Allocation: Malloc, calloc, free, realloc
- User defined data types: Structure, union, enumeration
- File I/O, header files, preprocessors, error handling
- Introduction to C++: Basic Ideas of OOP- encapsulation, inheritance and polymorphism, Classes and objects
- Fundamentals on Arduino Programming: Setup the Arduino software and start outputting code

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Solve problems systematically using a structured logic approach, OOP and Arduino programming.						3						
CO2	Practically analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.						3						
CO3	Construct or develop complete programs for simple to moderate problems individually.									2			

(3 – High, 2- Medium, 1-low)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level	Justifications
CO1-PO6	3	To apply reasoning informed by the contextual knowledge one needs to know how to solve problems using a structured logic approach.

CO2-PO6	3	To apply reasoning informed by the contextual knowledge one needs to know how to practically analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.
CO3-PO9	2	To function effectively as an individual, one needs to know how to develop complete programs individually.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 - 42 -
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	 21 _ _
Formal Assessment Continuous Assessment Final Examination	 4 3
Total	70

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week-1	Mathematical problems using printf, scanf
Week-2	Number System: Conversion between different number systems such as binary, octal, decimal and hexadecimal systems
Week-3	Control Structure: if-else, switch case, nested if-else, loop, nested loop
Week-4	Control Structure: loop, nested loop
Week-5	Array: one-dimensional array, multi-dimensional array, character array/ string
Week-6	Function: Function definition, function declaration, function call
Week-7	Lab Test – 1
Week-8	Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference
Week-9	Dynamic Memory Allocation: Malloc, calloc, free, realloc
Week-10	User defined data types: Structure, union, enumeration
Week-11	Bitwise operations: AND, OR, NOT, XOR, Left shift, Right Shift; File I/O, header files, preprocessors, error handling
Week-12	Introduction to C++: Classes and objects; Introduction to MATLAB: MATLAB environment, matrices, function, loop, file I/O
Week-13	Introduction to Arduino: Setup the Arduino software and start outputting code
Week-14	Lab Test – 2

ASSESSMENT STRATEGY

Component		Grading
Continuous	Lab participation and Report	30%

Assessment (60%)		
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. Teach Yourself C (3rd Edition) by Herbert Schidlt 2. Programming in Ansi C (6th Edition) by E Balagurusamy 3. C: The Complete Reference (4th Edition) by Herbert Schildt 4. C++: The Complete Reference (4th Edition) by Herbert Schildt 5. C Programming Language (2nd Edition) by Dennis M. Ritche

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	EECE 159 Fundamentals of Electrical Engineering	Lecture Contact Hours Credit Hours	3.00 3.00
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Basic electrical engineering is an introductory course in electrical engineering. Students are introduced to simple applied electrical circuits, theories and practice to impart skill set to have visualization of electrical engineering applications.			
OBJECTIVE			
1. To set a firm and solid foundation in Electrical Engineering with strong analytical skills and conceptual understanding of basic laws and analysis methods in electrical and magnetic Circuits. 2. To provide students of all branches of engineering with an overview of all the fields of electrical engineering 3. To prepare students for learning advanced topics in electrical engineering			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Correspon ding PO	Bloom's Taxonom y	KP	CA	CP	Assessment Methods

CO1	Understand & apply Kirchoff's laws, network theorems, time domain analysis for RL & RC series circuit	1, 2	C2, C3	K1			Q, ASG, F
CO2	Understand and analyse phasor diagram and waveforms for purely resistive, purely inductive and purely capacitive as well as series and parallel R-L, R-C & R-L-C circuits and also circuit Resonance.	2, 5	C3, C5	K6		CP1	Q, ASG, F
CO3	Understand concepts of Real, Reactive & apparent power and Power factor. Understand 3-phase supply and star and delta connection and their relationships. Power measurement by wattmeter	2, 12	C2, C3	K3		CP1	Q, ASG, F
CO4	Understand construction & working principle of 1-phase and 3-phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	1,3	C1, C2	K5		CP1	Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Laws of electric circuit: Ohm's Law, Kirchhoff's voltage and current laws, delta-wye transformation. Electrical networks: network analysis methods of branch and loop currents, method of node pair voltages, Thevenin's and Norton's theorems, Magnetic concepts and units: magnetic field, right hand rule, magnetic flux density, Biot Savart law, magnetic field intensity, measurement of magnetic flux, energy of magnetic field, characteristic of ferromagnetic materials, theory of ferromagnetism, B-H curve, hysteresis loss, eddy current and eddy current loss, total core loss. Introduction to magnetic circuits. Electromagnetic forces: forces upon a current carrying conductor and charged particles moving in a magnetic field. Electromagnetic torque; electric motor. Electromagnetic induction and emf; Lenz's law, Blv rule, elementary a.c. generator.
General concepts and definitions. Instantaneous current, voltage and power, R-, L-, C-, RL-, RC- and RLC- branches, Effective current and voltage: average values, form factor, crest factor, power real and reactive. Introduction to vector algebra. Impedance in polar and Cartesian forms. Sinusoidal single-phase circuit analysis. Impedance in series, parallel branches, series-parallel circuits. Network analysis – Thevenin's theorem. Balanced poly phase circuits: three phase, four wire system of generated emfs, three phase, three wire systems, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three phase circuit analysis and power measurement.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand & apply Kirchoff's laws, network theorems, time domain analysis for RL & RC series circuit	3	1										
CO2	Understand and analyse phasor diagram and waveforms for purely resistive, purely inductive and purely capacitive as well as series and parallel R-L, R-C & R-L-C circuits and also circuit Resonance.		3			2							
CO3	Understand concepts of Real, Reactive & apparent power and Power factor. Understand 3-phase supply and star and delta connection and their relationships. Power measurement by wattmeter		3										2
CO4	Understand construction & working principle of 1-phase and 3-phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	3		2									

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Basic knowledge about Ohm's and Kirchoff's laws will be gained by the students
CO1-PO2	1	Students will be able to identify, analyze and formulate problems in DC circuits domain
CO2-PO2	3	Students will identify and analyze various problems related to AC circuits using principles of mathematics.
CO2-PO5	2	Students use different measuring instruments for practical performance of series and parallel AC circuit.
CO3-PO2	3	Students will identify, formulate and analyze various problems related to 3-phase power measurement using principles of mathematics.
CO3-PO12	2	3-phase power measurement will be helpful to the students for lifelong learning.
CO4-PO1	3	Students will gain basic knowledge about 1-phase and 3-phase transformer along with auto transformer.
CO4-PO3	2	Students will be able to design that will meet the specified

		needs with appropriate consideration for the safety about 1-phase and 3-phase transformer along with auto transformer.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Lecture	Topic	CT	Remarks
Lec 1-10	Laws of electric circuit: Ohm's Law, Kirchhoff's voltage and current laws, delta-wye transformation. Electrical networks: network analysis methods of branch and loop currents, method of node pair voltages, Thevenin's and Norton's theorems.	CT-1	
Lec 11-18	Magnetic concepts and units: magnetic field, right hand rule, magnetic flux density, Biot Savart law, magnetic field intensity, measurement of magnetic flux, energy of magnetic field, characteristic of ferromagnetic materials, theory of ferromagnetism, B-H curve, hysteresis loss, eddy current and eddy current loss, total core loss.	CT-2 CT-3	
Lec 19-26	Introduction to magnetic circuits. Electromagnetic forces: forces upon a current carrying conductor and charged particles moving in a magnetic field. Electromagnetic torque; electric motor. Electromagnetic induction and emf; Lenz's law, Blv rule, elementary a.c. generator.		
Lec 27-35	General concepts and definitions. Instantaneous current, voltage and power, R-, L-, C-, RL-, RC- and RLC- branches, Effective current and voltage: average values, form factor, crest factor, power real and reactive.		
36-42	Introduction to vector algebra. Impedance in polar and Cartesian forms. Sinusoidal single-phase circuit analysis. Impedance in series, parallel branches, series-parallel circuits.		

	Network analysis – Thevenin's theorem. Balanced poly phase circuits: three phase, four wire system of generated emfs, three phase, three wire systems, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three phase circuit analysis and power measurement.		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO 1	Class Observations/Assignments	**20**	
CO 2		**20**	
CO 3		**20**	
CO 4		**20**	
	Exam		
CO 1	CT/Mid/Final Exam	**80**	
CO 2		**80**	
CO 3		**80**	
CO 4		**80**	

REFERENCE BOOKS

1. Introductory Circuit Analysis – R. L. Boylestad.
2. Introductory Circuit for Electrical & Computer Engineering – James W. Nilson.
3. Alternating Current Circuits – Russel M Kerchner and George F Corcoran.

Fall Semester L-1, T-II

COURSE INFORMATION

Course Code	**EECE 173**	Lecture Contact Hours	3.00
Course Title	**Electrical and Electronics Technology**	Credit Hours	3.00

PRE-REQUISITE

EECE-159

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course gives idea about basic circuit solution methods, introduction to electrical machines, basics of domestic electrical installations, diodes, transducers, amplifier, rectifier etc.

OBJECTIVE

1. This course gives idea about basic circuit solution methods, introduction to electrical machines and basics of domestic electrical installations.
2. Analyze the general and special-Purpose diode circuits.
3. Design biasing circuits for BJT.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome		Bloom's	KP	CA	CP	Assessment

		Corresponding PO	Taxonomy				Methods
CO1	Understand construction & working principle of 1-phase and 3-phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	1,3					
CO2	Understand generation of rotating magnetic fields. Understand construction and working of 3-phase induction motor, 1-phase induction motor, DC motors& synchronous generators.	1,3					
CO3	Analyze the general –and special-Purpose diode circuits.	1					
CO4	Design biasing circuits for BJT	1					

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Single phase transformer-equivalent circuit and laboratory testing, introduction to three phase transformers. DC generator: principle, types, performances and characteristics. D C Motor: principles, types of motor, performances, speed control, starters and characteristics. A C Machines: three phase induction motor principles, equivalent circuit. Introduction to synchronous machines and fractional horse power motors.

Semiconductor diode, transistor characteristics, equivalent circuits, self-biasing circuits, emitter-follower amplifiers, push-pull amplifier. Introduction to silicon-controlled rectifier and its application. Oscilloscope. Transducers: strain, temperature, pressure, speed and torque measurements.

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand construction & working principle of 1-phase and 3-phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	3		2									
CO2	Understand generation of rotating magnetic fields. Understand construction and working of 3-phase induction motor, 1-phase induction motor, DC motors& synchronous generators.	3		2									
CO3	Analyze the general –and special-Purpose diode circuits.	3											
CO4	Design biasing circuits for BJT	3											

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Students will gain basic knowledge about 1-phase and 3-phase transformer along with auto transformer.
CO1-PO3	2	Students will be able to design that will meet the specified needs with appropriate consideration for the safety about 1-hase and 3-phase transformer along with auto transformer
CO2-PO1	3	Students will gain basic knowledge about construction and principles of DC & AC electrical machines
CO2-PO3	2	Knowledge about DC & AC electrical machines will be useful for public health and safety.
CO3-PO1	3	Basic knowledge about general and special purpose diodes will be gained by the students
CO4-PO1	3	Students will be able to apply knowledge of biasing for BJT in solving circuits which will lead to solution of complex engineering problems.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Lecture	Topic	CT
Lec 1-10	Single phase transformer-equivalent circuit and laboratory testing, introduction to three phase transformers.	CT-1
Lec 11-18	Semiconductor diode, transistor characteristics, equivalent circuits, self-biasing circuits, emitter-follower amplifiers, push-pull amplifier.	CT-2
Lec 19-26	A C Machines: three phase induction motor principles, equivalent circuit. Introduction to synchronous machines and fractional horse power motors.	CT-3
Lec 27-35	General concepts and definitions. Instantaneous current, voltage and power, R-, L-, C-, RL-, RC- and RLC-branches, Effective current and voltage: average values, form factor, crest factor, power real and reactive.	
36-42	Introduction to silicon-controlled rectifier and its application. Oscilloscope. Transducers: strain, temperature, pressure, speed and torque measurements.	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO 1	Class Observations/Assignments	**20**	
CO 2		**20**	
CO 3		**20**	
CO 4		**20**	
	Exam		
CO 1	CT/Mid/Final Exam	**80**	
CO 2		**80**	
CO 3		**80**	
CO 4		**80**	

REFERENCE BOOKS

1. Electric Machines and Transformers – Irving L. Kosow.
2. Electrical Machines Fundamentals – Stephan J. Chapman.
3. A Text Book of Electrical Technology (AC, DC Machines) –B L Theraja and A. K. Theraja.
4. Electronic Divices and Circuit Theries – R. L. Boylsted.

Fall Semester L-1, T-II

COURSE INFORMATION

Course Code Course Title	EECE 174 Electrical and Electronic Technology Sessional	Lecture Contact Hours Credit Hours	3.00 1.50

PRE-REQUISITE

1. EECE 159 Fundamentals of Electrical Engineering

2. EECE 173 Electrical and Electronics Technology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Electrical Engineering lab is designed to impart into the students the basic concepts of electrical engineering encompassing the practical implementations of DC and AC circuits. At the beginning of this course, students will get to know the projection of fundamental DC circuit using the basic equipment along with the observation of the basic theorems as well as the AC circuit concepts will be experimented accompanying the showcase of various types of filter and their characteristics. In the following part of the lab, some basic electronics experiment using diode and transistor will be done. In the last part of the course, the students will be familiarized with various electrical machines like DC and Ac motor and generator.

OBJECTIVE

1. To introduce the students to basic DC circuit laws and solving of complex circuits using basic circuit theorems
2. To impart into the students with the AC circuit hardware construction and operation.
3. To familiarize the students with different type of filter construction and their characteristics.
4. To give in depth knowledge on the basic electronics circuit using diode and transistor.

To introduce the students to different type of Dc and AC motor and generators.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Achieving the quality to construct DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.	9	A4			2	R, Q, T
CO2	Attaining the competency to reproduce the basic filters and to explain their characteristics.	10	P3			3	R, Q, T
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component	9	A3	1		3	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 159 and EECE 173 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Achieving the quality to construct DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.									2			
CO2	Attaining the competency to reproduce the basic filters and to explain their characteristics.										2		
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component									2			

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO9	**2**	Students will work in teams to construct the circuits
CO2-PO10	**2**	Students will present and write technical reports
CO3-PO9	**2**	Students will work in tems to perform various experimetns

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	Exp 1: Verification of KVL and KCL
Week 2	Exp 2: Verification of Thevenin's Theorem
Week 3	Exp 3: Familiarization with alternating current (ac) waves and study of RLC series circuit
Week 4	Exp 4: Different types of filters and its characteristics with different input frequency
Week 5	Exp 5: Study the diode characteristics and rectifier circuit
Week 6	Exp 6: Study of N-P-N CB (Common base) and CE (Common emitter) transistor characteristics
Week 7	Exp 7: Regulation of the Transformer in Various Loads
Week 8	Exp 8: Study the properties of Three-Phase Alternator in various loads
Week 9	Exp 9: Study the properties of DC Shunt Motor.
Week 10	Exp 10: Study the properties of DC Separately Excited and Self-Excited Shunt Generator.
Week 11	Exp 11: Study the properties of Squirrel-Cage Induction Motor.
Week 12	Quiz
Week 13	Lab test + Viva
Week 14	Presentation

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C3, C5
			CO 2	C1, P3
			CO 3	C4
	Labtest-1,Labtest-2	30%	CO 1	C3, C5
			CO 2	C1, P3
			CO 3	C4
	Project and Presentation	25%	CO4	A1, A2, A3, A4
Lab Quiz		25%	CO 1	C3, C5
			CO 2	C1, P3
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

N/A

Fall Semester L-4, T-II

COURSE INFORMATION			
Course Code Course Title	**IPE 463** **CAD/CAM**	Lecture Contact Hours Credit Hours	: 2.00 : 2.00

PRE-REQUISITE
N/A
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To design, analyze and select commonly used robots and implement NC, CNC program based manufacturing using computer-controlled machines and rapid tooling techniques.
OBJECTIVE
1. To conduct study on Robot anatomy and drive systems of robots. 2. To expose students to servo drives using voltage, current and direct torque and PID control systems. 3. To introduce different motion control systems using various types of sensors, encoders and methods of integration by using PLCs. 4. To expose students to manual part programming using G and M Codes 5. To introduce machine programming using APT like programming languages 6. To expose students to programming of free form surfaces from CAD-CAM database for machining and rapid prototyping

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Explain robot anatomy and the degrees of freedom of industrial robots	1, 3, 5	C1,C2	1	1	1	T, Mid Term Exam, F
CO2	Explain strategies for robot motion control under the application of different types of sensor, encoders and methods of integration	1, 3	C1,C2	1	1	1	ASG, Mid Term Exam, F
CO3	Program PLC to Control coordinated motions of robot and write manual part program using G and M Codes	1, 3	C3,C4	3	2	5,6	ASG, Mid Term Exam, F
CO4	Prepare part program using programming languages such as APT and Explain the morphology of part program development for complex surfaces using CAD-CAM software for machining and rapid prototyping applications	1, 3, 5	C6	3	3	6,7	T, ASG, R, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)
C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create)

COURSE CONTENT

Robot: Robot anatomy, Drive systems of robots, Electrical and hydraulic systems, AC and DC drives, Servo drives using voltage control, current control and direct torque control, PID control systems and performance issues.
Feedback systems, Single loop and multi-loop, DSP based motion control systems.
Sensors for industrial robots, encoders, resolvers, hall-effect sensors, acoustic sensors, ultrasonic and optical/infrared sensors.
Elements of robot vision, Integration using PLCs, digital motion planning systems
Computer Control Machines: Introduction, classification, design features and control features of CNC machines; Programming: G and M Code programming, Offline (APT-like) programming; free form surface machining: Isoparametric, Isoplanar and Isoscallop machining strategies.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain robot anatomy and the degrees of freedom of industrial robots	3		3		3							
CO2	Explain strategies for robot motion control under the application of different types of sensor, encoders and methods of integration	3		3									
CO3	Program PLC to Control coordinated motions of robot and write manual part program using G and M Codes	3		3									
CO4	Prepare part program using programming languages such as APT and Explain the morphology of part program development for complex surfaces using CAD-CAM software for machining and rapid prototyping applications	3		3		1							

(3 – High, 2- Medium, 1-low)

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Understanding robot anatomy and the degrees of freedom of industrial robots need knowledge of mathematics, natural science, Engineering fundamentals.
CO1-PO3	3	Understanding robot anatomy and the degrees of freedom of industrial robots, students will be able to Design solutions for

		complex engineering problems and design systems, components or processes.
CO1-PO5	3	To design a robot students will need appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.
CO2-PO1	3	To understand robot motion control under the application of different types of sensor, encoders and methods of integration students will required knowledge of mathematics, natural science, Engineering fundamentals.
CO2-PO3	3	Understanding robot motion control under the application of different types of sensor, encoders and methods of integration, students will be able to Design solutions for complex engineering problems and design systems, components or processes.
CO3-PO1	3	Programing PLC to Control coordinated motions of robot and write manual part program using G and M Codes, students will required knowledge of mathematics, natural science, Engineering fundamentals.
CO3-PO3	3	Program PLC to Control coordinated motions of robot and write manual part program using G and M Codes, students will be able to Design solutions for complex engineering problems and design systems, components or processes
CO4-PO1	3	Preparing part program using programming languages, students will required knowledge of mathematics, natural science, Engineering fundamentals.
CO4-PO3	3	Preparing part program using programming languages, students will be able to Design solutions for complex engineering problems and design systems, components or processes
CO4-PO5	1	To prepare part program using programming languages, students will need appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	40
Revision	20
Assignment Preparations	20
Formal Assessment	
Continuous Assessment	2

Final Examination	3
Total	127

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

COURSE SCHEDULE

Week	Topics	ASSESSMENT
1	Introduction Robots: types, uses and classification and Robot applications	Class Test 1, ASG, F
2	Robot anatomy Axes system and Grippers	
3	Drive systems of robots: AC and DC drives, Servo drives using voltage control , current control and direct torque control,	
4	PID control systems and performance issues Integration using PLCs Digital motion planning systems	Class Test 2, ASG, PR, F
5	Sensors for industrial robots, encoders Resolvers, hall-effect sensors Acoustic sensors, ultrasonic and optical/infrared sensors,	
6	Elements of robot vision	
7	Integration using PLCs Digital motion planning systems	
8	Introduction to Automation, CAD/CAM/CAE: Overview of product life cycle, Essential components of soft automation (CAD and CAM). NC Machine tool: Historical Development, Principle of Numerical Control, Classification of Numerical Control, Numerical Control System. Principle of Numerical Control, Classification of Numerical Control, Numerical Control System.	Mid Term, F
9	Coordinate system, NC Program storage media, Symbolic codes NC words, part programming, tool radius compensation. G&M code applications and NC Par Programming examples and problem solving.	
10	APT programming features Definition of Geometry statements Geometry statement (examples)	
11	Definition of Motion statements Definition of Motion statements Motion statement (examples)	Class Test 3, ASG, R, PR, F
12	Geometry definition for turning and 21/2 axis milling Tool path generation, simulation and verification free form surface machining	
13	Overview, specific, RP &M process,	

	Application of RP and M, Stereo lithography process, Selective Laser Sintering, 3D Printing, Direct Tooling example	
14	Geometry input, Support Structure, Slice and Merge Software technology for RP&M and Review	

ASSESSMENT STRATEGY

Assessment Strategies			CO
Components		Grading	
Continuous Assessment (40%)	Test 1-3	20%	CO 1
			CO 3
			CO 4
	Class Participation	5%	CO 2
			CO 1
	Mid term	15%	CO 1
			CO 2
			CO 3
Final Exam		60%	CO 1
			CO 2
			CO 3
			CO 4
Total Marks		100%	

(CO = Course Outcome)

REFERENCE BOOKS

1. CAD/CAM: Computer-aided Design and Manufacturing - Mikell Groover
2. CAD/CAM theory and practice - Ibrahim Zeid
3. CAD/CAM/CIM - P. Radhakrishnan, S. Subramanyan, and V. Raju

Fall Semester L-4, T-II

COURSE INFORMATION

Course Code	**IPE 464**	Lecture Contact Hours	: 3.00
Course Title	**CAD/CAM Simulation sessional**	Credit Hours	: 1.50

PRE-REQUISITE

Concurrent with IPE-463

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The main aim is the use of computer systems to aid in the creation, modification, analysis or optimization of an engineering design.

OBJECTIVE

1. Create 2D and 3D computer drawings and models for manufacturing and prototyping.
2. Evaluate mechanical designs and select proper access and materials for production.
3. Evaluate computer aided design models and assemblies based on critical thinking and

problem-solving skills.

4. Apply design principles and rationale in a realistic and original design project.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Create 2D and 3D computer drawings and model for manufacturing and prototyping.	1, 3, 5	C6	1	1,3	1,2	R
CO2	Evaluate mechanical designs and select the proper access and materials for production.	1, 3	C3, C5	1, 2	1,2	5,6	R
CO3	Evaluate computer aided design models and assemblies based on critical thinking and problem solving skills.	1, 3	C5	1, 2	1	5,6	ASG,R
CO4	Apply design principles and rationale in a realistic and original design project.	1, 3, 5	C3, C4	1	5	2	ASG, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)
C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create)

COURSE CONTENT

Introduction to CAD/CAM, Geometric modeling, Computer graphics, Product Design and development using CATIA, Future directions for CAD/CAM, CAD/CAM Programming using MASTERCAM, Solidworks CAD/CAM package

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Create 2D and 3D computer drawings and model for manufacturing and prototyping.	3											
CO2	Evaluate mechanical designs and select the proper access and materials for production.		3	3									
CO3	Evaluate computer aided design models and assemblies based on critical thinking and problem solving skills.		3	3									
CO4	Apply design principles and rationale in a realistic and original design project.	3		3									

(3 – High, 2- Medium, 1-low)

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	To Create 2D and 3D computer drawings and model for manufacturing and prototyping students will require knowledge of mathematics, natural science, engineering fundamentals.
CO2-PO2	3	To evaluate mechanical designs, students need to Identify, formulate, research literature and analyse complex engineering problems.
CO2-PO3	3	Students will evaluate mechanical designs and select the proper access and materials for production.
CO3-PO2	3	To evaluate computer aided design models, students need to Identify, formulate, research literature and analyse complex engineering problems.
CO3-PO3	3	Students will evaluate computer aided design models and assemblies based on critical thinking and problem-solving skills.
CO4-PO1	3	To apply design principles and rationale in a realistic and original design project, students will require knowledge of mathematics, natural science, engineering fundamentals.
CO4-PO3	3	Students will apply design principles and rationale in a realistic and original design project.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision	 40 20
Assignment Preparations Formal Assessment Continuous Assessment Final Examination	20 2 3
Total	127

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

COURSE SCHEDULE

Week	Topics	Remarks
1	Introduction	
2	CATIA	Assignment (Extra)
3	CATIA	Submit Assignment 1

4	CATIA	Submit Assignment 2
5	CATIA	
6	**Quiz 1**	Submit Assignment 3
7	CATIA	Submit Assignment 4, 5 20% Drawing of the presentation should be completed (will be discussed in class for specific need/struggle you are facing to draw the product assigned)
8	CATIA	Submit Assignment 6, Draft submission of the report
9	CATIA	Submit Assignment 7
10	**Quiz 2**	Submit Assignment 8
11	CATIA	Initial submission of the SolidWorks drawing (Group wise) for the presentation. At least 80% of the drawing should be completed by this time
12	CATIA	Submit Assignment 9, Submit an initial Draft of the Presentation
13	**Presentation**	Submit Assignment 10
14	**Viva**	

ASSESSMENT STRATEGY

Assessment Strategies			CO	Bloom's Taxonomy
Components		Grading		
Continuous Assessment (70%)	Weekly Reports	20%	CO 1	C6
			CO 2	C3, C5
			CO 3	C5
			CO 4	C3, C4
	Class Participation	40%	CO 1	C6
			CO 2	C3, C5
			CO 3	C5
			CO 4	C3, C4
	Presentation	10%	CO 4	C3, C4
Final Report		30%	CO 1	C6
			CO 2	C3, C5
			CO 3	C5
			CO 4	C3, C4
Total Marks		100%		

(CO = Course Outcome)

REFERENCE BOOKS

1. CAD/CAM Lab Manual Book by Sathish D

SpringSemester L-4, T-I

COURSE INFORMATION			
Course Code Course Title	**: GEPM 467** **: Project Management and Finance**	Lecture Contact Hours Credit Hours	: 2.00 : 2.00

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course has been designed to understand the overlapping connection between engineering and management with financial matters in an organization through the study of varied management practices and finance as an engineer.

OBJECTIVE

a. This course has been designed to understand the overlapping connection between engineering and management with financial matters in an organization through the study of varied management practices and finance as an engineer.

b. To identify the tools and techniques needed to lead any project to its intended conclusion.

c. To introduce sales fundamentals include understanding the customer and the competition, sales strategy, sales management, product positioning, product life cycle, sales structures, margins, and prospecting for new customers.

d. Explain how engineering projects that are delivered through the support of project management activities contribute to the overall success and strategy of an organisation

LEARNING OUTCOMES & GENERIC SKILLS

No.	**Course Outcomes**	**Corresponding PO**	**Bloom's Taxonomy**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	Develop in depth idea on mechanical project management and organization to perform the Management Functions.	PO1, PO11	C3	1	1	-	Q, ASG, F
CO2	Compare between selected Theories of Management.	PO1	C4	1	2	1	Q, ASG, F
CO3	Design nuclear project and to perform the functions in the Marketing Mix	PO2, PO3	C5	1	2	-	Q, F, CS

CO4	Develop knowledge of effective material management; management and resource allocation; Engineering economy and assessment on ethical issues in business situations.	PO11	C6	2	3	1	Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Unit Overview and Introduction to Project Management

ii. The Organisation: strategy, structure, and culture

iii. Project Planning, Scheduling, and Resourcing

iv. Risk Management

v. Building a Project Team

vi. Cost Estimating

vii. Managing Project Quality and Supply Chain Management

b. Detail Contents:

Importance of project management to engineers, project life cycle, main stages of project definition, links between the organization, organizational strategy, and project management, the concepts of organizational strategy, corporate governance, enterprise risk management, importance of project planning, the links between project scope, scope management, product breakdown structures and work breakdown structures, problems arising from resource scheduling and the approaches used to resolve the problems, development of a project network diagram, differences between risk and uncertainty, some common risk management mistakes in projects, Building a project team, the challenges and problems with building teams, and the reality of building a team in relation to prescribed theory, the importance of cost estimating and the different types of costs incurred on engineering projects, the benefits, limitations, and challenges of cost estimating, the different estimating techniques used in the project life cycle, outline of the cost estimating process, key concepts of project quality management (QM), the key causes of quality failures in projects

CO-PO MAPPING

No.	**Course Outcome**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Develop in depth idea on mechanical project management and organization to perform the Management Functions	3										2	

CO2	Compare between selected Theories of Management.	3											
CO3	Design mechanical project and to perform the functions in the Marketing Mix		3	2									
CO4	Develop knowledge of effective material management; management and resource allocation; Engineering economy and assessment on ethical issues in business situations.											3	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	The knowledge of mathematics, science, and engineering fundamentals is required to develop in depth idea on Mechanical industrial management and organization to perform the Management Functions.
CO1-PO11	2	In order to develop in depth idea on nuclear project management and organization to perform the Management Functions, it is required to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
CO2-PO1	3	The knowledge of mathematics, science, Engineering fundamentals is required to compare between selected Theories of Management.
CO3-PO2	3	In order to design nuclear project and to perform the functions in the Marketing Mix, identification, formulation, research literature and analysis of complex engineering problems are required to reach substantiated conclusion using first principles of mathematics, sciences and engineering fundamentals.
CO3-PO3	2	In order to design nuclear project and to perform the functions in the Marketing Mix, it is required to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
CO4-PO12	3	In order to develop knowledge of effective material management; Students will learn Management and resource allocation; Engineering economy and assessment on ethical issues in Business situations, it is required to demonstrate

		knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	**28**
Self-Directed Learning	**70**
Formal Assessment	**6**
Total	**104**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-5	Importance of project management to engineers, project life cycle, main stages of project definition	CT 01	
Class 6-10	Links between the organization, organizational strategy, and project management, the concepts of organizational strategy, corporate governance, enterprise risk management		
Class 11- 14	Importance of project planning, the links between project scope, scope management, product breakdown structures and work breakdown structures, problems arising from resource scheduling and the approaches used to resolve the problems, development of a project network diagram	CT 02	
Class 15- 18	Differences between risk and uncertainty, some common risk management mistakes in projects		
Class 19-22	Building a project team, the challenges and problems with building teams, and the reality of building a team in relation to prescribed theory	MT	
Class 23-25	the importance of cost estimating and the different types of costs incurred on engineering projects, the benefits, limitations, and challenges of cost estimating	CT 03	
Class 26-28	Outline of the cost estimating process, key concepts of project quality management (QM), the key causes of quality failures in projects	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	20	
2	Assignment	20	
	Exam		
1	Final Exam, CT	80	
2	Final Exam, CT, MID	80	
3	Final Exam, CT	80	
4	Final Exam, CT, Mid	80	

REFERENCE BOOKS

1. P. Kotler, K. L. Keller, *Marketing Management*,15th ed., Pearson, 2016
2. D. H. Besterfield, G. Besterfield, *Total Quality Management*, 3rd ed,. Prentice Hall, 2002
3. J. Liker, *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer,* 1st ed., McGraw-Hill Education, 2004

Spring Semester L-4, T-I

COURSE INFORMATION			
Course Code	**: GEEM 437**	**Lecture Contact Hours**	**: 2.00**
Course Title	**: Engineering Ethics & Moral Philosophy**	**Credit Hours**	**: 2.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It is essential for professionals in any field to have an understanding of the ethical problems and principles in their field. But anyone, no matter what their job, must deal with many other professions as well. Part of professional ethics is the understanding of the ethics of other professions: how they interact and what can be expected from them as correct ethical behaviour. In turn, any professional will benefit from a critical scrutiny of their own ethics by those from other professions. The general principles of professional ethics will be examined, as well as the distinctive problems of the different fields. This course will help the mechanical engineering students to conceptualize the dynamics of ethical practice in the mechanical domain

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OBJECTIVE
1. To inculcate a sense of social responsibility. 2. To develop a firm ethical base. 3. To make the students realize the significance of ethics in a professional environment related to Mechanical Engineering

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the theoretical aspects of ethics and moral philosophy in professional fields.	PO1	C2	1	1	-	Q, ASG, F
CO2	Identify practical and legal problems commonly encountered by engineers in their professional field/industry	PO2, PO6	C3	1	1,2	-	Q, ASG, F
CO3	Develop foundation knowledge of ethics to be applied in professional fields	PO8	C6	1	-	-	Q, F, CS
CO4	Critically assess the codes of professional conduct and their implications in Mechanical Engineering Life	PO12	C5	1	2	-	Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Introduction to ethics

ii. Importance of Ethics in Mechanical Engineering

iii. Engineering Ethics

iv. Introduction to Philosophy of Engineering

v. Ethical Issues in Engineering Practice

b. Detail Contents:

Introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering technology, ethical terminology; Introduction to the Engineering Ethics: purpose, objectives, scope, methods etc. Introduction to Philosophy of Engineering; Professional Engineering Codes, Codes of Ethics (IEB); Code of Ethics (ASME)Ethical problem solving techniques; Case study methodology, different case studies; The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice; Ethics Issues in Mechanical Engineering; Safety, Risk and Liability; Trust and reliability.

CO-PO MAPPING

No.	**Course Outcome**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Understand the theoretical aspects of ethics and moral philosophy in professional fields.	1											
CO2	Identify practical and legal problems commonly encountered by engineers in their professional field/industry		2				3						
CO3	Develop foundation knowledge of ethics to be applied in professional fields								3				
CO4	Critically assess the codes of professional conduct and their implications in Mechanical Engineering Life												1

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	1	In order to understand the theoretical aspects of ethics and moral philosophy in professional fields, the knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems is to be applied.
CO2-PO2	2	In order to be able to identify practical and legal problems commonly encountered by engineers in their professional field/industry identification, formulation, research literature and analysis of complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences are required.
CO2-PO6	3	In order to be able to identify practical and legal problems commonly encountered by engineers in their professional field/industry application of reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex

		engineering problems is required.
CO3-PO8	3	In order to develop foundation knowledge of ethics to be applied in professional fields, application of ethical principles and commit to professional ethics and responsibilities and norms of engineering practice is required.
CO4-PO12	1	In order to engage in lifelong learning through acquiring knowledge on legal and ethical aspects of professions of Mechanical Engineering, it is required to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	70
Formal Assessment	6
Total	104

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1-5	Introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering technology	CT 01	
Class 6-10	Ethical terminology; Introduction to the Engineering Ethics: purpose, objectives, scope, methods etc		
Class 11- 14	Introduction to Philosophy of Engineering	CT 02	
Class 15- 18	Professional Engineering Codes, Codes of Ethics (IEB); Code of Ethics (ASME) Ethical problem solving techniques		
Class 19-22	Case study methodology, different case studies	MT	
Class 23-25	The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice	CT 03	
Class 26-28	Ethics Issues in Mechanical Engineering; Safety, Risk and Liability; Trust and reliability.	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	20	
2	Assignment	20	

	Exam		
1	Final Exam, CT	80	
2	Final Exam, CT, MID	80	
3	Final Exam, CT	100	
4	Final Exam, CT, Mid	100	

REFERENCE BOOKS

1. Charles E. Harris, et el. *Engineering Ethics: Concepts and Cases*, Cengage Learning Boston, USA: 4th Edition, 2009.
2. Charles B. Fleddermann, *Engineering Ethics*, 4th Edition, NewYork, USA: Mc-Grawhill: 2012.
3. Davis, M., ed. *Engineering Ethics*. Farnham, United Kingdom Ashgate Publishing Co, 2005.

Fall Semester L-2, T-II

COURSE INFORMATION

Course Code	**GELM 271**	Lecture Contact Hours	2.00
Course Title	**Leadership and Management**	Credit Hours	2.00

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer.

OBJECTIVE

1.To introduce different management functions and approaches.
2.To expose students to different views and styles of leadership
3.To understand how an organization functions collaboratively with managers and engineers.
4.To understand various personality traits and its impact on leadership and management.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Familiarize with the fundamental concepts of leadership and management skills	9,10	C1, C2	1			Q, ASG,F
CO2	Understand the role and contribution of a leader in achieving organizational goals	9,11	C1, C2	1			Q, ASG,F

CO3	Understand the contribution of leadership traits and management skills in decision making and solving real life problems	2,8,12	C1, C2	1,7			Q, ASG,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

Introduction to Leadership and Management; Management Fundamentals; Leadership & Motivation; Organizational Management; Planning and goal setting; Control; Change and Innovation; Attitude; Personality; Perception and Individual Decision Making; Understanding Work Team; HR Management; Operations Management; Information Technology and Management; Case studies.

b. Detailed Contents:

Introduction to Leadership and Management: Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history. Management Fundamentals: Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management. Leadership & Motivation: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory; Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).Organizational Management: Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration. Planning and goal setting: Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal. Control: Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence. Change and Innovation: Change and innovation; internal and external for change; changing process; creativity vs innovation. Attitude: Components of Attitude; behaviour model and characteristics model; behaviour vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction. Personality: Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).Perception and Individual Decision Making: Factors influencing perception; attribution theory; errors/biases in attribution; Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making. Understanding Work Team: Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team;

team effectiveness; team challenges.HR Management: Process of Human Resource Planning; forecasting demand for labour; staffing; internal supply of labour; performance appraisal. Operations Management: Project managing basics; goals and boundary of project; WBS; scheduling a project; Demand and supply forecasting; inventory control. Information Technology and Management: Management Information System (MIS); Enterprise Resource Planning (ERP) -For introductory knowledge.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Familiarize with the fundamental concepts of leadership and management skills									3	3		
CO2	Understand the role and contribution of a leader in achieving organizational goals									3		2	
CO3	Understand the contribution of leadership traits and management skills in decision making and solving real life problems		2						2				2

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO9	3	By familiarizing with the fundamental concepts of leadership and management skills, Students will function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
CO1-PO10	3	By familiarizing with the fundamental concepts of leadership and management skills, Students will communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
CO2-PO9	3	Understanding the role and contribution of a leader in achieving organizational goals, Students will be able to function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
CO2-PO11	2	Understanding the role and contribution of a leader in achieving organizational goals, Students will demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work,
CO3-PO2	2	To understand the contribution of leadership traits and management skills in decision making and solving real life problems, students need to Identify, formulate, research literature and analyse complex engineering problems
CO3-PO8	2	Understanding the contribution of leadership traits and

		management skills in decision making, Students will apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
CO3-PO12	2	Students will recognize the need for understanding the contribution of leadership traits and management skills in decision making and solving real life problems, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	38
Formal Assessment	5
Total	**71**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Lecture	Topic	CT	Remarks
Lec 1-2	Introduction to Leadership and Management: Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history. Management Fundamentals: Definition of management & manager; levels of management; management functions and skills; Mintzberg'smanagerial roles; Henri Fayol's management principles; strategic management.	CT-1 CT-2	
Lec 3-6	**Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory **Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory	CT-3	
Lec 7-8	**Case Study – I : Engineer as Great Leaders**		

Lec 9-10	**Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration. **Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.		
Lec 11-12	**Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence. **Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity vs innovation.		
Lec 13-14	**Case Study – II : Planning and Goal Setting; A Managerial Approach: Engineer as Great Managers (Interactive Discussions in the Class)** **Attitude:** Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.		
Lec 15-16	**Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality). **Perception and Individual Decision Making**: Factors influencing perception; attribution theory; errors/biases in attribution		
Lec 17-18	**Perception and Individual Decision Making**: Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making. **Case Study – III : A Case on Decision Making – Involves both leadership and**		

	managerial skills (Interactive Discussion in the Class)		
Lec 19-20	**Understanding Work Team:** Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges. **HR Management:** Process of Human Resource Planning; forecasting demand for labor; staffing.		
Lec 21-22	**HR Management:** Internal supply of labor; performance appraisal. **Operations Management:** Project managing basics; goals and boundary of project; WBS; scheduling a project.		
Lec 23-24	**Operations Management:** Demand and supply forecasting; inventory control. **Exercise – Use of Microsoft Project (MSP) for scheduling a project at student level**		
Lec 25-26	**Case Study – IV:** A case that covers all relevant theories taught throughout the course and involves both leadership and management issues, e.g., Columbia's Final Mission. (This may be given as group assignment followed by in class short presentations/discussions)		
Lec 27-28	**Information Technology and Management:** Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.		

ASSESSMENT STRATEGY

Assessment strategies			CO	Bloom's Taxonomy
Components		Grading		
Continuous Assessment (40%)	Class test 1-2	20%	CO 1	C1-C2, P1
			CO 2	C1-C2
	Class Participation	5%	CO 1	C1-C2, P1, A1
			CO 2	C1-2, P1-P2, A1
	Mid term	15%	CO 1	C1-C2, P1, A1
			CO 2	C1-C2, P1-P2, A1-

				A2
			CO 3	C1-C2, P1-P2, A1-A2
Final Exam		60%	CO 1	C1-C2, P1, A1
			CO 2	C1-C2, P1-P2, A1-A2
			CO 3	C1-C2, P1-P2, A1-A2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Engineering Management (Revised Edition) – A.K. Gupta
2. Industrial Engineering and Production Management - Martand T. Telsang
3. Leadership in Organizations – Gary Yukl
4. Developing Management Skills – David A. Whetten and Kim S. Cameron

Fall Semester L-4, T-2

COURSE INFORMATION

Course Code	: **GESL 407**	Lecture Contact Hours	: 2.00
Course Title	**: Environment, Sustainability and Law**	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Although the electricity is now an indispensible part of our day to day life, it is very important to know the fact that the ways which are being used to generate electricity are either environment friendly or not. Additionally, it is imperative to understand the far-reaching consequences of the ways of generating electricity. Moreover, the confliction of the world environmental law should be avoided. This course introduces the students regarding the improvement of electrical technology with era and compares the impact of electricity on environment, human beings and global climates. In addition, student will be familiar with the sustainability and law.

OBJECTIVE

1. Make able the students to compare and classify the growth of electrical, electronic and communication technologies with change of era. .

2. Impart the basic knowledge of improvement regarding electrical technology with the impact on environment, human beings and global climates.

3. Deliberate the message regarding the safety concepts, risk management, proactive management techniques for safety issue, safety standard and regulations for engineering works.

4. Impart the in-depth understanding about the legal issues regarding engineering,

environment, business and industrial law.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Correspon-ding POs	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Classify** the growth of electrical, electronic and communication technologies with change of era.	4	C4	1		3	T, F
CO2	**Contrast** improvement of electrical technology with the impact on environment, human beings and global climates.	7	C2	1		1, 3	T, Mid Term Exam, F
CO3	**Discuss** safety concepts, safety and risk management, proactive management techniques for safety issue, safety standard and regulations for engineering.	6	C6	2		3	T, Mid Term Exam, F
CO4	As a leader regarding **appraise** the legal issues regarding engineering, environment, business and industrial law, law of contract and elements for valid contract provided by the government.	12	C5	3	3	2,5	ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Environment: Society and development; Growth of electrical, electronic and communication technologies and its contribution to human development; Impact of EECE technology upon the environment, impact of the environment upon human changes in the global climates; Environment friendly technology, Technology and development; Technology and environment hazards, its remedy. Environmental Pollution from Power Plants, E-waste management. The improvement of working conditions in the power plants. Environment and sustainable development

Safety: Evolution of modern safety concepts, safety and risk management, productivity, worker health and safety, proactive management techniques for safety management, safety standard and regulations for engg works, fire safety, hazardous materials, Industrial Hygiene.

Legal Issues: Introduction to Legal Issues for engineering, business and industrial law, Law of contract, elements of valid contract, Consideration, parties competent to contract, Sale of goods and higher purchase. Industrial law in Bangladesh: various ordinance payments of wages, legislation relating employment in industries, factories, shops and agriculture, trade union act, industrial relation ordinance. Workman compensation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Classify** the growth of electrical, electronic and communication technologies with change of era.				3								
CO2	**Contrast** improvement of electrical technology with the impact on environment, human beings and global climates.							3					
CO3	**Discuss** safety concepts, safety and risk management, proactive management techniques for safety issue, safety standard and regulations for engineering.						3						
CO4	As a leader regarding **appraise** the legal issues regarding engineering, environment, business and industrial law, law of contract and elements for valid contract provided by the government.												3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 28 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 14 14
Formal Assessment Continuous Assessment Mid-Term Final Examination	 2 1 3
Total	104

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	**Topic**	CT
Week 1	**Environment, society and development**	CT 1
Class 1	**Environment:** society and development;	
Class 2	Growth of electrical, electronic and communication technologies and its	

	contribution to human development;	
Week 2	**Impact of EECE**	
Class 3	Impact of EECE technology upon the environment,	
Class 4	impact of the environment upon human changes in the global climates;	
Week 3	**Friendly technology**	
Class 5	Environment friendly technology,	
Class 6	Technology and development;	
Week 4	**Environmental Pollution**	
Class 7	Technology and environment hazards, its remedy.	
Class 8	Environmental Pollution from Power Plants,	
Week 5	**Environmental Pollution**	
Class 9	Environmental Pollution from Power Plants,	
Class 10	Environmental Pollution from Power Plants,	
Week 6	**Waste management**	Mid-term
Class 11	E-waste management.	
Class 12	The improvement of working conditions in the power plants.	
Week 7	**Sustainable development**	
Class 13	Environment and sustainable development	
Class 14	Safety: Evolution of modern safety concepts,	
Week 8	**Health and Safety**	
Class 15	Safety and risk management,	
Class 16	Productivity, worker health and safety,	
Week 9	**Health and Safety**	
Class 17	Proactive management techniques for safety management,	
Class 18	Safety standard and regulations for engineering works,	
Week 10	**Health and Safety**	
Class 19	Fire safety, hazardous materials	
Class 20	Industrial Hygiene	
Week 11	**Legal Issues**	
Class 21	**Legal Issues:** Introduction to Legal Issues for engineering, business and industrial law,	
Class 22	Law of contract, elements of valid contract,	
Week 12	**Legal Issues**	
Class 23	Consideration, parties competent to contract,	CT 2
Class 24	Sale of goods and higher purchase.	
Week 13	**Industrial Law**	
Class 25	Industrial law in Bangladesh: various ordinance payments of wages,	
Class 26	legislation relating employment in industries, factories, shops and agriculture	
Week 14	**Industrial Law**	
Class 27	Trade union act, industrial relation ordinance. Workman compensation	
Class 28	Review	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C4
			CO2	C2
			CO 3	C6
	Class Participation	5%	CO 4	C5
	Mid term	15%	CO 2	C2
			CO3	C6
Final Exam		60%	CO 1	C4
			CO 2	C2
			CO 3	C6
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning by Bent Sørensen

2. Applications in Electronics Pervading Industry, Environment and Society by Alessandro De Gloria

CHAPTER 7
COURSE OFFERED BY ME TO STUDENTS OF OTHER DEPARTMENTS

7.1 List of courses offered by ME department to other departments

Course No	Course Name	Level-Term	Dept	Contact Hours	Credit Hours
ME 132	Workshop Technology Sessional	1-I	CE	3.0	1.5
ME 122	Fundamentals of Mechanical Engineering and Robotics Sessional	1-II	CSE	2.0	2.0
ME 283	Fundamental of Mechanical Engineering	2-I	EECE	3.0	3.0
ME 284	Fundamental of Mechanical Engineering Sessional	2-I	EECE	3.0	1.5
Shop 108	Workshop Technology Sessional-I	1-I	AE	0.75	1.50
Shop 112	Workshop Technology Sessional-II	1-II	AE	0.75	1.50
ME 249	Engineering Mechanics (Statics and Dynamics)	2-I	AE	4.0	4.0
ME 180	Basic Engineering Drawing	1-I	NSE	3.0	1.5
ME 253	Engineering Mechanics	2-I	NSE	3.0	3.0
ME 254	Engineering Mechanics Sessional	2-I	NSE	1.5	0.75
ME 142	Workshop Sessional	1-1	EWCE	3.00	1.5
ME 176	Workshop Practice	1-I	PME	3.0	1.5
ME 178	Basic Engineering Drawing and CAD	1-I	PME	3.0	1.5
ME 271	Fluid Mechanics	2-II	PME	3.0	3.0
ME 272	Fluid Mechanics Sessional	2-II	PME	1.5	0.75

7.2 Proforma of courses offered by ME department to other departments

Spring/Fall Semester L-1, T-I

COURSE INFORMATION			
Course Code	**ME 132**	Lecture Contact Hours	**: 3.00**
Course Title	**Workshop Technology Sessional**	Credit Hours	**: 1.50**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various welding techniques and put theory in practice. Our mission is to expose students to the constructions of different mechanical machines and analyze their performance. This course is targeted to verify the working principle of types of welding, casting, molding and also to gain knowledge of different manufacturing parts from lathe, drilling, milling and drilling machine etc. and relate them with their theoretical knowledge.

OBJECTIVE

1. To use different manufacturing (machining, welding, foundry, sheet metal working, etc.) processes required to manufacture a product from the raw materials.

2. To use different measuring, marking, cutting tools used in workshop.

3. Be aware of the safety precautions while working in workshop.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding	1	C3			1	R, Q, LT
CO2	Be able to **compare** between different types of welding and machining processes and **select** proper cutting tool for specific machining processes.	2,3	C1, C3			1	R, Q, LT

CO3	**Find** out about the importance of general safety precautions on different shop floors	1	C4			1	R, Q, LT
CO4	**Develop** practical skills by performing the experiments in different shops of workshop	5	C3			6	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Experiments:

1) Design and making of pattern for casting
2) Mold making, casting and assembly of final project
3) Study of electric arc welding
4) Study of Resistance Welding/Spot Welding
5) Study of Welding joints and welding positions
6) Study of Gas Welding/cutting
7) Study of TIG and MIG Welding
8) Manufacturing of machine component by using Lathe machine
9) Manufacturing of machine component by using Shaper machine
10) Manufacturing of a machine component by using Milling Machine
11) Manufacturing of a machine component by using Drilling Machine
12) Carpentry: Middle Lap T Joint, Cross Lap Joint, Mortise And Tenon T joint, Bridle T Joint

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding.	3											
CO2	Be able to **compare** between different types of welding and machining processes and **select** proper cutting tool for specific machining processes.		3	2									
CO3	**Find** out about the importance of general safety precautions on different shop floors	3											
CO4	**Develop** practical skills by performing the experiments in different shops of workshop					3							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required.
CO2-PO2	**3**	In order to perform the experiments, the knowledge of engineering fundamentals would be required
CO2-PO3	**2**	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO1	**3**	For performing the experiments, safety precautions are very essential in this laboratory.
CO4-PO5	**3**	Students will acquire knowledge on how to select and apply appropriate techniques, resources, and modern engineering tools.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Expt-01: Design and making of pattern for casting
Week-2	Expt-02: Mold making, casting and assembly of final project
Week-3	Expt-03: Study of electric arc welding
Week-4	Expt-04: Study of Resistance Welding/Spot Welding
Week-5	Expt-05: Study of Welding joints and welding positions
Week-6	Expt-06: Study of Gas Welding/cutting
Week-7	Expt-07: Study of TIG and MIG Welding
Week-8	Expt-08: Manufacturing of machine component by using Lathe machine
Week-9	Expt-09: Manufacturing of machine component by using Shaper machine

Week-10	Expt-10: Manufacturing of a machine component by using Milling Machine
Week-11	Expt-11: Manufacturing of a machine component by using Drilling Machine
Week-12	Expt-12: Carpentry: Middle Lap T Joint, Cross Lap Joint, Mortise And Tenon T joint, Bridle T Joint
Week-13	Viva
Week-14	Quiz Test

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Machine Shop Practice – James Anderson, W. A. Chapman.
2. Callister W. D., Material Science & Engineering, John Wiley & Sons.

Spring/Fall Semester L-1, T-II

COURSE INFORMATION

Course Code	**ME 122**	Lecture Contact Hours	**: 4.00**
Course Title	**Fundamentals of Mechanical Engineering and Robotics Sessional**	Credit Hours	**: 2.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To introduce the students with various fields of Mechanical Engineering with a special consideration to the fields relevant to the computer science and engineering discipline. A good number of theory based and lab based sessions are included to enhance the confidence of the students in this branch of engineering.

OBJECTIVE
1. To make the students familiar to with engine and its various features 2. To make the students understand various types of power plant 3. To introduce the students to various heat transferring devices 4. To make the students knowledgeable with power and motions transferring element used in robot design

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Have theoretical and practical understanding of vehicle components and control	1, 2	C2, C3, P3			3	Q, ASG, F, R
CO2	Have introductory theoretical and practical knowledge of power plant and their main components.	1	C2			4	Q, ASG, F
CO3	Demonstrate fundamental ideas about heat transferring devices	1, 3	C2, P3			4,5	Q, ASG, F, R
CO4	Demonstrate basic knowledge about power transferring elements and components of robot.	1, 2	C3, P3			4	ASG, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. IC Engine, Automobile, Hybrid and Electric Vehicle
2. Power plant
3. Heat Transfer and equipment
4. Pump, Compressor, Valve
5. Kinematics of Rigid body
6. Power transferring devices
7. Robotics and Control

b. Detail Contents:

1. IC Engine, Automobile, Hybrid and Electric Vehicle — Types of IC Engine, Operating principle, thermodynamic cycle, Valve timing diagram, VVTi, ECM, Sensors used in modern vehicle, Hybrid Technology, Electric vehicle.

Lab experiment 01: Study of various components of IC Engine and their operation

Lab experiment 02: Study of Power train in automobile.

2. Power plant — Types of power plant, Introduction to Coal based, Gas based and Nuclear power plant, Control system of power plant, Steam generator, Cooling tower.

Lab experiment 03: Study of cooling tower efficiency.

3. Heat Transfer and equipment— Modes of heat transfer, Heat transfer using finned surface, Thermo-electric cooling, Heat pipe, Cooling of microchip and processor.

4. Pump, Compressor, Valve – Centrifugal pump, Positive displacement pump, Hydraulic and pneumatic actuator, Control valve (Pressure, flow and direction control valve)

Lab experiment04: Study of Injection molding machine and its control system

5. Kinematics of Rigid body – Truss, Frame, Kinematic linkage,

6. Power transferring device – Belt-pulley, Various types of gear and gear train, Fluid Coupling, CVT

Lab experiment 05: Study of various types of gear and their application.

7. Robotics – Introduction to Robotics, Plane, rotational and spatial motion with applications to manipulators, Geometric configurations, arms and grippers, Control system of robots.

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	1 1	12
CO1	Have theoretical and practical knowledge of vehicle components and control	3	2										
CO2	Have introductory theoretical and practical knowledge of power plant and their main components.	3											
CO3	Demonstrate fundamental ideas about heat transferring devices	3		1									
CO4	Demonstrate basic knowledge about power transferring elements and components of robot.	3	3										

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**3**	Students will have both theoretical and practical knowledge regarding engine and vehicle components and operation that will impart both knowledge from basic science and engineering practice
CO1-PO2	**2**	Students will have both theoretical and practical knowledge regarding engine and vehicle components and operation that will impart both knowledge from basic science and engineering practice
CO2-PO1	**3**	Students will have theoretical knowledge as well as established engineering practices on power plant components and their operation
CO3-PO1	**2**	Students will have theoretical knowledge as well as established engineering practices on various heat transferring technique and devices
CO3-PO3	**1**	Students will have and use knowledge on cooling tower that guide the design of cooling tower in real field
CO4-PO1	**3**	Students will have knowledge on engineering practice in designing robots and various manipulator
CO4-PO2	**3**	Student will lean technique to perform analysis of simple robot structure

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	56
Self-Directed Learning	25
Formal Assessment	5.5
Total	**96.5**

TEACHING METHODOLOGY
Class Lecture, Lab experiment, Report, Problem solving

COURSE SCHEDULE

Week	Topic	CT	Remarks
Class 1 – 8	IC Engine, Automobile, Hybrid and Electric Vehicle — Types of IC Engine, Operating principle, thermodynamic cycle, Valve timing diagram, VVTi, ECM, Sensors used in modern vehicle, Hybrid Technology, Electric vehicle. Lab 01 & 02		
Class 9 – 14	Power plant — Types of power plant, Introduction to Coal based, Gas based and Nuclear power plant, Control system of power plant, Steam generator, Cooling tower. Lab 03	CT-1	
Class 15 - 18	Heat Transfer and equipment— Modes of heat transfer, Heat transfer using finned surface, Thermo-electric cooling, Heat pipe, Cooling of microchip and processor.	CT-2	
Class 19 - 24	Pump, Compressor, Valve – Centrifugal pump, Positive displacement pump, Hydraulic and pneumatic actuator, Control valve (Pressure, flow and direction control valve)	Mid-Term	
Class 25 - 34	Kinematics of Rigid body – Truss, Frame, Kinematic linkage,		
35-44	Power transferring device – Belt-pulley, Various types of gear and gear train, Fluid		

	Coupling, CVT Lab 05		
Class 45-56	Robotics – Introduction to Robotics, Plane, rotational and spatial motion with applications to manipulators, Geometric configurations, arms and grippers, Control system of robots.	CT-3	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, Report	**80**	
2	Final Exam, Report, MID	**80**	
3	Final Exam, Report	**100**	
4	Final Exam, Report, Mid	**100**	

REFERENCE BOOKS

1. A Text Book of Thermal Engineering - R S Khurmi & J K Gupta

2. Heat Engines – D. A. Low

3. Thermal Engineering- Mahesh M Rathor

4. Lab sheet

REFERENCE SITE

N/A

Spring Semester L-2, T-1

COURSE INFORMATION			
Course Code Course Title	**ME 283** **Fundamental of Mechanical Engineering**	Lecture Contact Hours Credit Hours	**: 3.00** **: 3.00**

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To introduce the students with various fields of Mechanical Engineering with a special consideration to the fields relevant to the Electrical, Electronic and Communication engineering discipline.
OBJECTIVE
1. To introduce various energy sources available in the world, energy economics and energy savings 2. To introduce steam generating units with accessories and mountings 3. To introduce internal combustion engine and gas turbine and their applications 4. To introduce fluid mechanics and machinery like water turbine, pump, compressor etc. 5. To briefly introduce various type of power plants 6. To briefly introduce hybrid technology, electric car and robot 7. To briefly introduce psychrometry, refrigeration and air conditioning
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Demonstrate knowledge on various energy sources and energy economics	1	C1			3	Q, ASG, F
CO2	Demonstrate knowledge on various mechanical components in power plants	1	C2, C3			4	Q, ASG, F
CO3	Demonstrate knowledge on hybrid and electric car	1	C3			4	Q, ASG,

	technology						F
CO4	Perform basic oral and written technical communication according to the accepted standards of the mechanical engineering community	1	C2			4	ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Present,ation; R - Report; F – Final Exam)

COURSE CONTENT

a. Main Contents:

1. Energy sources, Energy economics
2. Steam generator
3. Internal combustion engine, Gas Turbine
4. Water turbine, Pump, Compressor
5. Power plant
6. Automobiles and Robotics
7. Air conditioning and Refrigeration

b. Detail Contents:

1. Various Energy Source — Renewable and nonrenewable energy sources and their applications, Energy economics and proper use.

2. Steam Generator – Various types of steam generator, Mountings and accessories, Rankin cycle, Introduction to steam table, Heat recovery steam generator.

3. Internal Combustion Engine, Gas Turbine — Operating principle of IC (both SI and CI) engine, Valve timing diagram, cycle diagram, relevant mathematics, Gas turbine operation, Components of GT, thermodynamic cycle, Application of SI, CI engine and GT in power generation. Hybrid technology – Various hybrid vehicles, Types, Applications

4. Water Turbine, Pump, Compressor- Introduction to water turbine, Kaplan turbine, Pelton wheel components and operation., study of centrifugal and axial flow machines, pumps, fans, blowers and compressors, study of reciprocating pumps..

5. Power plant – Basic of coal based, GT base, Combined cycle based and nuclear power plant

6. Automobiles and Robotics – Hybrid Technology, Electric Car, Introduction to robotics

7. Refrigeration and Psychrometry –Vapor compression and Absorption refrigeration, COP, Cycle, Psychrometric chart, Basic application of psychrometric chart, Basic of

air conditioning

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on various energy sources and energy economics	2											
CO2	Demonstrate knowledge on various mechanical components in power plants	3											
CO3	Demonstrate knowledge on hybrid and electric car technology	3											
CO4	Perform basic oral and written technical communication according to the accepted standards of the mechanical engineering community	2											

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**2**	Students will have idea on various energy sources, energy economics and savings which will increase their knowledge to prepare the framework for solving design problem
CO2-PO1	**3**	Students will have theoretical knowledge as well as established engineering practices on various mechanical components used in power plant
CO3-PO1	**3**	Students will have theoretical knowledge as well as established engineering practices on hybrid and electric car technology
CO3-PO1	**2**	By presentation of a particular subject topic students will practice communication but mainly gain knowledge on various communication norms in this discipline.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75

Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Presentation, Problem solving

COURSE SCHEDULE

Lecture	Content	CT
L 1 – L 6	Renewable and nonrenewable energy sources and their applications, Energy economics and proper use.	01
L 7 – L 15	Various types of steam generator, Mountings and accessories, Rankin cycle, Introduction to steam table, Heat recovery steam generator.	
L 16 – L 24	Operating principle of IC (both SI and CI) engine, Valve timing diagram, cycle diagram, relevant mathematics, Gas turbine operation, Components of GT, thermodynamic cycle, Application of SI, CI engine and GT in power generation. Hybrid technology – Various hybrid vehicles, Types, Applications	02
L 25 - L 33	Water Turbine, Pump, Compressor- Introduction to water turbine, Kaplan turbine, Pelton wheel components and operation., study of centrifugal and axial flow machines, pumps, fans, blowers and compressors, study of reciprocating pumps	Mid
L 34 – L 36	Basic of coal based, GT base, Combined cycle based and nuclear power plant	04
L 37 – L 38	Hybrid Technology, Electric Car, Introduction to robotics	
L 39 – L 42	Vapor compression and Absorption refrigeration, COP, Cycle, Psychrometric chart, Basic application of psychrometric chart, Basic of air conditioning.	

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	

	3	Final Exam, CT	**100**		
	4	Final Exam, CT, Mid	**100**		

REFERENCE BOOKS
1. A Text Book of Thermal Engineering - R S Khurmi & J K Gupta 2. Heat Engines – D. A. Low 3. Thermal Engineering- Mahesh M Rathore

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 284** **Fundamental of Mechanical Engineering Sessional**	Lecture Contact Hours Credit Hours	**3.00** **1.50**
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To help the students to explore various mechanical equipment and processes and put theory in practice. The students will be exposed to various equipment used in power plant for power generation like turbine, cooling tower, engine etc. and various properties like flash point fire point etc. Thy will be able to understand the working principle of various equipment first hand and compute their performance.			
OBJECTIVE			
1. Be able to familiarize the students with the basic mechanical equipment like engine, turbine, pump, refrigeration unit etc. **2.** Be able to calculate various parameters of equipment like power generation, efficiency, flow rate etc. **3.** To develop skills of handling basic mechanical equipment by engaging students in experiences with experimental processes and by growing the capability operate them. **4.** Be able to impart practical knowledge on mechanical equipment crafting and develop collaborative learning skill.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to compute the various properties of fuels	1,4	C5, P4			4,8	ASG, R, F, Pr
CO2	Be able to identify various component of engine and conduct performance analysis	1,5	C5, P4			4	ASG, R, F, Pr
CO3	Be able to compute performance of fluid machineries like pump and turbine	1,5	C5, P4			4	ASG, R, F, Pr
CO4	Demonstrate practical knowledge on psychrometric analysis of air and refrigeration system	1,4	C5, P4			4	ASG, R, F, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1 Introduction to the lab equipment's and safety measures
Expt-01: Determination of flash point of liquid fuel
Expt-02: Viscosity test of liquid substance
4 Expt-03: Study of refrigeration and air conditioning cycle.
Expt-04: Study of an automotive engine, different system and performance test
Expt-05: Determination of water flow rate
Expt-06: Study of sling Psychrometer
Expt-07: Performance test of a cooling tower.
Expt-08: Study of propeller turbine characteristics

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to compute the various properties of fuels	3			2								
CO2	Be able to identify various component of engine and conduct performance analysis.	3				2							
CO3	Be able to compute performance of fluid machineries like pump and turbine	3				2							
CO4	Demonstrate practical knowledge on psychrometric analysis of air and refrigeration system	3			2								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to evaluate fuel properties, the knowledge of natural science and mathematics would be required.
CO1-PO4	**2**	Students will go through some published literature to check the process and obtained result for various fuel properties
CO2-PO1	**3**	In order to evaluate engine performance, the knowledge of natural science and mathematics would be required.
CO2-PO5	**2**	Modern tools will be used to measure the performance
CO3-PO1	**3**	In order to evaluate pump performance, the knowledge of natural science and mathematics would be required.
CO3-PO5	**2**	Modern tools will be used to measure the performance
CO4-PO1	**3**	In order to evaluate psychrometric properties of air and refrigeration system, the knowledge of natural science and mathematics would be required.
CO4-PO4	**2**	Students will go through some published literature to check the process and obtained result for various psychrometric properties

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	1 Introduction to the lab equipment's and safety measures
Week 2	Expt-01: Determination of flash point of liquid fuel
Week 3	Expt-02: Viscosity test of liquid substance
Week 4	4 Expt-03: Study of refrigeration and air conditioning cycle.
Week 5	Expt-04: Study of an automotive engine, different system and performance test
Week 6	Expt-05: Determination of water flow rate
Week 7	Expt-06: Study of sling Psychrometer
Week 8	Expt-07: Performance test of a cooling tower.
Week 9	Expt-08: Study of propeller turbine characteristics
Week 10	Practice Lab
Week 11	Practice Lab
Week 12	Lab Test + Viva

Week 13	Quiz test
Week 14	Presentation

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1,2,3,4	Lab participation and Report	**20**	
1,2,3,4	Presentation	**20**	
	Exam		
1,2,3,4	Lab Test 1 & 2	**30**	
1,2,3,4	Final Exam	**30**	

REFERENCE BOOKS

. Lab Handbook

. Introduction to Thermal Engineering – R. S. Khurmi

REFERENCE SITE

N/A

Spring Semester L-1, T-1

COURSE INFORMATION

Course Code	SHOP 108	Lecture Contact Hours	: 1.50
Course Title	Workshop Technology Sessional – I	Credit Hours	: 0.75

PRE-REQUISITE

Course Code: N/A
Course Title: N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing and production. The workshop practical courses make students competent in handling practical work in engineering environment.

OBJECTIVE
1. To know about Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores, create molding by using molding sand and analyze metal melting and Casting inspection of casting and casting defects. 2. To know about Electric arc welding, Gas welding, Metal Inert Gas (MIG) welding, Tungsten Inert Gas (TIG) welding and analyze the procedure of different welding. 3. To create a congenial environment that promotes learning, growth and imparts ability to work with multi-disciplinary groups in professional, industry and research organizations.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** mold by using molding sand and analyze metal melting and Casting inspection of casting and casting defects.	3	P4			K5	R, Q, T , ASG, F
CO2	Be able to **analyze** about Electric arc welding, Gas welding, Metal Inert Gas (MIG) welding, Tungsten Inert Gas (TIG) welding and analyze the procedure of different welding.	2	C4			K3	R, Q,T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT	
Exp No	**Exp Name**
1.	Familiarization of Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores. Create molding by using molding sand.
2.	Analyze metal melting and Casting, inspection of casting and casting defects.
3.	Electric arc welding and analyze the procedure of arc welding. Resistance Welding and Spot Welding.
4.	Gas welding and analyze the procedure of Gas welding.
5.	Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and analyze the procedure of these both

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **construct** molding by using mold sand and analyze metal melting and Casting inspection of casting and casting defects.			2									
CO2	Be able to **analyze** about Electric arc welding, Gas welding, Metal Inert Gas (MIG) welding, Tungsten Inert Gas (TIG) welding and analyze the procedure of different welding..		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
Total	21

Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 03 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 01
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Familiarization of Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores. Create molding by using molding sand.
Week 2	Analyze metal melting and Casting, inspection of casting and casting defects.
Week 3	Electric arc welding and analyze the procedure of arc welding. Resistance Welding and Spot Welding.
Week 4	Lab Test-1
Week 5	Gas welding and analyze the procedure of Gas welding.
Week 6	Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and analyze the procedure of these both
Week 7	Lab Quiz

ASSESSMENT STRATEGY

Components	**Grading**	CO	Blooms Taxonomy
Conduct Lab Test/ Class Performance	25%	CO 1	P4/ Articulation
		CO 2	C4/Analyse
Report Writing/Programming	15%	CO 1	P4/ Articulation
		CO 2	C4/Analyse
Mid Term Evaluation (exam/project/assignment)	20%	CO1	P4/ Articulation

Final Evaluation (Exam/project/assignment)	30%	CO1, CO2,	C4/Analyse, P4/ Articulation
Viva Voce/ Presentation	10%	CO1, CO2	C4/Analyse, P4/ Articulation
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Machine Shop Practice – James Anderson; W. A. Chapman.
2. Shop Theory –Anderson & Tatro.

Fall Semester L-1 T-II

COURSE INFORMATION

Course Code	SHOP 112	Lecture Contact Hours	: 1.50
Course Title	Workshop Technology Sessional –II	Credit Hours	: 0.75

PRE-REQUISITE

Course Code: SHOP 108
Course Title: Workshop Technology Sessional –I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing parts and production of samples. The workshop practical courses make students competent in handling practical work in engineering environment. This course gives undergraduates the opportunity to engage in machine shop operation under the supervision of qualified machine shop personnel. Students learn to operate the lathe, milling and drilling machines. The course may be repeated for credit multiple times, either on different topics (e.g., CNC coding)

OBJECTIVE

1. To Know about Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine and create part by doing different operations.

2. To learn to use CNC Milling machine to manufacture a part automatically by using a CAD drawing.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the use of Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine	5	P3			K6	R, Q, T, ASG, F
CO2	Be able to **analyze** a job for CNC Milling machine to manufacture a part automatically by using a CAD drawing.	2	C4			K3	R, Q, T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	**Exp Name**
1.	Study of Lathe Machine and Its Various Operations in Manufacturing parts.
2.	Study of Milling Machine and Its Various Operations in Manufacturing gears.
3.	Study of Shaping Machine and Its Various Operations in Manufacturing grooves.
4.	Study of Drilling Machine and Its Various Operations.
5.	Study of CNC Machine and Its Various Operations in Manufacturing parts.

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **demonstrate** the use of Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine					2							
CO2	Be able to **analyze** a job for CNC Milling machine to manufacture a part automatically by using a CAD drawing..		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
Total	21
Self-Directed Learning	
Preparation of Lab Reports	05
Preparation of Lab Test	05
Preparation of presentation	03
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	07
Final Quiz	1
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	Study of Lathe Machine and Its Various Operations in Manufacturing parts.
Week 2	Study of Milling Machine and Its Various Operations in Manufacturing gears.
Week 3	Study of Shaping Machine and Its Various Operations in Manufacturing grooves.
Week 4	Lab Test-1
Week 5	Study of Drilling Machine and Its Various Operations.
Week 6	Study of CNC Machine and Its Various Operations in Manufacturing parts.
Week 7	Lab Quiz

ASSESSMENT STRATEGY			
Components	**Grading**	CO	Blooms Taxonomy
Conduct Lab Test/ Class Performance	25%	CO 1	P3/Precision
Report Writing/Programming	15%	CO 1	P3/Precision
Mid Term Evaluation (exam/project/assignment)	20%	CO1	P3/ Precision
Final Evaluation (Exam/project/assignment)	30%	CO1, CO2	P3/Precision, C4/Analyse
Viva Voce/ Presentation	10%	CO1, CO2	P3/Precision, C4/Analyse
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Machine Shop Practice – James Anderson; W. A. Chapman.
2. Shop Theory –Anderson & Tatro.

Spring Semester L-2, T-1

COURSE INFORMATION			
Course Code Course Title	**ME 249** **Engineering Mechanics (Statics and Dynamics)**	Lecture Contact Hours Credit Hours	**4.00** **4.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To provide the students with the basic knowledge in the mechanics of rigid body which will be helpful while studying strength of materials, aircraft structures etc.			

OBJECTIVE

1. To be able to express and resolve the position and force into vector unit components.
2. To determine the forces in the members of trusses and frames using the method of joints and sections.
3. To draw and describe the free-body diagram and to solve the problems using the equations of equilibrium.
4. To determine to the location of centre of gravity and centric for a system and to determine the moment of inertia for an area.
5. To apply Newton's laws of motion and conservation principles to solve real life
6. To understand the principles and methods used in analyzing motion of a particle.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Explain** basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).	1	C1, C2	1			Q, ASG, F
CO2	**Demonstrate** use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems	2	C3, C4	1,2			Q, ASG, F

CO3	**Apply** scalar and vector analytical techniques for analyzing forces in statically determinate structures	5	C3	6	1,2		Q, F, CS
CO4	**Evaluate** equilibrium of particles and bodies in real world problems.	2	C4,C5	1,2	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Properties of forces, moments, couples and resultants;

ii.Moment of inertia of areas and masses;

iii. Principle of work, energy, impulse and momentum

iv. System of particles;

v. Kinematics of rigid bodies

b. Detail Contents:

Statics of particles and rigid bodies; Properties of forces, moments, couples and resultants; Analysis of two- and three-dimensional problems; Centroids of lines, areas and volumes; Forces in truss, frames, and cables; Friction; Moments of inertia of areas and masses; Relative motion.

Planar mechanisms, linkages, mobility; instant centers of rotation, Kennedy’s theorem; Velocity and acceleration polygons; Euler’s first law; angular momentum and Euler’s second law.

Kinetics of particles: Newton ‘s second law of motion; Principles of work, energy, impulse and momentum; System of particles; Kinematics of rigid bodies;

Kinetics of plane motion of rigid bodies: forces and acceleration; Principles of work and energy.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).	2											
CO2	**Demonstrate** use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems		3										
CO3	**Apply** scalar and vector analytical techniques for analyzing forces in statically determinate structures					2							
CO4	**Evaluate** equilibrium of particles and bodies in real world problems.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	2	Student will gain knowledge and thus will be able to explain Kinematic concepts.
CO2-PO2	3	Students will be able to demonstrate the basics dynamics concept.
CO3-PO5	2	Students will be able to apply various analysing techniques.
CO4-P02	3	Student will learn how to evaluate equilibrium of particles.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Lecture	70
Self-Directed Learning	84
Formal Assessment	6
Total	**160**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week-1	**Topic**	**CT**
Class-1	Fundamental concepts and principles	CT-1
Class-2	Systems of units and conversion from one system of units to another	
Class-3	Forces in a plane	
Class-4	Forces on a particle: resultant of two forces	
Week-2	**Statics of Particles**	
Class-5	Addition of vectors	
Class-6	Resultant of several concurrent forces	
Class-7	Resolution of a force into components and rectangular components of a force: unit vectors	
Class-8	Equilibrium of a particle	
Week-3	**Rigid Bodies: Equivalent Systems of Forces**	
Class-9	Moment of a force about a point, given axis	
Class-10	Varignon’s theorem	
Class-11	Moment of a couple	
Class-12	Reduction of a system of forces to one force and one couple	
Week-4	**Equilibrium of Rigid Bodies**	Mid Exam
Class-13	Equilibrium in two dimensions	
Class-14	Equilibrium of a two force body	
Class-15	Equilibrium of a three force body	
Class-16	Equilibrium in three dimensions	
Week-5	**Distributed Forces: Centroids and Centres of Gravity**	
Class-17	Centre of Gravity of a two dimensional body	

Class-18	Determination of centroids by integration	
Class-19	Centre of Gravity of a three dimensional body	
Class-20	Determination of centroids of volumes by integration	
Week-6	**Analysis of structures**	
Class-21	Analysis of trusses by method of joints	
Class-22	Analysis of trusses by method of sections	
Class-23	Analysis of frames	
Class-24	Analysis of cables	
Week-7	**Friction**	CT-2
Class-25	Introduction	
Class-26	The Laws of Dry Friction, Coefficients of Friction	
Class-27	Angles of Friction	
Class-28	Problems involving Dry Friction	
Week-8	**Distributed Forces: Moments of inertia**	
Class-29	Moments of inertia of areas	
Class-30	Polar moment of inertia and radius of gyration of an area	
Class-31	Moments of inertia of a mass	
Class-32	Moments of inertia of composite bodies	
Week-9	**Instant centres of rotation, Kennedy's theorem, Velocity and acceleration polygons**	
Class-33	Instant centres of rotation	
Class-34	Kennedy's theorem	
Class-35	Velocity and acceleration polygons	
Class-36	Velocity and acceleration polygons	
Week-10	**Euler's First Law, Angular Momentum and Euler's Second law**	CT-3
Class-37	Euler's first law	
Class-38	Angular momentum	
Class-39	Angular momentum	
Class-40	Euler's second law	
Week 11	**Kinetics of Particles: Newton's Second Law**	
Class-41	Newton's second law of motion	
Class-42	Linear momentum of a particle : rate of change of linear momentum	
Class-43	Equations of motion	
Class-44	Annear momentum of a particle : rate of change of angular	

	momentum
Week 12	**Kinetics of Particles: Energy and Momentum Methods**
Class45	Kinetic energy of a particle: principles of work and energy
Class-46	Applications of principles of work and energy
Class-47	Principle of impulse and momentum
Class-48	Problems involving energy and momentum
Week 13	**System of Particles**
Class-49	Linear and angular momentum of system of particles
Class-50	Conservation of momentum of a system of particles
Class-51	Kinetic energy of a system of particles
Class-52	Principle of impulse and momentum of a system of particles
Week 14	**Kinematics of rigid bodies**
Class-53	Rotation about a fixed axis
Class-54	General plane motion
Class-55	Instantaneous centre of rotation in plane motion
Class-56	Absolute and relative acceleration in plane motion

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

Vector Mechanics for Engineers: Statics and Dynamics – Ferdinand P. Beer, E Russell Jr. Johnstone; McGraw-Hill Companies, 5th edition 1988.

b. Engineering Mechanics - Timoshenko, D H Young, J V Rao

c. Engineering Mechanics – Andrew Pytel, JaonKiusaloas

d. Engineering Mechanics, Statics and Dynamics – Joseph F Shelley; McGraw-Hill, 1980. e. Engineering‘s Mechanics - J.L. Merian& LG Kraige

Spring/Fall Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	ME 180 Basic Engineering Drawing	Lecture Contact Hours Credit Hours	3.00 1.50
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course is designed for learners to learn engineering drawing skills both manual and computer based as a means of accurately and clearly communicating ideas, information and instructions and use them to communicate with others through engineering drawings and solve complex problems of real world.			
OBJECTIVE			
1. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions. 2. To enable the students to read various professional drawing that will enhance their exposure to real engineering practices. 2. To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to prepare engineering drawing of basic element using manual tools	1	C3, A3			4	
CO2	Be able to prepare engineering drawing of basic element using computer software	1,5	C3, A3			4,6	
CO3	Be able to identify and interpret	2	C3, A3			4	

	real life engineering drawings						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction; Instruments and their uses; First and third angle projections; Orthographic drawings; Isometric views; Sectional views and conventional practices; Introduction to AutoCAD/Solid Works, Real life drawing inspection and identification

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to prepare engineering drawing of basic element using manual tools	3											
CO2	Be able to prepare engineering drawing of basic element using computer software	3				3							
CO3	Be able to identify and interpret real life engineering drawings		3										

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO1	**2**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO5	**3**	Students will use AutoCAD / Solid Works software
CO3-PO1	**2**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Weeks	**Topics**	**Remarks**
Week-1	Introduction	**Mid-term**
Week-2	First and third angle projections	
Week-3	Orthographic drawings	
Week-4	Orthographic drawings	
Week-5	Isometric views	
Week-6	Isometric views	
Week-7	Mid-term Exam	
Week-8	Sectional views and conventional practices	**Final Exam**
Week-9	Solid Works Practice – Orthographic Drawing	
Week-10	Solid Works Practice – Orthographic Drawing	
Week-11	Solid Works Practice – Orthographic Drawing	

Week-12	Actual drawing reading practice – Power plant layout, Cooling tower sectional view, Steam generator sectional view	
Week-13	Actual drawing reading practice – Pump cut sectional view, Welding joints ISO symbol, Fluid power and control ANSI symbol	
Week-14	Final Exam	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1,2,3,4	Lab participation and Report	**20**	
1,2,3,4	Presentation	**20**	
	Exam		
1,2,3,4	Lab Test 1 & 2	**30**	
1,2,3,4	Final Exam	**30**	

REFERENCE BOOKS

Lab Handbook

Mechanical Engineering Drawing – A C Mandal, M Quamrul Islam

REFERENCE SITE

N/A

Spring/Fall Semester L-2, T-1

COURSE INFORMATION			
Course Code Course Title	**ME 253** **Engineering Mechanics**	Lecture Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To provide the students with the basic knowledge in the mechanics of rigid body which will be helpful while studying strength of materials, aircraft structures etc.

OBJECTIVE

a) To be able to express and resolve the position and force into vector unit components.

b) To determine the forces in the members of trusses and frames using the method of joints and sections.

c) To draw and describe the free-body diagram and to solve the problems using the equations of equilibrium.

d) To determine to the location of centre of gravity and centric for a system and to determine the moment of inertia for an area.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Explain** basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).	1	C1,C2	1			Q, ASG, F
CO2	**Demonstrate** use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems	2	C3,C4	1,2			Q, ASG, F
CO3	**Apply** scalar and vector analytical techniques for analyzing forces in statically determinate	5	C3	6	1,2		Q, F, CS

	structures						
CO4	**Evaluate** equilibrium of particles and bodies in real world problems.	2	C4,C5	1,2	1,2		Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

I) i. Properties of forces, moments, couples and resultants;

II) . Moment of inertia of areas and masses;

III) iii. Principle of work, energy, impulse and momentum

IV) iv. System of particles;

V) v. Kinematics of rigid bodies

b. Detail Contents:

Statics of particles and rigid bodies; Properties of forces, moments, couples and resultants; Analysis of two- and three-dimensional problems; Centroids of lines, areas and volumes; Forces in truss, frames, and cables; Friction; Moments of inertia of areas and masses; Relative motion.

Planar mechanisms, linkages, mobility; instant centres of rotation, Kennedy’s theorem; Velocity and acceleration polygons; Euler’s first law; angular momentum and Euler’s second law.

Kinetics of particles: Newton ‘s second law of motion; Principles of work, energy, impulse and momentum; System of particles; Kinematics of rigid bodies;

Kinetics of plane motion of rigid bodies: forces and acceleration; Principles of work and energy.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).	2											
CO2	**Demonstrate** use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems		3										
CO3	**Apply** scalar and vector analytical techniques for analyzing forces in statically determinate structures					2							
CO4	**Evaluate** equilibrium of particles and bodies in real world problems.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	2	Student will gain knowledge and thus will be able to explain Kinematic concepts.
CO2-PO2	3	Students will be able to demonstrate the basics dynamics concept.
CO3-PO5	2	Students will be able to apply various analysing techniques.
CO4-P02	3	Student will learn how to evaluate equilibrium of particles.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	42
Self-Directed Learning	76
Formal Assessment	6
Total	**130**

TEACHING METHODOLOGY
Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Lecture	**Topic**	**CT**
01-03	Fundamental concepts and principles	CT-1
	Systems of units and conversion from one system of units to another	
	Forces in a plane	
	Forces on a particle: resultant of two forces	
04-06	**Statics of Particles**	
	Addition of vectors	
	Resultant of several concurrent forces	
	Resolution of a force into components and rectangular components of a force: unit vectors	
	Equilibrium of a particle	
07-09	**Rigid Bodies: Equivalent Systems of Forces**	
	Moment of a force about a point, given axis	
	Varignon's theorem	
	Moment of a couple	
	Reduction of a system of forces to one force and one couple	
10-12	**Equilibrium of Rigid Bodies**	Mid Exam
	Equilibrium in two dimensions	
	Equilibrium of a two force body	
	Equilibrium of a three force body	
	Equilibrium in three dimensions	
13-15	**Distributed Forces: Centroids and Centres of Gravity**	
	Centre of Gravity of a two dimensional body	
	Determination of centroids by integration	

	Centre of Gravity of a three dimensional body	
	Determination of centroids of volumes by integration	
16-18	**Analysis of structures**	
	Analysis of trusses by method of joints	
	Analysis of trusses by method of sections	
	Analysis of frames	
	Analysis of cables	
19-21	**Friction**	CT-2
	Introduction	
	The Laws of Dry Friction, Coefficients of Friction	
	Angles of Friction	
	Problems involving Dry Friction	
22-24	**Distributed Forces: Moments of inertia**	
	Moments of inertia of areas	
	Polar moment of inertia and radius of gyration of an area	
	Moments of inertia of a mass	
	Moments of inertia of composite bodies	
23-27	**Instant centres of rotation, Kennedy's theorem, Velocity and acceleration polygons**	
	Instant centres of rotation	
	Kennedy's theorem	
	Velocity and acceleration polygons	
	Velocity and acceleration polygons	
28-30	**Euler's First Law, Angular Momentum and Euler's Second law**	CT-3
	Euler's first law	
	Angular momentum	
	Angular momentum	
	Euler's second law	
31-33	**Kinetics of Particles: Newton's Second Law**	
	Newton's second law of motion	
	Linear momentum of a particle : rate of change of linear momentum	
	Equations of motion	
	Annear momentum of a particle : rate of change of angular momentum	

34-36	**Kinetics of Particles: Energy and Momentum Methods**
	Kinetic energy of a particle: principles of work and energy
	Applications of principles of work and energy
	Principle of impulse and momentum
	Problems involving energy and momentum
37-39	**System of Particles**
	Linear and angular momentum of system of particles
	Conservation of momentum of a system of particles
	Kinetic energy of a system of particles
	Principle of impulse and momentum of a system of particles
40-42	**Kinematics of rigid bodies**
	Rotation about a fixed axis
	General plane motion
	Instantaneous centre of rotation in plane motion
	Absolute and relative acceleration in plane motion

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
2	Assignment	**20**	
	Exam		
1	Final Exam, CT	**80**	
2	Final Exam, CT, MID	**80**	
3	Final Exam, CT	**100**	
4	Final Exam, CT, Mid	**100**	

REFERENCE BOOKS

1. Vector Mechanics for Engineers: Statics and Dynamics – Ferdinand P. Beer, E Russell Jr. Johnstone; McGraw-Hill Companies, 5th edition 1988.
2. Engineering Mechanics - Timoshenko, D H Young, J V Rao
3. Engineering Mechanics – Andrew Pytel, Jaon Kiusaloas

4. Engineering Mechanics, Statics and Dynamics – Joseph F Shelley; McGraw-Hill, 1980.
5. Engineering's Mechanics - J.L. Merian& LG Kraige

Spring Semester L-2, T-1

COURSE INFORMATION			
Course Code	**ME 254**	Lecture Contact Hours	**3.00**
Course Title	**Engineering Mechanics Sessional**	Credit Hours	**1.50**

PRE-REQUISITE

ME 253

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed for learners to learn various theories and applications of engineering mechanics in practical form. This sessional course is design to build up the confidence among the students in applying various theory of mechanics

OBJECTIVE

1. Demonstrate practical understanding on various laws used in engineering mechanics
2. Demonstrate practical understanding on various systems of rigid body mechanics

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to demonstrate practical understanding on various laws used in engineering mechanics	1	C4, P3			3	Q, ASG, R, F
CO2	Be able to demonstrate practical knowledge on various systems taught in the theory class	2	C4, P4			3,4	Q, ASG, R, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
1. Study of coefficient of friction by changing angle of inclination. 2. Study of impulse momentum principle 3. Study of friction wheel 4. Study of Centroid of irregular shape body 5. Study of rigid body kinematics 6. Study of planar motion of rigid body

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to demonstrate practical understanding on various laws used in engineering mechanics	3											
CO2	Be able to demonstrate practical knowledge on various systems taught in the theory class		3										

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**3**	In order to demonstrate practical understanding theoretical framework of various engineering fundamental laws, knowledge of those law and their derivation from basic is necessary
CO2-PO2	**2**	Students will learn to analyse various engineering systems and deviation from theory in real world scenario

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation	 10 10 5

Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Weeks	Topics	Remarks
Week-1	1. Study of coefficient of friction by changing angle of inclination.	
Week-2	Study of impulse momentum principle	
Week-3	Study of friction wheel	
Week-4	Study of Centroid of irregular shape body	
Week-5	Study of rigid body kinematics	
Week-6	Study of planar motion of rigid body	
Week-7	Final Exam	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1,2	Lab participation and Report	**20**	
1,2	Presentation	**20**	
	Exam		
1,2	Lab Test 1 & 2	**30**	
1,2	Final Exam	**30**	

REFERENCE BOOKS

Lab Handbook

Ferdinand P. Beer,E RussellJr ,Vector Mechanics for Engineers: Statics. Johnston, Publisher – McGraw-Hill Companies, 5th edition 1988.

Joseph FShelley,Engineering Mechanics, Statics and Dynamics, USA: McGraw-Hill,1980.

Hibbeler, Russell Charles, and Russell C. Hibbeler. Engineering mechanics: statics & dynamics.

Pearson Education India, 2007.
REFERENCE SITE
N/A

Spring/Fall Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 142** **Workshop Sessional**	Lecture Contact Hours Credit Hours	**: 3.00** **: 1.50**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course students will be introduced with different wood working tools, bench tolls, hand tools and machine tools. Students will be also presented with welding techniques. This training will be useful for the students in later projects.			
OBJECTIVE			
1. Students will be able to recognize wood working tools, common bench tools, hand tools and machine tools. 2. Students will be able to identify the machines used in welding and machine shops and label them with their functions. 3. Students will be able to demonstrate a job with proper planning and estimating. 4. Students will be able to produce lab report with proper appearance, format, grammar, introduction, objective and procedure. Ability to produce lab report with proper results, discussions and conclusion			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Correspondin g PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and moulding.	1	C3			1	R, Q, LT

CO2	Be able to **compare** between different types of welding and machining processes and **select** proper cutting tool for specific machining processes.	2,3	C1, C3			1	R, Q, LT
CO3	**Find** out about the importance of general safety precautions on different shop floors	1	C4			1	R, Q, LT
CO4	**Develop** practical skills by performing the experiments in different shops of workshop	5	C3			6	R, Q, LT
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)							

COURSE CONTENT

Experiments:

1) Design and making of pattern for casting
2) Mold making, casting and assembly of final project
3) Study of electric arc welding
4) Study of Resistance Welding/Spot Welding
5) Study of Welding joints and welding positions
6) Study of Gas Welding/cutting
7) Study of TIG and MIG Welding
8) Manufacturing of machine component by using Lathe machine
9) Manufacturing of machine component by using Shaper machine
10) Manufacturing of a machine component by using Milling Machine
11) Manufacturing of a machine component by using Drilling Machine
12) Carpentry: Middle Lap T Joint, Cross Lap Joint, Mortise And Tenon T joint, Bridle T Joint

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding.	3											
CO2	Be able to **compare** between different types of welding and machining processes and **select** proper cutting tool for specific machining processes.		3	2									
CO3	**Find** out about the importance of general safety precautions on different shop floors	3											
CO4	**Develop** practical skills by performing the experiments in different shops of workshop					3							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required.
CO2-PO2	**3**	In order to perform the experiments, the knowledge of engineering fundamentals would be required
CO2-PO3	**2**	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO1	**3**	For performing the experiments, safety precautions are very essential in this laboratory.
CO4-PO5	**3**	Students will acquire knowledge on how to select and apply appropriate techniques, resources, and modern engineering tools.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week-1	Expt-01: Design and making of pattern for casting
Week-2	Expt-02: Mold making, casting and assembly of final project
Week-3	Expt-03: Study of electric arc welding
Week-4	Expt-04: Study of Resistance Welding/Spot Welding
Week-5	Expt-05: Study of Welding joints and welding positions
Week-6	Expt-06: Study of Gas Welding/cutting
Week-7	Expt-07: Study of TIG and MIG Welding
Week-8	Expt-08: Manufacturing of machine component by using Lathe machine
Week-9	Expt-09: Manufacturing of machine component by using Shaper machine
Week-10	Expt-10: Manufacturing of a machine component by using Milling Machine
Week-11	Expt-11: Manufacturing of a machine component by using Drilling Machine
Week-12	Expt-12: Carpentry: Middle Lap T Joint, Cross Lap Joint, Mortise And Tenon T joint, Bridle T Joint
Week-13	Viva

Week-14	Quiz Test

Components		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. Machine Shop Practice – James Anderson, W. A. Chapman. 2. Callister W. D., Material Science & Engineering, John Wiley & Sons.

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 176** **Workshop Practice**	Lecture Contact Hours Credit Hours	**3.00** **1.50**

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing and production. The workshop practical courses make students competent in handling practical work in engineering environment.

OBJECTIVE

1. The student will be able to use different manufacturing (machining, welding, foundry, sheet metal working, etc.) processes required to manufacture a product from the raw materials.
2. He will be able to use different measuring, marking, cutting tools used in workshop.
3. He will be aware of the safety precautions while working in workshop.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and moulding.	1	C3			1	R, Q, LT
CO2	Be able to compare between different types of welding and machining processes and select proper cutting tool for specific machining processes.	2,3	C1, C3			1	R, Q, LT
CO3	Find out about the importance of general safety precautions on different shop floors.	1	C4			1	R, Q, LT
CO4	Develop practical skills by performing the experiments in different shops of workshop.	5	C3			6	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Sheet Metal: Shop safety practice, Identification of different types of sheets/plates, e.g. CI, GI, MS, GP sheet etc. with commercial specification. Acquaintance with sheet metal working tools, machines and measuring instruments. Practice jobs on sheet metal (development of cones, bends, ducts etc.,

Machine and Fitting Shop: Shop safety practices, Acquaintance with tools used in fitting shop, e.g. Marking, Holding, Chiseling, Filing, Sawing etc. Tools, Practical jobs on the use of tools, Use of taps and dies. Acquaintance with different cutting tools and machine tools, Operation and maintenance of different machine tools, Practical jobs on: plain and taper turning, thread cutting, doing jobs by using shaper, milling, drilling and grinding machines.
Welding: Shop safety practice, Acquaintance with arc and gas welding tools, machines, electrodes, gas cylinders, their identification, types of gas flames, job preparation for welding. Practice on gas, arc welding and gas cutting of MS sheets and plates, soldering and brazing practices, study of welding defects.
Foundry: Shop safety practice, Acquaintance with foundry tools and equipments, introduction on foundry: molding, casting, pattern, core, bench, practice on simple bench or floor molding with solid and split pattern in green sand with and without cores, preparation of molding sand and core, preparation of mold, casting, study of defects in casting.

Experiments:

1) Design and making of pattern for casting
2) Mold making, casting and assembly of final project
3) Study of electric arc welding
4) Study of Resistance Welding/Spot Welding
5) Study of Welding joints and welding positions
6) Study of Gas Welding/cutting
7) Study of TIG and MIG Welding
8) Manufacturing of machine component by using Lathe machine
9) Manufacturing of machine component by using Shaper machine
10) Manufacturing of a machine component by using Milling Machine
11) Manufacturing of a machine component by using Drilling Machine

CO-PO MAPPING													
No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and moulding.	3											
CO2	Be able to compare between different types of welding and machining processes and select proper cutting tool for specific machining processes.		3	2									
CO3	Find out about the importance of general safety precautions on different shop floors	3											
CO4	Develop practical skills by performing the experiments in different shops of workshop					3							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required.
CO2-PO2	**3**	In order to perform the experiments, the knowledge of engineering fundamentals would be required
CO2-PO3	**2**	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO1	**3**	For performing the experiments, safety precautions are very essential in this laboratory.
CO4-PO5	**3**	Students will acquire knowledge on how to select and apply appropriate techniques, resources, and modern engineering tools.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Expt-01: Design and making of pattern for casting
Week-2	Expt-02: Mold making, casting and assembly of final project
Week-3	Expt-03: Study of electric arc welding
Week-4	Expt-04: Study of Resistance Welding/Spot Welding
Week-5	Expt-05: Study of Welding joints and welding positions
Week-6	Expt-06: Study of Gas Welding/cutting
Week-7	Expt-07: Study of TIG and MIG Welding
Week-8	Expt-08: Manufacturing of machine component by using Lathe machine
Week-9	Expt-09: Manufacturing of machine component by using Shaper machine
Week-10	Expt-10: Manufacturing of a machine component by using Milling Machine
Week-11	Expt-11: Manufacturing of a machine component by using Drilling Machine
Week-12	Final Lab Report Submission
Week-13	Viva
Week-14	Quiz Test

ASSESSMENT STRATEGY		
Components		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS
1. Machine Shop Practice – James Anderson, W. A. Chapman. 2. Callister W. D., Material Science & Engineering, John Wiley & Sons.

Spring/Fall Semester L-1, T-I

COURSE INFORMATION			
Course Code	**ME 178**	Lecture Contact Hours	**3.00**
Course Title	**Basic Engineering Drawing and CAD**	Credit Hours	**1.50**

PRE-REQUISITE
N/A
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course is designed for learners to learn engineering drawing skills both manual and computer based as a means of accurately and clearly communicating ideas, information and instructions and use them to communicate with others through engineering drawings and solve complex problems of

real world.

OBJECTIVE

1. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.

2. To enable the students to read various professional drawing that will enhance their exposure to real engineering practices.

2. To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to prepare engineering drawing of basic element using manual tools	1	C3, A3			4	
CO2	Be able to prepare engineering drawing of basic element using computer software	1,5	C3, A3			4,6	
CO3	Be able to identify and interpret real life engineering drawings	2	C3, A3			4	

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction; Instruments and their uses; First and third angle projections; Orthographic drawings; Isometric views; Sectional views and conventional practices; Introduction to AutoCAD/Solid Works, Real life drawing inspection and identification

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to prepare engineering drawing of basic element using manual tools	3											
CO2	Be able to prepare engineering drawing of basic element using computer software	3				3							
CO3	Be able to identify and interpret real life engineering drawings		3										

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO1	**2**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO5	**3**	Students will use AutoCAD / Solid Works software
CO3-PO1	**2**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20

Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Weeks	Topics	Remarks
Week-1	Introduction	Mid-term
Week-2	First and third angle projections	
Week-3	Orthographic drawings	
Week-4	Orthographic drawings	
Week-5	Isometric views	
Week-6	Isometric views	
Week-7	Mid-term Exam	
Week-8	Sectional views and conventional practices	Final Exam
Week-9	Solid Works Practice – Orthographic Drawing	
Week-10	Solid Works Practice – Orthographic Drawing	
Week-11	Solid Works Practice – Orthographic Drawing	
Week-12	Actual drawing reading practice – Fractional distillation column, Fuel storage tank sectional view, Gas plant, off-shore oil and gas plant layout	
Week-13	Actual drawing reading practice – Pump cut sectional view, Welding joints ISO symbol, Fluid power and control ANSI symbol	
Week-14	Final Exam	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1,2,3,4	Lab participation and Report	**20**	
1,2,3,4	Presentation	**20**	
	Exam		
1,2,3,4	Lab Test 1 & 2	**30**	
1,2,3,4	Final Exam	**30**	

REFERENCE BOOKS

Lab Handbook

Mechanical Engineering Drawing – A C Mandal, M Quamrul Islam

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code	**ME 271**	Lecture Contact Hours	**3.00**
Course Title	**Fluid Mechanics**	Credit Hours	**3.00**

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To give fundamental knowledge of fluid, its properties and behaviour under various conditions of internal and external flows. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

To introduce the students to different fluid power driven machineries and components, Fluid turbo-machinery theory, performance characteristics of centrifugal and axial flow fans, compressors, pumps and turbines, fluid vibrations and sound, water hammer, introduction to fluid power controls and fluid amplifiers, operating principle and design.

OBJECTIVE

1. The course on fluid mechanics is devised to introduce fundamental aspects of fluid flow behaviour.

2. Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Identify how properties of fluids change with temperature and their effect on pressure and fluid flow and define the relationship between pressure and elevation as it relates to manometers, barometers and other pressure measuring devices	1,2	C1, C2, C3	1,4, 6			Q, ASG, F
CO2	Calculate forces on a plane and buoyancy on a body submerged in a static fluid and analyze performance and frictional	2,3	C2, C3	2,5, 6			Q, ASG, F

	losses in pipe system						
CO3	Clear understanding of general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids	1,2	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	Analyze performance/efficiency of different turbo machineries.	1,2	C4	2,5	1		Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Fundamental concepts, Viscosity, Compressibility, Surface tension and capillarity, Vapor pressure, Manometers and other pressure measuring devices.

Fluid Statics: Pressure at a point, pressure gradient, Pressure on flat and curved surfaces immersed in fluids, centre of pressure. Buoyancy and flotation, Metacentre and metacentric height, Stability of submerged and floating bodies.

Kinematics of Fluid Flow: Velocity and acceleration of fluid particles, types of fluid flow, systems and control volumes; one and two dimensional flow; continuity equation. Eulers' equation and Bernoulli's' equation. Energy equation with or without losses, comparison of energy equation with Bernoulli's equation, kinetic energy correction factor. Flow measuring devices. Flow through sharp edged orifice, the pitot tube, the venturi-meter, the flow nozzle and orifice meter.

Fluid Machinery: Introduction to roto-dynamic and positive displacement machinery; Euler's pump turbine equation. Degrees of reaction. Impulse and reaction turbine classification; performance of Pelton wheel, Francis turbine and Kaplan turbine; characteristic curves, governing of turbines, selections and model test of turbine.

Reciprocating Pumps: Working principle of reciprocating pump. Types of reciprocating pumps, Work done by reciprocating pump; Co-efficient of discharge, Slip, Cavitation of reciprocating pumps; Effect of acceleration of piston on velocity and pressure in the suction and delivery pipes.

Centrifugal Pumps: Work done and efficiency of centrifugal pumps, Advantage over reciprocating pumps, Types of centrifugal pumps, Characteristics curves. Priming, Troubles and remedies, Specific speed. Pumps in series and in parallel, Multistage pumps, Turbine pump, Selection of pumps.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify how properties of fluids change with temperature and their effect on pressure and fluid flow and define the relationship between pressure and elevation as it relates to manometers, barometers and other pressure measuring devices	3	3										
CO2	Calculate forces on a plane and buoyancy on a body submerged in a static fluid and analyze performance and frictional losses in pipe system	2	3										
CO3	Clear understanding of general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids	3	2										
CO4	Analyze performance/efficiency of different turbo machineries.	3	3										

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Students will be able to know about the properties of fluids. Students will get clear theoretical knowledge about pressure measuring devices and by using these devices they can measure

		the fluid pressure.
CO1-PO2	3	Students will develop the ability to illustrate a relationship between pressure and elevation. The relationship relates to manometers, barometers and other pressure measuring devices which are essential in fluid mechanics.
CO2-PO1	2	Students get definition of buoyancy, buoyant force, submerged body, metacentre, metacentric height and other terms of fluid mechanics.
CO2-PO2	3	Students will be able to determine forces on a plane and buoyancy on a body submerged in a static fluid.
CO3-PO1	3	The students will attain the knowledge to understand energy equation
CO3-PO2	2	Students will have an ability to calculate the change in different dimensional flow in pipes
CO2-PO1	3	Students will be able to determine the performance of a hydraulic or turbo machines in operation using different system parameters.
CO2-PO2	3	Students will also have in depth knowledge about drawing schematic and usage of velocity triangle diagrams for axial and radial turbomachines

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Lecture-1: **Introduction**: Fundamental concepts, Viscosity, Compressibility, Surface tension and capillarity Lecture-2: Vapor pressure, Manometers and other pressure measuring devices
Week-2	Lecture-3 :**Fluid Statics**: Pressure at a point, pressure gradient, Pressure on flat and curved surfaces immersed in fluids, center of pressure

	Lecture-4 :Buoyancy and flotation
Week-3	Lecture-5 :Metacentre and metacentric height Lecture-6 :Stability of submerged and floating bodies Lecture-7 :**Kinematics of Fluid Flow**: Velocity and acceleration of fluid particles, types of fluid flow, systems and control volumes
Week-4	Lecture-8 :One and two dimensional flow; continuity equation Lecture-9 :Eulers' equation and Bernoulli's' equation
Week-5	Lecture-10: Energy equation with or without losses, comparison of energy equation with Bernoulli's equation, kinetic energy correction factor
Week-6	Lecture-11: Flow measuring devices Lecture-12 :Flow through sharp edged orifice, the pitot tube, the venturi-meter, the flow nozzle and orifice meter
Week-7	Lecture-13 :**Fluid Machinery**: Introduction to roto-dynamic and positive displacement machinery; Euler's pump turbine equation. Degrees of reaction
Week -8	Lecture-14 Impulse and reaction turbine classification Lecture-15 performance of Pelton wheel
Week-9	Lecture-16 Francis turbine and Kaplan turbine
Week-10	Lecture-17 Characteristic curves, governing of turbines Lecture-18 selections and model test of turbine
Week-11	Lecture-19 **Reciprocating Pumps**: Working principle of reciprocating pump Lecture-20 Types of reciprocating pumps Lecture-21 Work done by reciprocating pump
Week-12	Lecture-22 Co-efficient of discharge, Slip Lecture-23 Cavitation of reciprocating pumps Lecture-24 Effect of acceleration of piston on velocity and pressure in the suction and delivery pipes
Week-13	Lecture-25 **Centrifugal Pumps**: Work done and efficiency of centrifugal pumps, Advantage over reciprocating pumps, Types of centrifugal pumps Lecture-26 Characteristics curves. Priming Lecture-27 Troubles and remedies, Specific speed
Week-14	Lecture-28 Pumps in series and in parallel Lecture-29,30 Multistage pumps Lecture-31,32Turbine pump, Selection of pumps

ASSESSMENT STRATEGY			
Components	**Grading**	CO	Blooms Taxonomy

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	CT	**20**	
3	CT	**30**	
4	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**100**	
3	MID, Final Exam	**70**	
4	Final Exam	**70**	

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of fluid mechanics by Bruce Roy Munson and Donald F. Young
2. A Textbook of Fluid Mechanics and Hydraulic Machines by R. K. Bansal
3. Engineering Fluid Mechanics by C. T. Crowe, Donald F. Elger, and John A. Roberson
4. Transport Phenomena by Edwin N. Lightfoot, Robert Byron Bird, and Warren E. Stewart

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 272** **Fluid Mechanics Laboratory**	Lecture Contact Hours Credit Hours	3.00 1.50

PRE-REQUISITE
ME 271

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course provides an introduction to the principles of fluid mechanics of mechanical systems. The focus is to illustrate practical engineering applications of these principles in relation to simple fluid systems. The learning approach is to apply engineering principles to performance analysis and prediction of simple fluid systems. This will provide a basis for understanding how performance can be improved. Student will acquire an understanding of the essential theoretical basis of the fluid mechanics and machinery sciences and their application to a range of problems of relevance to practical engineering.

OBJECTIVE
1. This course provides an introduction to the principles of fluid mechanics of mechanical systems. 2. The focus is to illustrate practical engineering applications of these principles in relation to simple fluid systems. 3. By the end of this course students should be able to understand the basic principles and analysis of both static and dynamic fluid systems and their machinery applications

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Correspon ding PO	Bloom's Taxonomy	CP	CA	KP	Assess ment Method s
CO1	**Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow.	1	C3			1	R, Q, LT
CO2	**Illustrate** practical engineering applications of these principles in relation to simple fluid systems.	1	C2			1	R, Q, LT
CO3	**Evaluate** and design fluid engineering systems	2	C5			5	R, Q, LT

CO4	**Build** simple solutions to a range of problems in basic fluid flows.	4	C3			3	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1. Verification of Bernoulli’s equation.
2. Determination of coefficient of discharge by orifice.
3. Determination of coefficient of discharge by venturi meter.
4. Determination of head loss due to friction, bend, sudden expansion, sudden contraction, in gate and globe valves.
5. Performance test of pumps.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow.	3											
CO2	**Illustrate** practical engineering applications of these principles in relation to simple fluid systems.	3											
CO3	**Evaluate** and design fluid engineering systems		3										
CO4	**Build** simple solutions to a range of problems in basic fluid flows.				3								

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**3**	In order to identify the basics of fluid mechanics, the knowledge of engineering fundamental would be required.

CO2-PO1	**3**	In order to perform the experiments, practical engineering applications of these principles in relation to simple fluid systems knowledge would be required
CO3-PO2	**2**	In order to solve and design fluid engineering system, the knowledge of engineering fundamentals is also required.
CO4-PO4	**3**	For performing the experiments, basic simple solutions to a range of problems in basic fluid flows is needed.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Verification of Bernoulli’s equation.
Week-2	Generation of views of solid bodies in different planes
Week-3	Determination of coefficient of discharge by orifice.
Week-4	
Week-5	Determination of coefficient of discharge by venturimeter

Week-6	.
Week-7	Quiz
Week-8	
Week-9	Determination of head loss due to friction, bend, sudden expansion, sudden contraction in gate and globe valves
Week-10	
Week-11	Performance test of pumps.
Week-12	
Week-13	Quiz,Viva
Week-14	

Components		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

1. Fundamentals of fluid mechanics by Bruce Roy Munson and Donald F. Young

2. A Textbook of Fluid Mechanics and Hydraulic Machines by R. K. Bansal

3. Engineering Fluid Mechanics by C. T. Crowe, Donald F. Elger, and John A. Roberson

4. Transport Phenomena by Edwin N. Lightfoot, Robert Byron Bird, and Warren E. Stewart

Appendix:

Bloom's Taxonomy

Bloom's Taxonomy was created in 1956 under the leadership of educational psychologist Dr Benjamin Bloom in order to promote higher forms of thinking in education, such as analyzing and evaluating concepts, processes, procedures, and principles rather than just remembering facts (rote learning). It is most often used when designing educational, training, and learning processes.
Bloom identified three *domains* of educational activities or learning (Bloom, et al. 1956):

- **Cognitive**: mental skills (*knowledge*)
- **Affective**: growth in feelings or emotional areas (*attitude or self*)
- **Psychomotor**: manual or physical skills (*skills*)

Cognitive Domain:
The cognitive domain involves knowledge and the development of intellectual skills (Bloom, et al, 1956). This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. There are six major categories of cognitive processes, which are listed in order below, starting from the simplest to the most complex.

Category	**Examples, key words (verbs), and technologies for learning (activities)**
C 1: Remembering: Recall or retrieve previous learned information.	**Examples**: Recite a policy. Quote prices from memory to a customer. Recite the safety rules. **Key Words**: defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states **Technologies**: book marking, flash cards, rote learning based on repetition, reading
C 2: Understanding: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.	**Examples**: Rewrite the principles of test writing. Explain in one's own words the steps for performing a complex task. Translate an equation into a computer spreadsheet. **Key Words**: comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates **Technologies**: create an analogy, participating in cooperative learning, taking notes, storytelling, Internet

	search
C 3: Applying: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the work place.	**Examples**: Use a manual to calculate an employee's vacation time. Apply laws of statistics to evaluate the reliability of a written test. **Key Words**: applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses **Technologies**: collaborative learning, create a process, blog, practice
C 4: Analyzing: Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	**Examples**: Troubleshoot a piece of equipment by using logical deduction. Recognize logical fallacies in reasoning. Gathers information from a department and selects the required tasks for training. **Key Words**: analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates **Technologies**: Fishbowls, debating, questioning what happened, run a test
C 5: Evaluating: Make judgments about the value of ideas or materials.	**Examples**: Select the most effective solution. Hire the most qualified candidate. Explain and justify a new budget. **Key Words**: appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports **Technologies**: survey, blogging
C 6: Creating: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	**Examples**: Write a company operations or process manual. Design a machine to perform a specific task. Integrates training from several sources to solve a problem. Revises and process to improve the outcome. **Key Words**: categorizes, combines, compiles, composes,

	creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes **Technologies**: Create a new model, write an essay, network with others

Affective Domain:

The affective domain (Krathwohl, Bloom, Masia, 1973) includes the manner in which we deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. The five major categories are listed from the simplest behavior to the most complex.

Category	**Example and Key Words (verbs)**
A 1: Receiving Phenomena: Awareness, willingness to hear, selected attention.	**Examples**: Listen to others with respect. Listen for and remember the name of newly introduced people. **Key Words**: acknowledge, asks, attentive, courteous, dutiful, follows, gives, listens, understands
A 2: Responds to Phenomena: Active participation on the part of the learners. Attend and react to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation).	**Examples**: Participates in class discussions. Gives a presentation. Questions new ideals, concepts, models, etc. in order to fully understand them. Know the safety rules and practice them. **Key Words**: answers, assists, aids, complies, conforms, discusses, greets, helps, labels, performs, presents, tells
A 3: Valuing: The worth or value a person attaches to a particular object, phenomenon, or behavior. This ranges from simple acceptance to the more complex state of commitment. Valuing is based on the internalization of a set of specified values, while clues to these values are expressed in the learner's overt behavior and are often identifiable.	**Examples**: Demonstrates belief in the democratic process. Is sensitive towards individual and cultural differences (value diversity). Shows the ability to solve problems. Proposes a plan to social improvement and follows through with commitment. Informs management on matters that one feels strongly about. **Key Words**: appreciates, cherish, treasure,

	demonstrates, initiates, invites, joins, justifies, proposes, respect, shares
A 4: Organization: Organizes values into priorities by contrasting different values, resolving conflicts between them, and creating an unique value system. The emphasis is on comparing, relating, and synthesizing values.	**Examples**: Recognizes the need for balance between freedom and responsible behavior. Explains the role of systematic planning in solving problems. Accepts professional ethical standards. Creates a life plan in harmony with abilities, interests, and beliefs. Prioritizes time effectively to meet the needs of the organization, family, and self. **Key Words**: compares, relates, synthesizes
A 5: Internalizes Values (characterization): Has a value system that controls their behavior. The behavior is pervasive, consistent, predictable, and most important characteristic of the learner. Instructional objectives are concerned with the student's general patterns of adjustment (personal, social, emotional).	**Examples**: Shows self-reliance when working independently. Cooperates in group activities (displays teamwork). Uses an objective approach in problem solving. Displays a professional commitment to ethical practice on a daily basis. Revises judgments and changes behavior in light of new evidence. Values people for what they are, not how they look. **Key Words**: acts, discriminates, displays, influences, modifies, performs, qualifies, questions, revises, serves, solves, verifies

<u>Psychomotor Domain:</u>

The psychomotor domain (Simpson, 1972) includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution. Thus, psychomotor skills rage from manual tasks, such as digging a ditch or washing a car, to more complex tasks, such as operating a complex piece of machinery or dancing.

The seven major categories are listed from the simplest behavior to the most complex:

Category	**Example and Key Words (verbs)**
P 1: Perception (awareness): The ability to use	**Examples**: Detects non-verbal communication

sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation.	cues. Estimate where a ball will land after it is thrown and then moving to the correct location to catch the ball. Adjusts heat of stove to correct temperature by smell and taste of food. Adjusts the height of the forks on a forklift by comparing where the forks are in relation to the pallet. **Key Words**: chooses, describes, detects, differentiates, distinguishes, identifies, isolates, relates, selects.
P 2: Set: Readiness to act. It includes mental, physical, and emotional sets. These three sets are dispositions that predetermine a person's response to different situations (sometimes called mindsets).	**Examples**: Knows and acts upon a sequence of steps in a manufacturing process. Recognize one's abilities and limitations. Shows desire to learn a new process (motivation). NOTE: This subdivision of Psychomotor is closely related with the "Responding to phenomena" subdivision of the Affective domain. **Key Words**: begins, displays, explains, moves, proceeds, reacts, shows, states, volunteers.
P 3: Guided Response: The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing.	**Examples**: Performs a mathematical equation as demonstrated. Follows instructions to build a model. Responds hand-signals of instructor while learning to operate a forklift. **Key Words**: copies, traces, follows, react, reproduce, responds
P 4: Mechanism (basic proficiency): This is the intermediate stage in learning a complex skill. Learned responses have become habitual and the movements can be performed with some confidence and proficiency.	**Examples**: Use a personal computer. Repair a leaking faucet. Drive a car. **Key Words**: assembles, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches.
P 5: Complex Overt Response (Expert): The skillful performance of motor acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly	**Examples**: Maneuvers a car into a tight parallel parking spot. Operates a computer quickly and accurately. Displays competence while playing the

coordinated performance, requiring a minimum of energy. This category includes performing without hesitation, and automatic performance. For example, players are often utter sounds of satisfaction or expletives as soon as they hit a tennis ball or throw a football, because they can tell by the feel of the act what the result will produce.	piano. **Key Words**: assembles, builds, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches. NOTE: The Key Words are the same as Mechanism, but will have adverbs or adjectives that indicate that the performance is quicker, better, more accurate, etc.
P 6: Adaptation: Skills are well developed and the individual can modify movement patterns to fit special requirements.	**Examples**: Responds effectively to unexpected experiences. Modifies instruction to meet the needs of the learners. Perform a task with a machine that it was not originally intended to do (machine is not damaged and there is no danger in performing the new task). **Key Words**: adapts, alters, changes, rearranges, reorganizes, revises, varies.
P 7: Origination: Creating new movement patterns to fit a particular situation or specific problem. Learning outcomes emphasize creativity based upon highly developed skills.	**Examples**: Constructs a new theory. Develops a new and comprehensive training programming. Creates a new gymnastic routine. **Key Words**: arranges, builds, combines, composes, constructs, creates, designs, initiate, makes, originates.

(Ref: http://www.nwlink.com/~donclark/hrd/bloom.html)

Program Outcome (PO)

Program Outcomes (POs) or graduate attributes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These statements relate to the knowledge, skills and attitudes acquired by students while progressing through the program. The program must demonstrate that by the time of graduation, students have achieved an acceptable minimum level of certain knowledge, skills and behavioral traits. The BAETE specifically requires that students acquire the following graduate attributes:

(a) Engineering knowledge: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.

(b) Problem analysis: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)

(c) Design/development of solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)

(d) Investigation: Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

(e) Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)

(f) The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)

(g) Environment and sustainability: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)

(h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)

(i) Individual work and teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

(j) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(k) Project management and finance: Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

(l) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

In addition to incorporating the above-listed POs (graduate attributes), the educational institution may include additional outcomes in its learning programs. An engineering program that aims to attain the abovementioned POs should ensure that its curriculum encompasses all the attributes of the Knowledge Profile (K1 – K8) as presented in Table 4.1 and as included in the PO statements. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are given in Tables 4.2 and 4.3, respectively.

Table 4.1: Knowledge Profile

	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

Table 4.2: Range of Complex Engineering Problem Solving

Attribute	**Complex Engineering Problems** have characteristic P1 and some or all of P2 to P7:
Depth of knowledge required	P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	P2: Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	P5: Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder	P6: Involve diverse groups of stakeholders with widely varying

Table 4.3: Range of Complex Engineering Activities

Attribute	**Complex activities** means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches

(Source: BAETE Accreditation Manual For Undergraduate Programs, [Version 2, 2019])