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 Eligibility of Students for Admission in MIST

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)	120
2		Computer Science and Engineering (CSE)	120
3		Electrical, Electronic & Communication Engineering (EECE)	120
4		Mechanical Engineering (ME)	120
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		Environmental, Water Resource and Costal Engineering	60
10		Industrial and Production Engineering (IPE)	50
11		Petroleum and Mining Engineering (PME)	25
12	B	Architecture (Arch)	25
	Total		810

At MIST, the total number is 810. 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, MIST and MOD employee	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 under graduate (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.

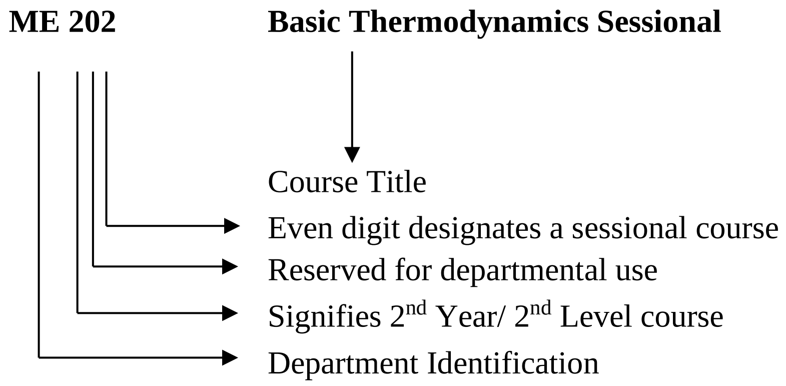
b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

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



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 Limits on the Credit Hours to be taken

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 Course Add/Drop

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 Test/Assignment	20%
Mid-Term Assessment (Exam/Project)	15%
Final Examination (Section A & B)	60%
Total	100%

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

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

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

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

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

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

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 Rules of Different Examinations

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.

Program Educational Objectives (PEO)

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

1. **PEO-1:** To develop strong academic foundation, technical and professional skills to excel in various sectors such as govt./nongovt jobs, industrial and production related jobs, allied sectors and military.

2. **PEO-2:** To provide sufficient depth of knowledge to engage in lifelong learning, higher education, collaborative and multi-disciplinary work, as well as conduct research and development in traditional and emerging areas of mechanical engineering.

3. **PEO-3:** To develop versatile leaders capable of working in diverse teams to solve complex engineering problems from first principles and demonstrate ethical judgement and team spirit and interpersonal skills for contributing to society.

4. **PEO-4:** To adapt at employing knowledge, technology, modern tools and entrepreneurial skills to establish sustainable business solutions as well as pursuing diverse career paths.

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.

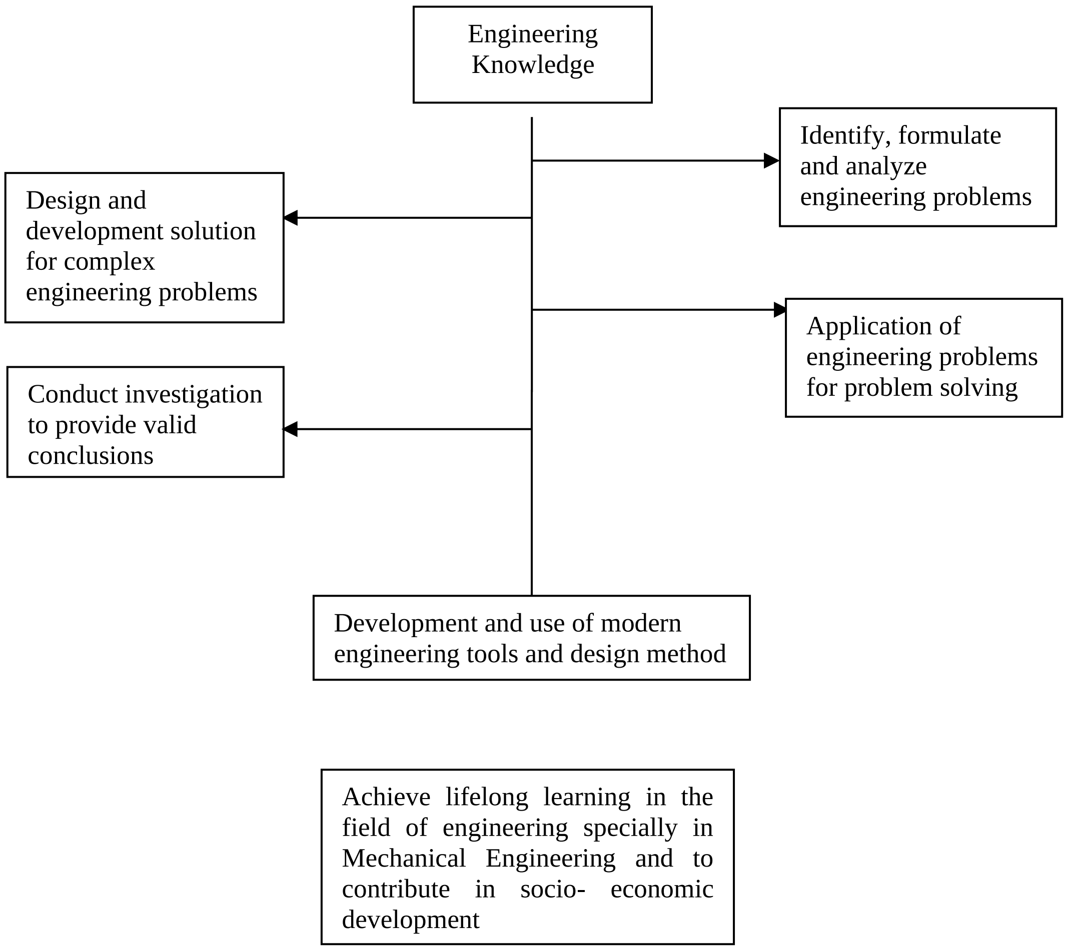
3. Learn independently, be self- aware and self- manage their time and workload.

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 OF BACHELOR IN MECHANICAL ENGINEERING

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	2.0+1.5	3.0+0.0	3.0+1.5	3.0+1.5	3.0+1.5	-	20.00
2-I	2.0+1.5	3.0+0.0	-	6.0+2.25	3.0+1.5	-	19.25
2-II	2.0+0.0	3.0+0.0	-	12.0+5.25	-	-	22.25
3-I	0.0+2.0	-	-	14.0+4.0	-	-	20.00
3-II	-	-	-	15.0+5.5	-	-	20.50
4-I	2.0+0.0	-	-	6.0+6.0	-	6.0**+0.0	20.00
4-II	4.0+0.0	-	-	3.0+3.0	0.0+1.5	6.0**+0.0	17.50
Total	14.0+5.0 =19.0	12.0+0.0 =12.0	6.0+3.0 =9.0	64.0+30.50 = 94.50	9.0+4.5 =13.5	12+0 =12.0	160.00
% of total theory course	11.97%	10.26%	5.13%	54.70%	7.69%	10.26%	
% of total course	11.88%	7.50%	5.63%	59.06%	8.44%	7.50%	

**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	09.0	25.0	20.5
1-II	14.0	12.0	51.0	40.5
2-I	14.0	10.5	75.5	59.75
2-II	17.0	10.5	103.0	82.0
3-I	14.0	12.0	129.0	102
3-II	15.0	09.0 + 04 Weeks	153.0 + 04 Weeks	122.5

4-I	14.0	12.0	179.0 + 04 Weeks	142.5
4-II	13.0	9.0	201.0 + 04 Weeks	160.0
Total	117.0	84.0 + 04 Weeks	**201.0 + 04 Weeks**	**160.0**

4.3 Term-wise Distribution of Courses

LEVEL- 1 TERM-I

Course No	Course Name	Types of Courses	Credit hours	Contact hours
ME 161	Introduction to Mechanical Engineering	Theory	2.00	2.00
ME 193	Engineering Materials	Theory	3.00	3.00
EECE 159	Fundamentals of Electrical Engineering	Theory	3.00	3.00
PHY 101	Physics (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	1.50	3.00
ME 194	Engineering Materials Sessional	Sessional	1.50	3.00
SHOP 162	Workshop Practice Sessional	Sessional	1.50	3.00
			4.50	**9.00**
Credit hours: 20.50; Contact hours: 25.00				

*GEBL 101 Bangla Language and Literature Course may be offered in place of GEBS 101 Bangladesh Studies

LEVEL-1 TERM-II

Course No	Course Name	Types of Courses	Credit hours	Contact hours
ME 103	Thermodynamics	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
GES 107	Fundamentals of Sociology	Theory	2.00	2.00
			14.00	**14.00**
CHEM 102	Chemistry Sessional	Sessional	1.50	3.00
LANG 102	Communicative English I	Sessional	1.50	3.00
ME 104	Thermodynamics Sessional	Sessional	1.50	3.00
EECE 174	Electrical and Electronics Technology Sessional	Sessional	1.50	3.00
			6.00	**12.00**
Credit hours: 20.00; Contact hours: 26.00				

LEVEL –2, TERM – I

Course No	Course Name	Types of Courses	Credit hours	Contact 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& Coordinate Geometry	Theory	3.00	3.00
ME 221	Fluid Mechanics - I	Theory	3.00	3.00
GEE 205	Fundamentals of Economics	Theory	2.00	2.00
			14.00	**14.00**

ME 222	Fluid Mechanics Sessional	Sessional	0.75	1.50
CSE 276	Computer Programming Language Sessional	Sessional	1.50	3.00
ME 258	Mechanical Engineering Drawing – I	Sessional	1.50	3.00
LANG 202	Communicative English - II	Sessional	1.50	3.00
			5.25	**10.50**
Credit hours: 19.25; Contact hours: 24.50				

LEVEL-2, TERM –II

Course No	Course Name	Types of Courses	Credit hours	Contact hours
ME 247	Engineering Mechanics - II	Theory	3.00	3.00
ME 243	Mechanics of Solids	Theory	3.00	3.00
MATH 265	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
ME 223	Fluid Mechanics – II	Theory	3.00	3.00
			17.00	**17.00**
ME 224	Fluid Mechanics – II Sessional	Sessional	0.75	1.50
ME 244	Mechanics of Solids Sessional	Sessional	1.50	3.00
ME 264	Numerical Analysis Sessional	Sessional	1.50	3.00
ME 260	Mechanical Engineering Drawing – II	Sessional	1.50	3.00
			5.25	**10.50**
Credit hours: 22.25; Contact hours: 27.50				

LEVEL – 3, TERM –I

Course No	Course Name	Types of Courses	Credit hours	Contact hours
ME 333	Manufacturing Technology	Theory	3.00	3.00
ME 361	Instrumentation and Measurement	Theory	2.00	2.00
ME 305	Heat and Mass transfer	Theory	3.00	3.00
ME 341	Machine Design – I	Theory	3.00	3.00
ME 321	Fluid Machinery	Theory	3.00	3.00
			14.00	**14.00**
ME 306	Heat and Mass transfer Sessional	Sessional	1.50	3.00
ME 334	Manufacturing Technology Sessional	Sessional	1.50	3.00
GERM 352	Fundamentals of Research Methodology	Sessional	2.00	4.00
ME 366	Engineering Simulation	Sessional	1.00	2.00
			6.00	**12.00**
Credit hours: 20.00; Contact hours: 26.00				

LEVEL –3, TERM – II

Course No	Course Name	Types of Courses	Credit hours	Contact hours
ME 375	Control Engineering	Theory	3.00	3.00
ME 345	Mechanics of Machinery	Theory	3.00	3.00
ME 301	IC Engine	Theory	3.00	3.00
ME 307	Heat Transfer Equipment Design	Theory	3.00	3.00
ME 343	Machine Design – II	Theory	3.00	3.00
			15.00	**15.00**

ME 302	IC Engine Sessional	Sessional	1.50	3.00
ME 346	Mechanics of Machinery Sessional	Sessional	1.50	3.00
ME 376	Control Engineering Sessional	Sessional	1.50	3.00
ME 372	Industrial Training*	Sessional	1.00	04 Weeks
			5.50	**09.00 + 04 Weeks**
Credit hours: 20.50; Contact hours: 24.00 + 04 Weeks				

* 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**	**Types of Courses**	**Credit hours**	**Contact hours**
GEPM 467	Project Management & Finance	Theory	2.00	2.00
ME 403	Power Plant Engineering	Theory	3.00	3.00
ME 467	Automobile Engineering	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
			14.00	**14.00**
ME 404	Power plant Engineering Sessional	Sessional	1.50	3.00
ME 468	Automobile Engineering Sessional	Sessional	1.50	3.00
ME 400	Final Year Design and Research Project	Sessional	3.00	6.00
			6.00	**12.00**
Credit hours: 20.00; Contact hours: 26.00				

LEVEL – 4, TERM – II

Course No	**Course Name**	**Types of Courses**	**Credit hours**	**Contact hours**
ME 405	Heating, Ventilation, and Air conditioning	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
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
			13.00	**13.00**
IPE 464	CAD/ CAM Simulation Sessional	Sessional	1.50	3.00
ME 400	Final Year Design and Research Project	Sessional	3.00	6.00
			4.50	**09.00**
Credit hours: 17.50; Contact hours: 22.00				

4.4 List of Elective Courses

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 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 445	Noise and vibration	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 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 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 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 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

Fall Semester L-1, T-II

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. To 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. To familiarize with the zeroth, first and second laws of thermodynamics and show how to apply these laws. 3. To instruct in analysing air standard cycles, such as reciprocating piston engines, gas turbine engines, vapour power cycles and 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	Explain the fundamental background of thermodynamics principles.	1	C2	1			Q, ASG, F
CO2	Apply the 1st and 2nd laws of thermodynamics in	2	C3	2			Q, ASG, F

	performance analysis of various power plants, engines and refrigeration systems.						
CO3	Analyse thermodynamic cycles.	2	C4	1			Q, ASG, F
CO4	Perform psychrometric analysis for heating/cooling processes	1	C3	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

- Definitions of thermodynamic terms and concepts
- First law of thermodynamics
- Thermodynamic Properties of Pure Substances
- Evaluating properties
- Control volume analysis using energy
- Second law of Thermodynamics
- Entropy
- Exergy/ availability analysis
- Vapor power systems - Carnot cycle, Rankine cycle.
- Gas power systems - Otto cycle, Diesel cycle, dual cycle, Brayton cycle, Ericsson and Stirling cycle.
- Refrigeration and Heat pump system
- Thermodynamic relations
- Ideal gas mixture and psychrometric applications
- Reacting mixtures and combustion

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 background of thermodynamics principles	✓											
CO2	Apply the 1st and 2nd laws of thermodynamics in performance analysis of various power plants, engines and refrigeration systems		✓										
CO3	Analyse thermodynamic cycles		✓										
CO4	Perform psychrometric analysis for heating/cooling processes	✓											

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to explain the fundamental background of thermodynamics principles.
CO2-PO2	3	Thermodynamic laws will be ingratiated into the students' knowledge profile.
CO3-PO2	3	Developing solutions for efficiency in various thermodynamic cycle problems will provide knowledge from physics and mathematics.
CO4-PO1	3	Developing analysis for heating/cooling 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 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.	CT 01	
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	CT 02 MT	
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	CT 03	

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. 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

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code	**ME 104**	Lecture Contact Hours	**: 3.00**
Course Title	**Thermodynamics Sessional**	Credit Hours	**: 1.50**
PRE-REQUISITE			
None			
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 with relationships 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 concepts to apply, 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	Demonstrate proficiency in using and maintaining various equipment	5	C3			1	R, Q, LT
CO2	Analyze the experimental data generated individually and/or in a group	9	C4			1	R, Q, LT
CO3	Organize the obtained results in the form of technical reports	10	C4			2	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) Determination of Relative Humidity. Viscosity test of liquid substance

2) **Determination of viscosity of various grades of liquid fuel.**
3) **Calibration of Pressure Gauge by Dead Weight Tester.**
4) **Study of Compressor, Condenser, and Evaporator of Split and Window Air conditioner.**
5) **Study of Vapor Compression Refrigeration Cycle (Refrigeration and Air-conditioning Unit).**
6) **Study of Mechanical Heat Pump.**
7) **Determination of Calorific value of Gaseous Fuel by Gas Calorimeter.**
8) **Determination of Carbon Residue of a Given Fuel.**
9) **Proximate Analysis of Coal.**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Demonstrate** proficiency in using and maintaining various equipment					✓							
CO2	**Analyze** the experimental data generated individually and/or in a group									✓			
CO3	**Organize** the obtained results in the form of technical reports										✓		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	In order to perform the basics of thermodynamic experiment, different modern tools and equipments student will use.
CO2-PO9	**3**	In order to perform the experiments, student must conduct experiments in a group or individually.
CO3-PO10	**3**	In order to organize the thermodynamics problems, the technical reports must be submitted.

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 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 various sources of energy	1	C1	2			Q, ASG, F
CO2	Explain internal combustion engines, turbines, refrigeration and air conditioning system, different materials, fluid machineries etc. as well as Robotics, MEMs etc	1	C2	1			Q, ASG, F
CO3	Explain various engineering measurement units and their conversion for solving problems using various charts	1	C2	2			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

Contents:

Introduction to: Sources of energy, construction of various types of engines and related systems, fluid machinery, refrigeration and air-conditioning, selection of materials for various engineering applications, and electromechanical systems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify various sources of energy.	✓											
CO2	Explain internal combustion engines, turbines, refrigeration and air conditioning system, different materials, fluid machineries etc. as well as Robotics, MEMs etc.	✓											
CO3	Explain various engineering measurement units and their conversion for solving problems using various charts.	✓											

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will have basic knowledge of identifying various sources of energy.
CO2-PO1	**3**	Students will learn to perform explain internal combustion engines, turbines, refrigeration and air conditioning system, different materials, fluid machineries etc. as well as Robotics, MEMs etc.
CO3-PO1	**3**	Students will learn to perform explain various engineering measurement units and their conversion for solving problems using various charts.

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	Various Energy Source — Renewable and non-renewable energy sources and their application	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	
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	Gas Turbine and Application—Gas turbine components, Application in aviation and power industry	CT 03 and Mid Term
Class 23 - 28	Fluid Machines – Various types of pumps, 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	CT	**20**	
2	CT	**20**	
3	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	Final Exam	**80**	
3	Final Exam	**70**	

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 Practice 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	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes with modern tools	5	P3			1	R, Q, LT
CO2	Develop practical skills by performing different manufacturing processes individually and/or in a team.	9	P3			2	R, Q, LT

CO3	Justify results obtained in the form of technical reports, projects and presentations	10	C4			1	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 patterns 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) **Manufacturing machine components by using a Milling Machine**
11) **Manufacturing machine components 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	**Identify** the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes with modern tools					✓							
CO2	**Develop** practical skills by performing different manufacturing									✓			

	processes individually and/or in a team.												
CO3	**Justify** results obtained in the form of technical reports, projects and presentations										✓		

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO5	**3**	In order to identify basics concepts of Safety and precaution systems, tools handling and manufacturing processes would be required.
CO2-PO9	**3**	In order to perform the experiments, the different manufacturing processes need to understand and analyze individually and/or in a team.
CO3-PO10	**3**	In order to justify the performed result, the technical reports is 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 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.

Spring Semester L-1, T-I

COURSE INFORMATION			
CourseCode Course Title	: **ME 193** : **Engineering Materials**	Lecture Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
N/A			
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. To introduce various engineering materials including metals, composites, plastics, adhesives and recognize the process used to construct objects from these materials and the external factors that can change the effectiveness of these materials. 2. 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	State different types of materials and their importance in engineering applications.	1	C1	1			Q, ASG, F

CO2	Illustrate the manufacturing techniques applicable to different materials.	1	C3	2			Q, ASG, F
CO3	Analyze the application of materials microstructure in the design of materials and their processing to obtain desired properties.	1	C4	2			Q, F, CS
CO4	Explain phase diagrams and heat treatment processes to compare performance of different materials.	1	C2	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

- Introduction to different classes of engineering materials such as metals, polymers, ceramics and composites
- Crystalline and non-crystalline materials
- Defects in solids
- Mechanical properties of materials on the basis of microstructure
- Phase diagrams
- Heat treatment

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	State different types of materials and their importance in engineering applications.	✓											
CO2	Illustrate the manufacturing techniques applicable to different materials.	✓											

CO3	Analyze the application of materials microstructure in the design of materials and their processing to obtain desired properties.	✓											
CO4	Explain phase diagrams and heat treatment processes to compare performance of different materials.	✓											

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to state different types of materials and their importance in engineering applications.
CO2-PO1	3	Students will be able to identify engineering materials.
CO3-PO1	3	Students will have knowledge of special bodies and will observe how this knowledge relates to engineering.
CO4-PO1	3	Students will have the abilities to explain phase diagrams and heat treatment processes to compare performance of different materials.

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.

Spring Semester L-1, T-I

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

PRE-REQUISITE
None
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	Interpret microstructures and microstructural changes of materials using appropriate laboratory equipment	5	P3			1	R, Q, LT

CO2	Analyze micrographs generated for various samples individually and/or in a team	9	P2			2	R, Q, LT
CO3	Justify results obtained in the form of technical reports, projects and presentations.	10	P3			2	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. **Metallographic Sample Specimen Preparation and Microscopic Examination.**
2. **Microstudy of Steels.**
3. **Microstudy of Hypo- and Hyper-eutectoid steels.**
4. **Microstudy of Cast Irons.**
5. **Heat Treatment of Steels-1 (Annealing).**
6. **Heat Treatment of Steels-2 (Normalizing).**
7. **Heat Treatment of Steels-3 (Hardening and Quenching).**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Interpret microstructures and microstructural changes of materials using appropriate laboratory equipment					✓							
CO2	Analyze micrographs generated for various samples individually and/or in a team									✓			
CO3	Justify results obtained in the form of technical reports, projects and presentations.										✓		

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	Using a specific way to predict and work accordingly by understanding and using modern tools. It requires a good knowledge of application of materials engineering.
CO2-PO9	**3**	In order to describe basic structures and composition of materials, knowledge of identification and formulation of engineering systems would be required individually or in a group
CO3-PO10	**3**	In order to justify the performed result, the technical reports 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 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 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. 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 Course Title	**: ME 221** **: Fluid Mechanics-I**	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	Explain various properties and fundamental equations related to fluids and their applications	1	C2	1			Q, ASG, F

CO2	Determine the hydrostatic pressure of fluid body and pressure force on partially or fully submerged solid body	2	C3	2			Q, ASG, F
CO3	Demonstrate the ability to use fundamental equations related to fluids in solving fluid flow problems	1	C3	1			Q, F, CS
CO4	Solve fluid flow-related problems analytically	1	C3	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

Fluid and its properties, Newton's Law of viscosity, Manometry – various types of manometer and pressure measurement processes, Force on submerged planes (vertical, inclined and curved), Buoyancy and flotation, Stability of partially submerged body, Continuity equation, Impulse momentum equation, Euler and Bernoullie’s equation and their applications, Flow measurement devices - Orificemeter, venturimeter, pitot tube, Fluid kinematics – Lagrangian and Eulerian Frame of reference, Velocity and acceleration, Stream line, Streak line, Path line, Stream function, Potential function, Vorticity and circulation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain various properties and fundamental equations related to fluids and their applications	√											

CO2	Determine the hydrostatic pressure of fluid body and pressure force on partially or fully submerged solid body		√										
CO3	Demonstrate the ability to use fundamental equations related to fluids in solving fluid flow problems	√											
CO4	Solve fluid flow-related problems analytically	√											

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.
CO2-PO2	3	Students will be able to determine the hydrostatic pressure of fluid body and pressure force on partially or fully submerged solid body
CO3-PO1	3	Students will be able to demonstrate the ability to use fundamental equations related to fluids in solving fluid flow problems.
CO4-PO1	3	Students will have an ability to calculate the change in different dimensional flow in pipes.

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	Fluid and its properties, Newton's Law of viscosity	CT 01	
Class 13-21	Manometry – various types of manometer and pressure measurement processes	CT 02	
Class 22- 27	Force on submerged planes (vertical, inclined and curved), Buoyancy and flotation, Stability of partially submerged body	MT	
Class 28- 36	Continuity equation, Impulse momentum equation, Euler and Bernoullie's equation and their applications	MT	
Class 37-39	Flow measurement devices - Orificemeter, venturimeter, pitot tube	CT 03	
Class 40-42	Fluid kinematics – Lagrangian and Eulerian Frame of reference, Velocity and acceleration, Stream line, Streak line, Path line, Stream function, Potential function, Vorticity and circulation.	Final Exam	

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- John Cimbala, Yunus 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.

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 222** **Fluid Mechanics-I Sessional**	Contact Hours Credit Hours	**: 3.00** **: 1.50**
PRE-REQUISITE			
ME 221			
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	Demonstrate proficiency in using different types of equipment for analyzing the		P3			1	R, Q, LT

	performance parameters of various fluid machineries.	5					
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data.in relation to simple fluid systems.	9	P2			1	R, Q, LT
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.	10	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. Verification of Bernoulli's equation
2. Calibration of notch:
   a) Rectangular notch
   b) Triangular notch (V notch)
3. Determination of the location of the center of pressure for a submerged plane surface.
4. Study of flow through orifice meter and venturi meter.
5. Study of the characteristics of centrifugal pumps with series and parallel connection.
6. Study of reciprocating pump characteristics.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	Demonstrate proficiency in using different types of equipment for analyzing various properties of fluids.					√							
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data.in relation to simple fluid systems.									√			
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	In order to identify the basics of fluid mechanics, knowledge of fluid dynamics principles would be required.
CO2-PO9	**3**	In order to perform the experiments, practical engineering applications of these principles in relation to simple fluid systems knowledge would be required
CO3-PO10	**3**	In order to solve and design a fluid engineering system, the knowledge of fluid machinery is 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

Week-1	Expt-01: Verification of Bernoulli's equation
Week-2	Expt-02 (a): Calibration of notch rectangular notch (b): Calibration of Triangular notch (V notch)
Week-3	Expt-03: Determination of the location of the centre of pressure for a submerged plane surface
Week-4	Expt-04: Study of flow through orifice meter and venturi meter
Week-5	Expt-05: Study of the characteristics of centrifugal pumps with series and parallel connection
Week-6	Expt-06 Quiz Test: Study of reciprocating pump characteristics
Week-7	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-2, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 223** **Fluid Mechanics-II**	Lecture Contact Hours Credit Hours	**2.00** **2.00**

PRE-REQUISITE
ME-221
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	Analyze fluid flow problems using dimensional analysis.	2	C4	1			Q, ASG, F
CO2	Explain various aspects of compressible fluid flow, boundary layer, and their applications.	1	C2	2			Q, ASG, F
CO3	Explain open channel flow and flow measurement and their applications	1	C2	2			Q, F, CS

CO4	Design various types of pipe network systems and losses associated with it	2	C6	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

Contents:

Dimensional analysis and similitude Fundamental relations of compressible flow, Speed of sound wave, Fundamentals of Flow through converging-diverging nozzles and shock wave. Introduction to boundary layer theory, Various boundary layer thickness, Local and average boundary layer thickness and shear stress, Boundary layer separation and prevention Introduction to open channel flow, Flow measurement, Hydraulic jump, Economic channel section Real fluid flow; Frictional losses in pipes and fittings Flow around the submerged body, Drag and lift coefficient.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Analyze fluid flow problems using dimensional analysis.		√										
CO2	Explain various aspects of compressible fluid flow, boundary layer, and their applications.	√											
CO3	Explain open channel flow and flow measurement and their applications	√											
CO4	Design various types of pipe network systems and losses associated with it		√										

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justification
CO1-PO2	3	Students will learn to analyze fluid problems using dimensional analysis.
CO2-PO1	3	Students will be able to understand the fundamental relations of compressible flow.
CO3-PO1	3	Students will gather knowledge on open channel flows.
CO4-PO2	3	Students will be able to design various types of pipe network systems and the losses associated with it.

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	Final	

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-2, T-II

COURSE INFORMATION			
Course Code	**ME 224**	Contact Hours	**: 3.00**
Course Title	**Fluid Mechanics-II Sessional**	Credit Hours	**: 1.50**

PRE-REQUISITE

ME 223

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	Demonstrate proficiency in using different types of equipment for analyzing the performance parameters of various fluid machineries.	5	P3			1	R, Q, LT
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data.in relation to simple fluid systems.	9	P2			1	R, Q, LT
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.	10	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. **Study of pipe friction**
2. **Study of the drag coefficient over bluff body**
3. **Study of hydraulic jump**
4. **Study of propeller turbine characteristics**
5. **Study of a Pelton wheel characteristics**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate proficiency in using different types of equipment for analyzing various properties of fluids.					√							
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data.in relation to simple fluid systems.									√			
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	In order to identify the basics of fluid mechanics, knowledge of fluid dynamics principles would be required.
CO2-PO9	**3**	In order to perform the experiments, practical engineering applications of these principles in relation to simple fluid systems knowledge would be required
CO3-PO10	**3**	In order to solve and design a fluid engineering system, the knowledge of fluid machinery 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 of Lab Test Preparation of presentation	 10 10 5

Preparation of Quiz Engagement in Group Projects	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: Study of pipe friction
Week-2	Expt-02: Study of the drag coefficient over bluff body
Week-3	Expt-03: Study of hydraulic jump
Week-4	Expt-04: Study of propeller turbine characteristics
Week-5	Expt-05: Study of a Pelton wheel characteristics
Week-6	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-2, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 243** **Mechanics of Solid**	Contact Hours Credit Hours	**: 3.00** **: 3.00**

PRE-REQUISITE

None

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	Calculate the effects of stress and deformation under static loading on mechanical structures or components.	1	C3	1			Q, ASG, F

CO2	Analyze the magnitude of minimum safe load and stresses to operate individual members and structure without failure.	2	C4	2			Q, ASG, F
CO3	Determine the behavior of beam & column under various loadings.	2	C3	2			Q, F, CS
CO4	Assess the combined loading in a mechanical system.	2	C3	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

Contents:

Stress and strain – axial loading, torsion, pure bending, analysis and design of beams for bending, shearing stresses in beams and thin-walled members, transformation of stress, columns

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; Mohr's Circle; Columns: Euler's formula, intermediate column formulas, the Secant formula, Flexure formula of curved beams. Introduction to experimental stress analysis techniques.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Calculate the effects of stress and deformation under static loading on mechanical structures or components.	√											

CO2	Analyze the magnitude of minimum safe load and stresses to operate individual members and structure without failure.		√										
CO3	Determine the behavior of beam & column under various loadings.		√										
CO4	Assess the combined loading in a mechanical system.		√										

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.
CO2-PO2	3	Students will know how to calculate permissible load, stresses.
CO3-PO2	3	Students will know how to determine the behavior of beam & column under various loadings.
CO4-PO2	3	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 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	Stress analysis: statically indeterminate axially loaded member, axially loaded member	CT 01	
Class 7-14	Thermal and centrifugal stresses; Stresses in thin and thick-walled cylinders and spheres.	CT 02	
Class 15- 22	Beams: Shear force and bending moment diagrams; various types of stresses in beams		
Class 23- 28	Flexural formula; Deflection of beams: integration and area moment methods; Introduction to reinforced concrete beams and slabs, Composite beams	MT	
Class 29-35	Torsion formula; Angle of twist; Modulus of rupture; Helical springs	MT	
Class 36-42	Combined stresses: principal stress, Mohr's Circle; Columns: Euler's formula, intermediate column formulas, the Secant formula	CT 03	

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

Fall Semester L-2, T-II

COURSE INFORMATION			
CourseCode Course Title	**ME 244** **Mechanics of Solids Sessional**	Contact Hours Credit Hours	**: 3.00** **: 1.50**
PRE-REQUISITE			
ME 243			
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 in still 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 Methods
CO1	Demonstrate proficiency in using different types of equipment for analyzing	5	C3			4	R, Q, LT

	various mechanical properties.						
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data.	9	C4			1	R, Q, LT
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.	10	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	Demonstrate proficiency in using different types of equipment for analyzing various mechanical properties.					√							
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data.									√			
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO5	**3**	In order to identify the basics of solid mechanics, the knowledge of engineering fundamental would be required.
CO2-PO9	**3**	In order to perform the experiments, the fundamentalknowledge of stress strainwould be required
CO3-PO10	**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 Practical	 14 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

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 245** **Engineering Mechanics I**	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	Demonstrate the equilibrium of a particle and rigid bodies in space	1	C3	1			Q, ASG, F
CO2	Analyze force systems of planar truss member, structures	2	C4	2			Q, ASG, F
CO3	Analyze systems that include frictional forces	2	C4	2			Q, F, CS
CO4	Determine location of center of gravity, centroids and moment of inertia of bodies of arbitrary shape	2	C3	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 **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.

CO-PO MAPPING

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Students will be able to** demonstrate the equilibrium of a particle and rigid bodies in space

CO2-PO2	**3**	**Students will be able to** analyse force systems of planar truss member, structures
CO3-PO2	**3**	**Students will be able to** analyse systems that include frictional forces
CO4-PO2	**2**	**Students will be able to** determine location of centre of gravity, centroids and moment of inertia of bodies of arbitrary shape

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	Final	
Class 40-42	Solving basic problems using software	Final	

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			
Course Code Course Title	**ME 247** **Engineering Mechanics II**	Contact Hours 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. To explain basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts). 2. To explain and be able to apply Newton's laws of motion.

3. To 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. To introduce velocity and acceleration diagram.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Explain kinematics of particles and rigid bodies for engineering applications.	1	C2	1			Q, ASG, F
CO2	Illustrate kinetics of particle and rigid body for engineering applications.	1	C3	1			Q, ASG, F
CO3	Solve problems related to various motions, acceleration, force, work, energy, impulse and momentum of particle and rigid body.	2	C3	1			Q, ASG, F
CO4	Design of machine parts for various motions and forces.	2	C6	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

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.
6. Kinematic pairs, chains, and mechanisms: velocity and acceleration.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain kinematics of particles and rigid bodies for engineering applications.	√											
CO2	Illustrate kinetics of particle and rigid body for engineering applications.	√											
CO3	Solve problems related to various motions, acceleration, force, work, energy, impulse and momentum of particle and rigid body.		√										
CO4	Design of machine parts for various motions and forces.		√										

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-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-PO1	3	Students will be able to illustrate kinetics of particle and rigid body for engineering applications.

CO3-PO2	3	Students will be able to solve problems related to various motions, acceleration, force, work, energy, impulse and momentum of particle and rigid body.
CO4-PO2	3	Students will be able to design of machine parts for various motions and forces.

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 Course Title	**ME 258** **Mechanical Engineering Drawing-I**	Lecture Contact Hours Credit Hours	**3.00** **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	Demonstrate proficiency in using drawing instruments for sketches.	5	P3			5	T,ASG,Q
CO2	Analyze the 2D and 3D views for various sample objects individually and/or in a team.	9	P5			5	T,ASG,Q
CO3	Justify sketches obtained in the form of drawing reports, and projects.	10	C4			5	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, Instrument and their uses. (1)
2. Dimensioning and Title box. (1)
3. First and third angle projections. (1)
4. Orthographic drawings (2)
5. Sectional views and conventional practices. (2)
6. Auxiliary views. (1)
7. Isometric views (3)
8. Reading Mechanical Design of HVAC System. (1)

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate proficiency in using drawing instruments for sketches.					√							
CO2	Analyze the 2D and 3D views for various sample objects individually and/or in a team.									√			
CO3	Justify sketches obtained in the form of drawing reports, and projects.										√		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1PO3	**3**	To operate AutoCad and make use of it, knowledge regarding modern engineering and IT tools will be required.
CO2PO9	**3**	Student must analyze the 2D and 3D views for various sample objects individually and/or in a team.
CO3PO10	**3**	To communicate with other engineering professionals and manufacturers of mechanical systems, the skill to read manufacturing and construction drawings is a must.

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-II

COURSE INFORMATION			
Course Code Course Title	**ME-260** **Mechanical Engineering Drawing-II**	Contact Hours Credit Hours	**3.00** **1.50**
PRE-REQUISITE			
None			
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 proficiency in utilizing various drawing and modification commands within SolidWorks to create and manipulate 2D sketches and drawings effectively.	5	P3			6	T, ASG, Q
CO2	Generate 3D solid models using SolidWorks, employing fundamental techniques such as extrusion, revolve, and loft, to represent real-world objects accurately.	3	C6			5	T, ASG, Q
CO3	Develop the ability to design complex 3D assemblies by integrating multiple solid models, understanding assembly constraints, and utilizing assembly features	3	C6			5	T, ASG, Q

	like mates and fasteners within SolidWorks.						
CO4	Apply the acquired knowledge and skills in SolidWorks throughout the engineering career to efficiently solve design problems, collaborate on projects, and communicate design concepts effectively.	12	C3			2	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) and Planes, Sketching on planes, Sketches (Line tool, rectangle tool, circle tool), dimensions.
2. Smart dimensions, Sketch relations, Extrude Boss/Base, Extrude cut
3. Revolve Boss/Base, Revolve Cut, Sketching on surfaces, Filet, Rib, Draft, Shell, Sectional View.
4. Sketches (Arc tool, spline tool, slot tool, ellipse tool, polygon tool, filet tool), Convert entities, Mirror entities.
5. Linear pattern, Circular pattern, Sketch driven pattern, Curve driven pattern.
6. Reference Geometry Swept Boss/Base, Swept Cut, Mirror
7. 3D Sketches, Lofted boss/base, Lofted cut
8. Boundary Boss/Base, Boundary Cut, Curve through XYZ points, Aerofoil.
9. Helix and Spiral, Assembly
10. Assembly, Mass & Volume Properties.
11. 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 proficiency in utilizing various drawing and modification commands within SolidWorks to create and manipulate 2D sketches and drawings effectively.					√							
CO2	Generate 3D solid models using SolidWorks, employing fundamental techniques such as extrusion, revolve, and loft, to			√									

	represent real-world objects accurately.												
CO3	Develop the ability to design complex 3D assemblies by integrating multiple solid models, understanding assembly constraints, and utilizing assembly features like mates and fasteners within SolidWorks.			√									
CO4	Apply the acquired knowledge and skills in SolidWorks throughout the engineering career to efficiently solve design problems, collaborate on projects, and communicate design concepts effectively.												√

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 designthree-dimensional assemblies incorporating multiple solid models require knowledge of system and component design.
CO3-PO12	**2**	Knowledge and skill of SolidWorks to efficiently solve design problems, collaborate on projects, and communicate design concepts effectively throughout the engineering 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 Assignment	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, Similarities and differences between conventional drawing and computer aided drawing (CAD) and Planes, Sketching on planes, Sketches (Line tool, rectangle tool, circle tool), dimensions
Week-2	Smart dimensions, Sketch relations, Extrude Boss/Base, Extrude cut
Week-3	Revolve Boss/Base, Revolve Cut, Sketching on surfaces, Filet, Rib, Draft, Shell, Sectional View
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-II

COURSE INFORMATION			
Course Code Course Title	**ME 263** **Numerical Analysis**	Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Engineering applications require 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 the ability to solve engineering problems with analytical methods.	1	C3	2			Q, ASG, F

CO2	Compare numerical algorithms and techniques in terms of their effectiveness in solving real life engineering problems.	5	C5	1			Q, ASG, F
CO3	Develop graphical representation of engineering data set generated from numerical algorithms.	5	C6	2			Q, F, CS

COURSE CONTENT
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. 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. Solving ODE, Euler's Method, Heun's Method, Runge-Kutta Methods for lower and higher order, and Engineering Applications of Roots of Equations. Boundary Value Problems, Eigen Value Problems. Gauss Elimination, Gauss-Jordan, LU Decomposition, Matrix Inverse, Gauss-Seidel.) derivation of Laplace Equation, Laplacian Difference Equation, Liebman 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.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate the ability to solve engineering problems with analytical methods.	√											
CO2	Compare numerical algorithms and techniques in terms of their effectiveness in solving real life engineering problems.					√							
CO3	Develop graphical representation of engineering data set generated from numerical algorithms.					√							

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-PO5	3	Students by analyzing different mathematical equations and applying numerical algorithms will be able to solve complex Engineering problems.
CO3-PO5	3	Students will learn to develop a graphical representation of engineering data sets generated from numerical algorithms.

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, Liebman Method.	CT 03	
Class 37-42	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)	CT 04	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Assignment	**20**	
5	Assignment	**30**	
	Exam		
1	Final Exam, CT	**80**	

	5	Final Exam, CT, MID	**70**		

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-II

COURSE INFORMATION			
Course Code Course Title	**ME-264** **Numerical Analysis Sessional**	Contact Hours Credit Hours	**3.00** **1.50**
PRE-REQUISITE			
None			
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	Demonstrate proficiency in using different types of commands within MATLAB software for analyzing various numerical problems.	5	C2			2	T, ASG, Q
CO2	Analyze the numerical problems individually and/or in a team to choose	9	P4			2	T, ASG,Q

	the appropriate solution method						
CO3	Justify the obtained results from numerical computation through technical reports, graphs and contours.	10	C6			2	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 to MATLAB and short brief regarding the activities and contents of the sessional
2. Bisection method, Newton-Rephson method, Secant method
3. Gauss elimination, Gauss-Jordan
4. LU decomposition, the matrix inverse
5. Newton's divided difference interpolating polynomials, Lagrange interpolating polynomials
6. The trapezoidal rule, Simpson's ⅓ rd rule, Simpson's ⅜ th rule
7. Euler's method, Heun's method, Runge-Kutta methods for lower and higher order
8. Finite difference method: Laplace equation, Liebmann method (PDE Toolbox)

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate proficiency in using different types of commands within MATLAB software for analyzing various numerical problems.					√							
CO2	Analyze the numerical problems individually and/or in a team to choose the appropriate solution method									√			
CO3	Justify the obtained results from numerical computation through technical reports, graphs and contours.										√		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO5	**3**	Modern tool usage is required to perceive the propagation of errors through complex numerical algorithms.
CO2-PO9	**3**	Student must analyze the numerical problems individually and/or in a team to choose the appropriate solution method.

CO3-PO10	**3**	In order to justify the performed result, the technical reports 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 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

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code	**ME 301**	Contact Hours	**3.00**
Course Title	**IC 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	Identify various parts of reciprocating engines as well as their operations.	1	C1				ASG, T, F
CO2	Evaluate engine performance parameter with some aspects of design of engine parts	4	C3				ASG, T, F
CO3	Discuss the combustion and flame propagation, pollution formation and their control.	7	C2				CS, 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:

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.

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; Volumetric efficiency of engines.

Performance and design: performance of supercharged engines and un-supercharged engines, design Considerations, application of principle of similitude in engine design.

Engine cooling and lubrication: components, functions and working principles.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify various parts of reciprocating engines as well as their operations.	✓											
CO2	Evaluate engine performance parameter with some aspects of design of engine parts				✓								
CO3	Discuss the combustion and flame propagation, pollution formation and their control.							✓					

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Students will be able to identify various parts of reciprocating engines as well as their operations
CO2-PO4	**3**	Students will be able to evaluate engine performance parameter with some aspects of design of engine parts
CO3-PO7	**3**	Students will be able to discuss the combustion and flame propagation, pollution formation and their control.

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, Case study, Class test	**40**	
CO3	Homework/ Assignment. Class test, Mid-term.	**70**	
	Exam		
CO1	Final Exam	**50**	
CO2		**60**	
CO3		**30**	

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

Fall Semester L-3, T-II

COURSE INFORMATION

Course Code Course Title	**ME 302** **IC Engine Sessional**	Contact Hours Credit Hours	**: 3.00** **: 1.50**

PRE-REQUISITE

None

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	Identify various IC engine parts, their assembling and dismantling.	5	P3			1	R, Q, LT
CO2	Perform experiments individually and/or within a team.	9	P1			2	R, Q, LT
CO3	Demonstrate skills in analysing and interpreting observations in the form of formal reports.	10	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	Identify various IC engine parts, their assembling and dismantling.					√							
CO2	Perform experiments individually and/or within a team.									√			
CO3	Demonstrate skills in analysing and interpreting observations in the form of formal reports.										√		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO5	**3**	In order to identify the properties of a substance mechanics, the knowledge of problem analysis would be required.
CO2-PO9	**3**	In order to define energy transfer, the fundamental knowledge of mathematics would be required

CO3-PO10	**3**	The engineering efficiency, power, torque, and turbo charger will provide the students proper knowledge how those study could impact the 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 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-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME 305** **Heat and Mass Transfer**	Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

Thermodynamics (ME 103)
Fluid Mechanics I (ME 221)
Fluid Mechanics II (ME 223)

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. To understand the fundamentals of heat and mass transfer and practical applications in industry. 2. To familiarize basic tools to design process operations involving heat transfer and mass transfer 3. To 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	Illustrate the fundaments and basic laws of steady state heat conduction, convection and radiation.	PO1	C4	2			Q, ASG,F
CO2	Apply fundamental knowledge of heat transfer to the solution of complex engineering problem	PO1	C3	2			Q, ASG,F
CO3	Analyse complex engineering problem reaching substantiated conclusions	PO2	C2	1			Q, ASG,F
CO4	Discuss mechanisms of mass transfer for various practical applications.	PO1	C2	1	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

Basic modes of heat transfer; General conduction equation; Steady state conduction in different geometries and composite structures; Critical thickness of insulation; Thermal contact resistance; Conduction with heat Generation.
Physical mechanism of convection; Thermal and hydraulic boundary layer; General knowledge on differential convection equations; Thermal analysis for internal and external forced convection: Laminar flow in tubes, turbulent flow in tubes, and flow over flat plate.
Thermal radiation; Laws of radiation; Black body concepts; Emissive power ; Radiation shape factor; Gray bodies ; Radiation shields.
Mechanism of mass transfer by diffusion, convection and change of phase; Analogy between heat and mass transfer.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Illustrate the fundaments and basic laws of steady state heat conduction, convection and radiation.	√											
CO2	Apply fundamental knowledge of heat transfer to the solution of complex engineering problem	√											
CO3	Analyse complex engineering problem reaching substantiated conclusions		√										
CO4	Discuss mechanisms of mass transfer for various practical applications.	√											

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Students will be able to analyze steady state heat conduction through different types of bodies.
CO2-PO1	3	Students will be able to implement different convective heat transfer correlations to solve engineering problems.
CO3-PO2	3	Students will be able to explain radiative heat transfer for various surface types.
CO4-PO1	3	Students will be able to discuss mechanisms of mass transfer for various practical applications.

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 modes of heat transfer; General conduction equation; Steady state conduction in different geometries and composite structures; Critical thickness of insulation; Thermal contact resistance; Conduction with heat Generation.	CT-1	Lecture 01-10 Theory: 60% Problem: 30% Practical Application:10% CT 01 will cover these sections.
Lec 11-30	Physical mechanism of convection; Thermal and hydraulic boundary layer; General knowledge on differential convection equations; Thermal analysis for internal and external forced convection: Laminar flow in tubes, turbulent flow in tubes, and flow over flat plate.	CT-2	Lecture 10-30 Theory: 30% Problem: 50% Practical Application: 20% CT02 / Mid-Term will cover this section
Lec 31-36	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 37-42	Mechanism of mass transfer by diffusion, convection and change of phase; Analogy between heat and mass transfer.	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-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME-306** **Heat Transfer Sessional**	Lecture Contact Hours Credit Hours	**3.00** **1.50**
PRE-REQUISITE			
None			
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	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Conduct** heat and mass transfer experiments using engineering equipment.	5	P3			3	R, Q, LT
CO2	**Design** a project on thermal systems in a team by utilizing various available resources.	9	C4			4	R, Q, LT
CO3	**Demonstrate** skills in analyzing and interpreting	10	C4			8	R, Q, LT

	data in the form of formal reports.							

(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 Forced convection heat transfer**
   a) **Circular tube**
   b) **Flat plate**
   c) **Fin/flat plate/pipe bundle**
2. **Study of Heat exchanger**
   a) **Counter flow**
   b) **Parallel flow**
3. **Study of Natural Convection heat transfer over Fin/flat plate/pipe bundle**
4. **Study of Conduction heat transfer**
   a) **Thermal conductivity of a metal by a steady state method**
   b) **Thermal contact conductance**
5. **Study of Radiation heat transfer**
   a) **Inverse square law for light radiation.**
   b) **Lambert's cosine law for light**
   c) **Lambert's law of absorption for light.**
   d) **Radiation and convection**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Conduct heat and mass transfer experiments using engineering equipment.					√							
CO2	Design a project on thermal systems in a team by utilizing various available resources.									√			
CO3	Demonstrate skills in analyzing and interpreting data in the form of formal reports.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	In order to analyze heat and mass transfer in complex systems, use of modern tools is required.
CO2-PO9	**3**	In order to design the project on thermal system, the student must work in a team.
CO3-PO10	**3**	In order to justify the performed result, the technical reports are 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 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 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 light radiation. (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, (7th 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-3, T-II

COURSE INFORMATION			
Course Code **Course Title**	**ME 307** **Heat Transfer Equipment Design**	Lecture Contact Hours Credit Hours	**3.00** **3.00**
PRE-REQUISITE			
Heat and Mass Transfer (ME 305)			
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			
1. Design, inspect, maintain and operate heat exchangers and analyze their performance. 2. Carry out heat exchanger analysis for counter flow, cross flow and multi-pass heat exchangers and to apply the relevant correction factors. 3. 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.			

4. 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	Explain design concepts of thermal system covering design parameters, material selection, cost considerations, economic aspects, and availability.	1	C2	1			T, ASG, F
CO2	Implement analytical methods for solving steady state heat transfer problems in fins and transient heat transfer problems in different geometries.	2	C3	2			T, ASG, F
CO3	Investigate various heat exchanger performance through the application of key concepts such as log mean temperature difference, effectiveness-NTU, and F correction factor.	4	C4	2			T, ASG, F
CO4	Analyze the phase change heat transfer mechanisms in various heat exchange equipment.	2	C4	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:

Concept of thermal system design; Heat transfer equipment design: Design parameters, materials, cost, economics, choice and availability; Optimization: Safety and reliability.

Heat transfer from finned surface: Basic fin design, types of fins, Fin performance, Efficiency of fins, Equation of heat transfer from fins.

Unsteady heat transfer: Lumped system analysis, Heisler chart.

Basic thermal design methods of heat exchangers: Types of heat exchangers; Parallel flow, counter flow, cross flow, shell-and-tube, mixed and unmixed, single, multiple pass, compact heat exchangers; Fouling of heat exchangers.

Thermo fluid characteristics: Sizing 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: Cooling tower design using Markel's method.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain design concepts of thermal system covering design parameters, material selection, cost considerations, economic aspects, and availability.	✓											
CO2	Implement analytical methods for solving steady state heat transfer problems in fins and transient heat transfer problems in different geometries.		✓										
CO3	Investigate various heat exchanger performance through the application of key concepts such as log mean temperature difference, effectiveness-NTU, and F correction factor.				✓								
CO4	Analyze the phase change heat transfer mechanisms in various heat exchange equipment.		✓										

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	**3**	The student will learn to explain design concepts of thermal system covering design parameters, material selection, cost considerations, economic aspects, and availability.

CO2-PO2	**3**	Students will be able to implement analytical methods for solving steady state heat transfer problems in fins and transient heat transfer problems in different geometries
CO3-PO4	**3**	They will be able to investigate various heat exchanger performance through the application of key concepts such as log mean temperature difference, effectiveness -NTU, and F correction factor.
CO4-PO2	**3**	The student will learn to analyse the phase change heat transfer mechanisms in various heat exchange equipment.

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,	CT 01	

	Efficiency of fins, Equation of heat transfer from fins, Analysis of unsteady heat conduction.		
6-8	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.	Mid Term Exam	
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	**20**	

		equipment. Class test, Mid-term.		
	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

Spring Semester L-3, T-I

COURSE INFORMATION

Course Code	: **ME 321**	Contact Hours	: **3.00**
Course Title	: **Fluid Machinery**	Credit Hours	: **3.00**

PRE-REQUISITE

Fluid Mechanics I (ME 221)
Fluid Mechanics II (ME 223)

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	Explain various fluid machineries.	1	C2	1			Q, ASG, F
CO2	Assess performance parameters of various fluid machineries.	1	C3	2			Q, F
CO3	Solve different problems related to fluid machineries.	2	C3	2			Q, F, CS
CO4	Categorize turbo machineries for practical application.	2	C4	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; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

Centrifugal Pump
Reciprocating pump
Fan, Blower and Compressor
Impulse Turbine
Reaction Turbine
Turbine Performance

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain various fluid machineries.	✓											

CO2	Assess performance parameters of various fluid machineries.	✓											
CO3	Solve different problems related to fluid machineries.		✓										
CO4	Categorize turbo machineries for practical application.		✓										

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will be able to explain various fluid machineries.
CO2-PO1	**3**	Students will be able to assess performance parameters of various fluid machineries.
CO3-PO2	**3**	Students will be able to Solve different problems related to fluid machineries.
CO4-PO2	**3**	Students will able to categorize turbo machineries for practical 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
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**	
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 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 Semester L-3, T-I

COURSE INFORMATION

Course Code	**ME 333**	Lecture Contact Hours	3.00
Course Title	**Manufacturing Technology**	Credit Hours	3.00

PRE-REQUISITE

Engineering Materials (ME 193), Heat and Mass Transfer (ME 305)

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	C1			1	Q, ASG, F
CO2	Analyze various Machines, machining operations of manufacturing products and process planning	2	C4			1	Q, ASG, F
CO3	Explain economic performance, quality philosophy and quality control in manufacturing	1	C2			1	Q, F, CS
CO4	Design theoretical impacts of materials in product and their failure analysis	2	C6			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; F – Final Exam)

COURSE CONTENT

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.

Introductory topics on CAD, CAM, CIM (Computer Integrated Manufacturing) and FMS (Flexible Manufacturing Systems)

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	√											
CO2	Analyze various Machines, machining operations of manufacturing products and process planning		√										
CO3	Explain economic performance, quality philosophy and quality control in manufacturing	√											
CO4	Design theoretical impacts of materials in product and their failure analysis		√										

(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 demonstrate knowledge of manufacturing processes with set of functional requirements and product development.
CO2-PO2	**3**	Students will be able to analyze various Machines, machining operations of manufacturing products and process planning.
CO3-PO1	3	Students will be able to explain economic performance, quality philosophy and quality control in manufacturing.
CO4-PO2	**3**	Students will be able to design theoretical impacts of materials in product and their failure 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	Topic	CT	Remarks
Class (1-4)	Basic manufacturing process overview: Conventional and non-conventional (Mechanical, Thermal, Chemical) machining process.	CT-1	
Class (5-16)	Methods of manufacture and process– metal casting, metal forming and metal joining, welding.	CT-2	
Class (17-26)	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.	Mid Term	
Class (27-31)	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.		
Class (32-33)	Introductory topics on CAD, CAM, CIM (Computer Integrated Manufacturing) and FMS (Flexible Manufacturing Systems)	CT-3	
Class (34-42)	Quality control: Concept of quality circle, TQM and TQC. Machine Tools and operations: Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine.		

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. Manufacturing Engineering and Technology – Serope Kalpakjiann Steven R. Schmid 2. Manufacturing processes and materials for Engineering – Doyle Morris. 3. Introduction to Manufacturing process – Jhon A Schey.

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	**ME-334** **Manufacturing Technology Sessional**	Lecture Contact Hours Credit Hours	**3.00** **1.50**
PRE-REQUISITE			
None			
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	Demonstrate proficiency in using different types of machines for performing various machining operations.	5	C5			5	R, Q, LT
CO2	Prepare an industrial shape by using various machining operations and machines as a team.	9	P5			3	R, Q, LT
CO3	Demonstrate the ability of writing and presenting the information collected from various machining operations.	10	P5			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) Study of Different Types of Chips 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	Demonstrate proficiency in using different types of machines for performing various machining operations.					√							
CO2	Prepare an industrial shape by using various machining operations and machines as a team.									√			
CO3	Demonstrate the ability of writing and presenting the information collected from various machining operations.										√		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO5	3	Student must use different types of machines for performing various machining operations
CO2-PO9	3	In order to perform the experiments, the student must prepare an industrial shape as a team.
CO3-PO10	3	In order to justify the performed result, the technical reports 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 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

Fall Semester L-3, T-I

COURSE INFORMATION			
Course Code	**ME-341**	Contact Hours	**3.00**
Course Title	**Machine Design-I**	Credit Hours	**3.00**

PRE-REQUISITE

ME 193, ME 243, 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

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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	Calculate the factors of safety for various materials under different loadings.	1	C3	1			R, Q, LT
CO2	Analyze failure resulting from static and variable loadings.	4	C4	2			R, Q, LT
CO3	Design various machine components from stress and failure analysis.	4	C6	2			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

Introduction to design; Stress analyses; Pressure vessels; Stresses in curved members; Deflection and stiffness considerations; Shock and impact; Column design; Statistical considerations; Design for static strength; Fracture mechanics in design; Design for fatigue strength; Design of screws, fasteners and connections; Keys and couplings, welded and brazed joints.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Calculate the factors of safety for various materials under different loadings.	√											
CO2	Analyze failure resulting from static and variable loadings.				√								
CO3	Design various machine components from stress and failure analysis.				√								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Students will be able to calculate the factors of safety for various materials under different loadings.
CO2-PO4	**3**	Students will be able to analyze failure resulting from static and variable loadings.
CO3-PO4	**3**	Students will be able to design various machine components from stress and failure 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

Lectures	**Topic**	**CT**	**Remarks**
Class 1-6	Introduction to design; Stress analyses; Pressure vessels;	CT 01	
Class 7-12	Stresses in curved members; Deflection and stiffness considerations; Shock and impact;	CT 02	
Class 13-21	Column design; Statistical considerations; Design for static strength;	MT	

Class 22-27	Fracture mechanics in design; Design for fatigue strength;	CT 03	
Class 28-36	Design of screws, fasteners and connections;		
Class 37-42	Keys and couplings, welded and brazed joints.		

ASSESSMENT STRATEGY

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

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.
6. Juvinall, RC &Marshek, KM, Fundamentals of Machine Component Design, 3rd edn, Wiley,

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code	**ME-343**	Contact Hours	**3.00**
Course Title	**Machine Design-II**	Credit Hours	**3.00**
PRE-REQUISITE			
ME 193, ME 243, ME 247, ME 341			
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

1. To analyze the failure resulting from static and variable loading
2. To apply the fundamentals of the theory of failure and stress analysis to design machine components
3. To introduce the design modifications to be considered for ease of manufacturing
4. 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	Calculate the factors of safety for various materials under different loadings	1	C3	1			Q, ASG, F
CO2	Analyze failure resulting from static and variable loadings	4	C4	2			Q, F, CS
CO3	Design various machine components due to different types of forces.	4	C6	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; F – Final Exam)

COURSE CONTENT

Mechanical springs; Rolling contact bearings; Lubrication and journal bearings; Spur, helical, worm and bevel gears; Types of fits; Shafts; Brakes and clutches; Rope, belt and chain drives; Design with composite materials.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Calculate the factors of safety for various materials under different loadings	✓											
CO2	Analyze failure resulting from static and variable loadings				✓								
CO3	Design various machine components due to different types of forces.				✓								

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	3	Students will be able to calculate the factors of safety for various materials under different loadings
CO2-PO4	3	Students will be able to analyze failure resulting from static and variable loadings.
CO3-PO4	3	Students will able to design various machine components due to different types of forces.

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	Mechanical springs; Rolling contact bearings	CT 01	
Class 7-12	Lubrication and journal bearings;	CT 02	
Class 13-21	Spur, helical, worm and bevel gears;	CT 03	
Class 22-27	Types of fits; Shafts; Brakes and clutches	MT	
Class 28-36	Rope, belt and chain drives;		
Class 37-42	Design with composite materials.		

Fall Semester L-3, T-II

COURSE INFORMATION

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

PRE-REQUISITE

Engineering Mechanics-I (ME 245)
Engineering Mechanics-II (ME 247)

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	Explain different terminology, types and their use in design and solve problems related to different machinery systems.	1	C2	1			
CO2	Demonstrate the ability to select suitable machinery systems for specific applications.	2	C2	1			
CO3	Determine the importance of vibration control and its significance on engineering design.	2	C3	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:

Gears and Gear trains: Classification of Gears and gear terminology, fundamental law of gearing, involute and cycloidal gear profiles, spur gear contact ratio and interference/undercutting, gear trains - simple, compound, reverted and epicyclic gear train

Gyroscopic Couple and Precessional Motion: Principle of gyroscope, gyroscopic effect on an airplane and ship, stability of different vehicles: curved path and taking turn

Belt Drives and Shoe Brakes:
Centrifugal and driving tensions; Modification for V-grooved pulley; Initial tension; Belt creep; External and internal shoe brakes; Graphical method

Cams:
Types of CAMS and follower motion;
CAM functional considerations;
CAM profiles

Balancing of Rotating and Reciprocating Masses

- Balancing of single or various rotating mass(es) by single/two rotating mass(es) in various planes
- Primary and secondary unbalanced reciprocating masses
- Partial balancing of locomotives with various cylinders
- Balancing of radial and V-engines

Vibrations: Free, Transverse vibrations of beams, Torsional, Damped, Forced, Forced-Damped, Whirling of shafts and rotors; Vibration of geared systems; Vibration absorption, isolation and deisolation, Vibration measuring instruments.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain different terminology, types and their use in design and solve problems related to different machinery systems.	✓											
CO2	Demonstrate the ability to select suitable machinery systems for specific applications.		✓										
CO3	Determine the importance of vibration control and its significance on engineering design.		✓										

(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 explain different terminology, types and their use in design and solve problems related to different machinery systems.
CO2-PO2	**3**	Students will be able to demonstrate the ability to select suitable machinery systems for specific applications.
CO3-PO2	**3**	Students will be able to determine the importance of vibration control and its significance on engineering design

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	CT 02	

	Static and dynamic balancing: Reciprocating and rotating parts		
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		
CO1	CT	**20**	
CO2	CT	**30**	
CO3	CT	**20**	
	Exam		
CO1	Mid, Final	**80**	
CO2	Mid, Final	**70**	
CO3	Mid, Final	**80**	

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

COURSE INFORMATION			
Course Code	**ME 346**	Contact Hours	**: 3.00**
Course Title	**Mechanics of Machinery Sessional**	Credit Hours	**: 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	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
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 behaviour 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:

Balancing the masses of rotating and reciprocating machine elements. Applying the advanced concepts of kinematics and dynamics in real life problems including linkage mechanisms and cam mechanisms, reciprocating and rotating machinery.

Determine the forces and power calculations for brakes and dynamo-meter. Provide students with the skills, knowledge required to describe and analyze the effects of forces on the motion of particles, rigid bodies and vibrating systems, in order to predict dynamic behavior as a basis for engineering design.

The principles of vibrations.

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	√											
CO2	Explain the kinetics of particles or rigid bodies moving with planar motion.	√											

CO3	Analyze and solve engineering problems relating to the dynamic behaviour of vibrating single-degree and two-degrees of freedom, undamped and damped systems.		√										
CO4	Relate basic principles to applications of vibration transducers / accelerometers.				√								

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 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: 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**	Contact Hours Credit Hours	: **3.00** : **3.00**
PRE-REQUISITE			
EECE 173, MATH 101, MATH 103, MATH 201			
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	Explain the basic functioning of different types of measurement systems.	1	C2	1			Q, ASG, F
CO2	Analyze developed mathematical models for various measurement systems.	2	C4	1			Q, ASG, F
CO3	Illustrate signal processing, filtering, amplification and their applications in engineering systems.	1	C3	1			Q, F, CS
CO4	Select proper sensors for mechatronics and automations.	5	C5	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

Mathematical modelling of zero, first & second order measurement systems.
Integrated sensors
Application of sensors in automotive, robotics, aerospace etc.
Basic principles and terminologies of measurement and instrumentation, Characterization and behavior of typical measuring systems,
Different types of sensing elements such as ultrasonic 159 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	Explain the basic functioning of different types of measurement systems.	√											
CO2	Analyze developed mathematical models for various measurement systems.		√										
CO3	Illustrate signal processing, filtering, amplification and their applications in engineering systems.	√											
CO4	Select proper sensors for mechatronics and automations.					√							

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will be able to explain the basic functioning of different types of measurement systems.
CO1-PO2	**3**	Students will be able to analyze developed mathematical models for various measurement systems.
CO2-PO1	**3**	Students will be able to illustrate signal processing, filtering, amplification and their applications in engineering systems.
CO2-PO5	**3**	Students will be able to select proper sensors for mechatronics and automations.

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	Mathematical modelling of zero, first & second order measurement systems.	CT-1	
3-5	Integrated sensors Application of sensors in automotive, robotics, aerospace etc.	CT-2	
6-10	Basic principles and terminologies of measurement and instrumentation, Characterization and behavior of typical measuring systems, Different types of sensing elements such as ultrasonic 159 transducer, pressure sensor, proximity sensor, thermocouple, thermistor, photodetector, hall effect sensor etc.	Mid-Term	
11-14	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.	CT-3	

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. 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**	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	Demonstrate proficiency in using different types of simulation tools for solving various engineering problems.	5	P1		2	3	R, Q, LT
CO2	Compare generated data from simulation with various experimental research works, individually or in a team.	9	P3			2	R, Q, LT
CO3	Justify the data collected from simulation through technical reports and presentations.	10	C4	2		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. **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	Demonstrate proficiency in using different types of simulation tools for solving various engineering problems.					√							
CO2	Compare generated data from simulation with various experimental research works, individually or in a team.									√			
CO3	Justify the data collected from simulation through technical reports and presentations.										√		

Justification for CO-PO mapping:		
Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO5	**3**	In order to differentiate between the linear and non linear model, the knowledge of engineering mathematics would be required.
CO2-PO9	**2**	In order to simulate differential equations, the knowledge of identification and formulae would be required
CO3-PO10	**2**	In order estimate and validate a model, the knowledge of investigation, analysis and interpretation of data are also 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

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, 1st 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 (4th 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 372** **: Industrial Training**	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				Pr , R
CO2	Recognize the structure and management of an industry/organization to apply this knowledge in the individual's professional life.	9	A1				Pr , R
CO3	Internalize the industrial training knowledge further in project or research work.	12	A5				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			√									
CO2	**Recognize** the structure and management of an industry/organization to apply this knowledge in the individual's professional life.									√			
CO3	**Internalize** the industrial training knowledge further in project or research work.												√

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 375** **Control Engineering**	Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

Instrumentation and Measurements (ME 361)
Engineering Mechanics II (ME 247)
Math 103,
Math 201,
CSE 171

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 modelling, 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	Explain different types of control systems and their working principles.	1	C2			1	ASG, F
CO2	Create mathematical models, subsequent block diagram and signal flow graphs of different dynamic real world systems.	2	C6			2	T, ASG, Mid Term, F
CO3	Design control systems for controlling various practical dynamic systems.	3	C6			1	Mid Term, F
CO4	Evaluate responses of control systems to different type of inputs, their stability and robustness using analytical methods and software.	5	C5			2	PR, 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

Control Systems, Block Diagrams, Mass-Spring-Damper Systems, RLC Circuit based Control, State Variable Approach, Inputs and Responses of Control Systems, Stability Analysis, Evans Root Locus techniques, Gain and Phase margins, Actuator Control, Design of Feedback Control Systems, 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	Explain different types of control systems and their working principles.	✓											
CO2	Create mathematical models, subsequent block diagram and signal flow graphs of different dynamic real world systems.		✓										
CO3	Design control systems for controlling various practical dynamic systems.			✓									
CO4	Evaluate responses of control systems to different type of inputs, their stability and robustness using analytical methods and software.					✓							

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	3	Student will be able to explain different types of control systems and their working principles.
CO2-PO2	3	Student will be able to create mathematical models, subsequent block diagram and signal flow graphs of different dynamic real world systems.
CO3-PO3	3	Student will be able to design control systems for controlling various practical dynamic systems.
CO4-PO5	3	Student will be able to evaluate responses of control systems to different type of inputs, their stability and robustness using analytical methods and software.

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	Control Systems
Week-2	Block Diagrams
Week-3	Mass-Spring-Damper Systems
Week-4	RLC Circuit based Control,
Week-5	State Variable Approach,
Week-6	Inputs and Responses of Control Systems
Week-7	Stability Analysis,
Week-8	Evans Root Locus techniques
Week-9	Gain and Phase margins,
Week-10	Actuator Control,
Week-11	Design of Feedback Control Systems,
Week-12	Thermostatic control systems,
Week-13-14	Ectromechanical, hydraulic and pneumatic positioner systems.

ASSESSMENT STRATEGY

Components	**Grading**	CO	Blooms Taxonomy

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. 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

Google Classroom (TBA)

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	**ME 376** **Control Engineering Sessional**	Lecture Contact Hours Credit Hours	**: 3.00** **: 1.50**
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Control Engineering is a fundamental discipline in mechanical engineering that intersects with electronics and software engineering, particularly in the context of automation and robotics. The lab sessions are meticulously curated to introduce students to the practical aspects of control systems, using microcontrollers as the core component to drive actuators, manage sensors, and implement feedback mechanisms. This course rationale stems from the industry's increasing reliance on smart, automated systems which necessitates a strong foundation in both the theory and application of control principles.			
OBJECTIVE			
1. The ME 376 lab course bridges theoretical concepts of control engineering with practical applications. 2. Uses hands-on experiments and projects to facilitate learning. 3. Follows a progression from basic programming skills to complex control systems. 4. Designed to equip students with knowledge and skills for: • Designing control systems. • Analysing control systems. • Implementing control systems using modern technology.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To integrate software and hardware components to develop functional control systems.	2	P2			1	R, Q, LT

CO2	To use different principles of control engineering to design, implement, and troubleshoot microcontroller-based control systems.	1	P4			2	R, Q, LT
CO3	To apply appropriate control mechanism based on the specific requirements of a project.	3	P3			1	R, Q, LT
CO4	To develop different control engineering projects that require planning, execution, and continuous refinement over multiple sessions.	11	C4			2	R, PR

(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 Control Engineering & Basic C++ Programming (Arduino IDE based)**
2. **Micro-controller-based control system using various types actuator using different microcontroller.**
3. **Speed control of Stepper motor with Stepper driver using micro-controller (Arduino)**
4. **Temperature-controlled chamber using temperature sensors and a heating element.**
5. **Introduction to Pneumatic Control System with trainer board.**
6. **Feedback Control System using DC Motor & Encoder.**
7. **Open-ended Project/ Continuous Project works & discussions.**

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To integrate software and hardware components to develop functional control systems.		✓										
CO2	To use different principles of control engineering to design, implement, and troubleshoot microcontroller-based control systems.	✓											
CO3	To apply appropriate control mechanism based on the specific requirements of a project.			✓									
CO4	To develop different control engineering projects that require planning, execution, and continuous refinement over multiple sessions.											✓	

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO2	**3**	Integrating software and hardware is essential for creating efficient control systems that can interact seamlessly with the physical world.
CO2-PO1	**2**	Understanding control engineering principles is crucial for designing effective and reliable microcontroller-based systems that meet specific functional requirements.
CO3-PO3	**3**	The ability to select and apply the right control mechanism ensures optimal performance and adaptability of control systems to various applications.
CO4-PO1	**3**	Undertaking projects cultivates problem-solving skills, innovation, and adaptability, necessary for tackling real-world engineering challenges.

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: Introduction to Control Engineering & Basic C++ Programming (Arduino IDE based)
Week-2	Exp 2: Micro-controller-based control system using various types actuator using different microcontroller.
Week-3	Exp 3: Speed control of Stepper motor with Stepper driver using micro-controller (Arduino)
Week-4	Exp 4: Temperature-controlled chamber using temperature sensors and a heating element.
Week-5	Exp 5: Introduction to Pneumatic Control System with trainer board
Week-6	Exp 6: Feedback Control System using DC Motor & Encoder
Week-7	Open-ended Project/ Continuous Project works & discussions
Week-8	Open-ended Project/ Continuous Project works & discussions
Week-9	Open-ended Project/ Continuous Project works & discussions
Week-10	Open-ended Project/ Continuous Project works & discussions
Week-11	Open-ended Project/ Continuous Project works & discussions
Week-12	Open-ended Project/ Continuous Project works & discussions
Week-13	Open-ended Project/ Continuous Project works & discussions
Week-14	Project Presentation & Report Submission

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (10%)	Lab participation and Report	15%
	Lab Quiz	25%
Project Presentation & Report Submission		50%
Total Marks		100%

REFERENCE BOOKS

1. Introduction to Automatic Controls (2nd 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			
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 encourage study research literatures to identify a possible engineering thesis/ project topic with a minimum level of novelty. **3.** To enable the student to design a thesis/project work with proper plan to manage the thesis/project considering time and budget. 4. To enable the student to use cutting edge tools to complete their project. **5**. To enable the student to work individually in various sections of his or her thesis/project and enable the student to complete the thesis/project as a team. **6.** To enable the students to present the thesis/project results through written technical documents and oral presentation. **7.** To impart professional ethics and responsibilities to the students while drafting their technical report and presentation as well as during the project work.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify, formulate, review literature and analyse appropriate problem or topic related to Mechanical Engineering.	12	C5	8	1	2	PW, APW
CO2	Incorporate the use of modern engineering tools in the design, development and verification process.	5	PA, A4	6	1	5	Mid Term Exam
CO3	Value ethical and professional responsibilities during the course of the Final Year Design and Research Project.	8	A4	7	5	2	PR, R, ASG, F
CO4	Work Effectively individually and in a Team.	9	A5	4	1	1	PW, Pr
CO5	Write professional technical document related to the topic or project and orally present the results.	10	A2	4	1		FPr, FR
CO6	Conduct the economic analysis and estimate the cost of the final year design and research project.	11	C6	6			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, formulate, review literature and analyse appropriate problem or topic related to Mechanical Engineering.												√
CO2	Incorporate the use of modern engineering tools in the design, development and verification process.					√							
CO3	Value ethical and professional responsibilities during the course of the Final Year Design and Research Project.								√				
CO4	Work Effectively in a Team.									√			
CO5	Write professional technical document related to the topic or project and orally present the results.										√		
C06	Conduct the economic analysis and estimate the cost of the final year design and research project.											√	

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO12	**3**	Ability to investigate and Evaluate performance of the system
CO2-PO5	**3**	Incorporating the use of modern engineering tools in the design, development and verification process
CO3-PO8	**3**	Students will learn to value ethical and professional responsibilities during the course of the Final Year Design and Research Project.
CO4-PO9	**3**	Ability to work effectively in a Team
CO5-PO10	**3**	Students will be able to write professional technical document related to the topic or project and orally present the results.
CO6-PO11	**3**	Ability to conduct the economic analysis and estimate the cost of the final year design and research project

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-I

COURSE INFORMATION			
Course Code Course Title	**ME 403** **Power Plant Engineering**	Lecture Contact Hours Credit Hours	**3.00** **3.00**
PRE-REQUISITE			
Thermodynamics (ME 103), Fluid Mechanics I (ME 221), Fluid Mechanics II (ME 223), Fluid Machinery (ME 321), Heat and Mass Transfer (ME 305), Instrumentation and Measurements (ME 361)			
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	Illustrate an overview of the energy use and demand in Bangladesh as well as in other countries with the various aspects of power generation.	1	C3	1			Q, ASG, F
CO2	Demonstrate the processes, technologies and functions of various power plants.	2	C3	1			Q, ASG, F
CO3	Develop analytic ability in real-world engineering applications using thermodynamics principles.	2	C6	2			Q, ASG, F
CO4	Compare various energy, environmental, and economics related issues of power plants.	7	C5	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

Power and energy, sources of energy, electricity industry in Bangladesh

Load estimation, load and load duration curves, effect of variable load on power plant operation; Siting of power plants; Power plant economics; Theory of rates.

Fuels and fuel handling systems, combustion systems: fluidized-bed combustion, pulverized fuel, and cyclone burners; Liquid fuel, gaseous fuel, and dual-fuel burners.

Steam generator, condenser and regenerative feedwater heaters, cooling towers, makeup and feedwater system.

Steam turbine: operation and maintenance of steam power plants.

Feed water treatment

Gas turbine power plant: Elements of gas turbine power plants; Gas turbine fuels; Performance analysis; Cogeneration; Combined cycle power plants: components and performance analysis; IGCC.

IC engine power plants: components and performance analysis.

Hydro-electric power plant: Hydrological cycles; Hydrographs; Classification and Performance analysis; Governing of hydraulic turbines.

Nuclear power plant: Fission and Fusion reactions, chain reaction;
Types of nuclear power plants; Safety features and waste management of nuclear power plants.

Environmental considerations: Flue gas desulphurization, electrostatic precipitator, ash handling systems, stacks, and de-nitriding systems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Illustrate an overview of the energy use and demand in Bangladesh as well as in other countries with the various aspects of power generation.	√											
CO2	Demonstrate the processes, technologies and functions of various power plants.		√										
CO3	Develop analytic ability in real-world engineering applications using thermodynamics principles.		√										
CO4	Compare various energy, environmental, and economics related issues of power plants.							√					

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO1	3	Students will be able to illustrate an overview of the energy use and demand in Bangladesh as well as in other countries with the various aspects of power generation.
CO2-PO2	3	Students will be able to demonstrate the processes, technologies and functions of various power plants.
CO3-PO2	3	Students will be able to develop analytic ability in real-world engineering applications using thermodynamics principles.
CO4-PO7	3	Students will be able to compare various energy, environmental, and economics related issues of power plants.

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, electricity industry in Bangladesh Load estimation, load and load duration curves, effect of variable load on power plant operation; Siting of power plants; Power plant economics; Theory of rates.	CT-1	
Lec 6-18	Fuels and fuel handling systems, combustion systems: fluidized-bed combustion, pulverized fuel, and cyclone burners; Liquid fuel, gaseous fuel, and dual-fuel burners. Steam generator, condenser and regenerative feedwater heaters, cooling towers, makeup and feedwater system.	` CT-2	
Lec 19-22	Steam turbine: operation and maintenance of steam power plants. Feed water treatment Gas turbine power plant: Elements of gas turbine power plants; Gas turbine fuels; Performance analysis; Cogeneration; Combined cycle power plants: components and performance analysis; IGCC.	Mid Term	

Lec 23-30	IC engine power plants: components and performance analysis. Hydro-electric power plant: Hydrological cycles; Hydrographs; Classification and Performance analysis; Governing of hydraulic turbines.		
Lec 31-36	Nuclear power plant: Fission and Fusion reactions, chain reaction; Types of nuclear power plants; Safety features and waste management of nuclear power plants.	CT-3	
Lec 37-42	Environmental considerations: Flue gas desulphurization, electrostatic precipitator, ash handling systems, stacks, and de-nitriding systems.		

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-4, T-I

COURSE INFORMATION

Course Code	**ME 404**	Lecture Contact Hours	**: 3.00**
Course Title	**Power Plant Engineering 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	Operate various equipment of power generation along with their safety considerations.	5	P5			1	R, Q, LT
CO2	Analyze the experimental data generated.	4	P3			1	R, Q, LT
CO3	Organize the obtained results in the form of technical reports.	10	C4, C5			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 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	Operate various equipment of power generation along with their safety considerations.					√							
CO2	Analyze the experimental data generated.				√								
CO3	Organize the obtained results in the form of technical reports.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justification**
CO1-PO5	**3**	In order to identify the basics of power plants, a fundamental knowledge of engineering would be required.
CO2-PO4	**3**	In order to perform the experiments, a fundamental knowledge of diagrams and efficiencies would be required
CO3-PO10	**3**	In order to solve the power plant problems, the knowledge of energy efficiency, pollution.

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 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

Fall Semester L-4, T-II

COURSE INFORMATION

CourseCode Course Title	**ME 405** **Heating, Ventilation and Air Conditioning**	Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

Thermodynamics (ME 103), Fluid Mechanics I (ME 221), Fluid Mechanics II (ME 223)

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 HVAC systems and their components.	2	C3	1			ASG, F
CO2	Explain HVAC principles considering human comfort, environment and energy efficiency.	7	C2	1			T, ASG, F
CO3	Design HVAC systems for spaces.	4	C6	2			T, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation

COURSE CONTENT

Introduction to HVAC:
The need for HVAC, References, standards and codes, Terms, definitions and units, HVAC system type overview, Ventilation and air quality, Buildings and energy efficiency
Refrigeration in HVAC:
Phase change and refrigerants, Vapor compression cycle, Chilled water vs. D/X cooling, Decarbonization and heat pumps
Psychrometric:
Properties of moist air, Psychrometric chart, Sensible and latent, Combined processes, Mixing of air streams
Design conditions
All Air Systems:
Definition of "all air systems", Types of all supply and return air systems: Recirculating / Mixed Air Systems, Dedicated Outside Air (DOAS) Systems, Overhead / Dilution Type: Constant Volume (CAV) and Variable Volume (VAV), Displacement / UFAD Type,
Types of exhaust systems: General – Toilet, etc., Laboratory, process, or other specialty systems, Types of central equipment: Packaged / Unitary systems, Split systems, Air handling units, Fans,

Types of terminal equipment: Air Terminal Units / VAV Boxes, Grilles, Registers, & Diffusers, System Comparison – Advantages / Disadvantages, Hybrid approaches, Applications / Examples
Hydronic Systems:
Definition of "hydronics", Comparison to air systems, Types of hydronic systems: Heating Hot Water, Chilled Water, Glycol Water, Types of central equipment: Boilers, Chillers, Cooling Towers / Fluid Coolers, Pumps, Heat Exchangers, Types of terminal equipment:
Coils, Unit Heaters, Fan Coil Units, Chilled Beams, Radiant, System Comparison – Advantages / Disadvantages
Steam and Steam Condensate:
Comparison to air and hydronic systems, ASME Codes / Safety, Types of steam and condensate systems:
Low Pressure, High Pressure, Condensate Collection: Gravity return, Pumped return, Vacuum, Types of central equipment: Boilers, Heat Exchangers, Make-up water systems, Types of terminal equipment: Coils, Humidifiers, Unit Heaters, Fan, Coil Units, Radiant
System Comparison - Advantages / Disadvantages, Applications / Examples
Building Automation Systems:
Definition / Purpose of "Building Automation System (BAS)", Types of HVAC control systems: Local, Centralized (Building-wide), Pneumatic, Direct Digital Control, Pneumatic-Hybrid, Programmable Logic Control (PLC), Type of control equipment, Valves, Dampers, Actuators, Sensors and thermostats, Types of Controls: Proportional/Modulating Control Concepts, Open/Closed Loop Control
Green Buildings:
Renewable and waste heat recovery system

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 HVAC systems and their components.		√										
CO2	Explain HVAC principles considering human comfort, environment and energy efficiency.							√					
CO3	Design HVAC systems for spaces.				√								

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**

CO1-PO2	**3**	Students will be able to demonstrate knowledge on HVAC systems and their components.
CO2-PO7	**3**	Students will be able to explain HVAC principles considering human comfort, environment and energy efficiency.
CO3-PO4	**3**	Students will be able to design HVAC systems for spaces.

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	Introduction to HVAC: The need for HVAC, References, standards and codes, Terms, definitions and units, HVAC system type overview, Ventilation and air quality, Buildings and energy efficiency	CT1	
3-4	Refrigeration in HVAC: Phase change and refrigerants, Vapor compression cycle, Chilled water vs. D/X cooling, Decarbonization and heat pumps	CT2	

	Psychrometric: Properties of moist air, Psychrometric chart, Sensible and latent, Combined processes, Mixing of air streams		
5-6	Design conditions All Air Systems: Definition of "all air systems", Types of all supply and return air systems: Recirculating / Mixed Air Systems, Dedicated Outside Air (DOAS) Systems, Overhead / Dilution Type: Constant Volume (CAV) and Variable Volume (VAV), Displacement / UFAD Type, Types of exhaust systems: General – Toilet, etc., Laboratory, process, or other specialty systems, Types of central equipment: Packaged / Unitary systems, Split systems, Air handling units, Fans, Types of terminal equipment: Air Terminal Units / VAV Boxes, Grilles, Registers, & Diffusers, System Comparison – Advantages / Disadvantages, Hybrid approaches, Applications / Examples		
7-8	Hydronic Systems: Definition of "hydronics", Comparison to air systems, Types of hydronic systems: Heating Hot Water, Chilled Water, Glycol Water, Types of central equipment: Boilers, Chillers, Cooling Towers / Fluid Coolers, Pumps, Heat Exchangers, Types of terminal equipment: Coils, Unit Heaters, Fan Coil Units, Chilled Beams, Radiant, System Comparison – Advantages / Disadvantages	MID TERM	
9-10	Steam and Steam Condensate: Comparison to air and hydronic systems, ASME Codes / Safety, Types of steam and condensate systems:		
11-12	Low Pressure, High Pressure, Condensate Collection: Gravity return, Pumped return, Vacuum, Types of central equipment: Boilers, Heat Exchangers, Make-up water systems, Types of terminal equipment: Coils, Humidifiers, Unit Heaters, Fan, Coil Units, Radiant System Comparison - Advantages / Disadvantages, Applications / Examples	CT3	
13-14	Building Automation Systems: Definition / Purpose of "Building Automation System (BAS)", Types of HVAC control systems: Local, Centralized (Building-wide), Pneumatic,		

	Direct Digital Control, Pneumatic-Hybrid, Programmable Logic Control (PLC), Type of control equipment, Valves, Dampers, Actuators, Sensors and thermostats, Types of Controls: Proportional/Modulating Control Concepts, Open/Closed Loop Control Green Buildings: Renewable and waste heat recovery system		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
CO1	Homework/ Assignment	**50**	
CO2	Homework/ Assignment, Case study, Class test	**40**	
CO3	Homework/ Assignment. Class test, Mid-term.	**70**	
	Exam		
CO1	Final Exam	**50**	
CO2		**60**	
CO3		**30**	

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 Applications

REFERENCE SITE

N/A

Fall Semester L-4, T-I

COURSE INFORMATION

Course Code Course Title	**ME 467** **Automobile Engineering**	Contact Hours Credit Hours	**3.00** **3.00**

PRE-REQUISITE

Thermodynamics (ME 103), IC Engine (ME 301), Control Engineering (ME 375), Instrumentation and Measurements (ME 361)

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

1. To understand the fundamental principles and technologies involved in automobile engineering.
2. To learn the main components and systems.
3. To 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	Explain the anatomy of the modern Automobile including Hybrid and Electric vehicles.	1	C2			1	Q, ASG, F
CO2	Illustrate the working principles, functions of various systems, and safety features used in modern vehicles.	1	C3			1	Q, ASG, F
CO3	Assess various systems in modern automobiles considering future development of the industry based on the environmental impact of emissions.	7	C3			1	Q, F, CS
CO4	Solve problems related to automobiles using modern tools.	5	C3			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; F – Final Exam)

COURSE CONTENT
Overview of vehicle industry Transmission system Automotive Suspension System Steering System Automotive Brake System Automotive Air Conditioning System Starting system Sensors and Vehicle safety systems Hybrid and Electric Vehicles OBD, problem analysis and solution.

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 anatomy of the modern Automobile including Hybrid and Electric vehicles.	√											
CO2	Illustrate the working principles, functions of various systems, and safety features used in modern vehicles.	√											
CO3	Assess various systems in modern automobiles considering future development of the industry based on the environmental impact of emissions.							√					
CO4	Solve problems related to automobiles using modern tools.					√							

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to explain the anatomy of the modern Automobile including Hybrid and Electric vehicles.

CO2-PO1	3	Students will be able to illustrate the working principles, functions of various systems, and safety features used in modern vehicles.
CO3-PO7	3	Students will be able to assess various systems in modern automobiles considering future development of the industry based on the environmental impact of emissions.
CO4-PO5	3	Students will be able to solve problems related to automobiles using modern tools.

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)	Overview of vehicle industry Transmission system	CT-1	
Class (6-16)	Automotive Suspension System Steering System	CT-2	
Class (17-25)	Automotive Brake System Automotive Air Conditioning System	Mid Term	
Class (26-32)	Starting system Sensors and Vehicle safety systems		
Class (33-38)	Hybrid and Electric Vehicles	CT-3	
Class (39-42)	OBD, problem analysis and solution.		

ASSESSMENT STRATEGY

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

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-4, T-I

COURSE INFORMATION

Course Code	**ME 468**	Contact Hours	: **3.00**
Course Title	**Automobile Engineering Sessional**	Credit Hours	**: 1.50**

PRE-REQUISITE

None

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
O1	Demonstrate understanding of various automobile parts and engine subsystems.	5	C3			1	R, Q, LT
CO2	Perform experiments individually and collaboratively within a team.	9	P5		3	5	R, Q, LT
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.	10	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	Demonstrate understanding of various automobile parts and engine subsystems.					√							
CO2	Perform experiments individually and collaboratively within a team.									√			
CO3	Demonstrate the ability of writing and presenting the information collected from experiments.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO5	**3**	In order to understand Automobile system, the knowledge of engineering fundamental would be required.
CO2-PO9	**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-PO10	**3**	The study will enable students to investigate different mechanism hands on, test them and gather results for analyzing.

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 Engagement in Group Projects	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 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/Fall Semester L-4, T- I or II

COURSE INFORMATION			
Course Code Course Title	**ME 407** **Advanced Thermodynamics**	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	Correspond ing PO	Bloom's Taxonomy	KP	CP	C A	Assessment Methods
CO1	Understand the laws of thermodynamics applied to mixture of gases and thermodynamic potentials.	1	C1	3			Q, ASG, F
CO2	Analyze the thermodynamics laws for various thermal systems and to solve various numerical problems.	4	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 efficiency of various thermal systems.	2	C2, C3	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:

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.	√											
CO2	Analyze the thermodynamics laws for various thermal systems and to solve various numerical problems.				√								
CO3	Evaluate the thermodynamic properties of various thermal systems.		√										
CO4	Synthesize I law and II law efficiency of various thermal systems.		√										

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.
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.

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	CT-3	

	Enthalpy of reaction- First and Second law analysis of reacting systems- Applications.		
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.; Usage of renewable energy 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 explore topics such as energy consumption, the pros and cons of renewable energy, energy production and cons, energy conversion, environmental issues and concerns, biomass and bio fuels, geothermal, wind, power, solar power, and hydropower systems.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods

CO1	Identify existing issues in the energy industry regarding conventional and non-conventional energy sources.	6	C1	K1			Q, ASG, F
CO2	Classify various renewable energy sources based on their underlying theory.	1	C1	K1			Q, ASG, F
CO3	Investigate case studies of various renewable energy projects that are shaping today's world.	4	C4	K2			Q, F, CS
CO4	Design various renewable energy conversion mechanisms and devices.	3	C6	K2			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 conventional and non-conventional fuel

ii) Solar Energy

iii) Bio-energy

iv) Wind energy

v) Hydro-energy

vi) Other Sources of renewable energy

vii) Hybrid energy systems

b) 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 – Geothermal, Tidal, OTEC, Salinity Gradient, etc

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 existing issues in the energy industry regarding conventional and non-conventional energy sources.						√						
CO2	Classify various renewable energy sources based on their underlying theory.	√											
CO3	Investigate case studies of various renewable energy projects that are shaping today's world.				√								
CO4	Design various renewable energy conversion mechanisms and devices.			√									

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO6	**3**	Students will identify existing issues in the energy industry regarding conventional and non-conventional energy sources.
CO2-PO1	**3**	Students will classify various renewable energy sources based on their underlying theory.
CO3-PO4	**3**	Students will investigate case studies of various renewable energy projects that are shaping today's world.

CO4-PO3	**3**	Students will design various renewable energy conversion mechanisms and 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** Definitions, Policies, SDGs, Advantages and Disadvantages	CT-01	
Class 4 – 20	**2. Solar Energy** Solar radiation and its measurement — Solar thermal conversion — Solar photovoltaic devices and systems		
Class 21 – 26	**3. Bioenergy** Energy from bio-mass — bio-energy conversion techniques	MID	
Class 27 – 30	**4. Wind energy** Wind energy Conversion — Wind turbine design and principles	CT-02	
Class 31 – 34	**5. Hydro-energy** Hydro-energy conversion techniques	CT-03	
Class 35 – 42	**6. Other Sources of renewable energy** Emerging energy sources		

	7.Hybrid energy systems		

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	ME 411	Lecture Contact Hours	3.00
Course Title	Combustion and Pollution	Credit Hours	3.00

PRE-REQUISITE

ME-103:Thermodynamics
ME-205: Heat and Mass Transfer
ME -221: 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 students 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 analyse 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 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 on-going 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	1	C1,C3	1			ASG,T,F
CO2	Explain the responsibility of engineers to the community in terms of providing a safe healthy environment.	2	C3	2			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	1	C5,C6	2			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	C5,C6	2			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, 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. 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 on-going 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	√											
CO2	Explain the responsibility of engineers to the community in terms of providing a safe healthy environment		√										
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	√											
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		√										

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.
CO2-PO2	**3**	Research literature on the responsibility of engineers to the community
CO3-PO1	**3**	Develop solution for the reduction strategies of pollutant species in combustion systems.
CO4-PO2	**3**	Identification for increasing engine performance and maintaining low emission characteristics using first principles of mathematics 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

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 sulphur, and other pollutants	MID	
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	: **ME 413** : **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	Distinguish the interrelationship of energy, ecology and environment and their impacts.	1	C1	2			Q, ASG, F
CO2	Analyze data regarding energy generation, efficiency, and environmental impacts.	2	C4	2			Q, ASG, F
CO3	Evaluate the connections between technological aspects of socio-political and economic components in terms of various energy sources.	7	C5	2			Q, F, CS
CO4	Illustrate the applications of modern energy conversion and storage technologies with consideration for environmental concerns.	3	C3	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

The Future, Energy Myths & a Brief History of Energy, Energy Sources, Demand, Generation and Consumptions, Energy, Ecology and Environment.

The future and The Origin of Fossil Fuel, Oil Reservoirs, 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 and Environmental Impact.

Energy conversion and storage technologies: fuel Cells, batteries and environmental impacts, Methods for energy conversion and environmental impacts for electricity, heating, and cooling.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Distinguish the interrelationship of energy, ecology and environment and their impacts.	√											
CO2	Analyze data regarding energy generation, efficiency, and environmental impacts.		√										
CO3	Evaluate the connections between technological aspects of socio-political and economic components in terms of various energy sources.							√					
CO4	Illustrate the applications of modern energy conversion and storage technologies with consideration for environmental concerns.			√									

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will be able to distinguish the interrelationship of energy, ecology and environment and their impacts.
CO2-PO2	**3**	Students will be able to analyse data regarding energy generation, efficiency, and environmental impacts.
CO3-PO7	**3**	Students will be able to evaluate the connections between technological aspects of socio-political and economic components in terms of various energy sources.
CO4-PO3	**3**	Students will be able to illustrate the applications of modern energy conversion and storage technologies with consideration for environmental concerns.

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, Energy Myths & a Brief History of Energy	01	
04-06	Energy Sources, Demand, Generation and Consumptions		
07-09	Energy, Ecology and Environment.		
10-12	The future and The Origin of Fossil Fuel, Oil Reservoirs		
13-15	Drilling Methods	02	
16-18	Size and Discoverability of Oil Fields		
19-21	The Future of Fossil Fuels, Alternative Energy Sources		
22-24	The Future of Fossil Fuels, Alternative Energy Sources	Mid	
25-27	Wealth, Resources, and Power: The Changing Parameters of Global Security		
28-30	Oil, Geography, and War: The Competitive Pursuit of Petroleum Plenty		
31-33	Oil Conflict and Environmental Impact		
34-36	Energy conversion and storage technologies: fuel Cells, batteries and environmental impacts		
37-39	Energy conversion and storage technologies: fuel Cells, batteries and environmental impacts	03	
40-42	Methods for energy conversion and environmental impacts for electricity, heating, and cooling		

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, environment and development -- José Goldemberg
2. Energy, Sustainability and the Environment -- Fereidoon P. Sioshansi
3. Energy, the Environment, and Sustainability -- Efstathios E Michaelides

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	Correspondin g 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	2	C2,C3	4	2		Q, F, CS, Pr

	computational tools - to further research and development in science and technology						

(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.				√								
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.												
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		√										

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 – Dimitri Gidaspow, 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	**Analyze** the potential of Nano-Science and Technology in Industrial, biomedical and environmentally friendly applications	7	C2, C4	2	1,5		Q, F, CS, Pr
CO5	**Develop** ethical thinking and judgement pertaining to use of nanomaterials and	8	C4,C5	3,5			Q,F

	demonstrate ethical conduct in class.						

(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	√											
CO2	**Demonstrate** understanding of the various types of Fabrication processes involved in micro and nano fabrications		√										
CO3	**Familiarize** with different characterization and mechanical tests of nanomaterials		√										

CO4	**Analyze** the potential of Nano-Science and Technology in Industrial, biomedical and environmentally friendly applications							√					
CO5	**Develop** ethical thinking and judgement pertaining to use of nanomaterials and **demonstrate** ethical conduct in class.								√				

(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-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.

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. To introduce the student to conservation equations applications and stability of fluid flow. 2. To give an idea of piping system design for plumbing and the economics of the piping system. 3. To give an idea of various types of fountains and basic design principle 4. To introduce the designs of various hydraulic equipment.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Apply conservation equations in solving various engineering problems	1	C1, C3	2			Q, ASG, F
CO2	Design piping (plumbing/ fountain/fluid supply) system	3	C3	2			ASG, F
CO3	Design of various hydraulic machines	3	C3	2			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. Integral/ differential form of conservation equations
2. Solution of Navier Stokes equation in simple flow conditions
3. Piping system design in buildings
4. Fountain design
5. Hydraulic machine 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 desing.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Apply conservation equations in solving various engineering problems	√											
CO2	Design piping (plumbing/ fountain/fluid supply) system			√									
CO3	Design of various hydraulic machines			√									

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.**
CO2-PO3	**3**	**Students will learn to design piping systems**
CO3-PO3	**2**	**Students will learn to design simple hydraulic machines**

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	Mid Term
Class 35-36	Unsteady flow in pipes, water hammer	
Class 37-42	Hydraulic Machine design	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	**100**	

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. To describe, using basic formulas, the scientific basis for balancing the four forces of action on an aircraft in flight 2. To derive and apply the aircraft flight mechanics equations to analyze the flight performance of aircraft in different situations 3. To calculate aerodynamic loads (such as lift, induced drag, total drag, load factor) acting on an aircraft 4. To understand and apply potential flow theory
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate knowledge of the application of potential flow theory	1	C2	2			Q, F
CO2	Explain the fundamental principles and equations of aerodynamics for analyzing flight performance	2	C3, C4	2			Q, ASG, F
CO3	Formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic configurations	2	C3, C4	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

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. 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. Boundary layer separation and its effects. Flow control techniques.

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 the application of potential flow theory	√											
CO2	Explain the fundamental principles and equations of aerodynamics for analyzing flight performance		√										
CO3	Formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic configurations		√										

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will learn about fundamental potential flow theory and its applications
CO2-PO2	3	Students will learn about analyzing various problems of aerodynamics.
CO3-PO2	3	Students will learn to analyse various forces acting on airplane and analyze its 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 1-6	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	MT	
Class 25-30	Vortex sheet, Vortex system and flow over a rotating circular cylinder, Thin airfoil theory, Flow over finite wings		
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	100	

REFERENCE BOOKS

1. Fundamentals of Aerodynamics - John D. Anderson

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	Demonstrate the underpinning mathematical concepts applicable to the engineering discipline.	1		1			Q, ASG, F
CO2	Analyse problems involving in Engineering and Applied Science reaching substantiated conclusions using first principle of mathematics, natural science and engineering science.	2		2			Q, ASG, F
CO3	Apply modern engineering tools and appropriate techniques including prediction and modelling to engineering problems	5		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	Demonstrate the underpinning mathematical concepts applicable to the engineering discipline.	√											
CO2	Analyse problems involving in Engineering and Applied Science reaching substantiated conclusions using first principle of mathematics, natural science and engineering science.		√										
CO3	Apply modern engineering tools and appropriate techniques including prediction and modelling to engineering problems					√							

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.**
CO2-PO2	**3**	Understanding of nature of various functions will enhance pupil’s engineering knowledge
CO3-PO5	**3**	They will be competent enough to develop solutions regarding 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 behaviour of equilibrium and frozen flows with real gas properties.	√											
CO2	Analyze non-equilibrium (rate) processes and behavior for gas dynamic flows.			√									
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		√										
CO4	Use the general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids			√									

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.	√											
CO2	Analyzing different types of heat transfer, beam problems and solving them by applying finite element method.		√										
CO3	Understanding of the underpinning Finite element concepts applicable to the engineering discipline		√										
CO4	Connecting the theoretical problems and solving them by applying finite element analysis for an approximate real solution.				√								

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 of different hydraulic and pneumatic systems and their components	1	C2	1,2			Q, F
CO2	Design a hydraulic circuit for the desired application	3	C3	4,6	1,2 ,3		ASG, F
CO3	Investigate hydraulic and pneumatic circuit diagrams for troubleshooting and improvement	4	C4	3	1,2		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. 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 hydraulic circuit for desired operation, Hydraulic system maintenance, Contamination.

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 hydraulic and pneumatic systems and their components	√											
CO2	Design a hydraulic circuit for the desired application			√									
CO3	Investigate hydraulic and pneumatic circuit diagrams for troubleshooting and improvement				√								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	Students will gather knowledge derived from physics and engineering fundamentals and common engineering practice.
CO2-PO3	**3**	Students will learn to solve complex fluid power system design
CO3-PO4	**3**	Students will learn to investigate complex fluid power system design

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	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. To 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. To improve the student's understanding of the basic principles of fluid mechanics 3. To 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 fluid-flow systems.	3	C3	1			Q, ASG, F

CO2	Improve the understanding of the basic principles of fluid mechanics.	1	C3	2			Q, ASG, F
CO3	Develop capability of solving some of the difficulties that one may encounter in CFD, such as geometry simplification, mesh problems, convergence problems, and multiple solutions.	4	C6	2			Q, F, CS
CO4	Develop 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	C6	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 Computational Fluid Dynamics (CFD)
2. Introduction to control volume method
3. Numerical solution of diffusion type equations: Steady one-dimensional conduction, unsteady one dimensional conduction, two and three- dimensional situations
4. Numerical solution of convection-diffusion-type equations: Steady one-dimensional convection-diffusion, discretization equation in two and three-dimensions
5. 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.			√									
CO2	Improve the understanding of the basic principles of fluid mechanics.	√											
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.				√								
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.			√									

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
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.
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.
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.

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		

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) Computational Fluid Dynamics, J.D. Anderson
2) Computational Methods for Fluid Dynamics, J.H. Ferziger& M. Peric
3) Computational Techniques for Fluid Dynamics 1, C.A.J. Fletcher
4) 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	√											
CO2	Calculate forces and work done by a jet on fixed or moving plate and curved plates		√										
CO3	Know the working of turbines and select the type of turbine for an application			√									
CO4	Do the analysis of air compressors and select the suitable one for a specific application			√									

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 vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.	MT	
Class 37-39	Compressors: classification of compressors, reciprocating compressor-single stage compressor,	CT 03	

	equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)		
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

Fluid Mechanics - I (ME 221), Fluid Mechanics - II (ME 223)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Engineering approach to the analysis of circulatory and respiratory systems and to other problems in physiology involving fluid dynamics; Review of relevant anatomy and physiology emphasizing qualitative consideration; Presentations and discussions; Simulation of physiological phenomena

OBJECTIVE

i. To understand physiologically relevant fluid and solid mechanic
ii. To apply fluid mechanical analyses relevant to biomedical engineering problems
iii. To uynderstand and analyse 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	Understand cardiovascular physiology and physiologically relevant fluid mechanics.	1	C2	2			Q, ASG, F
CO2	Analyse problems and synthesis solution related to physiological process.	4	C4	1			Q, ASG, F
CO3	Apply fluid mechanics models and engineering tools (software) currently used for clinical research problems.	5	C3	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

Review of Basic Fluid Mechanics Concepts, Cardiovascular Structure and Function, Pulmonary Anatomy, Pulmonary Physiology, and Respiration, Haematology and Blood Rheology, Anatomy and Physiology of Blood Vessels, Mechanics of Heart Valves, Flow and Pressure Measurement, Role of computational fluid dynamics (CFD) in biomedical flow analysis and Recent research challenges in biological fluid dynamics

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understand cardiovascular physiology and physiologically relevant fluid mechanics.	√											
CO2	Analyse problems and synthesis solution related to physiological process.				√								
CO3	Apply fluid mechanics models and engineering tools (software) currently used for clinical research problems.					√							

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Students will be able to understand cardiovascular physiology and physiologically relevant fluid mechanics.
CO2-PO4	**3**	Students will be able to analyse problems and synthesis solution related to physiological process.
CO3-PO5	**3**	Students will be able to apply fluid mechanics models and engineering tools (software) currently used for clinical research 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

Class	Topic	CT	Remarks
Class 1-3	Review of Basic Fluid Mechanics Concepts	CT 01	
Class 4-6	Cardiovascular Structure and Function		
Class 7- 12	Pulmonary Anatomy, Pulmonary Physiology, and Respiration	CT 02	
Class 13-18	Hematology and Blood Rheology		
Class 19-24	Anatomy and Physiology of Blood Vessels	Mid term	
Class 25-30	Mechanics of Heart Valves		
Class 31-36	Flow and Pressure Measurement		
Class 37-42	Role of computational fluid dynamics (CFD) in biomedical flow analysis and Recent research challenges in biological fluid dynamics	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, Mid	**100**	

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			√									

CO2	Understand the design and performance of 2-D rigid joint structures.		√										
CO3	Understand and analyse the elastic stability of 2-D rigid joint structures.						√						
CO4	Demonstrate knowledge on different on the frequency of rigid structures and finite element method.	√											

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	Understand the behavior of free and forced vibration, the concepts and methods of active and passive noise and vibration control	1	C2	1			Q, ASG, F
CO2	Measure and analyze noise and vibration signals, predict and describe their physical implication to the exposed body	2	C3	1			Q, ASG, F

CO3	Apply different engineering methods for controlling exposure to noise and vibration	3	C3	1			Q, F, CS
CO4	Evaluate the effect of noise and vibration on human body, and the implication of relevant legislation to the noise and vibration control	4	C5	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. 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	Understand the behavior of free and forced vibration, the concepts and methods of active and passive noise and vibration control.	√											
CO2	Measure and analyze noise and vibration signals, predict and describe their physical implication to the exposed body		√										
CO3	Apply different engineering methods for controlling exposure to noise and vibration			√									
CO4	Evaluate the effect of noise and vibration on human body, and the implication of relevant legislation to the noise and vibration control				√								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	**3**	Students will understand the behavior of free and forced vibration, the concepts and methods of active and passive noise and vibration control.
CO2-PO2	**2**	Students will measure and analyze noise and vibration signals, predict and describe their physical implication to the exposed body
CO3-PO3	**3**	Students will apply different engineering methods for controlling exposure to noise and vibration
CO4-P03	**3**	Students will evaluate the effect of noise and vibration on human body, and the implication of relevant legislation to the noise and vibration control

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	**100**	
4	Final Exam, CT, Mid	**100**	

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	Relate the engineering knowledge with the main terminologies and concepts of different robotic systems.	PO1	C5			1	T
CO2	Apply the concepts and mathematical modeling for analyzing the position, motion, dynamics, forces, and trajectory planning associated with robots.	PO2	C3			1	T,ASG,F
CO3	Choose appropriate sensor and actuators for various systems used in robots.	PO2	C5			2	T,F
CO4	Use various image processing techniques and artificial intelligence for development of advance robotic systems.	PO5	C3			2	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	Relate the engineering knowledge with the main terminologies and concepts of different robotic systems.	√											
CO2	Apply the concepts and mathematical modeling for analyzing the position, motion, dynamics, forces, and trajectory planning associated with robots.		√										
CO3	Choose appropriate sensor and actuators for various systems used in robots.		√										
CO4	Use various image processing techniques and artificial intelligence for development of advance robotic systems.					√							

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**3**	Students will relate the engineering knowledge with the main terminologies and concepts of different robotic systems.
CO2-PO2	**3**	Students will apply the concepts and mathematical modeling for analyzing the position, motion, dynamics, forces, and trajectory planning associated with robots.

CO3-PO2	**3**	Students will choose appropriate sensor and actuators for various systems used in robots
CO4-PO5	**3**	Students will use various image processing techniques and artificial intelligence for development of advance robotic systems.

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	**ME 449**	Lecture Contact Hours	: **3.00**
Course Title	**Composite Materials**	Credit Hours	: **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.

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.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Analyze** the design, manufacture and characterization of fibre-reinforced composites by using the concept of solid mechanics.	2	C3	2			Q, ASG, F
CO2	**Recognize** the design, manufacture, performance and service life of fibre-reinforced polymer matrix composites	2	C2	1			Q, ASG, F
CO3	**Explain** the modern application of advanced composites, especially glass and carbon fibre reinforced polymer matrix types.	5	C2	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 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	**Analyze** the design, manufacture and characterization of fibre-reinforced composites by using the concept of solid mechanics		√										
CO2	**Recognize** the design, manufacture, performance and service life of fibre-reinforced polymer matrix composites		√										
CO3	**Explain** the modern application of advanced composites, especially glass and carbon fibre reinforced polymer matrix types.					√							

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO2	**2**	Analysing 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-PO5	**2**	Students will learn about the modern processes of composite manufacturing. Also tools to be used for analysing and manufacturing complex composite structure and materials.

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.		
4	Fiber with Thermoplastic, Property, Uses, Example	CT 2	
5	Fiber with Thermoset (Glass fiber, Carbon fiber, Aramid fiber) with polymer.		
6	Ply Stiffness, Strength, Failure, **Review for Mid-Term**		
7	Laminate Layer, Stiffness strength, Failure Testing	MID	
8	Composite section and Failure mode.		
9-10	Inter-Laminar Stress and Stress concentration (Maximum 3 × 3 Matrix), Holes in laminates		
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	CT 3	

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	CT, MID	**30**	
2	CT, MID	**30**	
3	CT, MID	**30**	
	Exam		
1	Final Exam	**70**	
2	Final Exam	**70**	
3	Final Exam	**70**	

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, 9th 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

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	C2, C3	5,6	1		ASG, T, F
CO4	Analyze firefighting system of tall buildings and industrial areas.	2	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 vehicles.

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									
CO4	Design and analyze firefighting system of tall buildings and industrial areas.		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.
CO4-PO2	**3**	Students will apply appropriate techniques and select fire hydrant system following national standards.

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	C1, C2, C3	1,4, 6			Q, ASG, F

CO2	Articulate various types of maintenance procedures	3	C2, C3	1,4			Q, ASG, F
CO3	Identify and utilize important prevention techniques used in industry to evaluate maintenance parameters.	2	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	Relate regular automotive maintenance to industrial maintenance of automobiles.	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	√											
CO2	Articulate various types of maintenance procedures			√									
CO3	Identify and utilize important prevention techniques used in industry to evaluate maintenance parameters.		√										
CO4	Relate regular automotive maintenance to industrial maintenance of automobiles.		√										

(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
CO2-PO3	**2**	Students will be able to find solution by categorizing the problems into various classifications.
CO3-PO2	**2**	Students will have an ability to techniques used in industry to evaluate maintenance parameters..

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, Elimination of disturbances caused by reworking and replacement of parts and assemblies Objectives	CT 02	
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 Course Title	**ME 463** **Petroleum Engineering**	Contact Hours Credit Hours	3.00 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

1. To learn the fundamental concepts in petroleum production engineering.
2. To understand various aspects involved in drilling
3. To understand the process technologies for the petrochemical products.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Explain basic concepts of petroleum reservoir engineering, methods of oil production and drilling technologies for oil recovery.	1	C2	2			ASG, T, F
CO2	Define basic properties of reservoir rocks and fluids and methods for their calculation and measurement.	2	C1	2			ASG, T, F
CO3	Analyse the key issues in the design and optimisation of petroleum production systems.	3	C4	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

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	Explain basic concepts of petroleum reservoir engineering, methods of oil production and drilling technologies for oil recovery.	√											
CO2	Define basic properties of reservoir rocks and fluids and methods for their calculation and measurement.		√										
CO3	Analyse the key issues in the design and optimisation of petroleum production systems.			√									

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO1	**3**	Students will be able to explain basic concepts of petroleum reservoir engineering, methods of oil production and drilling technologies for oil recovery.
CO2-PO2	**3**	Students will be able to define basic properties of reservoir rocks and fluids and methods for their calculation and measurement
CO3-PO3	**3**	Students will be able to design and optimise petroleum production systems.

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 behaviour of hydrocarbon reserves	
Week-5	Analysis and prediction of reservoir performance.	Mid term
Week-6	Drilling rigs and their types	
Week-7	Rig moving equipment	
Week-8	Rig components and their auxiliaries	
Week-9	Drilling operations	CT 2
Week-10	Vertical and direction drilling	
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		
1	CT, MID	**30**	
2	CT, MID	**30**	
3	CT, MID	**30**	
	Exam		
1	Final Exam	**70**	
2	Final Exam	**70**	
3	Final Exam	**70**	

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	Identify different components of various types of automotive body and chassis layout	1	C1	1			Q, F
CO2	Interpret the underlying concepts and methods behind vehicle dynamic and vehicle aerodynamics	1	C2	1			Q, ASG, F
CO3	Apply different engineering methods for designing various chassis components and body structure	3	C3	1			Q, ASG, F

CO4	Analyze mechanics of different chassis elements and find optimum dimensions for them	4	C4	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	Identify different components of various types of automotive body and chassis layout	√											
CO2	Interpret the underlying concepts and methods behind vehicle dynamic and vehicle aerodynamics	√											
CO3	Apply different engineering methods for designing various chassis components and body structure			√									
CO4	Analyze mechanics of different chassis elements and find optimum dimensions for them				√								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	Identify different components of various types of automotive body and chassis layout
CO2-PO1	**3**	Interpret the underlying concepts and methods behind vehicle dynamic and vehicle aerodynamics
CO3-PO3	**3**	Apply different engineering methods for designing various chassis components and body structure
CO4-PO4	**3**	Analyze mechanics of different chassis elements and find optimum dimensions for 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, 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/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	C1, C2, C3	1,4,6			Q, ASG, F
CO2	Articulate various types of vehicle dynamics models	3	C2, C3	1,4			Q, ASG, F
CO3	Identify important vehicle tests commonly used in industry to	2	C2, C3, C4	1,3	1,2		Q, F, CS

	evaluate ride, steering and handling performance						
CO4	Relate chassis system characteristics to vehicle dynamic performance	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	√											
CO2	Articulate various types of vehicle dynamics models			√									

CO3	Identify and utilize important vehicle tests commonly used in industry to evaluate ride, steering and handling performance		√										
CO4	Relate chassis system characteristics to vehicle dynamic performance		√										

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to know about vehicle dynamics theory
CO2-PO3	2	Students will be able to find solution by categorizing the problems into various vehicle dynamic models.
CO3-PO2	2	Students will have an ability to use specific test for evaluating ride, steering and handling performance.
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

a) **Main Contents:**

viii) Bio-mechanics

ix) Materials for musculoskeletal system

x) Biomechanical Fluid Mechanics

xi) 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.		√										
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.			√									
CO3	Interpret data from living systems to facilitate the understanding of the human body through theoretical models and experimental methods.				√								

CO4	Evaluate alternate assumptions, approaches, procedures, trade-offs, and results related to engineering and biological problems.				√								

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	C1, C2	2			Q, ASG, F
CO2	Apply engineering techniques, tools and resources	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	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	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	√											
CO2	Apply engineering techniques, tools and resources					√							
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.				√								
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									√			

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 product has to be manufactured.	1	C1, C3	3			Q, ASG, F

CO2	Analyze, compare and finally gain theoretical experience for the advantages and limitations of different manufacturing processes.	2	C3	2,4	1		Q, ASG, F
CO3	Classify manufacturing processes according to the needs of products construction.	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	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.	√											
CO2	Analyze, compare and finally gain theoretical experience for the advantages and limitations of different manufacturing processes.		√										
CO3	Classify manufacturing processes according to the needs of products construction.				√								
CO4	Design the production of a mechanical component or a specific product using the manufacturing processes of casting, bulk deformation, sheet-metal forming, material removal and Joining.			√									

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.**
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.**
CO4-PO3	**3**	**Student will practice to Design the production of a mechanical component or a specific product using the manufacturing processes of casting.**

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 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. 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	C1, C3	1			Q, ASG, F
CO2	Identify specifications and required resources, reviewing and revising outcomes against task objectives and requirements	4	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.	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	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	√											
CO2	Identify specifications and required resources, reviewing and revising outcomes against task objectives and requirements				√								
CO3	Interpret information and specifications categorizing manufacturing methods, developing enterprise procedures, calculations relating to engineering processes within the scope of this unit.					√							
CO4	Access information sources using a variety of methods, applications, features and principles of engineering processes											√	

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	**3**	**Student will be able to describe different** application requirements.
CO2-PO4	**3**	**Students will be able to** identify specifications and required resources.
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.

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											√	
CO2	Application of human factors and engineering practice in accident prevention and reduction of health hazard											√	
CO3	Investigation on the detection and correction of hazards											√	

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 CodeCourse 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 fluency in basic nuclear physics.	1	C3	7			Q, ASG, F

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

b) 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.	√											
CO2	Develop knowledge of contextual factors impacting the engineering discipline		√										

	and learn about seminal radiation experiments and hypothesis.												
CO3	Describe the origins, interactions, uses, detection and biological/chemical effects of ionizing radiations to explore systems and reactors that use radiation.		√										

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	C1, C2			1	Q, F
CO2	Analyse, compare and finally gain theoretical experience for the advantages and limitations of different machine tools.	4	C1, C3			2	Q,F
CO3	Reduce vibration and chatter developing on machine tools.	2	C2, C3, C4			2	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	C2, C3, C4			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

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

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.
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.
CO4-PO3	**3**	Analyse similar possible linkages which can serve the same purpose and learn the most suitable design

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	C1, C2, A3	1,2,			Q, F
CO2	Understand the importance of Engine Maintenance	2	C2, C3, C4	3,4,5			Q, CS, F
CO3	Analyse all subsystem of automobile that requires maintenance	2	C2, C3, C4	3,4,5			Q, ASG, CS, F
CO4	Implement maintenance knowledge in real life to properly maintain automobile	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 of records, 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	√											
CO2	Understand the importance of Engine Maintenance		√										
CO3	Analyse all subsystem of automobile that requires maintenance		√										
CO4	Implement maintenance knowledge in real life to properly maintain automobile			√									

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification

CO1-PO1	3	Understand the fundamental knowledge maintenance and its application.
CO2-PO2	3	Identify engine components which need maintenance and how their application creates constant degradation.
CO3-PO2	3	Identify automobile subsystems and components which need maintenance and how they constantly degrade over time.
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, piezo resistive,
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	Introduce the fundamental concept of MEMS & Microsystem and their relevance to current industry/scientific needs	1	C1, C3	3			Q, ASG, F
CO2	Apply basic sensing principles of chem./bio systems to develop novel sensors	2	C1	2,4	1		Q, ASG, F
CO3	Discuss the limitations and challenges in the design and fabrication of micro sensors, sensing modalities to build the desired microsystem	1	C1, C2	4	1,2		Q, F, CS
CO4	Introduce students to writing and evaluating research proposals enabling them to apply general micromachining principles to build novel devices.	3	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	√											
CO2	Applying basic sensing principles of chem./bio systems to develop novel sensors		√										
CO3	To discuss the limitations and challenges in the design and fabrication of micro sensors, sensing modalities to build the desired microsystem	√											
CO4	To introduce students to writing and evaluating research proposals enabling them to apply general micromachining			√									

	principles to build novel devices.													

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Student will practice design related problems
CO2-PO2	3	Student will practice design related problems
CO3-PO1	2	Application of equation will enable the students to analyse problems arise in various engineering problems
CO4-PO3	3	Student will practice 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
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 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	Knowledge of a broad range of modeling and analytical methodologies and underlying mechanical principles commonly used in the development and analysis of mechatronic engineering systems.	2	C1	1			Q,T
CO2	Solve design problems relevant to mechatronics engineering, and an understanding on how to formulate and analyze design solutions in various engineering contexts relevant to sensors and control systems.	3	C3	1			Q,CA,KP

CO3	Identify principles and application of electrical and mechanical components- their functions in practical situations.	1	C1	1			T,PR,ASG
CO4	Apply knowledge and experience in designing mechatronic systems. Investigate further innovation of mechatronics with the advancement of technologies.	12	C3	2			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

1. Key elements of Mechatronic systems, representation into block diagrams.
2. Principles of sensors, their characteristics, and interfacing with microcontrollers.
3. Principles of passive and active electrical components, concepts of PLC and its programming and application in industries.
4. Various types of electrical, hydraulic and pneumatic actuation systems.
5. Control Systems such as PID and its application.
6. The motion of various configurations of robots, inverse kinematics and their programming.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Knowledge of a broad range of modeling and analytical methodologies and underlying mechanical principles commonly used in the development and analysis of mechatronic engineering systems.		√										
CO2	Solve design problems relevant to mechatronics engineering, and an understanding on how to formulate and analyze design solutions in various engineering contexts			√									

	relevant to sensors and control systems.												
CO3	Identify principles and application of electrical and mechanical components- their functions in practical situations.	√											
CO4	Apply knowledge and experience in designing mechatronic systems. Investigate further innovation of mechatronics with the advancement of technologies.												√

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO2	**3**	Students will be able to achieve range of modeling and analytical methodologies and underlying mechanical principles commonly used in the development and analysis of mechatronic engineering systems.
CO3-PO1	**3**	Students will be able to solve design problems relevant to mechatronics engineering, and an understanding on how to formulate and analyze design solutions in various engineering contexts relevant to sensors and control systems.
CO4-PO12	**3**	Students will be able to identify principles and application of electrical and mechanical components- their functions in practical situations.
CO4-PO12	**3**	Students will be able to apply knowledge and experience in designing mechatronic systems. Investigate further innovation of mechatronics with the advancement of technologies.

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	
1-3	Key elements of Mechatronic systems, representation into block diagrams.	CT-1
3-8	Principles of sensors, their characteristics, and interfacing with microcontrollers.	
8-11	Principles of passive and active electrical components, concepts of PLC and its programming and application in industries. Various types of electrical, hydraulic and pneumatic actuation systems. Control Systems such as PID and its application.	Mid-Term CT-2 CT - 3
12-14	The motion of various configurations of robots, inverse kinematics and their programming.	

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 equipment 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	C3	1,2	1		Q, ASG, F
CO3	Enunciate physical and chemical properties of	1	C5, C6	4	1		Q, F, CS

	natural and manmade fibres and their uses.						
CO4	Demonstrate the identification of different natural and man-made fibres.	3	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.												
CO2	Describe the manufacturing process of different man-made fibres.		√										
CO3	Enunciate physical and chemical properties of natural and manmade fibres and their uses.	√											
CO4	Demonstrate the identification of different natural and man-made fibres.			√									

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	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
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	√											
CO2	Demonstrate an understanding of the current technology applied to gun barrels and breeches						√						
CO3	Undertake analysis of gun recoil systems, barrel vibration and other aspects of gun dynamics		√										

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 – 42	Definition related to armament 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	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.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	Physics (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 265	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	3-1	Sci & Hum	4.00	2.00
GEBS 101	Bangladesh Studies	1-1	Sci & Hum	2.00	2.00
GES 107	Fundamentals of Sociology	1-2	Sci & Hum	2.00	2.00
GEE 205	Fundamentals of Economics	2-1	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 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	4-2	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			
1. To define the different parameter and concepts of inorganic chemistry. 2. To apply different chemical theory to evaluate structure of molecules. 3. To explain the basic concepts of physical chemistry. 4. 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	Define the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	1	C1	1			T, F
CO2	Evaluate structure of molecules using different theory on chemical bonding and hybridization	1	C5	1			T, F, ASG
CO3	Explain the mechanism of selective organic reactions.	1	C2	1			T, F, ASG
CO4	Discuss chemical equilibrium, thermo-chemistry, chemical and	1	C2	1			ASG ,Mid Term Exam, F

	ionic equilibria, electro-chemical cells.						

(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	Define the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	√											
CO2	Evaluate structure of molecules using different theory on chemical bonding and hybridization	√											
CO3	Explain the mechanism of selective organic reactions.	√											
CO4	Discuss chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.	√											

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will be able to define the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.
CO2-PO1	3	Students will be able to evaluate structure of molecules using different theory on chemical bonding and hybridization.
CO3-PO1	3	The students will be able to explain the mechanism of selective organic reactions.
CO4-PO1	3	Students will be able to discuss chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.

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	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. Modern Inorganic Chemistry – S. Z. Haider
2. Concise Inorganic Chemistry – J. D. Lee
3. A Textbook of Organic Chemistry – Arun Bahl And B. S. Bahl
4. Organic Chemistry – Morrison and Boyd
5. Principles of Physical Chemistry – Haque and Nawab
6. 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	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	C2	1			R,Q,T
CO2	Explain the different phenomena and perform experimentation regarding iodimetric and iodometric method, complexometric titration etc.	2	C2	1			R,Q,T
CO3	Measure zinc, ferrous content in water sample by using various titrimetric methods.	3	C3	1			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	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.	√											
CO2	Explain the different phenomena and perform experimentation regarding iodimetric and iodometric method, complexometric titration etc.		√										
CO3	Measure zinc, ferrous content in water sample by using various titrimetric methods.			√									

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will 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.
CO2-PO2	3	Students will be able to explain the different phenomena and perform experimentation regarding iodimetric and iodometric method, complexometric titration etc.
CO3-PO3	3	Students will be able to measure zinc, ferrous content in water sample by using various titrimetric methods.

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 Thiosulphate Pentahydrate (Na2S2O3.5H2 O) Solution with Standard Potassium Dichromate (K2Cr2O7) Solution.
Week-7	Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate
Week-8	(CuSO4 .5H2 O) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium Thiosulphate Pentahydrate (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

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**	
	Exam		
CO1	Final Exam	**50**	
CO2		**60**	
CO3		**30**	

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** **Physics (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	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, MT, F
CO2	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	C2	1			T, MT, F
CO3	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.	1	C3	2			T, ASG, MT, 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

Waves and Oscillations: Simple Harmonic Motion (SHM) and its properties, differential equation of a SHM and its solution, total energy and average energy of a body executing SHM, simple pendulum, torsional pendulum, spring-mass system, LC oscillatory circuit, two body oscillation and reduced mass, Composition of SHM, Damped oscillations, and its different condition, forced oscillations and its different condition, resonance, Wave motion : expression for a plane progressive wave, differential equation of wave motion, energy density of wave motion, average kinetic and potential energy of wave motion, Stationary wave.

Optics: Combination of lens, equivalent lens and power, Defects of images and different aberrations, Interference of light, Young's double slit experiment, interference in thin films, Newton's ring, Diffraction of light, Fraunhofer and Fresnel diffraction, diffraction by single slit and double slit, diffraction grating, Fraunhofer diffraction at a circular aperture, resolving power of optical instrument, Polarization of light, Brewster's law, Malus law, polarization by double refraction, Nicole prism, optical activity and polarimeters, Laser: spontaneous and stimulated emission.

Modern physics: Relativity : Frame of reference, postulates of special theory of relativity, 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 nuclei, nuclear mass and 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	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.	√											
CO2	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.	√											

CO3	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.	√											

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	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for test and examination	21
Formal Assessment	
Class Test / Mid-Term Exam	3
Final Examination	3
Total	**132**

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Weeks	Lect	Topics	Remarks
Week-1	1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	CT-1/

	2	Periodic motion, oscillatory motion, simple harmonic motion (SHM), properties of SHM, differential equations, general solution of SHM, graphical representation of SHM	Assignment
	3	Velocity, acceleration, phase and epoch, time period, frequency and angular frequency of SHM	
Week-2	4	Total energy and average energy of SHM, problems	
	5	Simple pendulum, torsional pendulum, spring-mass system	
	6	LC oscillatory circuit, two body oscillations, reduced mass	
Week-3	7	Composition of SHM	
	8	Composition of SHM, problems	
	9	Damped oscillations and its differential equation	
Week-4	10	Displacement equation of damped oscillations and its different conditions, electric damped oscillatory circuit	CT-2 /Assignment
	11	Forced oscillations and its differential equation, displacement equation of forced oscillations, resonance	
	12	Wave motion : expression for a plane progressive wave, differential equation of wave motion, particle velocity, wave velocity	
Week-5	13	Energy density of a plane progressive wave, average energy in a plane progressive wave, problems	
	14	Stationary wave : node, anti-node, problems	
	15	Lens and combination of lenses, equivalent lens, power of lens, cardinal points	
Week-6	16	Defects of images and different aberrations	
	17	Defects of images and different aberrations	
	18	Interference of light, young’s double slit experiment	
Week-7	19	Analytical treatment of interference, energy distribution	Mid Term/ Assignment
	20	Interference fringes, interference in thin films	
	21	Newton’s ring, Interferometer	
Week-8	22	Diffraction : Fresnel & Fraunhofer diffraction, diffraction by single slit	
	23	Diffraction by double slit, diffraction gratings	
	24	Fraunhofer diffraction at a circular aperture, resolving power of optical instrument	
Week-9	25	Polarization of light, Brewster’s law, Malus’ law	
	26	Polarization by double refraction, Nicol prism: Polarizer and analyzer	
	27	Optical activity: specific rotation, polarimeters	
Week-10	28	Laser: spontaneous and stimulated emission, applications of laser	
	29	Theory of relativity: Frame of reference, postulates of special relativity, Galilean relativity, Galilean transformation	
	30	Lorentz transformations, length contraction, time dilation	
Week-11	31	Velocity addition, relativistic mass and its expression,	CT-3 / Assignment
	32	Mass and energy equivalence equation and concept of massless particles and its expression, momentum energy relation, problems	
	33	Photoelectric effect, photocurrent and work function, kinetic energy, stopping potential	

Week-12	34	Photoelectric equation, characteristics of photoelectric effect	
	35	Compton effect: definition, Compton wavelength shift, limitation	
	36	De Broglie concept, condition for wave and particle behavior, Bohr atomic model	
Week-13	37	Expression for Bohr radii and orbital energy for hydrogen atom	
	38	Classification of nuclei, nuclear mass and nuclear binding energy	
	39	Radioactivity : Radioactive decay law, half- life	
Week-14	40	Mean life, nuclear reaction : concept of Fusion, Fission and nuclear chain reaction	
	41	General idea on nuclear reactor and nuclear power plant	
	42	Review of the syllabus	

ASSESSMENT STRATEGY

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test 1-3 / Assignment	20%	CO1, CO2, CO3	C1, C2, C3
	Class Attendance	5%		
	Class Performance	5%		
	Mid term	10%	CO1, CO2, CO3	C1, C2, C3
Final Exam (Section A & B)		60%	CO1	C1
			CO2	C2
			CO3	C3
Total Marks		100%		

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

REFERENCE BOOKS

1. Physics for Engineers : Part-I and Part-II : Dr Giasuddin Ahmad
2. Physics, Volume I and Volume II **:** Resnick and Halliday
3. Fundamentals of Physics : Halliday, Resnick and Walker
4. Physics for Scientists and Engineers: Serway and Jewett
5. Waves and Oscillations : Brij Lal and Subramannyam
6. The Physics of Vibrations and Waves: H. J. Pain
7. Concept of Modern Physics: Arthur Beiser
8. University Physics with Modern Physics: Hugh D. Young and Roger A. Freedman
9. Modern Physics for Science and Engineering: Marshall L. Burns
10. Modern Physics : B.L. Theraja
11. Fundamental of Optics: Francis A. Jenkins and Harvey E. White
12. Introduction to Modern Optics: Grant R. Fowles
13. Fundamental Optical Design: Michael J. Kidger
14. A Text Book of Optics **:** Brijlal and N. Subrahmanyam

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 is a laboratory course in basic physics in the fields of waves and oscillations, optics, mechanics, electricity, modern physics, and thermal physics. The course will emphasize the fundamental experiments in different fields of physics that can be applicable to a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as work with a 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	Define the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	1	C1	K1			R, Q, F
CO2	Describe the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	1	C2	K1			R, Q, T, F
CO3	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.	1	C2	K2			R, Q, T, F
CO4	Prepare a report for an experimental work.	1	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, resistance of a galvanometer, Electrochemical equivalent (ECE) of copper, comparison of the E.M.F's of two cells, radius of curvature, wavelength of light, focal length of lens, specific rotation of sugar, refractive index of a liquid, frequency of a tuning fork, acceleration due to gravity, spring constant, rigidity modulus, young's modulus, moment of inertia, conservation of linear momentum, thermal conductivity of a bad conductor, temperature co-efficient of resistance, pressure co-efficient of a gas, specific heat of a liquid, surface tension, Planck's constant.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Define the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	√											
CO2	Describe the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	√											
CO3	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.	√											
CO4	Prepare a report for an experimental work.	√											

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-PO1	3	Able to do work or complete a task as an individual and as a team
CO4-PO1	3	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%		
	Report Writing/ Assignment	30%	CO1, 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, A = Affective Domain, P = Psychomotor 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	Know the rate of change of a function with respect to independent variables and the different techniques of evaluating indefinite and definite integrals.	1	C1			1	T, F, ASG
CO2	Apply the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	1	C3			2	T, Mid Term Exam, F
CO3	Calculate the length, area, volume, centre of gravity and average value related to engineering study.	1	C3			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; 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	Know the rate of change of a function with respect to independent variables and the different techniques of evaluating indefinite and definite integrals.	√											
CO2	Apply the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	√											
CO3	Calculate the length, area, volume, center of Gravity and	√											

	average value related to engineering study.												

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1- PO1	3	Students will attain knowledge of mathematics, and engineering sciences has to be applied to describe the complete concept of differential and integral calculus.
CO2- PO1	3	Students will be able to apply proper and improper integral in the field of Engineering study using the knowledge of mathematics, science and engineering sciences.
CO3- PO1	3	Students will be able to calculate volume, average, center of gravity and area of any solid revolution object.

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 the classifications of partial differential equations.	1	C1	1			T,F,ASG
CO2	Solve ordinary and partial differential equations by using different rules	1	C3	2			T, Mid Term Exam, F
CO3	Apply the technique of inverse matrix and echelon form to get the solution of System of Linear Equation.	1	C3	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 theorem of Gases and vapours.

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 the classifications of partial differential equations.	√											
CO2	Solve ordinary and partial differential equations by using different rules	√											
CO3	Apply the technique of inverse matrix and echelon form to get the solution of System of Linear Equation.	√											

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will attain knowledge of mathematics, and engineering sciences has to be applied to describe the complete concept of differential and integral calculus.
CO2- PO1	3	Students will be able to apply proper and improper integral in the field of Engineering study using the knowledge of mathematics, science and engineering sciences.
CO3- PO1	3	Students will be able to calculate the volume, average, center of gravity and area of any solid revolution object.

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 Term
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 10^{th} 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 Laplace transform, inverse Laplace transform, some properties and definition of Geometry.	1	C1	1			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	2			T, Mid Term Exam, F
CO3	Calculate length, volume and area of objects related to engineering study by using vector.	1	C3	1			Mid Term Exam, F, ASG
CO4	Apply Laplace transform to ODE and PDEs and the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in engineering study.	1	C3	2			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

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
CO 1	Know the physical explanation of different vector notation and Laplace transform, inverse Laplace transform, some properties and definition of Geometry.	√											
CO 2	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.	√											
CO3	Calculate length, volume and area of objects related to engineering study by using vector.		√										
CO 4	Apply Laplace transform to ODE and PDEs and the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in engineering study.	√											

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1- PO1	3	Students should be able to apply knowledge of mathematics, science and engineering sciences to describe and identify the physical explanation of different vector notation, explain the complete concept about Laplace transform, 2D and 3D geometry.

CO2- PO1	3	Students should be able to explain the differentiation and integration of a vector valued functions in Cartesian, cylindrical and spherical geometry and solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc using the concept of mathematics and engineering sciences.
CO3- PO1	3	Students should be able to construct and calculate the area and volume of objects related to engineering study by using vector, solve the differential equations by Laplace transform which needs the concept of mathematics, physics and engineering sciences.
CO4-PO1	3	Students should be able to apply the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in engineering study.

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 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		Mid Term
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	
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 265** **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			Q, ASG, F
CO2	Explain the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	1	C2	2			Q, ASG, F
CO3	Apply Fourier Transform to solve boundary value problems.	1	C3	2			Q, ASG, F
CO4	Solve different coordinate system of engineering problems by Harmonic function.	1	C3	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.	√											
CO2	Explain the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	√											
CO3	Apply Fourier Transform to solve boundary value problems.	√											
CO4	Solve different coordinate system of engineering problems by Harmonic function.	√											

(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 be able to apply the knowledge of mathematics to Fourier Analysis and Complex Variable in the field of engineering study.
CO2-PO1	3	Students should be able to explain the characteristics of various components of EECE using the knowledge of mathematics regarding Complex Variable.

CO3-PO1	3	Students should be able to describe physical phenomena of different BVPs, using the knowledge of mathematics and sciences.
CO4-PO1	3	Students should be able to use the concept of Mathematics and sciences 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)**	**Mid Term**
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)**	
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%		

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	Communicate in English quickly and smartly using the techniques learnt in the class.	1	L2	1			ASG, Q,
CO2	Understand the techniques of academic reading and writing	1	L3	1			PR, Q, ASG,

CO3	Communicate ideas and opinions effectively within the shortest possible time	10	L4	1			PR, Q, ASG,
CO4	Excel in oral and written communication/ Presentation competency	10	L5	2			PR, Q, 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

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	Communicate in English quickly and smartly using the techniques learnt in the class.	√											
CO2	Understand the techniques of academic reading and writing	√											
CO3	Communicate ideas and opinions effectively within the shortest possible time										√		
CO4	Excel in oral and written communication/ Presentation competency										√		

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to listen, understand and speak English quickly and smartly using the Technics learnt in the class.
CO2-PO1	3	Students will be able to understand the techniques of Academic reading and academic writing
CO3-PO10	3	Students will be able to communicate effectively within the shortest possible time to present ideas and opinions
CO4-PO10	3	Students will be able to develop competency in oral, written communication/presentation

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	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. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication.
2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
3. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
4. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation).
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes.
7. Cambridge IELTS Practice Book.
8. Selected Sample Reports and Selected Research Articles.

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code	**LANG 202**	Lecture Contact Hours	**3.00**
Course Title	**Communicative English II**	Credit Hours	**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	L2	1			ASG, Q
CO2	Understand the techniques of effective academic writing such as research article/report writing	1	L3	1			ASG, Pr, Q
CO3	Communicate effectively within the shortest possible time to present any report and research work	10	L4	1			ASG, Pr, Q
CO4	Analyze any problem critically, analyze and interpret data and synthesize information to provide valid conclusions	10	L5	2			ASG, Pr, 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

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	√											
CO2	Understand the techniques of effective academic writing such as research article/report writing	√											
CO3	Communicate effectively within the shortest possible time to present any report and research work										√		
CO4	Analyze any problem critically, analyze and interpret data and synthesize information to provide valid conclusions.										√		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	3	Students will be able to understand the techniques of academic reading and become acquainted with technical vocabularies
CO2-PO2	3	Students will be able to understand the techniques of effective academic writing such as research article/report writing
CO3-PO10	3	Students will be able to communicate effectively within the shortest possible time to present any report and research work
CO4-PO10	3	Students will be able to analyze any problem critically, analyze and interpret data and synthesize information to provide valid conclusions

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	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. 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-1, T-I

COURSE INFORMATION			
Course Code Course Title	: **GEBS 101** : **Bangladesh Studies**	Lecture Contact Hours Credit Hours	**: 2.00** **: 2.00**

PRE-REQUISITE
N/A
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
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.
OBJECTIVE
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.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
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.	6	C1	1			Q, ASG, F
CO2	Explain the economy and patterns of economic changes through qualitative and quantitative analysis.	6	C2	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
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.						√						
CO2	Explain the economy and patterns of economic changes through qualitative and quantitative analysis.						√						

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO6	3	Students will be able to 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.
CO2-PO6	3	Students will be able to explain the economy and patterns of economic changes through qualitative and quantitative analysis.

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		CT-2
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)	
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**	
2	CT	**30**	
	Exam		
1	MID, Final Exam	**80**	
2	MID, Final Exam	**70**	

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

Fall Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	: **GEBL 101** : **Bangla Language and Literature**	Lecture Contact Hours Credit Hours	: **2.00** : **2.00**

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

বাংলা আমাদের মাতৃভাষা। বাংলা শুধু একটি ভাষাই নয়, বরং এর সাথে বাংলাভাষী মানুষদের সংস্কৃতি, ইতিহাস এবং স্বকীয়তা ওতপ্রোতভাবে জড়িত। এই ভাষা শেখার মাধ্যমে এ অঞ্চলের মানুষদের ঐতিহ্য, মূল্যবোধ এবং জীবনপ্রক্রিয়া সম্পর্কে সম্যক ধারণা লাভ করা যায়। সর্বোপরি 'বাংলা ভাষা ও সাহিত্য' বিষয়টি অধ্যয়নের মাধ্যমে স্নাতক (সম্মান) প্রোগ্রামের ছাত্রছাত্রীগণ এর তাত্ত্বিক বিষয়ে যেমন দক্ষতা অর্জন করবে তেমনি এই কোর্স হতে লব্ধ ধারণা তাদের জ্ঞানের পরিধি ও সংস্কৃতি সম্পর্কে ধারণা বৃদ্ধি এবং এর প্রায়োগিক কৌশলসমূহ আরও ভালোভাবে রপ্ত করতে সাহায্য করবে।

OBJECTIVE

প্রশিক্ষণের উদ্দেশ্য।

ক। বাংলা ভাষা, ব্যাকরণ ও সাহিত্যের মৌলিক বিষয় সম্পর্কে ধারণা প্রদান।

খ। মাতৃভাষার শুদ্ধ উচ্চারণ শিক্ষা।

গ। পঠিত বিষয়ের ভাব অনুধাবন করা এবং তা প্রকাশে দক্ষ করে তোলা।

ঘ। বাংলা ভাষায় পেশাগত দাপ্তরিক পত্রালাপ (Official Correspondence) এবং সৃজনশীল রচনার জন্য প্রাতিষ্ঠানিক শিক্ষা প্রদান।

প্রয়োগিক উদ্দেশ্য।

ক। সৃজনশীল রচনায় বাংলা ভাষার দক্ষ প্রয়োগ।

খ। মাতৃভাষায় শুদ্ধ উচ্চারণে বক্তব্য প্রদানের দক্ষতা অর্জন।

গ। লিখিত ও মৌখিক প্রয়োগে ভাষার সৌকর্য রক্ষা করা।

ঘ। মাতৃভাষায় দাপ্তরিক পত্রালাপে দক্ষতা অর্জন।

COURSE CONTENT

ক। সাহিত্য (প্রবন্ধ, গল্প ও কবিতা) - ৪০ নম্বর

খ। ব্যাকরণ, ভাষা শিক্ষা ও বিরচন - ৬০ নম্বর

(প্রবন্ধ, গল্প ও কবিতা সমূহ ঢাকা বিশ্ববিদ্যালয় এবং ইউজিসির সিলেবাস হতে সংগৃহীত)

গ। নির্বাচিত প্রবন্ধ **- ১৫ নম্বর**

(১) বাঙ্গালা ভাষা	-	বঙ্কিমচন্দ্র চট্টোপাধ্যায়
(২) তৈল	-	হরপ্রসাদ শাস্ত্রী

ঘ। নির্বাচিত গল্প **- ১৫ নম্বর**

(১) পুঁইমাচা	-	বিভুতিভূষণ বন্দোপাধ্যায়
(২) নয়নচারা	-	সৈয়দ ওয়ালীউল্লাহ

ঙ। নির্বাচিত কবিতা **- ১০ নম্বর**

(১) বিদ্রোহী	-	কাজী নজরুল ইসলাম
(২) বঙ্গভাষা	-	মাইকেল মধুসুদন দত্ত

চ। ব্যাকরণ ও ভাষা শিক্ষা **- ২৫ নম্বর**

(১) প্রমিত বাংলা বানানের নিয়ম।

(২) অশুদ্ধি সংশোধন।

(৩) বাগধারা।

(৪) প্রবাদ প্রবচন।

(৫) এক কথায় প্রকাশ।

(৬) প্রশাসনিক পরিভাষা।

(৭) প্রায় সমোচ্চারিত ভিন্নার্থক শব্দ।

(৮) বিভিন্ন শব্দের বিশিষ্টার্থে প্রয়োগ।

ছ। উচ্চারনবিধি **- ০৫ নম্বর**

জ। বিরচন **- ৩০ নম্বর**

(১) ইংরেজি থেকে বাংলা অনুবাদ/অনুচ্ছেদ রচনা।

(২) ভাব সম্প্রসারণ/সারাংশ/সারমর্ম।

(৩) পত্র/প্রতিবেদন রচনা।

(৪) প্রবন্ধ রচনা।

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

ক্র/নং	কোড নং	পাঠ্য বিষয়	পিরিয়ড সংখ্যা	মন্তব্য
		সাহিত্য (১২ পিরিয়ড)		
১	বাংলা:১-৪	প্রবন্ধ: বাঙ্গালা ভাষা	২	
২	বাংলা:৫-৭	প্রবন্ধ: তৈল	২	
৩	বাংলা:৮-১১	গল্প: পুঁইমাচা	২	
৪	বাংলা:১২-১৪	গল্প: নয়নচারা	২	
৫	বাংলা:১৫-১৮	কবিতা: বিদ্রোহী	২	
৬	বাংলা:১৯-২১	কবিতা: বঙ্গভাষা	২	
		ব্যাকরণ, ভাষা শিক্ষা ও মৌখিক প্রকাশ ক্ষমতার উন্নয়ন (১০ পিরিয়ড)		
৭	বাংলা:২২-২৪	প্রমিত বাংলা বানানের নিয়ম	২	
৮	বাংলা:২৫-২৬	অশুদ্ধি সংশোধন	১	
৯	বাংলা:২৭	বাগধারা	১	
১০	বাংলা:২৮	প্রবাদ প্রবচন	১	
১১	বাংলা: ২৯	এক কথায় প্রকাশ	১	
১২	বাংলা: ৩০	প্রশাসনিক পরিভাষা	১	
১৩	বাংলা: ৩১	প্রায় সমোচ্চারিত ভিন্নার্থক শব্দ	১	
১৪	বাংলা: ৩২	বিভিন্ন শব্দের বিশিষ্টার্থে প্রয়োগ	১	
১৫	বাংলা:৩৩-৩৪	উচ্চারনবিধি	১	
		বিরচন (০৪ পিরিয়ড)		
১৬	বাংলা: ৩৫-৩৬	ইংরেজি থেকে বাংলা অনুবাদ/অনুচ্ছেদ রচনা	১	
১৭	বাংলা: ৩৭	ভাব সম্প্রসারণ/সারাংশ/সারমর্ম	১	
১৮	বাংলা: ৩৮	পত্র/প্রতিবেদন রচনা	১	
১৯	বাংলা: ৩৯	প্রবন্ধ রচনা	১	
		পরীক্ষা (০২ পিরিয়ড)		
২০	বাংলা: ৪০-৪৫	পরীক্ষা (১+১)	২	
		মোট পিরিয়ড =	**২৮**	

ASSESSMENT STRATEGY

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

	2	MID, Final Exam	**70**		

REFERENCE BOOKS

ক। বিএমএ ক্যাডেট প্রেসি - বাংলা।

খ। বাংলা ব্যাকরণ - ড. শাহজাহান মুনীর, স্টুডেন্টস পাবলিকেশনস।

গ। প্রবন্ধসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।

ঘ। গল্পসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।

ঙ। কবিতাসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।

চ। বাংলা বানান অভিধান - বাংলা একাডেমি কর্তৃক প্রকাশিত।

ছ। বাংলা উচ্চারণ অভিধান - বাংলা একাডেমি কর্তৃক প্রকাশিত।

জ। প্রমিত বাংলা ব্যাকরণ ও নির্মিতি (তৃতীয় খণ্ড) - অধ্যাপক ড. হায়াৎ মামুদ ও অধ্যাপক ড. মোহাম্মদ আমীন।

ঝ। বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ - বাংলা একাডেমি কর্তৃক প্রকাশিত।

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	**GES 107** **Fundamentals of Sociology**	Lecture Contact Hours Credit Hours	2.00 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	6	L2	1		7	M
CO2	**Apply** sociological-imagination to the context of social problems of BD society	6	L3	1		7	M
CO3	**Understand** the stages of social research processes and methodologies	6	L2	1		7	F
CO4	**Analyze** different cultures, civilizations, and different social problems and design solutions for those	6	L4	3		7	M
CO5	**Understand** social stratification, different social systems, socialism, capitalism and relate them to BD society	6	L2	1		7	F
CO6	**Understand** contextual knowledge to assess societal and cultural issues in an environmental context for sustainable development	6	L2	1		7	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							√					
CO2	Apply sociological-imagination to the context of social problems of BD society							√					
CO3	Understand the stages ofsocial research processes and methodologies							√					
CO4	Analyze different cultures, civilizations, and different social problems and design solutions for those							√					
CO5	Understand social stratification, different social systems, socialism, capitalism and relate them to BD society							√					
CO6	Understand contextual knowledge to assess societal and cultural issues in an environmental context for sustainable development							√					

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO6	3	Knowledge of natural science helpsto understand the basic nature, scope, and perspectives of sociology
CO1-PO6	3	Ability to identify the basic nature, scope and perspectives of sociology
CO2-PO6	2	Ability to apply sociologicalimagination to the context of social problems of BD society
CO3-PO6	2	Ability to understand the stages of Social Research Processes and methodologies in societal and
CO4-PO6	2	Skilled enough to analyze different cultures, civilizations, and different social problems and design solutions
CO5-PO6	3	Ability to understand and analyze social stratification, different social systems, socialism, capitalism and relate them to BD society

CO6-PO6	3	Ability to apply contextual knowledge to assess societal and cultural issues in environmental the context for sustainable development

COURSE SCHEDULE			
		Intended Topics to be Covered	Assessment
Week 1			CT 1
	Class 1	Definition, nature, and scope of sociology	
	Class 2	Sociological imagination	
Week 2			
	Class 3	Perspectives of sociology	
	Class 4	Orientation of sociological theories	
Week 3			
	Class 5	Social research and its process.	
	Class 6	Research designs and techniques	
Week 4			
	Class 7	Introducing culture and its variations 8	
	Class 8	civilization	
Week 5			
	Class 9	Defining family and its changes	
	Class 10	Socialization process and development of self	
Week 6			Mid Term Exam
	Class 11	Introducing globalization and its impact on human life	
	Class 12	Factors responsible for globalization	
Week 7			
	Class 13	Media and its impact on modern society	
	Class 14	Addressing the social problems in Bangladesh	
Week 8			
	Class 15	Introducing social groups and organizations	
	Class 16	Introducing bureaucracy and good governance	
Week 9			CT 2
	Class 17	Introducing social stratifications and social inequality	
	Class 18	Poverty and its types and dimensions	
Week 10			
	Class 19	Industrial revolution and aftermath	
	Class 20	Urbanization and city development	
Week 11			CT 3
	Class 21	Capitalism: features and influence	
	Class 22	Socialism: features and influence	
Week 12			
	Class 23	Environment and human activities	
	Class 24	Climate change and global risk	
Week 13			
	Class 25	Population of Bangladesh: problem or prospect	
	Class 26	Crime and deviance: a brief analysis	
Week 14			

	Class 27	Review 1
	Class 28	Review 2

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment(1-3)	20%	CO1, CO2,CO3	L1, L2, L3
	Class Participation	5%	CO3,CO4	L2, L4
	Mid Term	15%	CO4,CO5	L2, L4
Final Exam		60%	CO1	L1, L2
			CO2	L3
			CO3	L2
			CO4	L4
			CO5 CO6	L2 L3
Total Marks		100%		

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

REFERENCES BOOKS

1. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
2. Sociology - Primary Principles: by CN Shankar Rao
3. Anthony Giddens- 7th edition
4. Relevant journal

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	**GELM 275** **Leadership and Management**	Lecture Contact Hours Credit Hours	2.00 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	10		1			Q, ASG,F
CO2	Understand the role and contribution of a leader in achieving organizational goals	9		1			Q, ASG,F
CO3	Understand the contribution of leadership traits and management skills in decision making and solving real life problems	12		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 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										√		
CO2	Understand the role and contribution of a leader in achieving organizational goals									√			
CO3	Understand the contribution of leadership traits and management skills in decision making and solving real life problems												√

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
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
CO3-PO12	3	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	CT-3	

	theory; reinforcement theory; equity theory; expectancy theory		
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. Students must be provided with SOLID reading material instead of referring text books. However, course teacher may select any text book as per his choice.
2. Engineering Management (Revised Edition) – A.K. Gupta
3. Industrial Engineering and Production Management - Martand T. Telsang
4. Leadership in Organizations – Gary Yukl
5. Developing Management Skills – David A. Whetten and Kim S. Cameron

Fall Semester L-3, T-I

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	Formulate problem statement and research questions/objectives.	2	C2			K1	ASG, Q
CO2	Prepare a research proposal considering background studies, problem statement, objectives, literature review and method in a team.	9	C6			K2	R, Pr, ASG, Q
CO3	Demonstrate ethical considerations in conducting research	8	C4			K2	R, Pr, 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)
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	Formulate problem statement and research questions/objectives.		√										
CO2	Prepare a research proposal considering background studies, problem statement, objectives, literature review and method in a team.									√			
CO3	Demonstrate ethical considerations in conducting research								√				

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO2	3	Student will understand research fundamentals
CO2-PO9	3	Student will find out research problems and formulate research statements
CO3-PO8	3	Students will be able to use gained knowledge in 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
	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. 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.

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	: **GEE 205** : **Fundamentals of Economics**	Lecture Contact Hours Credit Hours	: **2:00** : **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. To help students demonstrate the knowledge of the fundamental concepts of economics.
2. To teach how efficiency in organizational decision-making can be achieved.
3. To help students understand consumer behavior, elasticity of market demand and different market structure.
4. To help students realize the importance of various macroeconomic aggregates such as national income, full employment, unemployment, inflation, productivity and the major challenges associated with the measurement of these aggregates.
5. To help students apply the basic theories of economics to make their project management cost-effective.
6. To help students recognize the basic features of economic development and regarding planning for the economy of the country.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand the basic concepts and principles of microeconomics and macroeconomics.	1	C2	1			Q, ASG, F
CO2	Apply the basics of economics in optimization of a firm's decision.	1	C3	2			Q, ASG, F
CO3	Apply the concepts of consumer behavior, production process, cost of production and market structure to find the equilibrium that maximizes the welfare of the society.	11	C3	2			Q, F, CS

CO4	Interpret the reasoning behind the economic policies of the government to develop the domestic economy as well as the relationship with the global economy.	11	C2	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

Main Contents	Detail Contents
Short History of the Evolution of Economics Thought	Definition of economics in various predominant schools of economics.
Consumer Theory	• Definition of Utility • Law of diminishing marginal utility. • Indifference Curve & MRS • Budget Line & Relative price • Consumer Equilibrium
Theory of Production	• Short-run VS Long-run production function • Stages of production in one-variable input production • Long-run production curve.
Production Possibility Frontier	• PPF Curve. • Applying the PPF to Society's Choices by the Engineers.
Demand & Supply	• Definition. • Law of Demand. • Law of Supply • Movement along the curve & Shift • Equilibrium analysis
Elasticity of Demand	• Different types of elasticity. • Different types of price elasticity. • Relation between AR, MR and elasticity Mathematical Analysis
Cost Analysis	• Determining, Average Cost (AC), Marginal Cost (MC) from Total Cost (TC) • Depreciation & Break-even point • Short-run cost analysis • Long-run cost analysis
Analysis of Market Structure	• Perfectly Competitive Market • Monopoly and Monopolistic Market • Oligopoly (Cournot model & Stackelberg model)
National Income	• Definition of GDP, GNP, NNP, NI • Three approaches GDP calculation. • Shortcoming of GDP calculation.

Circular Flow of National Income	• Three sector Economy (Closed Economy) • Four Sector Economy (Open Economy)
Inflation	• Inflation measuring indices • Calculation of GDP deflator & CPI • Demand-Pull and Cost-Push Inflation
Money	• History of Money • Functions of Money • Fractional Reserve Banking
Monetary policy	• Analysis of Financial Market • Monetary Policy Instruments
Fiscal Policy	• Taxation Structures • Government Spending Multiplier • Tax Multiplier • Income Tax Calculation
Exchange rate	• Definition & Calculation • How exchange rate impacts import & exports • Balance of Payment
Unemployment	• Definition of terms related to unemployment. • Calculation of unemployment rate. • Four fundamental types of unemployment. • Keynes Full Employment Theory • Analysis of labor market through various unemployment theories.
Engineering Economics	• Definition • Single Payment factor • Single Payment factor (Inflation & Tax Adjusted) • Uniform Series factor. • Gradient Series factor
Industrial Economics	• Economics of industrial revolution • Economics of union: Bargaining theories of wages

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 microeconomics and macroeconomics.	√											
CO2	Apply the basics of economics in optimization of a firm's decision.	√											
CO3	Apply the concepts of consumer behavior, production process, cost of production and market structure to find the equilibrium that maximizes the welfare of the											√	

	society.												
CO4	Interpret the reasoning behind the economic policies of the government to develop the domestic economy as well as the relationship with the global economy.											√	

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	3	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	Short History of the Evolution of Economics Thought, Importance of Economics in Engineering, National Income, Circular Flow of National Income, Consumer theory, Inflation, Money, Theory of Production, Monetary policy.	CT-1	
5-7	Theory of Production, Fiscal Policy, Production Possibility Frontier, Demand & Supply, Exchange rate.		
8-9	Demand & Supply, Elasticity of Demand, Unemployment		
10-12	Elasticity of Demand, Cost Analysis, Engineering Economics, Analysis of Market Structure	CT-2	
13	Analysis of Market Structure	MID	
14	Industrial Economics		

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. Schaum's Outline of Microeconomics – McGraw-Hill by Dominick Salvatore (4rth Ed.)
2. Principle of Economics by N. Gregory Mankiw (8th Ed.)
3. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Ed.)
4. Introduction to Macroeconomics with Applications to Bangladesh Economy by Kazi Iqbal & Amin Bin Hasib
5. Schaum's Outline of Macroeconomics – McGraw-Hill by Eugene A. Diulio (3rd Ed.)
6. Macroeconomics by N. Gregory Mankiw (8th Ed.)
7. Schaum's Outline Engineering Economics – McGraw-Hill by Jose Sepulveda, William Souder & Byron Gottfried
8. Engineering Economics by Niall M. Fraser and Elizabeth M. Jewkes. (5th Ed.)

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	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Describe the fundamentals and concepts of procedural programming language.	1	C2			1	T
CO2	Analyse the fundamental principles, typical characteristics and mechanisms of a structured programming language.	2	C4			2	T, F, MT
CO3	Develop basic programming skills with respect to program design and development.	3	C6			2	F
CO4	Develop the communication skill by presenting topics on structured Programming Language.	10	C6			1	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

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 programming language.	√											
CO2	Analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.		√										
CO3	Develop basic programming skills with respect to program design and development.			√									
CO4	Develop the communication skill by presenting topics on structured Programming Language.										√		

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	3	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	42
Practical / Tutorial / Studio	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision	21

Assessment Preparations	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 (3^{rd} Edition) by Herbert Schidlt
2. Programming in Ansi C (6^{th} Edition) by E Balagurusamy
3. C: The Complete Reference (4^{th} Edition) by Herbert Schildt
4. C++: The Complete Reference (4^{th} 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	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Solve problems systematically using a structured logic approach, OOP and Arduino programming.	6	C3			1	T, ASG
CO2	Practically analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.	6	C4			2	T, ASG, Q
CO3	Construct or develop complete programs for simple to moderate problems individually.	9	C6			1	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

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.						√						
CO2	Practically analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.						√						
CO3	Construct or develop complete programs for simple to moderate problems individually.									√			

(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	3	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 Assessment (60%)	Lab participation and Report	30%

	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	Corresponding PO	Bloom's Taxonomy	KP	CA	CP	Assessment Methods
CO1	Understand Kirchoff's laws, network theorems, time domain	1	C2	1			Q, ASG, F

	analysis for RL & RC series circuit						
CO2	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	C1	1			Q, ASG, F
CO3	Understand concepts of Real, Reactive & apparent power and Power factor, 3-phase supply and star and delta connection and their relationships. Power measurement by wattmeter	2	C2	1			Q, ASG, F
CO4	Understand construction & working principle of 1-phase and 3-phase transformers Ideal and practical transformer and auto-transformer and its applications as well.	1	C2	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; 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 Kirchoff's laws, network theorems, time domain analysis for RL & RC series circuit	√											
CO2	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.		√										
CO3	Understand concepts of Real, Reactive & apparent power and Power factor, 3-phase supply and star and delta connection and their relationships. Power measurement by wattmeter		√										
CO4	Understand construction & working principle of 1-phase and 3-phase transformers Ideal and practical transformer and auto-transformer and its applications as well.	√											

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
CO2-PO2	3	Students will identify and analyze various problems related to AC circuits using principles of mathematics.
CO3-PO2	3	Students will identify, formulate and analyze various problems related to 3-phase power measurement using principles of mathematics.
CO4-PO1	3	Students will gain basic knowledge 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	
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.	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.		
Lec 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		**20**	

	CO 2	Class Observations/Assignments	**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	Corresponding PO	Bloom's Taxonomy	KP	CA	CP	Assessment 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	C2	1			R, Q, T

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	C2	1			R, Q, T
CO3	Analyze the general –and special-Purpose diode circuits.	1	C4	2			R, Q, T
CO4	Design biasing circuits for BJT	1	C6	1			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

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.	√											
CO2	Understand generation of rotating magnetic fields. Understand construction and working of 3-phase induction motor, 1-phase induction motor, DC motors& synchronous generators.	√											
CO3	Analyze the general –and special-Purpose diode circuits.	√											
CO4	Design biasing circuits for BJT	√											

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.
CO2-PO1	3	Students will gain basic knowledge about construction and principles of DC & AC electrical machines
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.	
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.	CT-3
Lec 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

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 De 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	C2				R, Q, T
CO2	Attaining the competency to reproduce the basic filters and to explain their characteristics.	10	C1				R, Q, T
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component	9	C1				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

Verification of KVL and KCL, verification of Thevenin's Theorem, familiarization with alternating current (ac) waves and study of RLC series circuit, different types of filters and its characteristics with different input frequency, study the diode characteristics and rectifier circuit, study of N-P-N CB (Common base) and CE (Common emitter) transistor characteristics, regulation of the Transformer in Various Loads, study the properties of Three-Phase Alternator in various loads, study the properties of DC Shunt Motor, study the properties of DC Separately Excited and Self-Excited Shunt Generator, study the properties of Squirrel-Cage Induction Motor.

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.									√			
CO2	Attaining the competency to reproduce the basic filters and to explain their characteristics.										√		
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component									√			

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications

C01-P09	**3**	Students will work in teams to construct the circuits
C02-PO10	**3**	Students will present and write technical reports
CO3-P09	**3**	Students will work in tems to perform various experimens

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
	Lab participation and Report	20%	CO 1	C3, C5

Continuous Assessment (40%)			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	**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 models for manufacturing and prototyping.	1	C3			1	R

CO2	Evaluate mechanical designs and select the proper access and materials for production.	3	C5			1	R
CO3	Evaluate computer aided design models and assemblies based on critical thinking and problem solving skills.	2	C5			1	ASG,R
CO4	Apply design principles and rationale in a realistic and original design project.	3	C3			1	ASG, R
CO5	Develop and present drawings and prototypes to the class.	3	C3			1	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, Solid works 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 models for manufacturing and prototyping.	√											
CO2	Evaluate mechanical designs and select the proper access and materials for production.			√									
CO3	Evaluate computer aided design models and assemblies based on critical thinking and problem solving skills.		√										
CO4	Apply design principles and rationale in a realistic and original design project.			√									
CO5	Develop and present drawings and prototypes to the class.			√									

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-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.
CO4-PO3	3	Students will apply design principles and rationale in a realistic and original design project.
CO5-PO3	3	Students will develop and present drawings and prototypes to the class.

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	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
Components		Grading		
Continuous Assessment (70%)	Weekly Reports	20%		CO 1
				CO 2
				CO 3
				CO 4
	Class Participation	40%		CO 1
				CO 2
				CO 3
				CO 4
	Presentation	10%		CO 4
Final Report		30%		CO 1
				CO 2
				CO 3
				CO 4
Total Marks		100%		

(CO = Course Outcome)

REFERENCE BOOKS

1. CAD/CAM Lab Manual Book by Sathish D

Spring Semester 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

Project Management and Finance course has been designed to understand the overlapping connection between engineering and management with financial matters through the study of Smart

Technologies, Project Management and financial matters in an organization which will equip with the skills to understand the application of computing technology in real-world situations.
OBJECTIVE
1. To identify and analyze practical problems commonly encountered in the computing industry and formulate solutions by considering financial aspects to some of the problems. 2. To gain the ability to continue professional development with an understanding of the legal issues, and to critically assess the codes of professional conduct for a computer professionals.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate different management and control frameworks and know their impact on the project management discipline.	1	C2	1			Q, ASG, F
CO2	Illustrate ability to analysis the impact of mechanical engineering solutions globally, in terms economic, societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6	C3	2			Q, ASG, F
CO3	Apply management software for planning and managing information technology projects.	5	C3	2			Q, F, CS
CO4	Apply modern engineering techniques, skills, and management principles to do work as a member and leader in a team, to manage projects in multidisciplinary environments.	11	C3	1			Q, F, CS, Pr
CO5	Demonstrate different management and control frameworks and know their impact on the project management discipline.	10	C3	2			Q, F, CS
CO5	Develop communication skills by presenting topics on project management and finance.	10	C3	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

Engineering Management: Principles of management; **Introduction to Project Management**: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Risk Management; **MIS**: Introduction, Decision Support Systems, MIS in decision making, Concept of Invention, Innovation, and Entrepreneurship; **Cost Management**: elements of cost of products, allocation of overhead costs, marginal costing, standard costing, cost planning and control, budget and budgetary control; **Development and planning process**: annual development plan, National budget; **Accounting in Action:** Meaning & Definition Of Accounting, Users And Uses Of Accounting, Why Ethics Is A Fundamental Accounting Concept, Accounting Standards And The Measurement Principles- Monetary Unit Assumption And The Economic Entity Assumption, Accounting Equation, The Effects Of Business Transactions On The Accounting Equation, The Five Financial Statements And How They Are Prepared, Ethics In Accounting, Engineering Accounting; **Financial management**: objectives, strategy, financing, performance analysis of the enterprise, investment appraisal, criteria of investment; **Marketing Management:** Concepts, strategy, sales promotion, patent laws; **Technology Management**: Management of innovation and changes, technology life cycle, Case studies;

CO-PO MAPPING

No.	**Course Outcome**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Demonstrate different management and control frameworks and know their impact on the project management discipline.	√											
CO2	Illustrate ability to analysis the impact of mechanical engineering solutions globally, in terms economic, societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.						√						
CO3	Apply management software to help plan for planning and managing information technology projects.					√							
CO4	Apply modern engineering techniques, skills, and management principles to do work as a member and leader in a team, to manage projects in multidisciplinary environments.										√	√	

CO1	Demonstrate different management and control frameworks and know their impact on the project management discipline.										√		
CO5	Develop communication skills by presenting topics on project management and finance.									√			

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	High	Demonstrate different management and control frameworks and know their impact on the project management discipline, we need knowledge of science and engineering.
CO2-PO6	3High	Illustrate ability to analysis the impact of mechanical engineering solutions globally, in terms economic, societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
CO3-PO5	High	Use the techniques, skills, and modern engineering tools in order to use management software to help plan and manage information technology projects.
CO4-PO11	High	Apply modern engineering tools, engineering techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multidisciplinary environments
CO5-PO10	3Low	Develop strong communication skills through a presentation on the selective topics from the course taught.

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	Lecture	Topics	Assessment Methods
1	Lec 1 Lec 2	Engineering Management: Principles of management, Introduction to Project Management	Class Test 1
2	Lec 3 Lec 4	Project Integration Management; Project Scope Management; Project Time Management; Project Cost Management	

3	Lec 5 Lec 6	Project Quality Management; Project Human Resource Management; Project Risk Management	
4	Lec 7 Lec 8	MIS: Introduction, Decision Support Systems, MIS in decision making.	
5	Lec 9 Lec 10	Concept of Invention, Innovation, and Entrepreneurship; Cost management elements of cost of products, allocation of overhead costs	Class Test 2
6	Lec 11 Lec 12	Marginal costing, Standard costing; Cost planning and control, budget and budgetary control	
7	Lec 13 Lec 14	Development and planning process; annual development plan; National budget	
8	Lec 15 Lec 16	Meaning & Definition Of Accounting, Users And Uses Of Accounting; Accounting Standards And The Measurement Principles	
9	Lec 17 Lec 18	Monetary Unit Assumption And The Economic Entity Assumption, Accounting Equation, The Effects Of Business Transactions On The Accounting Equation	Mid Term Exam
10	Lec 19 Lec 20	The Five Financial Statements And How They Are Prepared, Debits And Credits, Business Transactions, The Basic Steps In The Recording Process- Journal, Ledger, T Account,Trial Balance	
11	Lec 21 Lec 22	Financial management : objectives, strategy, financing, performance analysis of enterprise	
12	Lec 23 Lec 24	Financial management : investment appraisal, criteria of investment;	
13	Lec 25 Lec 26	Marketing Management: Concepts, strategy, sales promotion, patent laws.	
14	Lec 27 Lec 28	Technology Management; Management of innovation and changes, technology life cycle, Case studies.	

ASSESSMENT STRATEGY

Components		**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (40%)	Test 1-2		CO1	C1-C3
			CO4	C3
	Class Participation	5%	CO5	A2
	Mid term	15%	CO2	C3-C4
Final Exam		60%	CO1	C1-C3, P2
			CO2	C3-C4
			CO3	C4
			CO4	C3-C4

Total Marks	100%	

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

REFERENCE BOOKS

1. Project Management for Engineering, Business and Technology (5th) - John M. Nicholas, Herman Steyn,
2. Principles of Project Finance (1st) - E.R. Yescom

1. Project Management for Engineering, Business and Technology (5th) - John M. Nicholas, Herman Steyn,
2. Principles of Project Finance (1st) - E.R. Yescom
3. The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer (1st, McGraw-Hill Education, 2004) - J. Liker

Spring Semester L-4, T-II

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

This course motivates engineers to perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct and managing resources and decisions effectively. 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 behavior. It elevates the profession, raises future standards, and imprints on individual moral mindsets and behaviors.

OBJECTIVE

1. To develop a firm ethical base.
2. To gain the ability to continue professional development with an understanding of the legal issues, and to critically assess the codes of professional conduct for computer professionals.

3. To identify and analyze practical legal problems commonly encountered in the computing industry.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Demonstrate the theoretical aspects of ethics and moral philosophy in professional fields.	1	C3	1			Q, ASG, F
CO2	Identify practical and legal problems commonly encountered by engineers in their professional industry.	2	C1	2			Q, ASG, F
CO3	Apply knowledge of ethics them for solving engineering problems.	8	C3	2			Q, F, CS
CO4	Develop communication skills by presenting topics on Engineering Ethics and Moral Philosophy.	10	C3	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

Engineering Ethics: Introduction to Ethics; Theories of Ethics; Principles of Engineering Ethics; Ethical expectation: Employers and employees, Inter-professional relationship,
Standards and codes: Fundamental Canons, NSPE codes, IEEE codes of conduct, ACM codes; Institutionalization of ethical conduct. Ethical Dilemmas, Choices (Whistleblowing),
Computer Ethics: Computer Crime and Cyber Security, Privacy and Confidentiality issues in CSE, Legal Framework in CSE-Copyright laws, ICT Act, Right To Information (RTI), Patents, and Royalty etc. Ethical Challenges for CSE Engineers with the Advancement of Technology;
Case studies related to ethical issues in ICT and other Engineering disciplines.
Introduction to **Philosophy of Engineering**, metaphysics, epistemology, axiology, and logic.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate the theoretical aspects of ethics and moral philosophy in professional fields.	√											

CO2	Identify practical and legal problems commonly encountered by engineers in their professional industry.		√										
CO3	Apply knowledge of ethics them for solving engineering problems.								√				
CO4	Develop communication skills by presenting topics on Engineering Ethics and Moral Philosophy.										√		

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Demonstrate the theoretical aspects of ethics and moral philosophy in professional fields.
CO2-PO2	3	Analyze & identify practical and legal problems commonly encountered by engineers in their professional industry.
CO3-PO8	3	Apply knowledge of ethics them for solving engineering problems.
CO4-PO10	3	Develop communication skills through participating in presentations etc.

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

Lecture and Discussion, Collaborative Method, Problem-Based Method, Case Study

COURSE SCHEDULE

Week	**Lecture**	**Topics**	**Assessment**
1	**Lec 1**	Introduction to Ethics	
	Lec 2	**Chapter 1 - Engineers: Professionals for the Human Good**	
2	**Lec 3**	Public Good, Well-being, Prohibited Actions, Aspirational Ethics	**Case Study#1**
	Lec 4	**Chapter 2 - A Practical Ethics Toolkit**	**Class Test 1**
3	**Lec 5**	Ethical Analysis, Factual Issues, Line Drawing, Conflicting Values, Moral Theories, Approaches	
	Lec 6	**Chapter 3 – Responsibility in Engineering**	

4	**Lec 7**	Engineering Standards, Legal Liability, Standard of Practices	**Case Study#2**
	Lec 8	Impediments to Responsibility	
5	**Lec 9**	**Chapter 4- Engineers in Organization**	
	Lec 10	Engineers and Managers, Management Decisions	**Class Test 2**
6	**Lec 11**	Responsible Dissent, Whistleblowing and Loyalty	**Case Study#3**
	Lec 12	**Chapter 5 – Trust and Reliability**	
7	**Lec 13**	Forms of Dishonesty, Intellectual Property	
	Lec 14	Expert Witnessing, Confidentiality	**Midterm Exam**
8	**Lec 15**	**Chapter 6 – Engineer's Responsibility to Access and Manage Risk**	
	Lec 16	Risk, Liability, Critical Attitude	**Case Study#4**
9	**Lec 17**	Approaches, Communication	
	Lec 18	**Chapter 7 – Engineering and the Environment**	
10	**Lec 19**	Environmental Movement, Law and Policy, Life Cycle Analysis, Sustainable Development and Engineering Practices, 3P Program	**Case Study#5**
	Lec 20	**Chapter 8 – Engineering in the Global Context**	
11	**Lec 21**	Globalization, International Professionalism and Ethics, Ethical Resources	
	Lec 22	Professional Organization: ACM Standards and Codes, NSPE codes , IEEE codes of conduct	**Class Test 3**
12	**Lec 23**	Copyright laws, Computer Crime, Cyber Security Privacy, Confidentiality Issues	**Case Study#6**
	Lec 24	Metaphysics, Epistemology, Axiology and logic	
13	**Lec 25**	**Chapter 9 – New Horizon in Engineering**	
	Lec 26	Environmental Development and Sustainability	**Class Test 4**
14	**Lec 27**	Ethical Dilemmas, Ethical Challenges for CSE Engineers	
	Lec 28	**Review and Closing**	

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. Engineering Ethics Concepts and Cases (6^{th} Edition) – Charles E. Harris
2. An Outline of Philosophy by Dr. Abdul Matin
3. An Introduction to Ethics by William Lillie

Fall Semester L-4, T-2

COURSE INFORMATION			
Course Code Course Title	: **GESL 407** : **Environment, Sustainability and Law**	Lecture Contact Hours Credit Hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Although the electricity is now an indispensable 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	Corresponding 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	T, F
CO2	Contrast improvement of electrical technology with the impact on environment, human beings and global climates.	7	C5			1	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	C2			1	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	C3			1	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.				√								
CO2	**Contrast** improvement of electrical technology with the impact on environment, human beings and global climates.							√					
CO3	**Discuss** safety concepts, safety and risk management, proactive management techniques for safety issue, safety standard and regulations for engineering.						√						
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.												√

(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	28
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	14
Preparation for final examination	14
Formal Assessment	
Continuous Assessment	2
Mid-Term	1
Final Examination	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

	CO	Blooms Taxonomy	

Components		Grading		
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
Shop 132	Workshop Technology Sessional	1-*	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-II	NSE	1.5	0.75
ME 142	Workshop Sessional	1-*	EWCE	3.00	1.5
ME 176	Workshop Practice	1-I	PME	3.0	1.5
ME 180	Basic Engineering Drawing and CAD	1-*	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-*

COURSE INFORMATION			
Course Code	**Shop 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. To 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	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.	3	C3			1	R, Q, LT
CO2	Develop practical skills by performing different manufacturing processes individually and/or in a team.	9	C1, C3			1	R, Q, LT

CO3	Justify results obtained in the form of technical reports, projects and presentations.	10	C4			1	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 patterns 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) Manufacturing machine components by using a Milling Machine
11) Manufacturing machine components by Drill Machine.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.			√									
CO2	Develop practical skills by performing different manufacturing									√			

	processes individually and/or in a team.												
CO3	Justify results obtained in the form of technical reports, projects and presentations.									√			

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO3	**3**	In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required.
CO2-PO9	**3**	In order to perform the experiments, the knowledge of engineering fundamentals would be required
CO2-PO9	**2**	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO10	**3**	For performing the experiments, safety precautions are very essential 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	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.

***Details of program outcome and grading policy are attached as Annex A and Annex B.

Spring/Fall Semester L-1, T-*

COURSE INFORMATION			
Course Code Course Title	**ME 122** **Fundamentals of Mechanical Engineering and Robotics Sessional**	Lecture Contact Hours Credit Hours	**: 4.00** **: 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	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	C2, P3			4,5	Q, ASG, F, R
CO4	Demonstrate basic knowledge about power transferring elements and components of robot.	1	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	11	12
CO1	Have theoretical and practical knowledge of vehicle components and control	√											
CO2	Have introductory theoretical and practical knowledge of power plant and their main components.	√											
CO3	Demonstrate fundamental ideas about heat transferring devices	√											
CO4	Demonstrate basic knowledge about power transferring elements and components of robot.	√											

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		
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.		
Class 19 - 24	Pump, Compressor, Valve – Centrifugal pump, Positive displacement pump, Hydraulic and pneumatic actuator, Control valve (Pressure, flow and direction control valve)		
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.		

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	Identify various sources of energy	1	C1			3	Q, ASG, F
CO2	Explain internal combustion engines, turbines, refrigeration and air conditioning system, different materials, fluid machineries etc. as well as Robotics, MEMs etc	1	C2, C3			4	Q, ASG, F
CO3	Explain various engineering measurement units and their	1	C3			4	Q, ASG, F

	conversion for solving problems using various charts						

(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	Identify various sources of energy	√											
CO2	Explain internal combustion engines, turbines, refrigeration and air conditioning system, different materials, fluid machineries etc. as well as Robotics, MEMs etc	√											
CO3	Explain various engineering measurement units and their conversion for solving problems using various charts	√											

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 non-renewable 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	Compute the various properties of fuels	1	C5, P4			4,8	ASG, R, F, Pr
CO2	Identify various component of engine and conduct performance analysis	1	C5, P4			4	ASG, R, F, Pr

CO3	Compute performance of fluid machineries like pump and turbine	1	C5, P4			4	ASG, R, F, Pr
CO4	Compute psychrometric properties of air and performance of refrigeration system	1	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	Compute the various properties of fuels	√											
CO2	Identify various component of engine and conduct performance analysis	√											
CO3	Compute performance of fluid machineries like pump and turbine	√											
CO4	Compute psychrometric properties of air and performance of refrigeration system	√											

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	**2**	Students will be able to compute the various properties of fuels.
CO2-PO1	**3**	In order to evaluate engine performance, the knowledge of natural science and mathematics would be required.
CO3-PO1	**3**	In order to evaluate pump performance, the knowledge of natural science and mathematics would be required.
CO4-PO1	**3**	In order to evaluate psychrometric properties of air and refrigeration system, the knowledge of natural science and mathematics 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	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	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

1. Lab Handbook
2. Introduction to Thermal Engineering – R. S. Khurmi

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	**Identify** the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.	3	P4			K5	R, Q, T , ASG, F
CO2	**Develop** practical skills by performing different manufacturing processes individually and/or in a team.	9	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
CO 1	**Identify** the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.			√									
CO 2	**Develop** practical skills by performing different manufacturing processes individually and/or in a team.									√			

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 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
CO 1	Demonstrate the use of Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine.	5	P3			K6	R, Q, T, ASG, F

CO 2	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 Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate the use of Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine.					√							
CO2	Analyze a job for CNC Milling machine to manufacture a part automatically by using a CAD drawing.		√										

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical Total	 07 14 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	C2	1			Q, ASG, F
CO2	Demonstrate use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems	2	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	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).	√											
CO2	Demonstrate use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems		√										
CO3	Apply scalar and vector analytical techniques for analyzing forces in statically determinate structures					√							
CO4	Evaluate equilibrium of particles and bodies in real world problems.		√										

(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

a. 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	**ME 180**	Lecture Contact Hours	**3.00**
Course Title	**Basic Engineering Drawing**	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	Demonstrate proficiency in using drawing instruments for sketches.	5	C3, A3			4	
CO2	Analyze the 2D and 3D views for various sample objects individually and/or in a team.	9	C3, A3			4,6	

CO3	Justify sketches obtained in the form of drawing reports, and projects.	10	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	Demonstrate proficiency in using drawing instruments for sketches.					√							
CO2	Analyze the 2D and 3D views for various sample objects individually and/or in a team.									√			
CO3	Justify sketches obtained in the form of drawing reports, and projects.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO5	**3**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO9	**2**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO9	**3**	Students will use AutoCAD / Solid Works software
CO3-PO10	**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	
Week-2	First and third angle projections	
Week-3	Orthographic drawings	
Week-4	Orthographic drawings	**Mid-term**
Week-5	Isometric views	
Week-6	Isometric views	
Week-7	Mid-term Exam	
Week-8	Sectional views and conventional practices	
Week-9	Solid Works Practice – Orthographic Drawing	
Week-10	Solid Works Practice – Orthographic Drawing	**Final Exam**
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

Spring/Fall Semester L-2, T-1

COURSE INFORMATION

Course Code	**ME 253**	Lecture Contact Hours	**3.00**
Course Title	**Engineering Mechanics**	Credit Hours	**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 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 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).	√											
CO2	Demonstrate use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems		√										

CO3	Apply scalar and vector analytical techniques for analyzing forces in statically determinate structures					√							
CO4	Evaluate equilibrium of particles and bodies in real world problems.		√										

(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	Demonstrate practical understanding on various laws used in engineering mechanics	1	C4, P3			3	Q, ASG, R, F
CO2	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	√											
CO2	Be able to demonstrate practical knowledge on various systems taught in the theory class		√										

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	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

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-*

COURSE INFORMATION

Course Code	**ME 142**	Lecture Contact Hours	**: 3.00**
Course Title	**Workshop Sessional**	Credit Hours	**: 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	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.	3	C3			1	R, Q, LT
CO2	Develop practical skills by performing different manufacturing processes individually and/or in a team.	9	C1, C3			1	R, Q, LT
CO3	Justify results obtained in the form of technical reports, projects and presentations	10	C4			1	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	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.			√									
CO2	Develop practical skills by performing different manufacturing processes individually and/or in a team.									√			
CO3	Justify results obtained in the form of technical reports, projects and presentations										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**

CO1-PO3	**3**	In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required.
CO2-PO9	**3**	In order to perform the experiments, the knowledge of engineering fundamentals would be required
CO2-PO9	**2**	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO10	**3**	For performing the experiments, safety precautions are very essential in this laboratory.

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	**ME 176**	Lecture Contact Hours	**3.00**
Course Title	**Workshop Practice**	Credit Hours	**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	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.	3	C3			1	R, Q, LT
CO2	Develop practical skills by performing different manufacturing processes individually and/or in a team.	9	C1, C3			1	R, Q, LT
CO3	Justify results obtained in the form of technical reports, projects and presentations	10	C4			1	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	Identify the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.			√									
CO2	Develop practical skills by performing different manufacturing processes individually and/or in a team.									√			

CO3	Justify results obtained in the form of technical reports, projects and presentations										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO3	**3**	In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required.
CO2-PO9	**3**	In order to perform the experiments, the knowledge of engineering fundamentals would be required
CO2-PO9	**2**	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO10	**3**	For performing the experiments, safety precautions are very essential in this laboratory.

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-*

COURSE INFORMATION			
Course Code	**ME 180**	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	Demonstrate proficiency in using drawing instruments for sketches.	5	C3, A3			4	T, Q
CO2	Analyze the 2D and 3D views for various sample objects individually and/or in a team.	9	C3, A3			4,6	T, Q
CO3	Justify sketches obtained in the form of drawing reports, and projects.	10	C3, A3			4	T, 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

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	Demonstrate proficiency in using drawing instruments for sketches.					√							
CO2	Analyze the 2D and 3D views for various sample objects individually and/or in a team.									√			
CO3	Justify sketches obtained in the form of drawing reports, and projects.										√		

Justification for CO-PO mapping:

Mapping	**Corresponding Level of matching**	**Justifications**
CO1-PO5	**3**	In order to draw engineering drawing of various objects, the knowledge of practice in mechanical Engineering discipline would be required.
CO2-PO9	**3**	Students will use AutoCAD / Solid Works software
CO3-PO10	**3**	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	 10 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

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	Lab participation and Report	**20**	
1,2,3	Presentation	**20**	
	Exam		
1,2,3	Lab Test 1 & 2	**30**	
1,2,3	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 behavior 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. To introduce fundamental aspects of fluid flow behavior.
2. 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	Recognize the main terminology, concepts and techniques applicable to Fluid Mechanics.	1	C1, C2, C3	1, 4, 6			Q, ASG, F
CO2	Demonstrate the ability to use fundamental equations related to fluids in solving fluid flow problems.	1	C2, C3	2, 5, 6			Q, ASG, F
CO3	Explain various fluid machineries along with their performance parameters.	1	C2, C3, C4	1,3	1,2		Q, F, CS
CO4	Solve different problems related to fluid machineries.	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
CO1	Recognize the main terminology, concepts and techniques applicable to Fluid Mechanics	√						
CO2	Demonstrate the ability to use fundamental equations related to fluids in solving fluid flow problems	√						
CO3	Explain various fluid machineries along with their performance parameters	√						
CO4	Solve different problems related to fluid machineries.		√					

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO1	3	Students will be able to know about the main terminology, concepts and Fluid Mechanics
CO2-PO1	3	Students will develop the ability to use fundamental equations related to flui problems
CO3-PO1	2	Students will be able to determine the performance of a hydraulic or turbo ma different system parameters.
CO4-PO2	3	Students will also have in depth knowledge about drawing schematic and u 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, Su tension and capillarity Lecture-2, 3: Vapor pressure, Manometers and other pressure measuring devices
Week-2	Lecture-4,5 :**Fluid Statics**: Pressure at a point, pressure gradient, Pressure on flat and curved surfaces immersed in fluids, center of pressure Lecture-6 :Buoyancy and flotation Lecture-6 :Buoyancy and flotation
Week-3	Lecture-7 :Metacentre and metacentric height Lecture-8 :Stability of submerged and floating bodies Lecture-9 :**Kinematics of Fluid Flow**: Velocity and acceleration of fluid particles, types of fluid flow, systems and control volumes
Week-4	Lecture-10 :One and two dimensional flow; continuity equation Lecture-11, 12 :Eulers‘ equation and Bernoulli‘s‘ equation
Week-5	Lecture-13, 14, 15: Energy equation with or without losses, comparison of energy equation with Bernoulli‘s equation, kinetic energy correction factor
Week-6	Lecture-16: Flow measuring devices Lecture-17, 18 :Flow through sharp edged orifice, the pitot tube, the venturi-meter, the flow nozzle and orifice meter
Week-7	Lecture-19, 20, 21: **Fluid Machinery**: Introduction to roto-dynamic and positive displacement machinery; Euler‘s pump turbine equation. Degrees of reaction
Week -8	Lecture-22: Impulse and reaction turbine classification Lecture-23, 24: performance of Pelton wheel
Week-9	Lecture-25, 26, 27: Francis turbine and Kaplan turbine

Week-10	Lecture-28, 29: Characteristic curves, governing of turbines Lecture-30: selections and model test of turbine
Week-11	Lecture-31: **Reciprocating Pumps**: Working principle of reciprocating pump Lecture-32: Types of reciprocating pumps Lecture-33: Work done by reciprocating pump
Week-12	Lecture-34: Co-efficient of discharge, Slip Lecture-35: Cavitation of reciprocating pumps Lecture-36: Effect of acceleration of piston on velocity and pressure in the suction and delivery pipes
Week-13	Lecture-37: **Centrifugal Pumps**: Work done and efficiency of centrifugal pumps, Advantage over reciprocating pumps, Types of centrifugal pumps Lecture-38: Characteristics curves. Priming Lecture-39: Troubles and remedies, Specific speed
Week-14	Lecture-40: Pumps in series and in parallel Lecture-41: Multistage pumps Lecture-42: Turbine pump, Selection of pumps

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**	

(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. To introduce the principles of fluid mechanics of mechanical systems 2. To illustrate practical engineering applications of these principles in relation to simple fluid systems 3. 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	Corresponding PO	Bloom‘s Taxonomy	CP	CA	KP	Assessment Methods
CO1	Demonstrate proficiency in using different types of equipment for analyzing the performance parameters of various fluid flow device	1	C3			1	R, Q, LT

CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental dat	1	C2			1	R, Q, LT
CO3	Demonstrate the ability of writing and presenting the information collected from experiments	2	C5			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. Verification of Bernoulli's equation
2. Determination of coefficient of discharge of orifice meter and venturi meter
3. Determination of head loss due to friction
4. Study of the characteristics of centrifugal pump
5. 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	Demonstrate proficiency in using different types of equipment for analyzing the performance parameters of various fluid flow device					√							
CO2	Perform experiments individually and collaboratively within a team by collecting and interpreting experimental data									√			
CO3	Demonstrate the ability of writing and presenting the information collected from experiments										√		

Justification for CO-PO mapping:

Mapping	Corresponding Level of matching	Justifications
CO1-PO5	**3**	In order to identify the basics of fluid mechanics, the knowledge of engineering fundamental would be required.
CO2-PO9	**3**	In order to perform the experiments, practical engineering applications of these principles in relation to simple fluid systems knowledge would be required
CO3-PO10	**2**	In order to solve and design fluid engineering system, 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	Introductory class
Week-2	
Week-3	Verification of Bernoulli’s equation
Week-4	

Week-5	Determination of coefficient of discharge of orifice meter and venturi meter

Week-6	.
Week-7	Determination of head loss due to friction
Week-8	
Week-9	Study of the characteristics of centrifugal pump
Week-10	
Week-11	Study of propeller turbine characteristics
Week-12	
Week-13	Quiz and 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

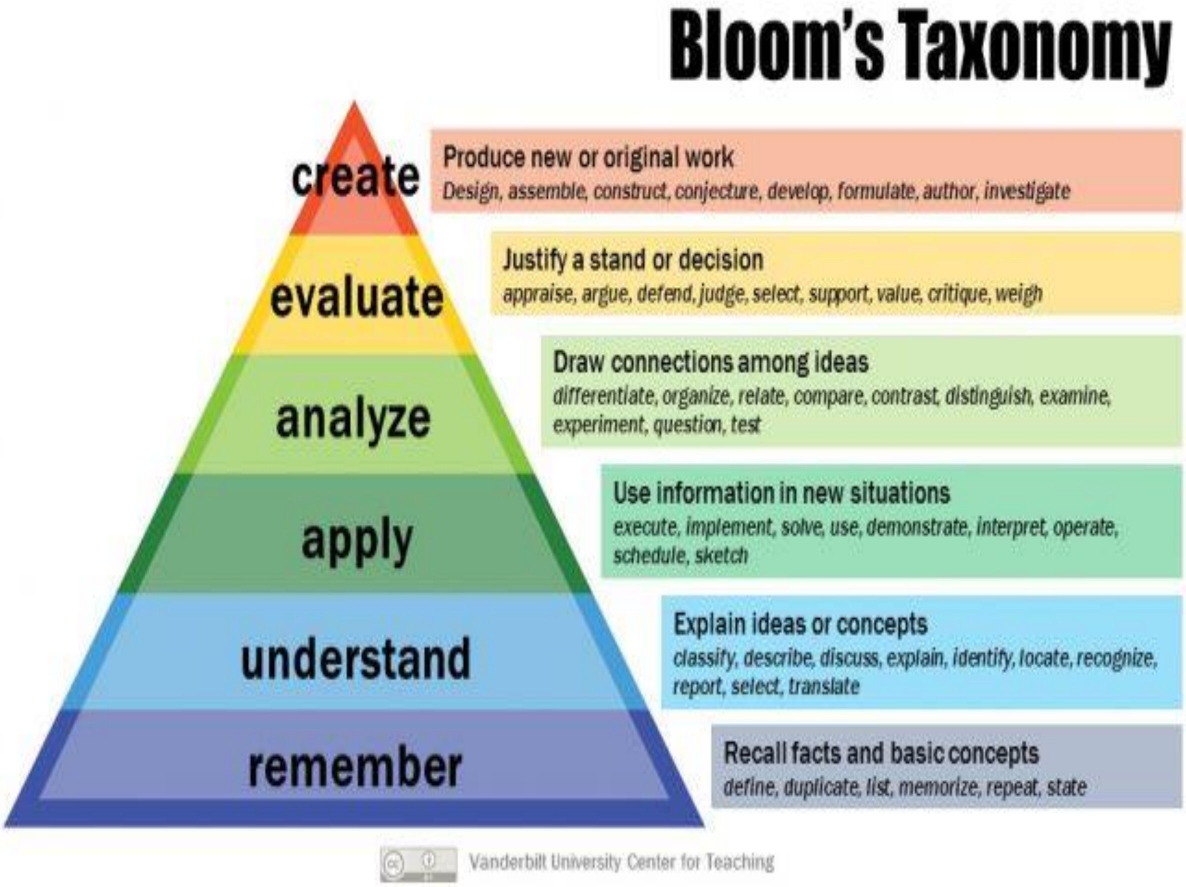
2. A Textbook of Fluid Mechanics and Hydraulic Machines by R. K. Bansal

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



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