Rules, Regulations & Syllabus
for the Degree of
B. Sc. in Mechanical Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

Effective for students admitted in Summer Semester 2021 (13^{th} batch) and onwards

August 2021

Department of Mechanical Engineering

Faculty of Mechanical Engineering

Bangladesh Army University of Science and Technology

Saidpur Cantonment, Saidpur 5311.

https://www.baust.edu.bd/departments/index/mechanical-engineering-me

SYLLABUS REVIEW COMMITTEE

DEPARTMENT OF MECHANICAL ENGINEERING, BAUST

The undergraduate course curriculum for the B. Sc. in Mechanical Engineering degree offered by the department of Mechanical Engineering (ME) of Bangladesh Army University of Science and Technology (BAUST) has been reviewed by the committee as mentioned below and will be implemented from Level-1 Term-I of ME 13th Batch.

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GENERAL INFORMATION

1.1 Introduction

With a view to meet the increasing demand for the development and dissemination of engineering and technological know-how, Bangladesh Armed Forces established the Bangladesh Army University of Science and Technology (BAUST), Saidpur that promises to provide facilities for higher technical education for the students from home and abroad. BAUST started its journey on 15 February 2015 by offering four-year bachelor's degrees on Computer Science and Engineering (CSE), Electrical and Electronic Engineering (EEE) and Mechanical Engineering (ME).

1.2 Aim

The aim of BAUST is to conduct undergraduate courses in various disciplines of Engineering according to syllabi leading to Bachelor of Science in Engineering (B. Sc. Engineering) for the students from home and abroad.

1.3 Objectives

The objectives of BAUST are:

1.3.1 To offer the following course with a view to meeting the increasing demands in the country:

Four-year bachelor's courses in

- ✓ Electrical and Electronic Engineering (EEE)
- ✓ Computer Science and Engineering (CSE)
- ✓ Mechanical Engineering (ME)
- ✓ Industrial and Production Engineering (IPE)
- ✓ Civil Engineering (CE)
- ✓ Business Administration
- ✓ English

1.3.2 To produce skilled, well disciplined, self-motivated and dedicated engineers and computer professionals.

1.3.3 To make provisions for research and development and dissemination of knowledge in appropriate fields of science and technology.

1.4 Mission and Vision of BAUST

The mission & vision of BAUST are given below-

1.4.1 Mission

1. Providing state of the art education to achieve disciplinary knowledge, problem solving skill, ability to lead and communication skill.
2. Providing a collaborative environment enabling free exchange of ideas to flourish research, creativity and innovation.
3. To remain current & responsive to the diverse needs of society and transform in a sustainable way.

1.4.2 Vision

The University aspires to transform into a center of excellence in Science, Engineering and Technology programs by providing innovative, multi-disciplinary courses and extensive research facilities to the young generation of the country and beyond. It endeavors to make the University a hub of knowledge and be recognized as a leading university of the country.

1.5 Location

BAUST is located at Saidpur Cantonment, Saidpur, Nilphamari, a hub of knowledge for Bangladesh Armed Forces. Saidpur Cantonment is a small, calm and quiet education village and free from all possible pollution of a city life. Whistling birds on the tree branches and overall bounty of nature adds to the already existing splendid academic atmosphere.

1.6 Eligibility of Students for BAUST Admission

The students must fulfill the following requirements:

a. **Bangladeshi Students:**

   Bangladeshi applicants who have passed HSC/Alim or equivalent or A level or equivalent examinations with at least GPA 2.00 in Mathematics (as a compulsory or an additional subject) are eligible to apply, if he/she fulfills the following conditions:

   i. HSC/Alim or equivalent examination in Science Group with Mathematics, Physics and Chemistry with minimum GPA 3.0 (with additional subject) and SSC/Dakhil or equivalent with minimum GPA 3.0. The total GPA of SSC/Dakhil or equivalent and HSC/Alim or equivalent should be at least GPA 7.0 (with additional subjects).

   ii. GCE O Level: Minimum C Grade in five subjects including, Mathematics, Physics and Chemistry (in the scale of A=5, B=4, C=3, D=2 and E=1). A Level: Minimum C Grade in 2 subjects including Mathematics, Physics/ Chemistry. The sum total of GPA in GCE A and O level should be 6. The candidates with E grade in any subject will not be considered.

   iii. Diploma holders in relevant subjects are eligible to apply with at least a GPA of 3.0. A Diploma holder may apply for a subject in B.Sc. Engineering without having the relevant Diploma background but from science discipline. In that case the Diploma holder will need a minimum GPA of 3.25.

iv. Applicants who have passed HSC or equivalent in the last three (3) consecutive years are eligible to apply.

v. Applicants who have obtained a total GPA of 9.0 or more in HSC/Alim or equivalent and SSC/Dakhil or equivalent are eligible for direct admission (without Admission Test). Direct admission facility may also be offered to the Diploma holders having minimum GPA 3.50 in relevant subjects (or minimum GPA 3.75 for a Diploma holder without having the relevant diploma background from science discipline) and at least GPA 3.00 in SSC/Dakhil or equivalent level.

Note:

a) 3% of the total seats are reserved for the children of Freedom Fighters and tuition fee waiver.
b) 10% Tuition Fee waiver will be applicable for the Children/Spouse of Armed Forces personnel.
c) 3% of the total seats are reserved for Remote and Undeveloped Areas.

b. Foreign Students:

i. Foreign nationals who have successfully passed in their Secondary School and Higher Secondary or their equivalent examination (after 12 years of schooling) having at least 50% marks from foreign educational institutes.

ii. Have English as medium of instruction or IELTS-5.0/TOEFL-79 on IBT.

iii. Apply within two years from the date of completion of the standard twelve years Course curriculum.

iv. Candidates for engineering programs must have Mathematics, Physics and Chemistry in Secondary or Higher Secondary or equivalent examination.

Candidates having contagious and communicable diseases or cardiac problems are not eligible for admission.

1.7 Number of Seats

The number of seats per department is given in following tables.

Name of the Department	Number of Seats
Electrical and Electronic Engineering	100
Computer Science and Engineering	100
Mechanical Engineering	100
Industrial Production Engineering	100
Civil Engineering	100
Business Administration	100
English	100

1.8 Selection Procedure

Applicants eligible for Admission Test will be selected on the basis of total GPA of SSC & HSC or ‘O’&`A’ Level results. Name of the eligible applicants will be published in the University website (www.baust.edu.bd) and Notice Board.

1.9 Syllabus for Admission Test

A Written and MCQ test will be conducted on Mathematics, Physics, Chemistry and English (Comprehension and Functional) as per the syllabus of HSC. The test will be of 100 marks and 2 hours duration. The distribution of marks is given below:

Sl.	Subjects	Marks
1.	Mathematics	40
2.	Physics	30
3.	Chemistry	20
4.	English	10
	Total	100

1.10 Final Selection

Students will be selected on the basis of results of the admission test. Merit List will be based on the basis of marks as shown below:

Details	Percentage
Descriptive and MCQ Admission Test	100%

1.11 Admission Procedure

a) <u>Bangladeshi Students</u>: The selected candidates must collect Admission Form from Admission Section of Registrar Office and complete admission and registration formalities within the given time frame with BAUST Admission Section and respective Faculty by paying prescribed fees. The following rules will apply in this regard:

i. Candidate failing to complete admission formalities within the prescribed date and time, his/ her selection will be considered as cancelled.

ii. Student who fails to attend the class without any permission from concerned authority within four weeks of the commencement of 1^{st} semester class, his/her admission will be considered as cancelled.

In such cases, the vacancies will be filled up by the candidates in the first merit list, other merit list(s) may be published from the waiting candidates for admission if required, who will have to follow the same procedure for admission.

b) <u>Foreign Students</u>: A maximum of 20 (twenty) students from a single country (per Faculty) and a maximum of 10 (ten) students in a single department shall be allowed.

i. Please go through the **"Information for International Students"** available on BAUST website (www.baust.edu.bd).

ii. Please download the prescribed application form from the link or apply online.

iii. Fill it up properly; incomplete application will not be processed. A separate sheet can be attached if the space provided is found insufficient.
The documents that need to be attached with the application are:
   a) All academic records (certificates).
   b) Marks certificate of the last public examination passed.
   c) Photo (Passport size; taken within 3 months).
   d) A copy of the detailed syllabus of the last public examination passed.
   e) A copy of valid passport showing the name, photo, nationality and the passport number of the applicant.
   f) Any other document supporting the requirements (if there is any) of the faculty concerned.
   g) NOC/PCF.
   h) Character Certificate.
   i) Medical Certificate.

v. Send the signed application form along with all necessary documents by post to the following address, and also send a scanned copy of the whole set of application to the email <admission@baust.edu.bd>

Room No. 104 (Admission Office)
Administration Building
BAUST
Saidpur – 5310, Bangladesh
Tel.: +88-01769-675554
Email: admission@baust.edu.bd

vi. **The International Student's Admission Office** will scrutinize all applications and forward all the valid applications to the competent authority for evaluation. During the evaluation process an applicant may be asked to submit further documents if necessary. Only short-listed applicants will be notified through their e-mails for further processing of their applications.

vii. Admission will be finalized after receiving the NOC/Clearance certificate from the competent authority of Bangladesh Government, and after verifying original academic records and transcripts.

c) **Cancellation of Admission:** The cancellation of admission is not permissible. However, on special circumstances, such cancellation may be considered as per the following guidelines:

Ser	**Description**	**Refundable**
1.	Before commencement of the classes	100% of the Establishment Fee and 100% of the Semester Fee
2.	Within the 1^{st} Week of commencement of the classes	The Caution money, 75% of the Establishment Fee and the Semester Fee.
3.	Within 2 weeks of commencement of the classes	The Caution money,50% of the Establishment Fee and the Semester Fee.
4.	After 2 weeks of commencement of the classes	Caution Money Only

1.12 Medical Checkup

Candidates selected through above procedure will have to go for medical checkup in BAUST/CMH, Saidpur Cantonment. If the medical authority considers any candidate unfit for study in University due to critical/contagious/mental diseases as shown in medical policy of University will be declared ineligible for admission.

1.13 Dope Test

BAUST ensures a drug free campus for every student. The University firmly believes that the use of drugs and other illegal substances can have a negative effect on the performance of the student's intellectual and spiritual development. The potential for alcohol and drug abuse threatens the viability of the student's professional development. In furtherance of these beliefs, BAUST has instituted an alcohol and drug testing policy to maintain wellness for students. Students will have to go through Dope Test during admission time.

1.14 Credit Transfer

BAUST students who wish to transfer their credits to a foreign university are advised to go through the website of that university very carefully and must understand all the procedure regarding admission, tuition and other fees, available financial aid and insurance policy, and available part-time work facility for the students etc. before enrollment.

Transfer from other University: Students with good academic records from other recognized University are eligible for transfer of their credits to BAUST. Students willing to transfer from another university must have transcripts of courses and grades, together with the copies of certificate/ mark sheet of SSC or HSC or transcripts of O and A levels. These Transcripts will be evaluated against the minimum entry requirement at BAUST.

Exemption of Courses: Students with extensive academic or professional experience may apply to waive courses by completing a ‘Request for Course Waiver form. This form should be submitted to the Coordinator of the Program/ Head of the Dept./ Dean of the Faculty with the relevant academic transcripts or evidence of an appropriate certification.

Students having completed any course of Bachelor’s degree from other recognized university are eligible for waiver provided that he/ she obtained at least a ‘C+’ grade or over 50 percent marks in that specific course. Waiver is given to only in the case of those conses which are included in the syllabus of the program, the student wants to get admitted. Course waiver requires approval from equivalence committee of BAUST.

Chapter 2
Department of Mechanical Engineering

2.1 Introduction to the Program

Mechanical Engineering plays a vital, and in fact, indispensable role in all fields of modern human activities. Consequently, Mechanical Engineering has established itself as one of the most important branches of engineering. The technical aspects of this branch of engineering are often categorized by terms such as engineering mechanics, materials science, thermodynamics, fluid mechanics, heat and mass transfer. The applied fields emerging out of these core disciplines are power generation, automotive engineering, refrigeration and air-conditioning, petroleum engineering, fluid machinery, fluidics, aeronautical and aerospace engineering, aeroacoustics, aeroelasticity, mechatronics, robotics, control engineering, computer-aided design (CAD), computer-aided manufacturing (CAM), railway engineering, renewable energy engineering, combustion and pollution, multi-phase flow, noise and vibration analysis, and process engineering. The students of mechanical engineering are required to have strong knowledge in the core subjects of the field, along with good understanding in basic science of the individual topics. The modern industry requires engineers with competence in multi discipline, which includes allied engineering fields of electrical and electronic engineering, computer science, and industrial and production engineering. Graduates are also required to have good communication skills and managerial capabilities. The curriculum of B. Sc. in Mechanical Engineering program is formulated to offer the students with state-of-the-art topics in core and applied fields of mechanical engineering, basic knowledge in arts and science, and competence in allied engineering.

The new generation of mechanical engineers is encouraged to undertake research and development activities in the above areas. The department of mechanical engineering is committed to the teaching and research on fundamentals as well as applied disciplines of mechanical and allied engineering fields.

2.2 Mission and Vision of the Department of Mechanical Engineering

2.2.1 Mission

- ✓ To provide high quality state-of-the-art education in Mechanical Engineering for producing skillful engineers who will be capable of solving real-world problems.
- ✓ To contribute towards the broadening of knowledge through eminent research and innovation in Mechanical Engineering and allied fields for addressing the emerging challenges of 21st century.
- ✓ To enable students in cultivating ethics for practicing sustainable development values as professionals and entrepreneurs.
- ✓ To introduce the practice of 'life-long learning' amongst the graduates for pursuing successful career paths.

2.2.2 Vision

The Department of Mechanical Engineering envisions to produce competent professionals with high morals who will meet the national and global needs through sustainable engineering practices, creative researches and innovations.

2.3 Program Educational Objectives (PEOs)

No.	PEO Statement
PEO-1	To produce graduates who will have consolidated competence in solving complex engineering problems in the fields of Mechanical Engineering viz. Power Generation, Automotive, Refrigeration and Air-conditioning, Petroleum, Aeronautical and Electromechanical industry. The curriculum aims at imparting a synergic view of industrial system vis-à-vis the environment, society and economics.
PEO-2	To prepare the graduates for their career paths in becoming successful entrepreneurs and professionals-cum-leaders with ethical values, technical and managerial expertise.
PEO-3	To provide graduates with necessary knowledge, soft skills and hands-on training required in their professional careers as well as in their pursuance of higher studies.
PEO-4	To develop graduates who will retain intellectual curiosity and exercise life-long learning in the sustainable development of industry and society.

2.4 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:

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

ii. **PO 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.

iii. **PO 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.

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

v. **PO 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.

vi. **PO 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.

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

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

ix. **PO 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.

x. **PO 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.

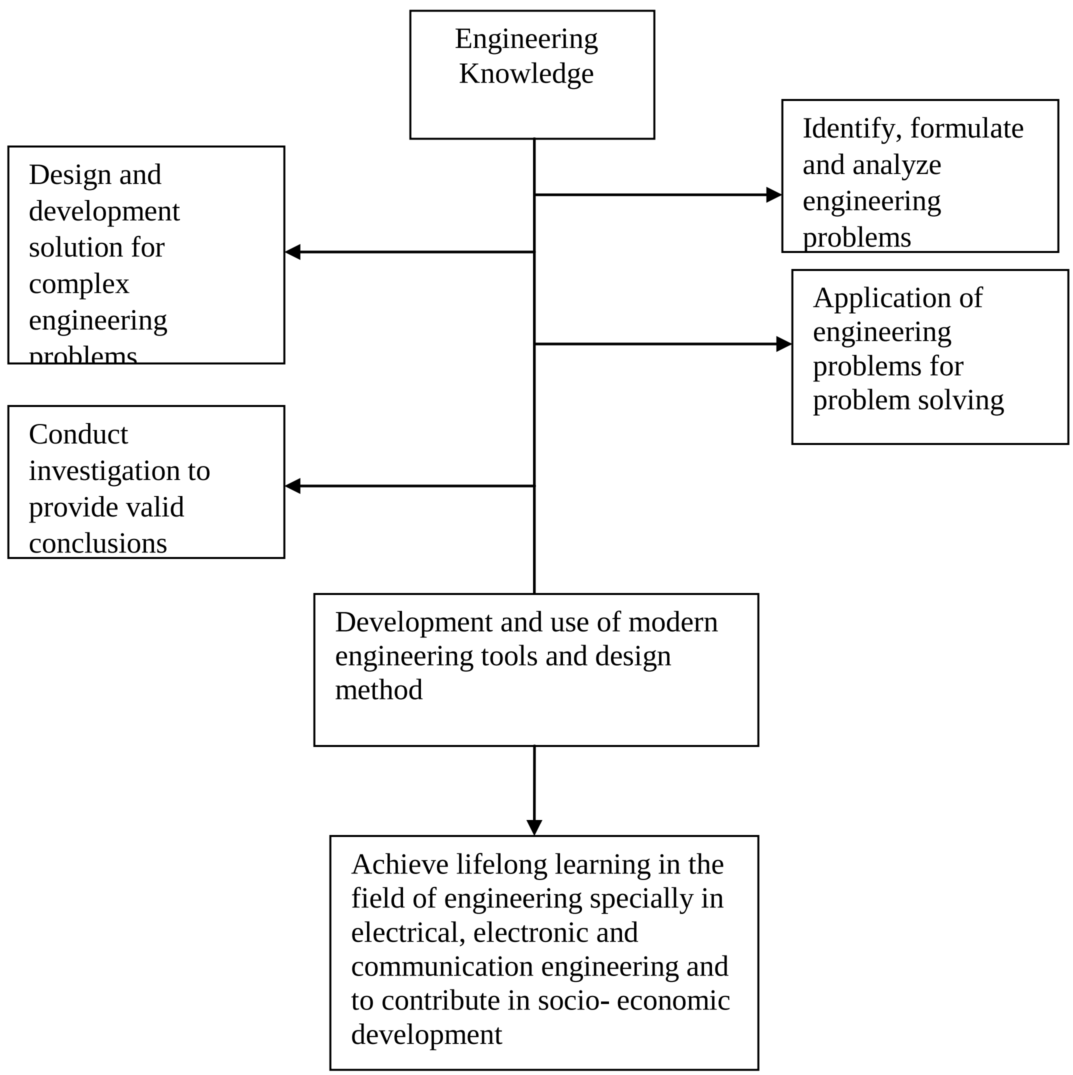
xi. **PO 11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multi-disciplinary environments.

xii. **PO 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.

2.5 Generic Skills

- Apply the principles and theory of mechanical engineering knowledge to the requirements, design and development of different mechanical systems with appropriate understanding.
- Define and use appropriate research methods and modern tools to conduct a specific project.
- Learn independently, be self- aware and self- manage their time and workload.
- Apply critical thinking to solve complex engineering problems.
- Analyze real time problems and justify the appropriate use of technology.
- Work effectively with others and exhibit social responsibility.

2.6 Curriculum/ Skill Mapping



CHAPTER 3
RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT BAUST

3.1 Introduction

The rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

3.2 The Course System

The salient features of the Course System are as follows:

a. Number of theory courses will be generally 4/5/6 in each term.
b. Students will get scope to improve their grading.
c. Continuous evaluation of students' performance.
d. 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.

3.3 Number of Terms in a Year

From Level 1 to Level 4 there shall be two regular Terms (Term-I and Term-II), each ordinarily having duration of not less than 14 weeks of classes.

In each Term there shall be 4/5/6 theory courses. Apart from theory courses there shall be some sessional courses in each term for engineering programs and there may be sessional courses in different terms for non- engineering programs also.

3.4 Duration of Terms

The duration of each term shall be as follows:

Sl. No.	Events	Duration (week)
1	Classes before Mid Term	7
2	Mid Term Examination (To be conducted in 8^{th} week of a term)	1
3	Mid Term Break/ Vacation	1
4	Classes after Mid Term	7
5	Lab test, quiz and viva/ Review Classes (if needed)	1
6	Preparatory Leave for Term Final Examination	2
7	Term Final Examination	3
8	Result Publication	1
9	Term End Vacation/ Industrial Attachment/ Referred/ Improvement/ Backlog Exam	3
	Total	**26**

3.5 Course Pattern and Credit Structure

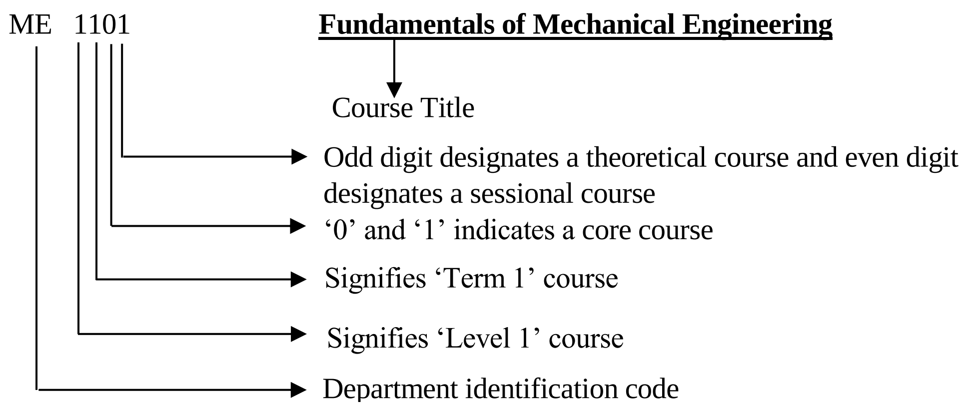
The undergraduate programs are covered by a set of theoretical courses. For engineering programs there is also a set of sessional courses to support the theoretical courses. For other program there may be some sessional courses in some terms.

3.5.1 Course Designation System

Each course is designated by a two to four letter code identifying the department offering the course followed by a four-digit number having the following interpretation:

- The first digit corresponds to the level in which the students normally take the course.
- The second digit corresponds to the term in which the students normally take the course.
- The third digit is reserved for departmental use. The fourth digit identifies a specific area/group of study within the department specified by individual departments.
- The last digit is an odd number for theoretical courses and an even number for sessional courses. This is only applicable for engineering programs.

The course designation system for Engineering Program is illustrated as follows:



3.5.2 Assignment of Credits

The assignment of credits to theoretical course is different from that of sessional course, which are as follows:

- For theoretical courses one lecture per week per term is equivalent to one credit.
- For sessional/laboratory courses two class hours per week per term is equivalent to one credit.
- Credits are also assigned to Project/Thesis work taken by the students. The total credit assigned to Project/ Thesis work is 6.00 (3.00 for Level-4 Term-I and 3.00 for Level-4 Term-II) for all engineering programs.

3.5.3 Types of Courses

The 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 the entire designated core courses of his/her discipline.
b. **Prerequisite Courses:** Some of the core courses are identified as prerequisite courses for some other courses. A prerequisite course is one, which is required to be completed before some other course(s) can be taken.
c. **Elective Courses:** Apart from the core courses, the students can choose from a set of elective courses in level-4 term-I and level-4 term-II. Elective courses are divided into different groups respective to the individual department.

3.6 Performance Evaluation: The Grading System

3.6.1 The Letter Grade

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 class tests, assignments, class performance, a midterm assessment and a term final examination. The assessment in sessional courses is made by evaluating performance of the student at work during the class, conduct of lab tests, report writing, a midterm evaluation, a final evaluation, final quiz and viva-voce. Each course has a certain number of credits, which describes its corresponding weightages. A letter grade with a specified number of grade points is awarded in each course for which a student is registered. 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.

Total credits specified in syllabus of each department have to be acquired in order to qualify for the respective degree. Letter grades and corresponding grade points shall be awarded according to the provisions shown below:

Grade	Grade Points	Numerical Markings
A+	4.00	80% and above
A	3.75	75% to below 80%
A-	3.50	70% to below 75%
B+	3.25	65% to below 70%
B	3.00	60% to below 65%
B-	2.75	55% to below 60%
C+	2.50	50% to below 55%
C	2.25	45% to below 50%
D	2.00	40% to below 45%
F*	0.00	Below 40%
I	-	Incomplete
W	-	Withdrawal
X	-	Continuation (For Project/ Thesis)

* Subject (s) in which a student gets 'F' grade shall not be counted towards the credit hours requirements and for the calculation of Grade Point Average (GPA)

3.6.2 Incomplete (I) Grade

If a student fails to attend 60% of the classes of any registered course in a Term whatever be the reasons, the registration shall be cancelled for that course and the course will be treated as Incomplete (I) course.

3.6.3 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to illness, accident or any other valid reason, he/ she may apply in prescribed form to the Registrar through his/ her Head of the Department for total withdrawal from the Term within 7 (seven) working days after the end of the Term final examination. However, he/ she may choose not to withdraw any laboratory/ sessional/ design course if the grade obtained in such a course is 'D' or better and that he/ she has to indicate clearly in his/ her withdrawal application. In case of illness the withdrawal application must be supported by a medical certificate from CMH/Medical Officer of BAUST. The Academic Council shall take the final decision about such an application.

3.7 Distribution of Marks

3.7.1 Theory Courses

Forty percent (40%) of marks of a theoretical course shall be allotted for continuous assessment, i.e., class tests/assignments/presentations, class evaluation, class participation and midterm evaluation. The rest sixty percent (60%) marks shall be allotted to the three-hour duration term final examination. Distribution of marks for a given theory course is as follows

Class performance	5%
Class Tests/ Assignments/ Presentations	20%
Mid-Term Assessment (Exam [1-hour duration] / Project)	15%
Final Examination (3 hours duration)	60%
Total	**100%**

The number of class tests/assignments/presentations of a course shall be 'n', where 'n' is the number of credits of the course. Evaluation of performance in class tests/assignments/presentations shall be on the basis of the best '(n-1)' class tests/assignments/presentations. The scheme of continuous assessment that a particular teacher wishes to follow for a course shall be announced within the first week of the start of classes.

Note:

a. 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 60 minutes. If mid-term assessment is done through project, then there should be project report and presentation.
b. 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.

c. The weightage of class performance can be assessed through class attendance, effective class participation and discipline.

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

3.7.2 Sessional/ Practical Courses

Sessional courses are designed and conducted by the concerned departments. Examination on sessional/practical subjects shall be conducted by the respective department before the end of the term. The date of practical examination shall be fixed by the respective department. Students shall be evaluated in the sessional courses on the basis of the followings:

3.7.2.1 Lab Based Sessional

Class Performance/Conduct of Lab Tests	25%
Report/Assignment	15%
Mid-Term Evaluation (Exam/Project/Assignment)	20%
Final Evaluation (Exam/Project/Assignment)	30%
Viva-Voce	10%
Total	**100%**

3.7.2.2 Programming/ Project Based Sessional

Class Performance/Conduct of Lab Tests	25%
Report/Assignment/Programming	15%
Mid-Term Evaluation (Exam/Project/Assignment)	20%
Final Evaluation (Exam/Project/Assignment)	30%
Viva-Voce/ Presentation	10%
Total	**100%**

3.8 Attendance

All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly. One is required to attend at least 75% of all classes held in any course. Student having attendance from 60% up to 75% shall have to pay a certain fine to attend the final examination. Students having attendance less than 60% shall not be allowed to attend the final examination.

3.9 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 C_1, C_2, …, C_n and his grade points in these courses are G_1, G_2, …, G_n respectively then

$$GPA = \frac{\sum_{i=1}^{n} CiGi}{\sum_{i=1}^{n} Ci}$$

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 TC_1, TC_2, …, TC_n and his GPA in these terms are GPA_1, GPA_2, GPA_n respectively then

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

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

Course	Credits, C_i	Grade	Grade, G_i	Points, C_I*G_i
ME 1101	3.00	A-	3.50	10.50
EEE 1159	3.00	A+	4.00	12.00
MATH 1101	3.00	B-	2.75	8.25
PHY 1105	3.00	D	2.00	6.00
HUM 1115	3.00	A-	3.50	10.5
ME 1108	1.50	A+	4.00	6.00
EEE 1160	0.75	B	3.00	2.25
HUM 1116	0.75	A+	4.00	3.00
Total	**18**			**58.50**

GPA = 58.50/18 = 3.25

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

Level	Term	Credit 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

3.10 Promotion to the Next Higher Term/ Level

a) In each term there shall be 4/5/6 theory courses. A student has to pass at least 2 out of 4, 3 out of 5 and 4 out of 6 theory courses in the final examination for promotion to next higher Term/ Level with a maximum of 2 (two) fail theory courses.

b) Besides theory courses there shall be some sessional courses in each term for engineering programs and there may be some sessional courses in some terms for other programs. For promotion to next higher Term/ Level a student has to pass in all the sessional courses of the term. A student failed in only one sessional course in the Final Exam shall get a chance to retake the sessional course. But the course has to be cleared within the immediate next Referred Examination.

c) Consequences of Failing in Sessional Courses: A student failing in one sessional course, must retake the sessional course in any suitable time as decided by the concerned department before the schedule of the Referred Exam and appear the sessional exam during the Referred Exam schedule. The student has to register the sessional course by depositing a prescribed fee. If any student fails in two sessional courses in the final exam or in the sessional retake course in the Referred Exam in a term, he/she fails in the term and has to repeat the term.

3.11 Conduct of Examinations

Class tests, Mid-term exam and Term final exam will be conducted for theory courses and sessional exams will be conducted for sessional/practical courses. Referred/Improvement/Backlog examination will be conducted for theory courses.

3.11.1 Class Tests/Assignments/Presentations

These are to be conducted by the course teacher(s) in class room for the theory courses. Concerned department will arrange and monitor these tests. Class tests will carry a weightage in the final assessment.

3.11.2 Mid Term Examination

Mid-term assessment (Examination/Project) for the theory courses will be conducted by the concerned department around the middle of a term. Duration of the mid- term examination will be maximum 1 (one) hour. The mid-term examination will carry a weightage in the final assessment.

3.11.3 Term Final Examination

The students will get a 02 week's preparatory leave for the term final examination usually after 14 weeks of classes. The term final examination will be conducted for all the theory courses over a period of 03 weeks by the Office of the Controller of Examinations. The duration of term final examinations will be of 03 hours irrespective of the credit hours of the theory courses. The term final examination will carry a weightage in the final assessment.

3.11.4 Sessional/Practical Examination

Sessional/Practical examinations for concerned program (both mid-term evaluation and final evaluation including viva-voce and quiz etc.) will be conducted by the concerned course teacher(s) and will be arranged and monitored by the concerned department. Both mid-term assessment and final assessment will carry weightage.

3.11.5 Referred Examination

The failed theory course(s) of the term final examination will be treated as referred course(s). Only for Level-1, Term-I, a student failed in a maximum of 3 (three) theory courses in the final examination will get a chance to appear in the next consequent referred examination because such a student will have no backlog course(s). But the student will not be promoted to the next higher level and Term if he/ she cannot clear at least one fail theory course out of the 3 (three) fail courses in the referred examination. Students having referred course (maximum three for L-1, T-I and maximum two for all other Levels and Terms) will have to appear in the next consequent referred examination, which will be held combinedly with the Improvement and Backlog examinations at the end of each semester or at the beginning of the next semester at any convenient time as decided by the authority. The maximum grade obtainable in Referred examinations shall be 'B'.

3.11.6 Improvement Examination

A student may also appear in the next consequent Improvement examination for the passed theory course(s) with letter grades less than 'B+' in the final examination. The maximum letter grade obtainable in the improvement examination shall be 'B+' and if he/ she cannot improve, the obtained grade of the final examination shall prevail.

3.11.7 Backlog Examination

From Level-1 Term-II and higher a student may have a maximum of 3 cumulative Backlog courses. Backlog course(s) are those theory course(s) which a student registered in a Term but even after the Final and Referred Examination he/ she obtained 'F' grade in that course(s). The maximum obtainable grade in the Backlog examination shall be 'B'. A student will get a maximum of 03 (three) chances to clear the Backlog course(s).

3.11.8 Number of Courses Allowable for Referred/Improvement/Backlog Examinations

A Students will be allowed to appear for a maximum of 3 (three) courses in the Referred and /or Improvement and /or Backlog Examination in a term.

3.11.9 Conducting and other Rules of Referred/Improvement/Backlog Examinations

Referred/ Improvement/ Backlog examinations will also be conducted by the Office of the Controller of Examinations. The Referred, Improvement and Backlog Examinations shall be held once in each term. Referred, Improvement and Backlog courses in each level-term shall be treated as self-study (i.e., retaining the already obtained marks of class performance, class tests and mid-term examination). The Referred, Improvement and Backlog Examinations will be held combinedly at any convenient time as decided by the authority. A student will be allowed to appear in a maximum of three courses from among his/ her Referred and/ or Improvement and/ or Backlog courses in a term.

3.12 Special Backlog Examination

A Special Backlog Examination on only Backlog courses may be conducted for the students who have completed their 4-year degree course (up to level-4 term-II) and have a shortage of maximum 12 (twelve) credits to obtain the Bachelor degree. The special backlog examination shall be arranged in a convenient time after 30 (thirty) days of publication of the final results of the level-4 term-II examination. The evaluation system shall be same as backlog with self-study. The students willing to appear at the special backlog examination have to apply to the Head of the Department and with his permission must register within 7 (seven) working days of publication of Level-4 Term-II Final and Backlog examination results. A student who will fail in the special backlog examination shall have to register the failed course(s) in the next regular term.

3.13 Exemption from Taking Courses for Level Repeat Students

If a student fails to get himself/ herself promoted to the next higher level/ term on poor academic performance, he/ she have to take readmission in the same level and term in which he/ she failed as a repeater student**.** In such case he/ she shall be exempted from repeating the passed theory and sessional courses. A Repeater student will have to repeat only those theory and sessional courses in which he/ she has failed even after the final and referred examinations.

3.14 Level/Term Repeat for Student under Punishment

No waiver shall be given to a student if a student repeats the Level/Term due to punishment; he/she must have to repeat all the courses of the repeating Level/Term.

3.15 Examination Code of Conduct for Examination

3.15.1 Conduct of the Examinees

a. An examinee must not write his/ her name or any indication mark anywhere in the answer script. If he/ she does so, the answer script will not be examined.
b. No examine will be allowed to leave the examination hall until an hour has passed from the time when the question paper is given nor will an examinee be allowed to sit for the examination 30 minutes after the starting of an examination. An examinee also will not be allowed to leave the examination hall during the last fifteen minutes of the examination unless he/ she submits the answer script.
c. An examinee must not bring any loose papers, books, notes, instruments etc. to the examination hall unless instructed.
d. An examinee shall not create any situation that may cause disturbance to other examinees and/ or breach of discipline.
e. An examinee must not communicate or attempt to communicate with other examinee/examinees nor shall he/ she copy or attempt to copy or take help or attempt to take help from any incriminating document.
f. The university campus including the rooms, toilets and circulation space is in examination premises.
g. In any matter not specifically mentioned in the regulations or on the cover page of the answer script, an examinee shall abide by the decision of the invigilator in the examination hall

3.15.2 Description of Major Unfair means activities

The following activities are treated as unfair means activities in the examinations:

- Possession of any incriminating document related to the course of examination.
- Copying/ attempt to copy/ taking help from any incriminating document.
- Insertion of any page in the answer script written outside of the examination hall.
- Writing anything on any part of body/ clothes of the student concerned/ chair, table, desk, bench, wall etc.
- Having the answers written on the answer script by other.
- Exchanging of the answer scripts or any part of it or additional answer sheet with other examinee(s).
- Carrying a cell phone/ non-essential electronic device(s).
- Misbehaving with invigilator(s) and/ or other examinees.

3.15.3 Penalty for Committing Offences Related to the Examination

Penalty will be imposed for the offences during examinations are to be classified as the following types in order of severity:

a) **Attempt to communicate with other examinee or examinees:** Issuing warning and/or changing of seats and or deduction of marks or expulsion from the examination hall.
b) **Possession of unauthorized document(s), and/or any unauthorized device(s):** cancellation of the answer script of that particular examination and he/she will get 'F' grade in that examination.
c) **Possession of unauthorized document(s), and/or any unauthorized device(s), and being caught while attempting to use them:** He/she will be expelled from that examination and will get 'F' grade in that examination. He /she will not be allowed to appear in the examination of the remaining courses. Accordingly, he/she will get 'F' grade in the results of the remaining courses. But in case of Referred/ Improvement/ Backlog Examinations, he/she will be expelled from that particular course and will get 'F' in the course.
d) **Possession of unauthorized document(s), and/or any unauthorized devices, and being caught with proof that those have been already used:** He/ She will be expelled from the entire examination of that term. Accordingly, he/ she will get 'F' grade in the result of all the courses.
e) **Attempt to get possession of question paper(s) or answer script(s) before the examination:** Expulsion from the University for the semester in which the offence is committed.
f) **Use of violent language and holding out threats to the invigilators, question paper setters, examiners and scrutinizers:** Cancellation of the enter examination of the student for that semester and expulsion for the university for good.
g) **Impersonating or causing to impersonate in the examination hall:** Cancellation of the entire examination of the student concerned for that semester and expulsion from the University for Good.
h) **Any other activities (which are not mentioned here) deemed to be unfair means in the examination:** Chief Invigilator and Chairman CECC will take the decision in consultation with the Vice-Chancellor.

3.16 Minimum Earned Credit and CGPA Requirement for Obtaining Degree

Minimum credit hour requirements for the award of bachelor's degree in engineering (B.Sc. Engineering) and other disciplines shall be decided as per the existing rules. The minimum CGPA requirement for obtaining a Bachelor's degree is 2.20. A student is expected to complete the whole course within 4 years (8 terms). For an unavoidable reason if a student fails to complete the course within the stipulated time of 4 years, he/ she must complete all degree requirements within a maximum period of 6 academic years (12 terms).

Failure to complete all degree requirements within the given time frame may disqualify a student from continuation of his/her study at the university.

3.17 Course Registration Procedure

The time and date for course registration shall be announced in advance by the Registrar's office. Students will register his/ her courses in a Term according to following guidelines:

i) A student must pay all Hall dues before the course registration of a Term.
ii) The student must pay the Semester Fee of the semester.
iii) The student will complete the registration and Head of the Department will verify it.

Finally, the Office of the Registrar will distribute course-wise list of registered students to the concerned department and Controller of Examinations.

3.18 Industrial/ Professional Training Requirements

Depending on the requirement of some Department, a student may have to complete a prescribed number of days of industrial/ professional training to the satisfaction of the concerned Department.

3.19 Rounding off the Decimal Marks

If there are any decimal marks in any of the examinations like class test, tutorial, term paper, viva voce, course final examination then instead of rounding off the decimal figure in the result of every subject/sessional, it is to be rounded off only once during tabulation while converting the total marks to percentage mark after summation of all the subject/sessional marks. To round off, 0.5 and above is to be converted to next higher whole number and less than 0.5 is to be converted to previous whole number (For example 58.5% would be 59% and 58.49% would be 58%).

3.20 Rounding off the GPA and CGPA

The GPA/CGPA is not to be rounded off like the total marks of each subject/sessional, but it is to be rounded off after two figures of decimal. To round of 3.555 and above after two figures of decimal, it is to be rounded off as 3.56 and 3.554 and below after two figures of decimal, it is to be rounded off as 3.55.

3.21 Honors, Dean's List and University Gold Medal

3.21.1 Honors/ Distinction

In all Engineering programs and in BBA program candidates for Bachelor's degree shall be awarded the degree with Honors if their CGPA is 3.75 or better. For English program they shall be awarded the degree with Distinction if their CGPA is 3.75 or better.

3.21.2 Dean's List

In recognition of excellent performance, the name of the students who maintain an average

GPA of 3.75 or above in two regular Terms of an academic year may be published in the Dean's List in each Faculty and he/ she will be given a certificate from the respective Dean as recognition. Students who have obtained an 'F' grade in any course during any of the two consecutive regular Terms will not be considered for Dean's List in that year.

3.21.3 University Gold Medal

University Gold Medal for outstanding graduates shall be presented to the students who will secure the 1st position in each Department and whose CGPA is above or equal to 3.75. The student must have completed his/ her undergraduate course work within four consecutive academic years with no 'F' grades and have a satisfactory attendance to his credit.

Chapter 4
COURSE REQUIREMENT FOR THE UNDERGRADUATE STUDY OF MECHANICAL ENGINEERING

4.1 Introduction

The lists of courses offered to the undergraduate students of Mechanical Engineering (ME) are categorized into Core courses and Optional courses. Some of the core courses are offered by the Department of ME and some by other departments. Students have the flexibility to choose from amongst the Optional courses.

4.2 Core Courses

The students have to complete all the core courses listed below:

4.2.1 List of Core Courses: MECHANICAL ENGINEERING

Course Code	Course Title	Level-Term	Contact Hours	Credit Hours
ME 1101	Fundamentals of Mechanical Engineering	1-I	3.00	3.00
ME 1108	Foundry, Welding and Machine Shop Practice	1-I	3.00	1.50
ME 2100	Mechanical Engineering Drawing	2-I	3.00	1.50
ME 2101	Engineering Thermodynamics	2-I	3.00	3.00
ME 2102	Engineering Thermodynamics Sessional	2-I	3.00	1.50
ME 2103	Engineering Mechanics-I	2-I	4.00	4.00
ME 2104	Engineering Mechanics -I Sessional	2-I	3.00	1.50
ME 2111	Numerical Analysis	2-I	3.00	3.00
ME 2112	Numerical Analysis Sessional	2-I	3.00	1.50
ME 2207	Engineering Metallurgy	2-II	3.00	3.00
ME 2208	Engineering Metallurgy Sessional	2-II	1.50	0.75
ME 2209	Mechanics of Solids	2-II	3.00	3.00
ME 2210	Mechanics of Solids Sessional	2-II	1.50	0.75
ME 3101	Heat Transfer –I	3-I	3.00	3.00
ME 3103	Engineering Mechanics -II	3-I	3.00	3.00
ME 3104	Engineering Mechanics -II Sessional	3-I	3.00	1.50

ME 3105	Fluid Mechanics-I	3-I	3.00	3.00
ME 3106	Fluid Mechanics-I Sessional	3-I	1.50	0.75
ME 3113	Machine Design-I	3-I	3.00	3.00
ME 3114	Machine Design –I Sessional	3-I	1.50	0.75
ME 3116	Capstone Project	3-I	3.00	1.50
ME 3201	Heat Transfer-II	3-II	3.00	3.00
ME 3202	Heat Transfer Sessional	3-II	3.00	1.50
ME 3205	Fluid Mechanics-II	3-II	3.00	3.00
ME 3206	Fluid Mechanics-II Sessional	3-II	1.50	0.75
ME 3207	Measurement, Instrumentation and Quality Control	3-II	3.00	3.00
ME 3208	Measurement, Instrumentation and Quality Control Sessional	3-II	1.50	0.75
ME 3213	Machine Design-II	3-II	3.00	3.00
ME 3214	Machine Design-II Sessional	3-II	1.50	0.75
ME 4101	Internal Combustion Engines	4-I	3.00	3.00
ME 4102	Internal Combustion Engines Sessional	4-I	3.00	1.50
ME 4105	Fluid Machinery	4-I	3.00	3.00
ME 4106	Fluid Machinery Sessional	4-I	1.50	0.75
ME 4117	Refrigeration and Air Conditioning	4-I	3.00	3.00
ME 4000	Project /Thesis	4-I	6.00	3.00
ME 4217	Power Plant Engineering	4-II	3.00	3.00
ME 4218	Power Plant Engineering Sessional	4-II	3.00	1.50
ME 4219	Automobile Engineering	4-II	3.00	3.00
ME 4233	Mechatronics	4-II	3.00	3.00
ME 4000	Project / Thesis	4-II	6.00	3.00
			Total Credit Hours =	**88.00**

4.2.2 List of Core Courses: Arts and Science

Course Code	Course Title	Level-Term	Contact Hours	Credit Hours
CHEM 1203	Chemistry	1-II	4.00	4.00
CHEM 1204	Chemistry Sessional	1-II	3.00	1.50

MATH 1101	Mathematics-I	1-I	3.00	3.00
MATH 1201	Mathematics-II	1-II	3.00	3.00
MATH 2101	Mathematics-III	2-I	3.00	3.00
MATH 2201	Mathematics -IV	2-II	3.00	3.00
HUM 2117	Economics	2-I	2.00	2.00
HUM 2219	Accounting	2-II	2.00	2.00
PHY 1105	Physics-I	1-I	3.00	3.00
PHY 1205	Physics-II	1-II	3.00	3.00
PHY 1206	Physics Sessional	1-II	3.00	1.50
HUM 1211	বাংলা ভাষা ও সাহিত্য	1-II	2.00	2.00
HUM 2211	স্বাধীন বাংলার অভ্যুদয়ের ইতিহাস	2-II	2.00	2.00
HUM 3111	Sociology	3-I	2.00	2.00
HUM 3113	Engineering Ethics	3-I	2.00	2.00
			Total Credit Hours =	**37.00**

4.2.3 List of Core Courses: CSE

Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
CSE 1271	Computer Programming	1-II	3.00	3.00
CSE 1272	Computer Programming Sessional	1-II	3.00	1.50
			Total Credit Hours =	**4.50**

4.2.4 List of Core Courses: EEE

Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
EEE 1159	Basic Electrical Engineering	1-I	3.00	3.00
EEE 1160	Basic Electrical Engineering Sessional	1-I	1.50	0.75
EEE 2259	Electrical Machines and Electronics Technology	2-II	4.00	4.00
EEE 2260	Electrical Machines and Electronics Technology Sessional	2-II	3.00	1.50

Total Credit Hours =	**9.25**

4.2.5 List of Core Courses: IPE

Course Code	Course Title	Level-Term	Contact Hours	Credit Hours
IPE 3277	Production Process	3-II	3.00	3.00
IPE 3278	Production Process Sessional	3-II	1.50	0.75
IPE 4115	Industrial Management	4-I	3.00	3.00
IPE 4207	Tool Engineering & Machine Tools	4- II	3.00	3.00
IPE 4208	Tool Engineering & Machine Tools Sessional	4- II	1.50	0.75
			Total Credit Hours =	**10.50**

4.2.6 List of Core Courses: English

Course Code	Course Title	Level-Term	Contact Hours	Credit Hours
HUM 1115	English	1-I	3.00	3.00
HUM 1116	Technical Report Writing & Presentation	1-I	1.50	0.75
			Total Credit Hours =	**03.75**

4.2.7 List of Prerequisite Courses

Course Code	Course Title	Prerequisite Course	
		Course Code	**Course Title**
MATH 1201	Mathematics-II	MATH 1101	Mathematics-I
PHY 1205	Physics-II	PHY 1105	Physics-I
MATH 2101	Mathematics-III	MATH 1201	Mathematics-II
MATH 2201	Mathematics -IV	MATH 2101	Mathematics-III
ME 3201	Heat Transfer –II	ME 3101	Heat Transfer –I
ME 3205	Fluid Mechanics –II	ME 3105	Fluid Mechanics –I
ME 3213	Machine Design – II	ME 3113	Machine Design –I

4.3 Optional Courses

From Level-4 Term-I, ME Department starts offering Optional courses. There are total two optional courses, one in Level-4 Term-I and another in Level-4 Term-II. In each term students have to choose one optional course from the various optional courses to be offered.

4.3.1 Optional-I Courses (For Level-4 Term-I)

Course Code	Course Title	Level-Term	Contact Hours	Credit Hours
ME 4121	Renewable Energy Technology	4-I	3.00	3.00
ME 4123	Energy Resources and Utilization	4-I	3.00	3.00
ME 4131	Petroleum Engineering	4-I	3.00	3.00
ME 4133	Composite Materials	4-I	3.00	3.00
ME 4135	Railway Engineering	4-I	3.00	3.00
ME 4137	Advanced Thermodynamics	4-I	3.00	3.00
ME 4139	Combustion and Pollution	4-I	3.00	3.00
ME 4141	Multi-phase Flow	4-I	3.00	3.00

4.3.2 Optional-II Courses (For Level-4 Term-II)

Course Code	Course Title	Level-Term	Contact Hours	Credit Hours
ME 4237	Aerodynamics	4-II	3.00	3.00
ME 4241	Robotics	4-II	3.00	3.00
ME 4245	Servomechanism and Control Engineering	4-II	3.00	3.00
ME 4247	Energy and Environment	4-II	3.00	3.00
ME 4249	Fluidics	4-II	3.00	3.00
ME 4251	Design of Fluid Machines	4-II	3.00	3.00
ME 4253	Theory of Structures	4-II	3.00	3.00
ME 4255	Noise and Vibration	4-II	3.00	3.00

4.4 Term Wise Distribution of Courses

4.4.1 Level-1 Term-I

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 1101	Fundamentals of Mechanical Engineering	Theory	3.00	3.00
EEE 1159	Basic Electrical Engineering	Theory	3.00	3.00
MATH 1101	Mathematics-I	Theory	3.00	3.00
PHY 1105	Physics-I	Theory	3.00	3.00
HUM 1115	English	Theory	3.00	3.00
		Sub Total =	**15.00**	**15.00**
ME 1108	Foundry, Welding and Machine Shop Practice	Sessional	3.00	1.50
EEE 1160	Basic Electrical Engineering Sessional	Sessional	1.50	0.75
HUM 1116	Technical Report Writing & Presentation	Sessional	1.50	0.75
		Sub Total =	**6.00**	**3.00**
		Total =	**21.00**	**18.00**

4.4.2 Level-1 Term-II

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
CSE 1271	Computer Programming	Theory	3.00	3.00
CHEM 1203	Chemistry	Theory	4.00	4.00
MATH 1201	Mathematics-II	Theory	3.00	3.00
PHY 1205	Physics-II	Theory	3.00	3.00
HUM 1211	বাংলা ভাষা ও সাহিত্য	Theory	2.00	2.00
		Sub Total =	**15.00**	**15.00**
CSE 1272	Computer Programming Sessional	Sessional	3.00	1.50
CHEM 1204	Chemistry Sessional	Sessional	3.00	1.50
PHY 1206	Physics Sessional	Sessional	3.00	1.50
		Sub Total =	**9.00**	**4.50**
		Total =	**24.00**	**19.50**

4.4.3 Level-2 Term-I

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 2101	Engineering Thermodynamics	Theory	3.00	3.00
ME 2103	Engineering Mechanics-I	Theory	4.00	4.00
ME 2111	Numerical Analysis	Theory	3.00	3.00
HUM 2117	Economics	Theory	2.00	2.00
MATH 2101	Mathematics-III	Theory	3.00	3.00
		Sub Total =	**15.00**	**15.00**
ME 2100	Mechanical Engineering Drawing	Sessional	3.00	1.50
ME 2102	Engineering Thermodynamics Sessional	Sessional	3.00	1.50
ME 2104	Engineering Mechanics -I Sessional	Sessional	3.00	1.50
ME 2112	Numerical Analysis Sessional	Sessional	3.00	1.50
		Sub Total =	**12.00**	**6.00**
		Total =	**27.00**	**21.00**

4.4.4 Level-2 Term-II

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 2207	Engineering Metallurgy	Theory	3.00	3.00
ME 2209	Mechanics of Solids	Theory	3.00	3.00
EEE 2259	Electrical Machines and Electronics Technology	Theory	4.00	4.00
MATH 2201	Mathematics -IV	Theory	3.00	3.00
HUM 2211	স্বাধীন বাংলার অভ্যুদয়ের ইতিহাস	Theory	2.00	2.00
HUM 2219	Accounting	Theory	2.00	2.00
		Sub Total =	**17.00**	**17.00**
ME 2208	Engineering Metallurgy Sessional	Sessional	1.50	0.75
ME 2210	Mechanics of Solids Sessional	Sessional	1.50	0.75
EEE 2260	Electrical Machines and Electronics Technology	Sessional	3.00	1.50
		Sub Total =	**6.00**	**3.00**
		Total =	**23.00**	**20.00**

4.4.5 Level-3 Term-I

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 3101	Heat Transfer –I	Theory	3.00	3.00
ME 3103	Engineering Mechanics -II	Theory	3.00	3.00
ME 3105	Fluid Mechanics –I	Theory	3.00	3.00
ME 3113	Machine Design –I	Theory	3.00	3.00
HUM 3111	Sociology	Theory	2.00	2.00
HUM 3113	Engineering Ethics	Theory	2.00	2.00
		Sub Total=	**16.00**	**16.00**
ME 3104	Engineering Mechanics -II Sessional	Sessional	3.00	1.50
ME 3106	Fluid Mechanics -I Sessional	Sessional	1.50	0.75
ME 3114	Machine Design-I Sessional	Sessional	1.50	0.75
ME 3116	Capstone Project	Sessional	3.00	1.50
		Sub Total =	**09.00**	**4.50**
		Total =	**25.00**	**20.50**

4.4.6 Level-3 Term-II

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 3201	Heat Transfer –II	Theory	3.00	3.00
ME 3205	Fluid Mechanics –II	Theory	3.00	3.00
ME 3207	Measurement, Instrumentation and Quality Control	Theory	3.00	3.00
ME 3213	Machine Design – II	Theory	3.00	3.00
IPE 3277	Production Process	Theory	3.00	3.00
		Sub Total =	**15.00**	**15.00**
ME 3202	Heat Transfer Sessional	Sessional	3.00	1.50
ME 3206	Fluid Mechanics- II Sessional	Sessional	1.50	0.75
ME 3208	Measurement, Instrumentation and Quality Control Sessional	Sessional	1.50	0.75
ME 3214	Machine Design -II Sessional	Sessional	1.50	0.75
IPE 3278	Production Process Sessional	Sessional	1.50	0.75
ME 3270 **	Industrial Training	Training	4 weeks	1.00
		Sub Total =	**9.00+4 weeks**	**5.50**
		Total =	**24.00+4 weeks**	**20.50**

** It will be conducted after the completion of Level- 3, at any convenient time as can be arranged by the Department. Results will be recorded as Satisfactory or Unsatisfactory after the completion of training.

4.4.7 Level-4 Term-I

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 4101	Internal Combustion Engines	Theory	3.00	3.00
ME 4105	Fluid Machinery	Theory	3.00	3.00
ME 4117	Refrigeration and Air Conditioning	Theory	3.00	3.00
IPE 4115	Industrial Management	Theory	3.00	3.00
ME ****	Optional- I	Theory	3.00	3.00
		Sub Total =	**15.00**	**15.00**
ME 4102	Internal Combustion Engines Sessional	Sessional	3.00	1.50
ME 4106	Fluid Machinery Sessional	Sessional	1.50	0.75
ME 4000	Project /Thesis	Sessional	6.00	3.00
		Sub Total =	**10.50**	**5.25**
		Total =	**25.50**	**20.25**

4.4.8 Level-4 Term-II

Course Code	Course Title	Type of Course	Contact Hours	Credit Hours
ME 4217	Power Plant Engineering	Theory	3.00	3.00
ME 4219	Automobile Engineering	Theory	3.00	3.00
ME 4233	Mechatronics	Theory	3.00	3.00
IPE 4207	Tool Engineering & Machine Tools	Theory	3.00	3.00
ME ****	Optional- II	Theory	3.00	3.00
		Sub Total =	**15.00**	**15.00**
ME 4218	Power Plant Engineering Sessional	Sessional	3.00	1.50
IPE 4208	Tool Engineering & Machine Tools Sessional	Sessional	1.50	0.75
ME 4000	Project /Thesis	Sessional	6.00	3.00
		Sub Total =	**10.50**	**5.25**
		Total =	**25.50**	**20.25**
			Grand Total =	**160.00**

4.5 Summary of the Credit Hours Requirements

To obtain B. Sc. Engineering degree in Mechanical Engineering (ME), the following credits are to be earned:

Sl. No.	Courses	Credit Hour
1	ME Dept. Core Courses	88.00
2	ME Dept. Elective Courses	06.00
3	ME Dept. Industrial Training	01.00
4	Courses to be offered by Arts and Science Dept.	37.00
5	Courses to be offered by CSE Dept.	04.50
6	Courses to be offered by EEE Dept.	09.25
7	Courses to be offered by IPE Dept.	10.50
8	Courses to be offered by English Dept.	03.75
	Total Credit Hours	**160.00**

4.6 Percentage Breakdown of Different Courses

The percentage breakdown of the courses:

Sl. No.	Course Group	Credit Hours	Total Credit Hours of the Group	Percentage (%)
1	Core Mechanical Engineering Courses	88.00	95.00	59.38
		06.00		
		01.00		
2	Allied Engineering Courses	04.50	24.25	15.16
		09.25		
		10.50		
3	Basic Science Courses	25.00	25.00	15.62
4	Courses to be offered by DBA	04.00	15.75	9.84
	Courses to be offered by English Dept.	03.75		
	Courses to be offered by Humanities Dept.	08.00		
	Total Credit Hours	**160.00**	**-**	

Chapter 5
DETAILED OUTLINE OF UNDERGRADUATE COURSES

5.1 Term Wise Description of Courses

5.1.1 Level-1 Term-I

ME 1101: Fundamentals of Mechanical Engineering

3.00 Contact Hour 3.00 Credit Hour

Energy: Sources, conventional and renewable energy, energy situation in Bangladesh, prospect of different energy sources in Bangladesh

Introduction to Steam Generation: Working principle of few common and modern boilers, difference between the fire tube and water tube boilers, description of boilers e.g. stationary fire tube boiler, Babcock and Willcox boiler, Stirling boiler, major boiler mountings and accessories, equivalent evaporation and boiler efficiency.

Internal Combustion Engines: Introduction of petrol and diesel engines, main parts, working principle of both 4 stroke and 2 stroke engines, ihp, bhp and mechanical efficiency calculations, air standard Otto cycle, Diesel cycle efficiency, p-v & T-s diagrams of cycles, brief description of carburetor, injection, ignition system, lubrication and cooling systems of IC engine.

Pumps, Blowers and Compressors: Introduction of pumps, blowers and compressors, classification and working principles.

Turbine: Working principle and application of different types of turbine.

Refrigeration and Air-conditioning Systems: Psychrometry, fundamentals of refrigeration and air-conditioning system.

Robotics: Introduction, purpose, laws of robotics, degree of freedom, manipulator-actuator and other components

EEE 1159: Basic Electrical Engineering

3.00 Contact Hour 3.00 Credit Hour

Fundamental Concepts and Units, Electrical Networks: Network laws and theorems, methods of analysis. Electrical field concepts: capacitance, transient and steady state analysis of electrical networks for different forcing functions, introduction to magnetic circuits.

Alternating Current: Effective and average values of alternating waveforms. Phasor and complex-impedance. Steady state analysis of AC networks. Balanced Poly-phase systems.

Introduction to Measurement of Electrical Quantities: Voltage, current and power.

MATH 1101: Mathematics-I

3.00 Contact Hour 3.00 Credit Hour

Calculus:

Differential Calculus: Limit, continuity and differentiability, successive differentiation of various types of functions, Leibnit'z theorem, Rolle's theorem, mean value theorem, expansion in finite and infinite forms, Lagrange's form of remainder, Cauchy's form of remainder (expansion of remainder), expansions of functions differentiation and integration, indeterminate form, cartesian differentiation, Euler's theorem, tangent and normal, sub tangent and subnormal in Cartesian and polar coordinates, maxima and minima of functions of single variables, curvature, asymptotes.

Integral Calculus: Definition of integrations, integration by the method of substitution, integration by parts, standard integrals, integration by the method of successive reduction, definite integrals and its use in summing series, Wallis' formula, improper integrals, beta function and gamma function, multiple integral and its application, area, volume of solid revolution, area under a plain curve in cartesian and polar coordinates, area of the region enclosed by two curves in Cartesian and polar coordinates, arc lengths of curves in cartesian and polar coordinates.

Coordinate Geometry:

Two Dimensions: Transformation of co-ordinates, equation of conics, its reduction to standard forms, pair of straight lines, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, circles and system of circles, orthogonal circles, radical axis and its properties, radical centers, coaxial circles and limiting points, equations of parabola, ellipse in cartesian and polar coordinates.

Three Dimensions: System of coordinates, projection, direction cosines, equations of planes and lines, angle between lines and planes, distance from a point to a plane, co-planner lines. Shortest distance between two given straight lines, standard equation of conicoids, sphere and ellipsoid.

PHY 1105: Physics-I

3.00 Contact Hour 3.00 Credit Hour

Structure of Matter: States of matter: solid, liquid, and gas. Classification of solids: amorphous, crystalline, ceramic and polymers; plasticity and elasticity, atomic arrangement in solid; different types of bonds in solids: metallic and Vander Waal's, covalent and ionic bond. Packing in solids; Inter atomic distances and forces of equilibrium; X-ray diffraction; Bragg's law, distinction between metal, insulator and semiconductor.

Electricity and Magnetism: Electricity: electric charges and Coulomb's law. The electric field: calculation of the electric flux and Gauss' law; some application of Gauss' law, electric potential, relation between electric potential and electric-field; capacitors: capacitance, dielectrics and atomic view, dielectric and Gauss' law; current and resistances: current density, ohm's law, resistivity-an atomic view, Ampere's law, Faraday's law; Lenz's law, self-inductance and mutual inductance.

Magnetic properties of matter: magneto motive force, magnetic field intensity, permeability, susceptibility; classification of magnetic materials, magnetization curves.

Modern Physics: Photoelectric effect, Compton effect, de-Broglie wave, Bohr atomic model, radioactive decay, half-life, mean life, isotopes; nuclear binding energy, alpha, beta, gamma decay.

Theory of Relativity: Michelson Morley's experiment, Galilean transformation, special theory of relativity, Lorentz transformation, relative velocity, length contraction, time dilation, mass energy relation.

HUM 1115: English

3.00 Contact Hour 3.00 Credit Hour

Introduction: Importance and Mastering various approaches to learning English.

Phonetics: Phonetic systems, correct English pronunciation.

Grammatical Problems: Grammar and usages.

Approaches to Communication: Communication today, business communication.

Methods of Writing: Business letter, tenders and quotations, resumes and job letters.

Comprehension: Paragraph writing, precise writing, amplification.

ME 1108: Foundry, Welding and Machine Shop Practice

3.00 Contact Hour 1.50 Credit Hour

Introduction: General shop safety practice; acquaintance with different marking tools, measuring tools, cutting hand tools; nomenclatures of cutting tools and gears.

Foundry: Introduction of molding, casting, pattern, core and bench; making a green sand mold using single piece pattern; casting process.

Welding: Acquaintance with arc and gas welding tools, electrodes, gas cylinders and flames; making a butt joint with the help of electric arc welding machine; gas cutting of MS sheets and plates.

Machine Shop: Acquaintance with single point cutter, drill bit, milling cutter and their operations and maintenance; Lathe machine: step and taper turning, thread cutting, drilling; milling machine: making a hexagonal head of a universal bolt using indexing; shaper machine: surface finishing.

EEE 1160: Basic Electrical Engineering Sessional

1.50 Contact Hour 0.75 Credit Hour

Laboratory experiments based on EEE 1159.

HUM 1116: Technical Report Writing & Presentation

1.50 Contact Hour 0.75 Credit Hour

Report Writing: Purpose of a report, classification of reports, organizing a report, writing short report, preparing complete analytical report, analysis and illustration of a report, problems in writing reports, journal articles, technical and scientific presentation.

5.1.2 Level-1 Term-II

CSE 1271: Computer Programming

3.00 Contact Hour 3.00 Credit Hour

Introduction: Introduction to computer hardware and its working principle, Programming logic, algorithms and flowcharts.

C/C++: Introduction, fundamentals of C and C++ programming languages, how to write and execute programs, how to do debugging and testing, C and C++ fundamentals-data types and expressions, operators, libraries and keywords, statements, arrays and strings, functions, control statements, pointers, input and output systems, object-oriented programming, Introduction to advanced programming.

CHEM 1203: Chemistry

4.00 Contact Hour 4.00 Credit Hour

Introduction: Introductory remarks on atomic structures and periodic tables.

Chemical Bonding: Types, properties, Lewis theory, VBT, MOT), hybridization and shapes of molecules, Selective organic reactions such as- addition, substitution, oxidation-reduction, alkylation and polymerization.

Phase Rule: Phase diagram of mono component system.

Solutions and their Classification: Unit expressing concentration, colligative properties of dilute solutions, thermochemistry, chemical kinetics, chemical equilibrium, pH and buffer solutions, and electrical properties of solution.

Glass Industry: Raw materials, classification, manufacturing processes, properties and application of glasses in chemical industries.

Ceramic Industry: Fundamental of ceramic industry, raw materials, property, manufacture and classification of ceramic products. Refractory materials: raw materials, properties, manufacture and classification of refractory materials.

Cement Industry: Raw materials, manufacturing, setting of cement, properties of cement.

Plastics and Fibers: Characterization and types of plastics, raw materials applications and manufacturing processes of plastics. Types of fibers, raw materials, applications and manufacturing processes of synthetic fibers.

Rubber: Source of natural rubber, chemical treatment of latex, raw materials, synthetic reactions and properties of synthetic rubber.

Environmental Pollution from Industry: Purification of industrial flue gases and gases from aerosols, effluents of industrial units and their purification, solid industrial wastes. Ecological problems of chemical technology: The problem of sustenance and the chemical industry.

Chemical Corrosion: Introduction to chemical corrosion, direct chemical corrosion, electrochemical corrosion, galvanic corrosion, atmospheric corrosion, open-air corrosion, corrosion in contact to soil, prevention of corrosion.

MATH 1201: Mathematics-II

3.00 Contact Hour 3.00 Credit Hour

Vector Analysis: Definition of vector, Equality of direction ratios and vectors, addition and multiplication of vectors, triple products and multiple products, differentiation of vectors, gradient of scalar functions, divergence and curl of point functions, physical significance of gradient, divergence and curl, integration of vectors (line, surface and volume integrals); Green's, Stoke's and Gauss's theorem and their application.

Matrices: Definition of matrix, algebra of matrices, multiplication of matrices, transpose of a matrix, inverse of matrix, rank and elementary transformation of matrices, solution of linear equations, linear dependence and independence of vectors, quadratic forms, matrix polynomials, determination of characteristic roots and vectors, null space and nullity of matrix, characteristic subspace of matrix.

PHY 1205: Physics-II

3.00 Contact Hour 3.00 Credit Hour

Geometrical Optics: Reflection and refraction by spherical surfaces, lenses, Combination of lenses, Equivalent lens and equivalent focal length. Defects of images formed by lenses, Monochromatic and chromatic aberrations, Spherical aberrations, astigmatism, coma, distortion and curvature of image, achromatism and achromatic combination of lenses.

Oscillations: Differential equation of Simple harmonic motion, combination of Simple harmonic motion, Lissajous figures, vibrating systems, undamped and damped oscillations, determination of damping co-efficient, forced oscillation, resonance, two-body oscillations.

Waves: Transverse and longitudinal nature of waves, progressive and stationary waves, power and intensity of wave motion, Energy calculation of progressive and stationary waves, interference of sound waves, wave velocity, group velocity and phase velocity. Sound waves: audible, ultrasonic, infrasonic and supersonic waves, beat, Meld's experiment, Doppler's effect and its application.

Acoustics: Intensity of sound, bell, acoustic intensity, architectural acoustics, noise insulation and reduction, sound distribution, Sabine's formula, room acoustics, requisites of a good auditorium.

Physical Optics: Theories of light, Huygens principle and construction, superposition of light waves.

Interference: Introduction, condition of interference, Young's double slit experiment, Interference by multiple reflection, Newton's rings.

Diffraction: Introduction, Fresnel & Fraunhofer diffraction, diffraction by single slit and double slit, plane diffraction gratings.

Polarization: Introduction, polarization by double refraction, Nicole prism, polarimeters, production and analysis of polarized light, optical activity, optics of crystals.

HUM 1211: বাংলা ভাষা ও সাহিত্য

2.00 Contact Hour 2.00 Credit Hour

ভাষাঃ বাংলা ধ্বনি ও বর্ণ, স্বর ও ব্যঞ্জন, স্বরধ্বনি ও স্বরবর্গ, ব্যঞ্জনবর্ণের উচ্চারণ, সংযুক্ত ব্যঞ্জনবর্ণ, সাধু ও চলিত ভাষা, বানানের নিয়ম, যতিচিহ্ন, বঙ্গানুবাদ।

নির্মিতিঃ দিনলিপি, অভিজ্ঞতা বর্ণনা, বক্তব্য লেখন, প্রতিবেদন তৈরি, ই-মেইল ও এসএমএস, ফেসবুক, পত্র লেখন, সংলাপ রচনা, ক্ষুদেগল্প লেখা, সংক্ষিপ্ত আলোচনা – একুশে ফেব্রুয়ারি, মুক্তিযুদ্ধ, বাংলা নববর্ষ, বাংলা উৎসব, ষড়ঋতু, বাংলা ভাষা, লোকসংস্কৃতি, মানবতা ও নৈতিকতা, বিশ্বায়ন, তথ্যপ্রযুক্তি।

কবিতাঃ বঙ্গবাণী, বঙ্গভাষা, খাঁচার ভিতর অচিন পাখি, নির্ঝরের স্বপ্নভঙ্গ, আজ সৃষ্টি সুখের উল্লাসে, বাংলার মুখ আমি, অমর একুশে, স্মৃতিস্তম্ভ, তোমাকে পাওয়ার জন্য হে স্বাধীনতা, আমার পরিচয়।

ছোটগল্পঃ পোস্টমাস্টার, বায়ুযানে পঞ্চাশ মেইল, পুঁইমাচা, মৌন নয়, নয়নচারা, একাত্তরের দিনগুলি, খাঁচা, অপঘাত।

প্রবন্ধঃ বাংলা ভাষা, সভ্যতার সংকট, তৈল, যৌবনে দাও রাজটিকা, বর্তমান বিশ্বসাহিত্য, আমাদের বাংলা উচ্চারণ, আমাদের আত্মপরিচয়।

নাটকঃ কবর।

CSE 1272: Computer Programming Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on CSE 1271.

CHEM 1204: Chemistry Sessional

3.00 Contact Hour 1.50 Credit Hour

Laboratory experiments based on CHEM 1203.

PHY 1206: Physics Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on PHY 1105 and PHY 1205

5.1.3 Level-2 Term-I

ME 2101: Engineering Thermodynamics

3.00 Contact Hour 3.00 Credit Hour

Introduction: Macroscopic and Microscopic points of view, definition of thermodynamic terms, heat, work and their path dependence.

Ideal Gas: Definition and suitability as thermodynamic fluid, equation of state, various thermodynamic processes, specific heats, internal energy, enthalpy.

Laws of Thermodynamics: Statement and their corollaries, criterion of reversibility and irreversibility, entropy, non-flow energy equation, internal energy, enthalpy, law of conservation of energy, perpetual motion machine of the first kind, limitation of the first law of thermodynamics, heat engines and heat pumps, specific heats, relation between specific heats, application of the first law to some common closed system processes, the first law as applied to open system, steady flow energy equation, applications of the steady flow energy equation, non-steady flow process, perpetual motion machine of the second kind, thermodynamics temperature scale, inequality of Clausius, entropy, temperature-entropy diagrams for gases and vapors, entropy changes for a perfect gas undergoing various reversible processes, principle of increase of entropy.

General Thermodynamics Relations: Exact differential, Maxwell's relations, derivation of some useful general thermodynamic relations, Gibbs function and Helmholtz, third law of thermodynamics.

Air Standard Cycles: Carnot cycle, Otto cycle, Diesel cycles, dual cycle, Stirling cycles, Ericsson cycle, Joule cycle, Brayton cycles and their applications, representation of various cycles on a p-V and T-S planes, cycle efficiency, air compressor and blowers.

Vapor Power Cycles: Vapor power cycle, Carnot cycle, Rankine cycle, reheat cycle and regenerative cycle, binary cycle, introduction to combined cycle, calculations of cycle efficiency.

Mixture of Gases and Vapors: Mixture of ideal gases, gravimetric and volumetric analysis, Dalton's law of partial pressure, volume and entropy of gaseous mixtures, isentropic process with gaseous mixtures, specific humidity, relative humidity, dew point, dry and wet bulb temperatures, adiabatic saturation, construction of psychometric chart and its uses

Fuels and their Properties: Types of fuels, formation of coal and petroleum fuel, grading of coal, calorific value of fuels and its measurement, freezing point, flash point, boiling point, viscosity of liquid fuels, modern development of solid, liquid and gaseous fuels, nuclear fuels.

ME 2103: Engineering Mechanics-I

4.00 Contact Hour 4.00 Credit Hour

Introduction: Fundamental concept and principles of mechanics, Resultant of several concurrent forces, resolution of forces into components.

Equilibrium of Particle: Free body diagram, Principle of transmissibility of forces and force couple system, Moment of a couple, equivalent couple, equivalent system of force couple systems, reduction of a system of forces.

Centroids and Center of Gravity: Centroids and CG of area and volume, Moment of inertia of area and mass, radius of gyration, parallel axes theorem, product of inertia, ellipsoid of inertia.

Analysis of Structure: trusses and frames.

Law of Friction: Equilibrium under frictional resistance, sliding friction, wedges and square threaded screw, Journal and thrust friction, rolling and belt frictions.

Kinematics of Particles: Rectilinear and curvilinear motion of particles, determination of motion of a particle, motion of several particles, rectangular components of velocity and acceleration, Motion relative to frame in translation, tangential, normal, radial and transverse components.

Kinematics of Rigid Bodies: Translation, rotation about a fixed axis, general plane motion, absolute velocity and acceleration, angular momentum, relative velocity and acceleration, Coriolis acceleration.

Kinetics of Particles: Newton's second law of motion, linear and angular momentum, radial and transverse components of motion, motion under a central force, satellite motion, equation of orbit, conditions of orbiting and escape, cycle time, changing of orbit.

Kinetics of Rigid Bodies in Two and Three Dimension: Translation, Rotation about a fixed axis, absolute/Relative velocity and acceleration in plane motion, instantaneous center of rotation, angular momentum, application of the principle of impulse and momentum, motion of a rigid body in three dimensions.

Energy and Momentum Methods: Principle of work and energy and its application, power and efficiency, potential energy, conservation of energy and its application to space mechanics, Direct and oblique central impact.

Plane Motion of Rigid Bodies: Equation of motions for a plane body, angular momentum and its rate of change, constrained plane motion; principle of work and energy, eccentric impact, systems of rigid bodies.

ME 2111: Numerical Analysis

3.00 Contact Hour 3.00 Credit Hour

Numerical Analysis: Solutions of linear equations: iterative method, Newton-Raphson method, Gauss's method, matrix method, iteration method.

Interpolation: Finite differences, interpolation formula, Newton's formula for forward and backward interpolation. Lagrange's interpolation formula, Stirling's interpolation formula, Gauss's central difference formula, Bessel's interpolation formula.

Numerical Differentiation: Use of interpolation formula, graphical method.

Numerical Integration: General formula for equidistant ordinates, trapezoidal rule, Simpson's rule, Gauss's formula. Use of Lagrange's interpolation, graphical integration.

Solutions of Differential Equations by Numerical Methods: Solution by Taylor's series, Picard's method, Euler's method, Runga-Kutta method.

Finite Element Method: Introduction of finite element method in engineering, finite element modeling.

HUM 2117: Economics

2.00 Contact Hour 2.00 Credit Hour

Money management: Engineering economic decisions; Time value of money; Market and effective interest rates; Equivalence calculation under inflation.

Evaluating business and engineering assets: Present worth, annual equivalence and rate-of-return analysis; Resolution of multiple rates of return.

Development of project cash flow: Accounting for depreciation and income taxes; Project cash flow analysis; Handling project uncertainty. Replacement decisions; Benefit-cost analysis.

MATH 2101: Mathematics-III

3.00 Credit Hour 3.00 Contract Hour

Ordinary Differential Equations: Formulation of Differential Equations. Degree and order of Ordinary differential equations, Solution of first order but higher degree differential equations Solution of first order differential equations by various method Solution of general linear equations of second and higher orders with constant co-efficient. Solution of Homogeneous linear equations and its applications. Solution of differential equations by the methods based on the factorization of the operators, Frobenious methods, Bessel's functions, Legendre's polynomials and properties

Partial Differential Equations: Introduction, Linear and nonlinear first order equations. Standard forms of linear equations of higher order, Equation of second order with variable coefficients. Wave equations, Particular solutions with boundary and initial conditions.

ME 2100: Mechanical Engineering Drawing

3.00 Contact Hour 1.50 Credit Hour

Fundamental Concepts: Introduction to pictorial drawing, drawing equipment and use of instruments, size description, scale, dimensioning rules.

Views and Projections: First angle, third angle projections, Orthographic projections, Isometric views, generation of views of solid bodies in different planes, sectional views, auxiliary views.

Application: Fasteners, gears, keys and springs; Sectional views and conventional practices; Auxiliary views; Specifications for manufacture;

Auto CAD: Introduction to CAD and its applications in working drawings; Surface development and intersections, Basic 3D drawing commands and drafting of 3D drawings on computer.

ME 2102: Engineering Thermodynamics Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on ME 2101.

ME 2104: Engineering Mechanics-I Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on the theory of ME 2103.

ME 2112: Numerical Analysis Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional using MATLAB to solve problems based on ME 2111.

5.1.4 Level-2 Term-II

ME 2207: Engineering Metallurgy

3.00 Contact Hour 3.00 Credit Hour

Metals and Alloys: Industrially significant properties of metals, Malleability, Ductility, Hardness, Toughness, Fatigue resistance, Destructive and non-destructive tests applicable to metals.

Crystal Structure of Metals: Types of crystal lattice, solidification of metals and alloys, nucleation, grain growth, cooling curves, variables affecting solidification, equilibrium diagram for binary alloys, interpretation of equilibrium diagram, structure and properties of metals and alloys related to equilibrium, Iron-Iron carbide equilibrium diagram, plain carbon steel and their micro-structure, crystal defects, dislocation theory.

Heat Treatment: Methods and effects of hardening, annealing, normalizing, quenching, tempering, austempering, case hardening process, precipitation process, nitriding, edge hardening, TTT diagram, S-curve.

Production, Properties and Uses: Ferrous materials, pig iron, wrought iron, cast iron, types of cast iron, production of steels, their types: Bessemer and open hearth processes, alloy steels, carbon steels.

Production Methods: Properties and uses of copper, Aluminum, Nickel, Tin and lead, alloys of noble metals, bearing materials, spring materials.

Metallurgical Aspect of Metal Joining: Surface treatments, plating, metal coating, metal spraying.

Powder Metallurgy: Introduction, powder metallurgy processes, preparation of metal powders, characteristics, mixing, compacting, sintering, application.

Composite Materials: Introduction to composite materials, importance of composite materials and uses, Latest developments in material science.

ME 2209: Mechanics of Solids

3.00 Contact Hour 3.00 Credit Hour

Simple Stress and Strain: Introduction, analysis of internal forces. Tension, compression, shear stress, axial stress in composites. Shearing, bending, centrifugal and thermal stresses, strain and deformation, stress-strain diagram, elasticity and elastic limits,

Modulus of Elasticity and Rigidity: Definition of some mechanical properties of materials, Poisson’s ratio, volumetric strain and bulk modulus. Relation between modulus of elasticity and bulk modulus, statically indeterminate members. Stresses in thin walled pressure vessels.

Statically Determinate Beams: Introduction, different types of loading and supports, shear force and bending moment diagram, various types of stresses in beams, flexure formula, economic sections, shearing stress in beam, general shear formula, deflection of beams, elastic curve, method of double integration, area moment and super-position methods, shearing stress and deflection in composite beams.

Statically Indeterminate Beams: Redundant supports in propped and restrained beams, solution by double integration. Area moment and superposition methods, design of restrained beams, continuous beams, three moment equation, determination of support reactions of continuous beam, shear and moment diagram.

Torsion: Torsion formula, angle of twist of solid and hollow shaft, torsional stiffness and equivalent shaft, classed coil helical spring.

Combined Stresses and Strains: Principal stresses and principal planes, combined axial and bending stresses, stress at a point, stress on inclined cutting planes, analytical method for the determination of stresses on oblique section, Mohr's circle, application of Mohr's circle to combined loading. Transformation of strain components, strain rosette. Relation between modulus of rigidity and modulus of elasticity.

Column Theory: Introduction to elastic stability, Euler's formula for central load and different end conditions, modes of failure and critical load, slenderness ratio and classification of columns, empirical formula for columns, secant formula for columns with eccentric loading.

EEE 2259: Electrical Machines and Electronics Technology

4.00 Contact Hour 4.00 Credit Hour

Balanced three-phase circuit analysis and power measurement. Single phase transformer-equivalent circuit and laboratory testing, introduction to three-phase transformer. DC generator: principle, types, performances and characteristics. DC motor: principles, types of motor, performances, speed control, starters and characteristics. AC machines: three phases.

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.

MATH 2201: Mathematics-IV

3.00 Contact Hour 3.00 Credit Hour

Statistical Analysis: Regression and correlation analysis, curve fitting, method of least square, elementary probability theory, random variable, probability distribution function, moment generating function, binomial distribution, negative binomial distribution,

geometric distribution, Poisson distribution, normal distribution, exponential distribution, physical significance and practical examples of such distributions, law of large number and central limit theorem, estimation, hypothesis testing.
Fourier Analysis: Real and complex form. Finite transform: Fourier integral, Fourier transforms and their uses in solving boundary value problems.
Complex Variables: Complex number system, general functions of a complex variable, limits and continuity of a function of complex variable and related theorems, complex function, differentiation and the Cauchy-Riemann equations. Line integral of a complex function, Cauchy's integral formula, Liouville's theorem, Taylor's and Laurent's theorem, singular residues, Cauchy's residue theorem.
Laplace Transform: Definition, Laplace transforms of some elementary functions, sufficient conditions for existence of Laplace transform, inverse Laplace transforms, Laplace transforms of derivatives, the unit step function, periodic function, some special theorems on Laplace transform, partial fraction, solutions of differential equations by Laplace transform, evaluation of improper integral.

HUM 2211: স্বাধীন বাংলার অভ্যুদয়ের ইতিহাস

2.00 Contact Hour 2.00 Credit Hour

সূচনা, দেশ ও জনগোষ্ঠীর সংক্ষিপ্ত ইতিহাস। সাম্প্রদায়িক রাজনীতি এবং দ্বিজাতিতত্ব, লাহোর প্রস্তাব এবং তার বৈশিষ্ট্য। পাকিস্তান রাষ্ট্রীয় কাঠামো, পূর্ব ও পশ্চিম পাকিস্তানের মাঝে বৈষম্যের চিত্র। ভাষা আন্দোলন ১৯৫২, বিভিন্ন পর্যায় এবং কর্মসূচী, ২১ শে ফেব্রুয়ারি, বাংলা ভাষার অধিকার প্রতিষ্ঠা। গণতান্ত্রিক রাজনীতির সূচনা, যুক্তফ্রন্ট গঠন, যুক্তফ্রন্টের ২১ দফা, ১৯৫৪ এর নির্বাচন, ফলাফল ও প্রভাব আইয়ুব খানের সামরিক শাসন, ৬৫ এর প্রেসিডেন্ট নির্বাচন, আইয়ুব বিরোধী আন্দোলন। স্বাধিকার আন্দোলনের সূচনা, বাঙ্গালী সংস্কৃতির জাগরণ, শেখ মুজিবুর রহমানের ৬ দফা আন্দোলন, আগরতলা ষড়যন্ত্র মামলা। ৬৯ এর গণঅভ্যুত্থান, ১১ দফা আন্দোলন, শেখ মুজিবের বঙ্গবন্ধু উপাধি লাভ। ৭০ এর নির্বাচন, ৭ মার্চের ভাষণ, ২৫ মার্চের গণহত্যা, বঙ্গবন্ধুর স্বাধীনতা ঘোষণা। মুক্তিযুদ্ধ ১৯৭১, মুজিবনগর সরকার, সশস্ত্র বাহিনীর যুদ্ধযাত্রা, স্বাধীন বাংলা বেতার কেন্দ্র, বিদেশী বন্ধু এবং রাষ্ট্রের সহযোগিতা, সাধারণ জনগণের যুদ্ধে অংশগ্রহণ, রাজাকার, আলবদর বাহিনীর নাশকতা, শরণার্থীদের চিত্র, চূড়ান্ত জয়লাভ এবং বঙ্গবন্ধুর স্বদেশ প্রত্যাবর্তন।

HUM 2219: Accounting

2.00 Contact Hour 2.00 Credit Hour

Fundamentals: Definition of accounting, accounting concept and convention, definition of book keeping, objects and advantages of book keeping, principles of double entry book keeping.
The Nature of Transaction: Classification of accounts, rules for debit and credit, kinds of cheques and treatment of cheques in accounts.
Journal: Journal posting, balancing and closing,

Trial Balance: Introduction to trial balance, functions, preparation of trial balance, limitations of trial balance, financial statements, analysis of financial statement.
Cost Accounting: Introduction, reasons for cost accounts, recorded cost, estimated cost, standard cost, elements of cost, cost statement, sources of cost data, distribution of overhead charges, stores ledger, marginal costing, break-even point, margin of safety, p/v ratio
Budgeting: Types of budgets, preparing budgets and budgetary controls.

ME 2208: Engineering Metallurgy Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 2207.

ME 2210: Mechanics of Solids Sessional

1.50 Contact Hour 0.75 Credit Hour

Experiments based on ME 2209.

EEE 2260: Electrical Machines and Electronics Technology Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on EEE 2259.

5.1.5 Level-3 Term-I

ME 3101 Heat Transfer –I

3.00 Contact Hour 3.00 Credit Hour

Basic modes of heat transfer; General conduction equation; Steady state conduction in different geometries and composite structures; Thermal contact resistance; Unsteady heat conduction in solids; Laws of radiation heat transfer; Radiation shape factor; Radiation interchange between two surfaces; Gas radiation; Heat and momentum transfer associated with laminar and turbulent flows of fluids in forced convection; Velocity and thermal boundary layer developments in tubes (ducts) and over flat plate; Natural convection heat transfer; Heat transfer mechanism with change of phase; Boiling and condensation: mechanism and heat transfer correlations; Mechanism of mass transfer by diffusion, convection and change of phase; Analogy between heat and mass transfer.

ME 3103: Engineering Mechanics-II

3.00 Contact Hour 3.00 Credit Hour

Mechanics of Machinery: Simple mechanism, inertia and kinetic energy of rotation and reciprocating parts, turning moment diagram, fluctuation of energy and speed, fly wheel balancing of stationary, rotating and reciprocating masses, balancing of in-line engines, principle of direct and reverse cranks in balancing problems, balancing machines, belt, rope and chain drives, law of gearing forms of tooth and types of gear, gear trains and their arrangements, analytical and tabular methods of simple, compound and epicyclic gear trains, compound epicyclic trains and their applications, torque transfer by gear train, types of governor and governing, working principles of different types of governor, controlling force curves, governor stability, sensitiveness, effort and power of governor, cam and follower, various profiles of cams and their motions, gyroscopic couple and processional motion.

Vibration: Free, forced and damped vibration of systems having one degree of freedom, beat, resonance and transient phenomena in forced vibration, torsional oscillation of shafts, whirling of shafts, transverse vibration of shafts, simple pendulum treated by energy method, simple situation of vibration with two degree of freedom having elastic constraints, torsional oscillation of shafts with multi rotors, self-excited vibration, vibration measurement and measuring instruments, elastic suspension of machinery for isolation of vibration, vibration isolation and transmissibility; isolation materials; vehicle suspension, vibration absorber.

ME 3105: Fluid Mechanics-I

3.00 Contact Hour 3.00 Credit Hour

Introduction: Fundamental concepts, viscosity, compressibility and elasticity, surface tension and capillarity, vapor pressure, manometer.
Fluid Statics: Pressure at a point, pressure gradient, pressure on flat and curved surfaces immersed in fluids, center of pressure. Buoyancy and flotation, metacenter and metacentric height, stability of submerged and floating bodies, fluid containers subjected to constant acceleration and rotation;
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. Euler's' equation and Bernoulli's' equation. Hydraulic grade line and energy grade line. Energy equation with or without losses, comparison of energy equation with Bernoulli's equation, kinetic energy correction factor. Transient flow in emptying of tank and flow between connected vessels. Flow measuring devices. Flow through sharp edged orifice, the pitot tube, the Venturi-meter, the flow nozzle and orifice meter, notches and sharp crested weirs.

Momentum equation for inertial control volume, application of momentum principle for incompressible fluids in variable area duct. Impact of jet on fixed and moving vanes. Application of momentum principle for jet propulsion and propellers. Momentum correction factor: Force caused by a flow round a pipe-bend, force at nozzle and reaction of a jet, force on solid body in a flowing fluid.
Dimensional Analysis: Fundamental & derived units, dimensional homogeneity, Buckingham theorem, significance of dimensionless numbers, application of dimensional analysis in fluid flow problems.

ME 3113: Machine Design-I

3.00 Contact Hour 3.00 Credit Hour

Introduction: Objectives of machine design, basic requirements for the design of machine elements and machines, approach to design, design methods and procedures, system design cycle.
Stress Analysis: Simple and combined stress; material and their properties, manufacturing considerations in design.
Theories of Failure: Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.
Joints: Power screw, screwed joints, riveted joints, welded joints, gaskets and gasket joints.
Springs: Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.
Columns: Design of column with central and eccentric loading.
Shaft Design: Design for fully reverse banding and steady torsion. Design for fluctuating banding and fluctuating torsion. Shaft deflection.
Key and Keyways: Types of keys, stresses in keys, key design, stress concentration in keyways.

HUM 3111: Sociology

2.00 Contact Hour 2.00 Credit Hour

Introduction: Nature, scope, aim and rise of industrial sociology. History of industrialization- ancient and modern. The development of industry and industrial society in Bangladesh.
The Concept of Work: Work and art, nature of industrial work, work ideology, work values. Role of work in man's life: work and mental health, work attitudes, work involvement. The motivation to work, work satisfaction, commitment to industrial work, development and commitment of industrial labor force in Bangladesh.
The Worker and the Factory: The factory system, its characteristics. The formal relations of production in the factory system.

The Industrial Bureaucracy: The executive in the industrial bureaucracy.
The Role of the Worker: Industrial production and the worker's role, social relations at work. Management as a social elite.
Industry and Community: Industry and family, industry and social change, shifting values, influence of convictions, religion and industrial development. Place of industrial worker in the society.
Industry and Social Stratification: Nature and causes of industrial conflict, role and functions of trade unionism, resolution of industrial conflict, collective bargaining.
Industrialization and Development: Patterns of industrial development in developing countries, role of foreign capital and borrowed technology. Technology and social structure.

HUM 3113: Engineering Ethics

2.00 Contact Hour 2.00 Credit Hour

Introduction: Introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering. Societal and environmental responsibilities of engineers, sustainable practices in engineering, safety, risk and liability in engineering practices.
Ethical Philosophy: Introduction to Philosophy of Engineering, The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice; Ethics Issues in Mechanical Engineering;
Ethical Codes and Standards: Professional Engineering Codes, Codes of Ethics (IEB); Code of Ethics (ASME).
Case Studies: Ethical problem-solving techniques; Case study methodology, different case studies.

ME 3104: Engineering Mechanics-II Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on ME 3103.

ME 3106: Fluid Mechanics-I Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 3105

ME 3114: Machine Design-I Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 3113.

ME 3116: Capstone Project

3.00 Contact Hour 1.50 Credit Hour

In this course students are required to undertake a design of a small electro-mechanical or instrumentation system. Use of locally available prospects materials will be emphasized. The capstone courses require students to draw upon all previous coursework and cultivate new skills in order to solve complex design problems associated with an assigned group project. The system design would involve the stages of concept building, engineering calculations, fabrication, presentation and demonstration of product. Emphasis is to be given in project management for solving Engineering problems to meet the socio-economic development. Lectures will be provided in the technical and project management aspects of the individual project selected

5.1.6 Level-3 Term-II

ME 3201 Heat Transfer –II

3.00 Contact Hour 3.00 Credit Hour

Concept of Thermal System Design: Heat transfer requirements, mechanical design, design parameters, materials, cost and economics, safety and reliability, choice and availability, optimization, cyclic service.
Heat Transfer from Finned Surface: Basic fin design, types of fins, fin performance, efficiency of fins, equation of heat transfer from fins, analysis of unsteady heat conduction.
Heat Exchangers: Parallel flow, counter flow, cross flow, shell-and-tube, mixed and unmixed, single and multiple pass heat exchangers. Thermo-fluid characteristics and sizing of heat exchangers, fouling of heat exchangers, performance of heat transfer equipment, the log mean temperature difference, effectiveness-NTU method; F correction factor.
Two-phase Heat Transfer Equipment: Boiler, Evaporator, Condenser, Cooling tower.
Thermal Systems with Internal Heat Source: Modeling of thermal equipment.

Advanced Topics on Heat Exchangers: Micro-channel heat exchangers, additive manufacturing of heat exchangers, heat exchangers in fluid machinery, aerospace and electro-mechanical applications.

ME 3205: Fluid Mechanics-II

3.00 Contact Hour 3.00 Credit Hour

Incompressible Viscous Flow: Viscous flow in pipes, laws of fluid friction. Froude's experiment, Darcy-Welsbach equation. Chezy, Manning and Hazen-Williams' formulae; Laminar flow, shear and pressure gradient in laminar flow, Hagen-Poiseuille law. Laminar flow through inclined pipes, annulus and parallel plates. Shear stresses in turbulent flow. Eddy viscosity, expression for friction factor in turbulent flow. Energy correction factors for laminar and turbulent pipe flow. Moody chart and its use. Flows in pipe network. Pipe line system design.
Boundary Layer Theory: General concept, boundary layer thickness, characteristics of boundary layer, boundary layer on a flat plate with zero pressure gradient, friction drag due to boundary layers, effect of pressure gradient, transition for flat plate flow. Separation, wake behind a cylinder. Flow around submerged objects, airfoil.
Open Channel Flow: Chezy equation, Ganguillet-Kutter, Bazin and Manning's Formulae, Optimum shape of flow cross section, Specific energy and critical depth, Froude number and its significance in channel flow, Hydraulic jump.
Ideal Fluid Flow: Rotational and irrotational motions, Circulation and vorticity, Velocity potential, Stream function, Relationship between stream function and velocity potential, Stream lines, Equipotential lines and flow-nets, Vortex motion, Free and forced vortex motion, Doublet, Simple flows, Superposition of simple flows, Flow around a cylinder with and without circulation, Magnus effect and aerodynamic lift, Outline of Navier Stoke equation.

ME 3207: Measurement, Instrumentation and Quality Control

3.00 Contact Hour 3.00 Credit Hour

Measurement
Basic Principles of Measurement: Measuring and recording methods, instrument calibration; measurement of displacement, pressure, temperature, heat-flux, flow, motion and vibration, force, torque, strain, etc.; data acquisition, analysis and processing, sources of error in measurements, error analysis.
Techniques: Techniques for maintaining standards, allowances and tolerance. Types of tolerance, grades of manufacturing accuracy, limits and fits, types of fits. Basic hole system and basic shaft system, selective assembly and interchangeable manufacturing, limit gauges, Taylor's principle of limit gauging.

Instrumentation

Sensors: Sensors for measuring stress, strain, pressure, temperature, position, velocity etc., signal conditioning techniques using Wheatstone bridge, operational amplifiers.

Quality Control: Objectives, quality and quality assurance, TQM; concepts and tools, statistical quality control (SQC), concepts of control charts, control charts for variables and attributes e.g. X, R, C, P etc. charts, drawing of control charts and selection of subgroups, acceptance sampling and sequential sampling.

Quality Assurance Programs: ISO, SA standards, requirements and certification procedure.

ME 3213: Machine Design-II

3.00 Contact Hour 3.00 Credit Hour

Design and Selection: Design and selection of sliding contact bearing, antifriction (ball and roller) bearing, Journal and plane surface bearing, Design of spur (loading and stresses), helical, bevel and worm gears, Design and selection of flexible power transmission elements, Belt (flat, v-belt, vv belt), chain (single and multi-strand) and rope drives, Design of brake and clutches.

IPE 3277: Production Process

3.00 Contact Hour 3.00 Credit Hour

Casting: Methods of sand casting, design of patterns, properties of molding sand, core and core making, casting in metallic and non-metallic moulds, die casting, centrifugal casting, precision investment casting, continuous casting. Defects of casting, causes and prevention.

Chip-less Metal Forming Process: Hot and cold working processes, rolling, properties of rolled products, cold drawing, forging, coining, stretching, bending, squeezing, extrusion, machines and tools for metal forming processes. Metal shearing operations, stamping, press and press tools.

Welding and Allied Processes: Gas welding: principle, equipment used, gas storage and safety measures. Gas cutting. Arc welding: principle, equipment used; AC and DC arc welding, electrodes, shielded arc welding: TIG, MIG and plasma arc welding; electrical resistance welding.

Special Welding Techniques: Thermit welding, LASER beam welding, brazing, soldering and braze welding, continuous welding. Welding job preparation, weldability, welded joint inspection, welding defects and causes of defects.

Metal Cutting Processes: Chip formation, types of chips, chip breakers, cutting forces, cutting fluid, tool geometry, cost and life of tool.

Machining Process: Lathe machine and accessories, types of lathes, drilling and other hole making machines, shapers and planners, milling, Gears and threads: manufacturing and related machines.

Finishing Operation: grinding, honing, lapping, super-finishing etc.
Modern Manufacturing Processes: ECM, EDM, USM etc., processing of synthetic materials.

ME 3202: Heat Transfer Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on ME 3101 and ME 3201.

ME 3206: Fluid Mechanics-II Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 3205.

ME 3208: Measurement, Instrumentation and Quality Control Sessional

1.50 Contact Hour 0.75 Credit Hour

Experiments based on ME 3207.

ME 3214: Machine Design-II Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 3213.

IPE 3278: Production Process Sessional

1.50 Contact Hour 0.75 Credit Hour
Sessional based on ME 3277.

5.1.7 Level-4 Term-I

ME 4101: Internal Combustion Engines

3.00 Contact Hour 3.00 Credit Hour

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 turbines; 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 engines, design considerations, application of principle of similitude engine design.
Compressors and turbines: Compression processes, volumetric efficiency, multistage compression, intercooling; various types of compressors and gas turbines.

ME 4105: Fluid Machinery

3.00 Contact Hour 3.00 Credit Hour

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, cavitation of turbines, torque converter and fluid couplings, hydraulic crane.
Reciprocating Pumps: Working principle of reciprocating pump. Types of reciprocating pumps, work done by reciprocating pump, coefficient of discharge, slip, cavitation of reciprocating pumps, effect of acceleration of piston on velocity and pressure in the suction and delivery pipes, indicator diagrams, effect of air vessels on suction and delivery line.
Centrifugal Pumps: Work done and efficiency of centrifugal pumps, advantage over reciprocating pumps, types of centrifugal pumps, minimum starting speed, least diameter of impeller, limitation of suction lift, characteristics curves, priming, troubles and remedies, specific speed and model testing, pumps in series and in parallel, deep tube well, multistage pumps, turbine pump, selection of pumps, introduction to impeller design.
Compressor and Blower: Types and working principles, axial flow pumps, jet pump, single and double jet pump, fan, blower.
Unsteady Flow: Introduction, inertia pressure, water hammer, surge tanks.
Gas Dynamics: One dimensional compressible fluid flow, energy relation for isentropic and isothermal flow, pressure wave propagation, Mach cone, stagnation properties, Converging diverging nozzles, subsonic and supersonic flow, normal shock relations, Fanno line and Rayleigh line.

ME 4117: Refrigeration and Air Conditioning

3.00 Contact Hour 3.00 Credit Hour

Refrigeration

Introduction: Applications of refrigeration, method of producing refrigeration, steady-flow energy equation, Carnot cycle and reversed Carnot cycle, coefficient of performance.

Vapor Compression Refrigeration Systems: Simple vapor compression refrigeration cycle, P-h and T-S diagrams, actual cycle and its analysis, volumetric efficiency of reciprocating compressors, study of compressor, condenser, expansion device and evaporator used in a refrigeration system.

Refrigerants: Classification and designation of refrigerants, primary and secondary refrigerants, azeotropes, desirable properties of refrigerants, applications of specific refrigerants, thermodynamic comparison of some common refrigerants.

Multi-pressure Refrigeration Systems: Applications, removal of flash vapor, inter-cooling, analysis of few multi-pressure systems.

Absorption Refrigeration: Simple and practical absorption refrigeration systems, coefficient of performance, absorbent-refrigerant combinations, comparison of vapor-compression and absorption refrigeration system, electrolux and commercial system of refrigeration.

Air-Cycle Refrigeration: Applications, Closed and open air-cycles, simple cycle and bootstrap cycle for aircraft air conditioning.

Steam-Jet Refrigeration: Applications, description and working principles of the system.

Low Temperature Refrigeration: Vapor compressor - cascade system, liquifiction of gas - air and Helium.

Manufacturing Dry Ice: Carbon dioxide, magnetic cooling, heat pump: refrigerant circuit, performance of heat pump, application of heat pump.

Solar absorption refrigeration, vortex tube refrigeration, thermoelectric refrigeration.

Air Conditioning

Psychometrics: Properties of air and water-vapor mixture, psychometric chart and its construction, various psychometric processes, psychrometers, combined heat and mass transfer between a wetted surface and moist air.

Air Conditioning Load Calculations: Thermal comfort. Comfort chart, inside and outside design conditions, heat transmission coefficients for building structures, heating and cooling load items and their calculations, determination of dehumidified air quantity, selection of cooling and dehumidifying coils, selection and specifications of an air conditioning equipment, basic types of air conditioning systems, design of air conditioning system, application of air-conditioning.

Conditioned Air Distribution Systems: Duct types, materials and constructions, duct layout and design, fan selection.

Chilled/Hot Water Distribution Systems: Direct and reversed systems, pipe layout and design, pump selection.

Refrigeration and Air Conditioning Controls: Reasons for use of controls in refrigeration and air conditioning systems, pneumatic, hydraulic, electric and electronic controls.
Food Processing and Preservation: Chilling, freezing, and free-drying, candy manufacturing, bakery products, fruits, vegetables.

IPE 4115: Industrial Management

3.00 Contact Hour 3.00 Credit Hour

Management Fundamentals: Scope, function and role of management, management and administration, role of manager.
Development of Management Thoughts: Taylor's scientific management theory, contribution of H. Fayol, E. Mayo, Gilbreths and other pioneers, classical management theory, principles of management.
Planning and Decision Making: Strategic management, planning process and organizational goal: MBO-nature and purpose, MBO process and effectiveness, managerial decision making: the nature of decision making and decision-making process, portfolio analysis: SWOT, BCG, SPACE etc.
Organization: Fundamentals, organization variables, organizational structure, span of control, authority, responsibility and accountability, centralization and decentralization, organization culture, reorganizing, organization development.
Personnel and Human Resources Management: Functions, personnel policies, manpower planning, recruitment and development, leading and motivating: Types of leadership and styles, theory of leadership, morale and motivation, motivation theories and morale building plans, individual and group behavior, job enlargement and enrichment, performance appraisal/ merit rating, job evaluation, salary, wages and wage incentive plans, fringe benefits.
Marketing: Concepts of marketing mix, product life cycle, marketing decision making, industrial and consumer selling, channel of distributions, sales promotion, patent and trade mark, marketing research, development of new product.
Management Information System: MIS application of computer in management and decision making (DSS).
Global Management: Comparison of management systems of USA, Japan and China.
Financial Management: Financial analysis, ratio analysis, different types of ratios and their uses, limitations and trend analysis, time value of money, decision making based on PW, EUAW, B/ C ratio, break even analysis, value engineering.
Safety Management and Emergency Planning: Preventive and break down maintenance, occupational safety, fire and explosion hazards, industrial safety, electrical hazards.

ME 4102: Internal Combustion Engines Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on ME 4101.

ME 4106: Fluid Machinery Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 4105.

ME 4000: Project/Thesis

6.00 Contact Hour 3.00 Credit Hour

Experimental and theoretical investigation of various problems related to Mechanical engineering. The topic should provide an opportunity to the student in developing initiative, creative ability and engineering judgment. Individual or group study (preferably not more than two in a group) will be required.

At the end of Term, the student is expected to complete the preliminary literature survey, select the topic for study- each student/group is expected to take part in the presentation of a least one seminar in the term, the seminar/seminars will be conducted on their respective Thesis/ Project topic, Complete theoretical study on the topic and submit a detailed report for evaluation.

5.1.8 Level-4 Term-II

ME 4217: Power Plant Engineering

3.00 Contact Hour 3.00 Credit Hour

Introduction: Sources of energy, Types of power plants and its modern trend, survey of power plants in Bangladesh.

Variable Load Problems: Principle of optimization, its application to power system planning and design and technical operation.

Power Plant Economics: Theory of tariffs Instrumentation in power plants, selection of plants, advantages, disadvantages and comparisons of different types of power plant.

Diesel Engine Power Plants: Scope, arrangements, air fuel system, cooling system and lubrication system, starting methods.

Steam Power Plants: Furnaces, Stokers and burners, fuels, fuel handling, combustion equipment, boilers, steam turbines- reheat, regenerative, superposed, binary and combined

cycles, condensers, evaporators and cooling towers, gas loop and water loop, steam piping and insulations, installation and operation, overall plant efficiency.
Hydro-electric Power Plants: Types of operation, site selection, turbine selection, seasonal and intermittent plants, components of the plant, efficiency, governing of water turbines.
Gas Turbine Power Plants: Scope, cycle analysis, installation, intercooling, regeneration and reheating, governing and maintenance.
Nuclear Power Plant: Types of reactors, layout of nuclear power plant, waste disposal.
Power Plant Accessories: Draft systems, chimney design, water-cooling systems, water conditioning and industrial water treatment.
Electrical Power Transmission: Basic concepts, types of transmission and distribution systems, instrumentation in power plants.
Solar Energy: Availability of solar energy, solar devices, direct production of electricity, solar thermal energy conservation system.

ME 4219: Automobile Engineering

3.00 Contact Hour 3.00 Credit Hour

Introduction: General classification of motor vehicles, layout and main components, specification of an automobile. Performance of an automobile, calculation of total loads, tractive effort and propulsive power.
Chassis: Frame and body, suspension system, springs, wheels and tires.
Engine: Types, comparison, rating and specification, constructional details of automobile engine, engine mounting, engine cooling and lubricating systems, exhaust system, emission control.
Transmission: Clutch, gear box, propeller shaft, universal joint, final drive, differential, rear axle and front axle, over drive, under drive.
Automobile Control System: Steering system, brakes and braking system, speed control and governing. Automatic control system.
Automobile Electrical System: Battery and its maintenance, battery charging, generator and charging system, the cutout starting system, Bendix drive and Solenoid drive, self-starter, lighting and wiring system.
Ignition System: Components, ignition timing and ignition advance, magnetos, carburetion and fuel injection system, firing order.
Repair and Maintenance: Servicing, tuning, overhauling, inspection and testing, trouble shooting, safety measures.
Recent Advancement in Automobiles: EFI system, variable valve timing, automatic clutch and gear-change, pollution control.
C. N. G.: Production, processing, conversion of petrol and diesel engines to CNG vehicles.

ME 4233: Mechatronics

3.00 Contact Hour 3.00 Credit Hour

Mechatronics, Sensors and Transducers: Introduction to mechatronics systems, measurement systems and control systems, open and closed loop systems. Sensors and transducers: Introduction to sensors and transducers, sensor characteristics, classification of sensor. Sensors for displacement, position, proximity, velocity, motion, force. Torque and tactile sensors. Pressure, temperature, light sensors. Ultrasonic sensors; range sensors.
Actuation Systems: Linear and rotary actuators. AC and DC motors, stepper motor, servo motor. Fluid power actuators, smart actuators.
System Modeling and Control: Introduction to signals, systems and controls. System representation: Transfer function form, block diagram form. Linearization of nonlinear systems; time delays; measurement of system performances.
Modeling of mechanical, electrical, fluid and thermal systems. Rotational-transnational systems, electromechanically systems.
Control Systems Design: Introduction. Classical design: transfer functions, frequency response analysis, root locus, bode plots, state-space design. Proportional-integral-derivative (PID) control, digital control, robust control, intelligent control.
Programming Logic Controllers: Introduction to PLC, basic structure, input/output processing; PLC programming, applications of PLC.

IPE 4207: Tool Engineering & Machine Tools

3.00 Contact Hour 3.00 Credit Hour

Tool Engineering
Work Holding Devices: Degrees of freedom, principles of location, locating methods, locators, clamping devices and forces, types, design and detailed study of jigs and fixtures used in various machining processes.
Die Design: Dies and punches, introduction to die cutting operations, die clearance, piercing and blanking die design, cutting by punches, strip layout, bending, forming and drawing dies, drawing forces, blank size determination.
Machine Tools
Fundamentals: Classification, specification of different machine tools, description of turret and copying lathe, universal milling machine, jig boring machine, honing machine, hobbing machine.
Kinematic Structure of Machine Tools: Developing the kinematic chain of machine tools, determination of transmission ratio, drawing of ray diagrams, analysis of kinematic structure, analysis of G.P. series.
Drive Systems: Mechanical, hydraulic, electrical and pneumatic drive systems, speed and feed gear boxes, optimum speed, gearbox design, basic principles of cluster gear design, step-less drives, control systems in machine tools.

Modern Machining Techniques: transfer line, numerical control of machine tools-fundamental concepts, main components of NC machine tools, types of NC machines- machining center, Introduction of part programming, Introduction of CNC and DNC, fundamentals of CAM, application of group technology and introduction to flexible manufacturing system.
Robotics: Introduction to robotics, basic components of robot technology levels, manipulator features arm geometry, rotation, drive system, work envelopes, mounting, internal components of controllers, general features, input power, master control memory.
Machine Installation and Testing: Installation procedure, foundation design, trends in the development of modern machine tools, testing after installation.

ME 4218: Power Plant Engineering Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional based on ME 4217.

IPE 4208: Tool Engineering & Machine Tools Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional based on ME 4207

ME 4000: Project/Thesis

6.00 Contact Hour 3.00 Credit Hour

Experimental and theoretical investigation of various problems related to Mechanical engineering. The topic should provide an opportunity to the student in developing initiative, creative ability and engineering judgment. Individual or group study (preferably not more than two in a group) will be required.
A completed report/thesis will have to be submitted on the project/thesis at the end of term.

5.2 Description of Optional Courses

ME 4121: Renewable Energy Technology

3.00 Contact Hour 3.00 Credit Hour

Sources of Energy: Energy cycle, non-renewable energy sources, coal, oil, natural gas, nuclear fuel, oil shale and tar sands, renewable energy sources, solar, biomass, wind hydropower, geothermal, waves, ocean thermal and tidal.
Energy Conversion Techniques: Solar thermal conversion, semiconductor devices, bio-chemical and thermo-chemical conversion of biomass, wind energy conversion, hydropower, ocean thermal energy conversion.
Energy Extraction: Geothermal, waves, tides, nuclear fission and fusion.
Energy Converting Devices and Storage: Thermoelectric, thermo-ionic converters, fuel cells, magneto hydrodynamics, storage of solar energy, demand of energy storage in stationary and transport applications.
Economic and environmental aspects of energy sources.

ME 4123: Energy Resources & Utilization

3.00 Contact Hour 3.00 Credit Hour

Resources: The energy cycle of the earth, the energy scope, a study of available energy resources for the world and energy demand, levels of extraction and technically feasible extraction.

Source and Conversion: Review of current conversion, systems bio-energy, hydro-power, wind power, types of wind energy collectors, storage system application, geo-thermal energy: sources, disposal of used geo-thermal fluids, application, geo-thermal power cycle, tidal energy: sources, schemes for power generation, ocean thermal energy conversion (otec), concepts of favorable location wave energy, wave energy extractors, solar energy: introduction, sun-earth angles, solar angle of incidence, solar time, solar radiation, estimation and measuring instruments, energy storage, collectors, solar pond design technique.

Application of Solar Energy: Heating, cooling, power generation, pumping, desalination, etc.

Utilization: Efficiencies of conversion system in current use, matching of energy sources to application hybrid & stored energy system, waste heat rejection and utilization.

Environmental Impact: Aspects of air and thermal pollution and waste disposal problems arising from conversion systems.

ME 4131: Petroleum Engineering

3.00 Contact Hour 3.00 Credit Hour

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.

ME 4133: Composite Materials

3.00 Contact Hour 3.00 Credit Hour

Fibrous composites; Reinforcement types; Ply strength; Failure criteria; Layered laminate; Laminate stiffness; Laminate Strength; Residual stress; Thin-walled; Composite section; Inter laminar stresses; Hole in laminate; Bucking of laminates.

ME 4135: Railway Engineering

3.00 Contact Hour 3.00 Credit Hour

Locomotive: Definition of locomotive, classification, working principles, different types of systems (fuel, lubrication, cooling, air), brake system, engine control, truck assembly, electrical equipment, excitation and power control system, load test and horsepower standardization, high potential test, troubleshooting, horsepower calculation and wheel slip, load regulator, engine governor, traction motor, generator, auxiliary generator, electrical control cabinet.

Carriage: Definition of carriage, types, description of carriage, power car, structure, under frame, bogie, load distribution, air brake system, distributor of valve, wheel profile, wheel defects, schedule of dimensions, axle load, passenger alarm communication system.

ME 4137: Advanced Thermodynamics

3.00 Contact Hour 3.00 Credit Hour

Introduction to classical and statistical viewpoints in thermodynamics; Concepts of equilibrium, stability, reversibility, irreversibility and availability; Concepts of entropy; Principle of increase of entropy; Calculation of entropy changes; Statistical interpretation; Entropy of mixing; Absolute entropy; Entropy flow and entropy production; Properties of pure substances; Ideal gases; Ideal gas mixtures of constant composition; Ideal gas mixtures of variable compositions; Thermodynamic potentials: Helmholtz free energy functions, Gibbs free energy function; Application of free energy functions; Transformations and thermodynamic potentials; Maxwell relations; Phase transitions; The Clausius-Clapeyron equation; Statistical mechanics: fundamental principles, energy states and levels; Thermodynamic probability: Bose-Einstein statistics, Fermi-Dirac statistics; Thermodynamic properties of a system; Special Topics: elastic systems, fuel cells, magnetic systems, thermo-electricity.

ME 4139: Combustion and Pollution

3.00 Contact Hour 3.00 Credit Hour

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 re-circulation, catalysis; Pollution control by modification of combustion parameters; Other pollution control strategies.

ME 4141: Multi-phase Flow

3.00 Contact Hour 3.00 Credit Hour

Introduction to fluid phases.

Stokes flow around a spherical particle and Oseen correction. Equation of motion for a small spherical particle in a non-uniform flow, the Basset-Boussinesq-Oseen equation. Other forces exerted by the carrier flow on a bubble/droplet/particle immersed in it. Saffman lift, Bjerknes force, thermophoresis, etc. Particle dynamics. Inertial effects.

Two Fluid Models. Turbulence modulation by particles.

Droplet/bubble deformation and breakup. Bubble dynamics. Cavitation. Droplet collisions and coalescence**.**

ME 4237: Aerodynamics

3.00 Contact Hour 3.00 Credit Hour

History: History of aeronautical engineering.

Airfoils, Wings and Other Aerodynamic Shapes: Airfoil nomenclature. lift, drag and moment coefficients, finite wing, flaps.

Elements of Airplane Performance: Power & thrust required for level, gliding, flight and altitude effects on power available, rate of climb, gliding flight, take off & landing performances.

Principles of Stability & Control: Static stability, dynamic stability, control, navigation.

Propulsion: Jet propulsion, turbojet engine, turbofan engine, ramjet engine, rocket jet engine.

ME 4241: Robotics

3.00 Contact Hour 3.00 Credit Hour

Introduction to robotics; Definitions; Plane, rotational and spatial motion with applications to manipulators; Geometric configurations: structural elements, linkages, arms and grippers; Kinematics of manipulators; Motion characteristics, trajectories, dynamics and control of manipulators; Actuators and sensors for manipulators; Application of industrial robots and programming; Teleoperators, mobile robots and automated guided vehicles. Special purpose robots.

ME 4245: Servomechanism and Control Engineering

3.00 Contact Hour 3.00 Credit Hour

Orientation of control system, open loop and feedback control system, representation of control components and systems, block diagrams, transfer functions modeling of mechanical, hydraulic pneumatic, electrical and electro-mechanical control components, modeling of feedback systems, block diagram algebra and single flow graphs.

Time response of first, second and higher order systems using classical and Laplace transform approaches, system stability analysis via Routh's stability criterion, basic actions and system type classification, system analysis, preliminary design by root locus method, frequency response analysis, use of bode plot, polar plots, Nichols chart, m and loci, gain-adjustment, correlation between time and frequency response-margin. interconnected power system, its development in Bangladesh, Introduction to modern control theory. Introduction to digital computer control.

ME 4247: Energy and Environment

3.00 Contact Hour 3.00 Credit Hour

Energy sources and utilization; Principles of energy conversion and storage. Building thermal energy-principles and optimization; Energy economy tools and techniques;

Environmental impacts of energy conversion; Environmental economics and management; Case studies.

ME 4249: Fluidics

3.00 Contact Hour 3.00 Credit Hour

Hydraulic and pneumatic components and systems; Servo control valves; Fluid transmission lines; Actuators; Fluids; Power supplies and fluid motors; Compressibility and leakage; System modelling, stability and compensation.

ME 4251: Design of Fluid Machines

3.00 Contact Hour 3.00 Credit Hour

General theory of fluid machines; Similarity considerations to fluid machines; Pumps, fans, blowers and compressors: design considerations; Cascade fluid mechanics including effects of viscosity, compressibility and three-dimensional flow; Performance characteristics and limitations; Cavitation and surging.

ME 4253: Theory of Structures

3.00 Contact Hour 3.00 Credit Hour

Preliminaries; Elements stiffness matrices; Pin-joint structures; 2-D rigid joint structures; Elastic plane element structures; Mixed elements structures; Elastic stability of 2-D rigid-joint structures; Frequency of rigid joint structures; Finite element method.

ME 4255: Noise and Vibration

3.00 Contact Hour 3.00 Credit Hour

Sound waves; Sound sources; Sound transmission through walls and structures; Acoustics of large and small rooms; Mechanism of sound absorption; Design of silencers. Vibration isolation, machine foundation design; Vibration absorption; Random vibration; Beam and plate vibrations.

5.3 Course Offered by ME Department to the Students of other Departments

5.3.1 List of Courses offered by ME Department to Students of other Departments

Offered to the Dept.	Course Code	Course Title	Level - Term	Contact Hours	Credit hours
CSE	ME 1181	Basic Mechanical Engineering	1-I	3.00	3.00
	ME 1250	Engineering Drawing and CAD Sessional	1-II	3.00	1.50
EEE	ME 1263	Fundamentals of Mechanical Engineering	1-II	3.00	3.00
	ME 1264	Fundamentals of Mechanical Engineering Sessional	1-II	3.00	1.50
IPE	ME 1270	Engineering Drawing	1-II	3.00	1.50
	ME 2169	Engineering Mechanics and Theory of Machines	2-I	3.00	3.00
	ME 2271	Basic Thermodynamics and Heat Transfer	2-II	3.00	3.00
	ME 2272	Basic Thermodynamics and Heat Transfer Sessional	2-II	3.00	1.50
	ME 2273	Engineering Materials	2-II	3.00	3.00
	ME 2274	Engineering Materials Sessional	2-II	1.50	0.75
	ME 2275	Mechanics of Materials	2-II	3.00	3.00
	ME 2276	Mechanics of Materials Sessional	2-II	1.50	0.75
	ME 3177	Fluid Mechanics and Machinery	3-I	3.00	3.00
	ME 3178	Fluid Mechanics and Machinery Sessional	3-I	1.50	0.75
CE	ME 1112	Mechanical Engineering Shop Practice	1-I	3.00	1.50
				Total Credit Hours =	**30.75**

5.3.2 Department of Computer Science and Engineering

ME 1181: Basic Mechanical Engineering

3.00 Contact Hour 3.00 Credit Hour

Sources of energy: conventional and renewable; Introduction to IC engines, Refrigeration and Air conditioning systems; Statics of particles and rigid bodies; Forces in trusses and frames; Relative motion; Kinematics of particles: Newton's Second Law of Motion;

Kinematics of rigid bodies; Introduction to Robotics; Plane, rotational and spatial motion with applications to manipulators; Geometric configurations: structural elements, linkage, arms and grippers; Motion characteristics.

ME 1250: Engineering Drawing Sessional

3.00 Contact Hour 1.50 Credit Hour

Introduction: Lettering, numbering and heading, instrument and their use, sectional views and isometric views of solid geometrical figures; Plan, elevation and section of multistoried buildings; Building services drawings, detailed drawing of lattice towers; Use of AutoCAD software.

5.3.3 Department of Electrical and Electronic Engineering

ME 1263: Fundamentals of Mechanical Engineering

3.00 Contact Hour 3.00 Credit Hour

Study of fuels, steam generating units with accessories and mountings, study of steam generators and turbines. Introduction to internal combustion engines and their cycles, study of SI engines, CI engines and gas turbines with their accessories. Refrigeration: Study of different refrigeration methods, refrigerants, refrigeration equipment, compressors, condensers, evaporators, expansion devices, other control and safety devices. Psychrometrics, study of air-conditioning systems with their accessories. Types of fluid machinery, study of impulse and reaction turbines, Pelton wheel and Kaplan turbines, study of centrifugal and axial flow machines, pumps, fans, blowers and compressors, study of reciprocating pumps.

ME 1264: Fundamentals of Mechanical Engineering Sessional

3.00 Contact Hour 1.50 Credit Hour

Students will perform experiments to verify practically the theories and concepts learned in ME 1263.

5.3.4 Department of Industrial and Production Engineering

ME 1270: Engineering Drawing

3.00 Contact Hour 1.50 Credit Hour

Introduction; Instruments and their uses; First and third angle projections; Orthographic drawings; Isometric views; Missing lines and views; Sectional views and conventional practices; Auxiliary views.

ME 2169: Engineering Mechanics and Theory of Machines

3.00 Contact Hour 3.00 Credit Hour

Statics: Force in trusses and frames; centroids and moment of inertia; kinetics of particles and rigid bodies.
Kinematics: The components of mechanism, joints, pairs and couplings, Grashoff's law, analytical methods for kinematics analysis, graphical determination of velocity and acceleration in mechanisms.
Dynamics: Newton's laws, applied and constraint forces, free body diagrams, velocity and acceleration analysis by vector mathematics linkage force analysis by virtual work methods, force analysis in linkages by graphical methods.
Theory of machines: Undamped and damped free vibration of one and two degrees of freedom, forced vibrations; whirling of shafts and rotors, Power transmission by ropes, belts, chains; gears and gear trains; study of cams, forced vibrations of machine tool mechanism: torsional vibration, balancing of rotary parts of machine tools, vibration absorption.

ME 2271: Basic Thermodynamics and Heat Transfer

3.00 Contact Hour 3.00 Credit Hour

Fundamental concepts-heat, Work and energy; Thermodynamic System-state, Process and cycle; Kinetic theory of gasses; Properties of gases and vapors; Non-flow and flow processes; Laws of thermodynamics and their corollaries, Second law of thermodynamics: Availability, Irreversibility and entropy. Ideal gases and their power cycles: Vapor power cycles and gas power cycles; Refrigeration cycles and reciprocating compressors. Equations of state; Mixtures of gases and vapors; Real gases; Psychometrics; Fuels and combustion.

Introduction to heat transfer; Modes of heat transfer; Steady and unsteady state heat conduction and radiation heat transfer, Convection heat transfer; Natural and forced convection; Heat exchangers.

ME 2273: Engineering Materials

3.00 Contact Hour 3.00 Credit Hour

Introduction: engineering materials, materials cycle, application and selection criteria of materials. atomic structure & bonding: elementary particles, electronic distribution and atomic size/structure, bonding-primary and secondary, effect of bonding on material properties. structure of solids: crystalline nature of metals, ceramics, semiconductors and polymers; crystal system/lattice/structure, crystallographic indexing of planes & directions, atomic aggregates and their structure, significance of microstructure; crystalline defects: dimensions, origin and their effect on properties; amorphous structure.
Phase diagrams: origin, construction, interpretation and application of binary phase diagrams with reference to a few important metallic and ceramic systems. properties of materials: physical, mechanical, chemical, electrical, semi/super conducting, magnetic, optical, thermal properties of solids; heat treatment of various metals and metallic alloys.
Engineering materials: structure, properties, processing, fabrication and application of metals and alloys, ceramics, rubber, plastics, semiconductors and composites.

ME 2275: Mechanics of Materials

3.00 Contact Hour 3.00 Credit Hour

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; Flexure formula; Deflection of beams: Integration and area moment methods; Introduction to reinforced concrete beams and slabs.
Torsion formula; Angle of twist; Modulus of rupture; Helical springs; Combined stresses: principal stress, Mohr’s Circle; Columns: Euler’s formula, intermediate column formulas, the Secant formula; Flexure formula of curved beams.
Introduction to experimental stress analysis techniques; Strain energy; Failure theories.

ME 2272: Basic Thermodynamics and Heat Transfer Sessional

3.00 Contact Hour 1.50 Credit Hour

Sessional works compatible to ME 2271.

ME 2274: Engineering Materials Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional works compatible to ME 2273.

ME 2276: Mechanics of Materials Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional works compatible to ME 2275.

ME 3177: Fluid Mechanics and Machinery

3.00 Contact Hour 3.00 Credit Hour

Fluid statics: Basic hydrostatic equation, Pressure variation in static incompressible and compressible fluids; Forces on plane and curved surfaces. Continuity, Momentum and energy equations; Introduction to in viscid incompressible flow to include two dimensional basic flows. Dimensional analysis and similitude; Fundamental relations of compressible flow, Real fluid flow; Frictional losses in pipes and fittings, Introduction to boundary layer theory, Introduction to open channel flow.

Types of fluid machinery, Rotodynamic and positive displacement machines; Impulse and reaction turbines; Centrifugal and axial flow pumps; Dimensional analysis applied to fluid machinery: specific speed. Unit power. Unit speed, Unit discharge; Performance and characteristics of turbines and pumps; Cavitation; Reciprocating pump, Gear and scow pumps; Fans, Blowers and Compressors.

ME 3178: Fluid Mechanics and Machinery Sessional

1.50 Contact Hour 0.75 Credit Hour

Sessional works compatible to ME 3177.

5.3.5 Department of Civil Engineering

ME 1112: Mechanical Engineering Shop Practice

3.00 Contact Hour 1.50 Credit Hour

Carpentry shop (3/2 hrs/week) : Wood working tools; wood working machine: band saw, scroll saw, circular saw, jointer, thickness planer, disc sander, wood lathe; types of sawing; common cuts in wood works; types of joint; defects of timber: natural defects and artificial defects; seasoning; preservation; substitute of timber; commercial forms of timber; characteristics of good timber; use of fastening; shop practice: practical job, planning and estimating of a given job.

Machine shop (3/4 hrs/week): Kinds of tools; common bench and hand tools; marking and layout tools, measuring tools, cutting tools, machine tools, bench work with job; drilling, shaper, lathe and milling machines: introduction, type, size and capacity, uses and applications.

Welding shop (3/4 hrs/week): Methods of metal joints: Riveting, grooving soldering, welding; Types of welding joints and welding practice; Position of arc welding and polarity: Flat, vertical, horizontal, overhead; Electric Arc welding and its machineries; Welding of different types of materials: Low carbon 43 steel, cast iron, brass, copper, stainless steel, aluminium; Types of electrode, fluxes and their composition; Arc welding defects; Test of Arc welding: Visual, destructive and non-destructive tests. Types of gas welding system and gas welding equipment; Gases and types of flame; welding of different types of materials; Gas welding defects; test of gas welding.

Chapter 6
Course Equivalence

6.1 Course Equivalence amongst Syllabuses

6.1.1 Equivalence List of Core Courses: Mechanical Engineering

Syllabus 2021					Syllabus 2018					Syllabus 2015				
Course Code	**Course Title**	**Level - Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course title**	**Level - Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level - Term**	**Contact Hours**	**Credit Hours**
ME 1101	Fundamentals of Mechanical Engineering	1-I	3.00	3.00	ME 1101	Fundamentals of Mechanical Engineering	1-I	3.0	3.00	ME 1101	Thermal Engineering	1-I	3.0	3.00
ME 1108	Foundry, Welding and Machine Shop Practice	1-I	3.00	1.50	ME 1108	Machine Shop Practice	1-I	3.0	1.50	ME 1210	Machine Shop Practice	1-II	3.0	1.50
					ME 1110	Foundry and Welding Shop Practice	1-I	1.5	0.75	ME 1110	Foundry and Welding Shop Practice	1-I	1.5	0.75
ME 2100	Mechanical Engineering Drawing	2-I	3.00	1.50	ME 1200	Mechanical Engineering Drawing-I	1-II	3.0	1.50	ME 1100	Mechanical Engineering Drawing –I	1-I	3.0	1.50
					ME 2200	Mechanical Engineering Drawing-II	2-II	3.0	1.50	ME 2200	Mechanical Engineering Drawing-II	2-II	3.0	1.50
ME 2101	Engineering Thermodynamics	2-I	3.00	3.00	ME 2101	Thermodynamics	2-I	3.0	3.00	ME 2101	Thermodynamics	2-I	3.0	3.00
ME 2102	Engineering Thermodynamics Sessional	2-I	3.00	1.50	ME 2102	Thermodynamics Sessional	2-I	1.5	0.75	ME 2102	Thermodynamics Sessional	2-I	1.5	0.75

ME 2103	Engineering Mechanics-I	2-I	4.00	4.00	ME 2103	Engineering Mechanics	2-I	4.0	4.00	ME 2103	Engineering Mechanics-I	2-I	3.0	3.00
										ME 2203	Engineering Mechanics-II	2-II	3.0	3.00
ME 2104	Engineering Mechanics -I Sessional	2-I	3.00	1.50	ME 2104	Engineering Mechanics Sessional	2-I	3.0	1.50	ME 2104	Engineering Mechanics-I Sessional	2-I	1.5	0.75
										ME 2204	Engineering Mechanics-II Sessional	2-II	1.5	0.75
ME 2111	Numerical Analysis	2-I	3.00	3.00	ME 3111	Numerical Analysis	3-I	3.00	3.00	ME 3111	Numerical Analysis	3-I	3.00	3.00
ME 2112	Numerical Analysis Sessional	2-I	3.00	1.50	ME 3112	Numerical Analysis Sessional	3-I	3.00	1.50	ME 3112	Numerical Analysis Sessional	3-I	3.00	1.50
ME 2207	Engineering Metallurgy	2-II	3.00	3.00	ME 2207	Engineering Metallurgy	2-II	3.0	3.00	ME 3207	Engineering Metallurgy	3-II	4.0	4.00
ME 2208	Engineering Metallurgy Sessional	2-II	1.50	0.75	ME 2208	Engineering Metallurgy Sessional	2-II	1.5	0.75	ME 3208	Engineering Metallurgy Sessional	3-II	1.5	0.75
ME 2209	Mechanics of Solids	2-II	3.00	3.00	ME 2209	Mechanics of Solids	2-II	3.0	3.00	ME 2209	Mechanics of Solids	2-II	3.0	3.00
ME 2210	Mechanics of Solids Sessional	2-II	1.50	0.75	ME 2210	Mechanics of Solids Sessional	2-II	1.5	0.75	ME 2210	Mechanics of Solids Sessional	2-II	1.5	0.75
ME 3101	Heat Transfer – I	3-I	3.00	3.00	ME 3101	Heat Transfer –I	3-I	3.0	3.00	ME 3101	Heat Transfer – I	3-I	3.0	3.00
ME 3103	Engineering Mechanics -II	3-I	3.00	3.00	ME 3203	Mechanics of Machinery	3-II	4.0	4.00	ME 3203	Engineering Mechanics-III	3-II	4.0	4.00

ME 3104	Engineering Mechanics -II Sessional	3-I	3.00	1.50	ME 3204	Mechanics of Machinery Sessional	3-II	1.50	0.75	ME 3204	Engineering Mechanics-III Sessional	3-II	1.50	0.75
ME 3105	Fluid Mechanics-I	3-I	3.00	3.00	ME 3105	Fluid Mechanics-I	3-I	3.0	3.00	ME 3105	Fluid Mechanics-I	3-I	3.0	3.00
ME 3106	Fluid Mechanics-I Sessional	3-I	1.50	0.75	ME 3106	Fluid Mechanics-I Sessional	3-I	1.5	0.75	ME 3106	Fluid Mechanics-I Sessional	3-I	1.5	0.75
ME 3113	Machine Design-I	3-I	3.00	3.00	ME 3113	Machine Design-I	3-I	3.0	3.00	ME 3113	Machine Design-I	3-I	3.0	3.00
ME 3114	Machine Design –I Sessional	3-I	1.50	0.75	ME 3114	Machine Design Sessional-I	3-I	1.5	0.75	ME 3114	Machine Design Sessional-I	3-I	1.5	0.75
ME 3116	Capstone Project	3-I	3.00	1.50	-	-	-	-	-	-	-	-	-	-
ME 3201	Heat Transfer-II	3-II	3.00	3.00	ME 3201	Heat Transfer-II	3-II	3.0	3.00	ME 3201	Heat Transfer-II	3-II	3.0	3.00
ME 3202	Heat Transfer Sessional	3-II	3.00	1.50	ME 3202	Heat Transfer Sessional	3-II	3.0	1.5	ME 3202	Heat Transfer Sessional	3-II	1.5	0.75
ME 3205	Fluid Mechanics-II	3-II	3.00	3.00	ME 3205	Fluid Mechanics-II	3-II	3.0	3.00	ME 3205	Fluid Mechanics-II	3-II	3.0	3.00
ME 3206	Fluid Mechanics-II Sessional	3-II	1.50	0.75	ME 3206	Fluid Mechanics-II Sessional	3-II	1.5	0.75	ME 3206	Fluid Mechanics-II Sessional	3-II	1.5	0.75
ME 3207	Measurement, Instrumentation and Quality Control	3-II	3.00	3.00	ME 3107	Measurement, Instrumentati on and Quality Control	3-I	3.00	3.00	ME 3107	Measurement, and Statistical Quality Control	3-I	3.00	3.00

ME 3208	Measurement, Instrumentation and Quality Control Sessional	3-II	1.50	0.75	ME 3108	Measurement, Instrumentation and Quality Control Sessional	3-I	1.50	0.75	ME 3108	Measurement, and Statistical Quality Control Sessional	3-I	1.50	0.75
ME 3213	Machine Design-II	3-II	3.00	3.00	ME 3213	Machine Design-II	3-II	3.0	3.00	ME 3213	Machine Design-II	3-II	3.0	3.00
ME 3214	Machine Design-II Sessional	3-II	1.50	0.75	ME 3214	Machine Design-II Sessional	3-II	1.5	0.75	ME 3214	Machine Design-II Sessional	3-II	1.5	0.75
ME 4101	Internal Combustion Engines	4-I	3.00	3.00	ME 4101	Internal Combustion Engines	4-I	3.0	3.00	ME 4101	Internal Combustion Engines	4-I	3.0	3.00
ME 4102	Internal Combustion Engines Sessional	4-I	3.00	1.50	ME 4102	Internal Combustion Engines Sessional	4-I	3.0	1.5	ME 4102	Internal Combustion Engines Sessional	4-I	1.5	0.75
ME 4105	Fluid Machinery	4-I	3.00	3.00	ME 4105	Fluid Machinery	4-I	3.0	3.00	ME 4105	Fluid Machinery	4-I	3.0	3.00
ME 4106	Fluid Machinery Sessional	4-I	1.50	0.75	ME 4106	Fluid Machinery Sessional	4-I	1.5	0.75	ME 4106	Fluid Machinery Sessional	4-I	1.5	0.75
ME 4117	Refrigeration and Air Conditioning	4-I	3.00	3.00	ME 4117	Refrigeration and Air Conditioning	4-I	3.0	3.00	ME 4117	Refrigeration and Air Conditioning	4-I	3.0	3.00
ME 4000	Project /Thesis	4-I	6.00	3.00	ME 4100	Project and Thesis-I	4-I	6.0	3.00	ME 4000	Project and Thesis	4-I	6.0	3.00
ME 4217	Power Plant Engineering	4-II	3.00	3.00	ME 4217	Power Plant Engineering	4-II	3.0	3.00	ME 4217	Power Plant Engineering	4-II	4.0	4.00

ME 4218	Power Plant Engineering Sessional	4-II	3.00	1.50	ME 4218	Steam Laboratories Sessional	4-II	1.5	0.75	-	-	-	-	-
ME 4219	Automobile Engineering	4-II	3.00	3.00	ME 4219	Automobile Engineering	4-II	3.0	3.00	ME 4219	Automobile Engineering	4-II	3.0	3.00
ME 4233	Mechatronics	4-II	3.00	3.00	ME 4233	Mechatronics	4-II	3.0	3.0	ME 4233	Mechatronics	4-II	3.0	3.00
ME 4000	Project / Thesis	4-II	6.00	3.00	ME 4200	Project and Thesis-II	4-II	6.0	3.00	ME 4000	Project and Thesis	4-II	6.0	3.00
			Total Credit Hours =	**88.00**				**Total Credit Hours =**	**88.25**				**Total Credit Hours =**	**93.00**

6.1.2 Equivalence List of Optional Courses: Mechanical Engineering

Syllabus 2021					**Syllabus 2018**					**Syllabus 2015**				
Course Code	**Course Title**	**Level - Term**	**Contact Hours**	**Credit Hours**	**Course code**	**Course title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
ME 4121	Renewable Energy Technology	4-I	3.00	3.00	ME 4121	Renewable Energy Technology	4-I	3.00	3.00	ME 4121	Renewable Energy Technology	4-I	3.00	3.00
ME 4123	Energy Resources and Utilization	4-I	3.00	3.00	ME 4123	Energy Resources and Utilization	4-I	3.00	3.00	ME 4123	Energy Resources and Utilization	4-I	3.00	3.00
ME 4131	Petroleum Engineering	4-I	3.00	3.00	ME 4131	Petroleum Engineering	4-I	3.00	3.00	ME 4131	Petroleum Engineering	4-I	3.00	3.00

ME 4133	Composite Materials	4-I	3.00	3.00	ME 4133	Composite Materials	4-I	3.00	3.00	ME 4133	Composite Materials	4-I	3.00	3.00
ME 4135	Railway Engineering	4-I	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4137	Advanced Thermodynamics	4-I	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4139	Combustion and Pollution	4-I	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4141	Multi-phase Flow	4-I	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4237	Aerodynamics	4-II	3.00	3.00	ME 4237	Aerodynamics	4-II	3.00	3.00	ME 4237	Aerodynamics	4-II	3.00	3.00
ME 4241	Robotics	4-II	3.00	3.00	ME 4241	Robotics	4-II	3.00	3.00	ME 4241	Robotics	4-II	3.00	3.00
ME 4245	Servomechanism and Control Engineering	4-II	3.00	3.00	ME 4245	Servomechanism and Control Engineering	4-II	3.00	3.00	ME 4245	Servomechanism and Control Engineering	4-II	3.00	3.00
ME 4247	Energy and Environment	4-II	3.00	3.00	ME 4247	Energy and Environment	4-II	3.00	3.00					
ME 4249	Fluidics	4-II	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4251	Design of Fluid Machines	4-II	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4253	Theory of Structures	4-II	3.00	3.00	-	-	-	-	-	-	-	-	-	-
ME 4255	Noise and Vibration	4-II	3.00	3.00	-	-	-	-	-	-	-	-	-	-
			Total Credit Hours =	**06.00**				**Total Credit Hours =**	**06.00**				**Total Credit Hours =**	**06.00**

6.1.3 Equivalence List of Core Courses: Arts and Science

Syllabus 2021					Syllabus 2018					Syllabus 2015				
Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
CHEM 1203	Chemistry	1-II	4.00	4.00	CHEM 1103	Chemistry-I	1-I	3.0	3.00	CHEM 1103	Chemistry-I	1-I	3.0	3.00
					CHEM 1203	Engineering Chemistry	1-II	3.0	3.00	CHEM 1203	Engineering Chemistry	1-II	3.0	3.00
CHEM 1204	Chemistry Sessional	1-II	3.00	1.50	CHEM 1104	Chemistry Sessional	1-I	3.0	1.50	CHEM 1104	Chemistry Sessional	1-I	3.0	1.50
MATH 1101	Mathematics-I	1-I	3.00	3.00	MATH 1101	Mathematics-I	1-I	4.0	4.00	MATH 1101	Mathematics-I	1-I	4.0	4.00
MATH 1201	Mathematics-II	1-II	3.00	3.00	MATH 1201	Mathematics-II	1-II	3.0	3.00	MATH 1201	Mathematics-II	1-II	3.0	3.00
MATH 2101	Mathematics-III	2-I	3.00	3.00	MATH 2101	Mathematics-III	2-I	3.0	3.00	MATH 2101	Mathematics-III	2-I	3.0	3.00
MATH 2201	Mathematics - IV	2-II	3.00	3.00	MATH 2201	Mathematics - IV	2-II	4.0	4.00	MATH 2201	Mathematics - IV	2-II	4.0	4.00
PHY 1105	Physics -I	1-I	3.00	3.00	PHY 1105	Physics -I	1-I	3.0	3.00	PHY 1105	Physics -I	1-I	3.0	3.00
PHY 1205	Physics -II	1-II	3.00	3.00	PHY 1205	Physics -II	1-II	3.0	3.00	PHY 1205	Physics -II	1-II	3.0	3.00

PHY 1206	Physics Sessional	1-II	3.00	1.50	PHY 1206	Physics Sessional	1-II	3.0	1.50	PHY 1206	Physics Sessional	1-II	3.0	1.50
HUM 1211	বাংলা ভাষা ও সাহিত্য	1-II	2.00	2.00	-	-	-	-	-	-	-	-	-	-
HUM 2211	স্বাধীন বাংলার অভ্যুদয়ের ইতিহাস	2-II	2.00	2.00	-	-	-	-	-	-	-	-	-	-
HUM 2117	Economics	2-I	2.00	2.00	HUM 2117	Sociology & Economics	2-I	3.0	3.00	HUM 2117	Sociology & Economics	2-I	3.0	3.00
HUM 2219	Accounting	2-II	2.00	2.00	HUM 2219	Accounting & Industrial Law	2-II	3.0	3.00	HUM 2219	Accounting & Industrial Law	2-II	3.0	3.00
HUM 3111	Sociology	3-I	2.00	2.00	HUM 2117	Sociology & Economics	2-I	3.0	3.00	HUM 2117	Sociology & Economics	2-I	3.0	3.00
HUM 3113	Engineering Ethics	3-I	2.00	2.00	-	-	-	-	-	-	-	-	-	-
Total Credit Hours =				**37.00**	**Total Credit Hours =**				**35.00**	**Total Credit Hours =**				**35.00**

6.1.4 Equivalence List of Core Courses: CSE

Syllabus 2021					Syllabus 2018					Syllabus 2015				
Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
CSE 1271	Computer Programming	1-II	3.00	3.00	CSE 1271	Computer Programming	1-II	3.0	3.00	CSE 1271	Computer Languages	1-II	3.0	3.00
CSE 1272	Computer Programming Sessional	1-II	3.00	1.50	CSE 1272	Computer Programming Sessional	1-II	3.0	1.50	CSE 1272	Computer Languages Sessional	1-II	3.0	1.50
Total Credit Hours =				**4.50**	**Total Credit Hours =**				**4.50**	**Total Credit Hours =**				**4.50**

6.1.5 Equivalence List of Core Courses: EEE

Syllabus 2021					Syllabus 2018					Syllabus 2015				
Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
EEE 1159	Basic Electrical Engineering	1-I	3.00	3.00	EEE 1159	Basic Electrical Engineering	1-I	3.0	3.00	EEE 1159	Basic Electrical Engineering	1-I	3.0	3.00
EEE 1160	Basic Electrical Engineering Sessional	1-I	1.50	0.75	EEE 1160	Basic Electrical Engineering Sessional	1-I	1.5	0.75	EEE 1160	Basic Electrical Engineering Sessional	1-I	1.5	0.75
EEE 2259	Electrical Machines and Electronics Technology	2-II	4.00	4.00	EEE 2159	Electrical Machines	2-I	3.0	3.00	EEE 2159	Electrical Machines & Electronics	2-I	4.0	4.00
					EEE 2259	Introduction to Analog and Digital Electronics	2-II	3.0	3.00	-	-	-	-	-

EEE 2260	Electrical Machines and Electronics Technology Sessional	2-II	3.00	1.50	EEE 2160	Electrical Machines Sessional	2-I	1.5	0.75	EEE 2160	Electrical Machines & Electronics Sessional	2-I	3.0	1.50
					EEE 2260	Introduction to Analog and Digital Electronics Sessional	2-II	1.5	0.75					
Total Credit Hours =				**9.25**	**Total Credit Hours =**				**11.25**	**Total Credit Hours =**				**9.25**

6.1.6 Equivalence List of Core Courses: IPE

Syllabus 2021					Syllabus 2018					Syllabus 2015				
Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
IPE 3277	Production Process	3-II	3.00	3.00	IPE 3277	Production Process	3-II	3.0	3.00	ME 2207	Production Process	2-II	4.0	4.00
IPE 3278	Production Process Sessional	3-II	1.50	0.75	IPE 3278	Production Process Sessional	3-II	1.5	0.75	ME 2207	Production Process Sessional	2-II	1.5	0.75
IPE 4115	Industrial Management	4-I	3.00	3.00	IPE 4115	Industrial Management	4-I	4.0	4.00	IPE 4115	Industrial Management	4-I	4.0	4.00
IPE 4207	Tool Engineering & Machine Tools	4- II	3.00	3.00	IPE 4207	Tool Engineering & Machine Tools	4-II	3.0	3.00	IPE 4207	Tool Engineering & Machine Tools	4-II	4.0	4.00
IPE 4208	Tool Engineering & Machine Tools Sessional	4- II	1.50	0.75	IPE 4208	Tool Engineering & Machine Tools Sessional	4-II	1.5	0.75	IPE 4208	Tool Engineering & Machine Tools Sessional	4-II	1.5	0.75
Total Credit Hours =				**10.50**	**Total Credit Hours =**				**11.50**	**Total Credit Hours =**				**8.75**

6.1.7 Equivalence List of Core Courses: English

Syllabus 2021					Syllabus 2018					Syllabus 2015				
Course Code	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**	**Course Code**	**Course Title**	**Level-Term**	**Contact Hours**	**Credit Hours**
HUM 1115	English	1-I	3.00	3.00	HUM 1215	English	1-II	3.00	3.00	HUM 1215	English	1-II	3.00	3.00
HUM 1116	Technical Report Writing & Presentation	1-I	1.50	0.75	HUM 1216	Technical Report Writing & Presentation	1-II	3.00	1.50	HUM 1216	Technical Report Writing & Presentation	1-II	3.00	1.50
Total Credit Hours =				**03.75**	**Total Credit Hours =**				**04.50**	**Total Credit Hours =**				**04.50**

Annexure

Annexure 1 OBE System Course Synopses

ME 1101: Fundamentals of Mechanical Engineering

COURSE INFORMATION			
Course Code	ME 1101	Lecture Contact Hours	3.00
Course Title	Fundamentals of Mechanical Engineering	Credit Hours	3.00
PRE-REQUISITE			
None.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course provides a prologue to the different basic concepts of Mechanical Engineering. The focus is to introduce the students to the different branches of ME, their basic working principles, and get the students acquainted with the real life fields of implementation of the systems and components pertaining to ME. The learning approach is to apply a synergistic approach to combine the basic knowledge of energy, thermodynamics, IC engine, different machineries, refrigeration, and robotics to build the core fields of Mechanical Engineering.			
OBJECTIVE			
• To introduce students to the various energy sources available in the world. • To introduce students to internal combustion engine, turbine and their applications. • To provide a brief introduction to refrigeration, fluid machinery, power plants and air-conditioning. • To provide a brief introduction to automobiles, robotics, electromechanical systems and relevant cutting-edge branches.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	Students will be able to **demonstrate** the core areas of mechanical engineering.	1	C2	2	1		ASG, CT, M, F
CO2	Students will be able to **demonstrate** the introductory knowledge of various engines and processes like internal combustion engines, turbines, pumps, etc. as well as advanced areas like automobile technology, robotics, MEMS etc.	6	C2	7	5		ASG, CT, M, F
CO3	Students will be able to **understand** different engineering concepts solutions in societal and environmental concepts.	7	C2	7	5		ASG, CT, M, F
CO4	Students will be able to **develop** a basic understanding of using mechanical engineering	1	C3	1	5		ASG, CT, M, F

	knowledge in real life practical fields.						

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT
a. Main Contents: • Introduction • Energy • Introduction to steam generation • Internal combustion engines • Pump, blowers, and compressors • Turbine • Refrigeration and air conditioning systems • Robotics **b. Detail Contents:** **Energy:** Sources, conventional and renewable energy, energy situation in Bangladesh, prospect of different energy sources in Bangladesh **Introduction to Steam Generation:** Working principle of few common and modern boilers, difference between the fire tube and water tube boilers, description of boilers e.g. stationary fire tube boiler, babcock and willcox boiler, stirling boiler, major boiler mountings and accessories, equivalent evaporation and boiler efficiency. **Internal Combustion Engines**: Introduction of petrol and diesel engines, main parts, working principle of both 4 stroke and 2 stroke engines, IHP, BHP and mechanical efficiency calculations, air standard Otto cycle, Diesel cycle efficiency, p-v & T-s diagrams of cycles, brief description of carburetion, injection, ignition system, lubrication and cooling systems of IC engine. **Pumps, Blowers and Compressors:** Introduction of pumps, blowers and compressors, classification and working principles. **Turbine:** Working principle and application of different types of turbine. **Refrigeration and Air-conditioning Systems:** Psychrometry, fundamentals of refrigeration and air-conditioning system. **Robotics:** Introduction, purpose, laws of robotics, degree of freedom, and manipulator-actuator.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Students will be able to **demonstrate** the core areas of mechanical engineering.	3											
CO2	Students will be able to **demonstrate** the introductory knowledge of						3						

	various engines and processes like internal combustion engines, turbines, pumps, etc. as well as advanced areas like automobile technology, robotics, MEMS etc.												
CO3	Students will be able to **understand** different engineering concepts solutions in societal and environmental concepts.							3					
CO4	Students will be able to **develop** a basic understanding of using mechanical engineering knowledge in real life practical fields.	1											

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will have basic knowledge of various core areas of mechanical engineering discipline
CO2-PO6	3	Demonstrate introductory knowledge of various engines and processes like internal combustion engines, turbines, pumps, psychometry etc. as well as advanced areas like automobile technology, robotics, MEMS etc. to assess societal and health safety.
CO3-PO7	3	Students will understand the engineering concepts solutions in societal and environmental concepts.
CO4-PO1	3	Students will be able to develop a basic understanding of mechanical engineering knowledge thus enabling themselves to use these in practical life.

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	Lecture	Topics	ASG/CT/M	Remarks
1	1	Course overview, introduction to mechanical engineering.		
	2	Energy: Sources-I		
	3	Conventional and renewable energy		
2	4	Energy situation in Bangladesh		
	5	Prospect of different energy sources in Bangladesh-I		
	6	Prospect of different energy sources in Bangladesh-II		
3	7	Introduction to Steam Generation		
	8	Introduction to few common and modern boilers		
	9	Difference between the fire tube and water tube boilers	CT-01	Lectures 1-6
4	10	Description of boilers e.g. stationary fire tube boiler		
	11	Babcock and willcox boiler		
	12	Stirling boiler		
5	13	Major boiler mountings and accessories-I		

	14	Major boiler mountings and accessories-II		
	15	Equivalent evaporation and boiler efficiency		
6	16	Internal Combustion Engines		
	17	Introduction of petrol and diesel engines, main parts		
	18	Working principle of both 4 stroke and 2 stroke engines	ASG-01	
7	19	IHP, BHP and mechanical efficiency calculations		
	20	Air standard Otto cycle-I		
	21	Air standard Otto cycle-II		
8	22	Diesel cycle efficiency	M	
	23	p-v & T-s diagrams of cycles		
	24	Brief description of carburetion		
9	25	Injection system		
	26	Ignition system		
	27	Lubrication and cooling systems of IC engine		
10	28	Pumps, Blowers and Compressors		
	29	Introduction of pumps, blowers and compressors	CT-02	Lectures 25-28
	30	Classification and working principles		
11	31	Turbine		
	32	Working principle and application of different types of turbine-I		
	33	Working principle and application of different types		

		of turbine-II		
12	34	Refrigeration and Air-conditioning Systems		
	35	Psychometry	ASG-02	
	36	Fundamentals of refrigeration and air-conditioning system		
13	37	Robotics		
	38	Introduction, purpose, laws of robotics		
	39	Degree of freedom, manipulator-actuator and other components		
14	40	Review class		
	41	Review class		
	42	Review class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG , CT	70	
2	ASG, CT	70	
3	ASG, CT	70	
4	ASG, CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	
4	M, F	30	

REFERENCE BOOKS

- R. S. Khurmi. *Thermal Engineering*, Nirja Publishers, India, 3rd Edition, ISBN: 9788121925730
- P. K. Nag. *Engineering Thermodynamics*, McGraw Hill Education Private Limited, India 5th Edition, ISBN: 978-1-25-906256-8

ME 1108: Machine Shop Practice

COURSE INFORMATION			
Course Code	ME 1108	Lecture Contact Hours	3.00
Course Title	Machine Shop Practice	Credit Hours	1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
In this course student will study shop safety practices in machine shop. The will acquaintance with different marking, measuring and cutting hand tools and their functions used in fitting shop. They will be familiarized with operation and maintenance of different machine tools and practical jobs on plain and taper turning, thread cutting, doing jobs by using lathe, shaper, milling, drilling and grinding machines. Students will acquaintance with arc and gas welding tools, electrodes, gas cylinders, and their operations. They will also learn 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. Students will able to analyze and solve industrial problems related to machine shop, foundry and welding shop.			
OBJECTIVE			
• To understand working principle of different machine tools. • To become skilled to operate various types of hand tools used in machine shop. • To know about various parts of different machine. • To know about the working principles of different machine tools like Lathe machine, Shaper machine, Drilling machine, Milling machine, Grinding machine etc. • To know about different types of molding, practice on simple bench or floor molding. • To be familiar with the preparation of molding sand & core. • To study about the defects in casting.			

- To be familiar with various kinds of welding tools.
- To be familiar with various types of welding defects.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-pondingPO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Understand** the basic concepts of molding, casting and different types of gas flames.	1	P1	1			Q, R, LT
CO2	**Discuss** the operation of different types of hand and machine tools which is used in different Industries.	9	P3	1			Q, R, LT
CO3	**Demonstrate** different industrial uses of Lathe, Milling, Drilling machines in production and manufacturing processes.	2	C4	5			Q, R, LT
CO4	**Analyze** and solve industrial problems related to machine shop.	4	P1	3			ASG, Q, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Study about 15 different types of hand tools and safety rules in machine shop.
- Study about a Lathe machine and its different operations.
- Making a job using different operations in Lathe machine.
- Making a hexagonal nut by using hand tools and machine tools.
- Study about a shaper machine and to make a plain surface/square block/V-block
- Study about a Milling machine and its different operations.
- To know about different types of molding, practice on simple bench or floor molding
- To Practice casting & know various kinds of casting defects
- Introduction to various kinds of welding tools.
- To practice gas & arc welding

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 of molding, casting and different types of gas flames.	3											
CO2	**Discuss** the operation of different types of hand and machine tools which is used in different Industries.									2			
CO3	**Demonstrate** different industrial uses of Lathe, Milling, Drilling machines in production and manufacturing processes.		3										
CO4	**Analyze** and solve industrial problems related to machine shop.				3								

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Student will able to familiar with shop safety practices and acquaintance with molding, casting and different types of gas flames.
CO2-PO9	3	Student will able to solve problems according to operation of different types of hand and machine tools.
CO3-PO2	2	Students will be able to perform the experiments on lathe, Milling, Drilling machines.
CO4-PO4	3	Student will able to analyze and solve industrial problems related to machine shop.

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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14

	Final Quiz	01
Total		112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, co-operative and collaborative method, project based method

COURSE SCHEDULE

Week	Topics	Remarks
1	Study about 15 different types of hand tools and safety rules in machine shop.	
2	Study about a Lathe machine and its different parts.	
3	Making a job using different operations in Lathe machine.	
4	Making a hexagonal nut by using hand tools and machine tools.	
5	Study about a shaper machine and to make a plain surface/square block/V-block	
6	Study about a Milling machine and its different operations.	
7	To know about different types of molding, practice on simple bench or floor molding	
8	To Practice casting & know various kinds of casting defects	
9	Introduction to various kinds of welding tools	
10	To practice gas & arc welding	
11	Lab Test	
12	Final Lab Report Submission	
13	Quiz	
14	Viva	

ASSESSMENT STRATEGY

Assessment Method		Grading
	Lab participation and Report	30%
	Lab Test	30%

Lab Quiz, Viva		40%
Total		100%

REFERENCE BOOKS

- R.G. Nagpal, (1999). *Machine Tool Engineering*. 1st Edition, Khanna Publisher, ISBN-13 978-8174090461.
- Prakash Hiralal Joshi, (2009). *Machine Tools Handbook: Design and Operation*. 1st Edition, McGraw-Hill Handbooks, ISBN-10: 0071494359
- P N Rao, (2009), *Manufacturing technology: foundry, forming and welding*.3rd Edition, New Delhi, India, McGraw-Hill ISBN- 0070087989 9780070087989.

ME 2101: Engineering Thermodynamics

COURSE INFORMATION

Course Code	ME 2101	Lecture Contact Hours	3.00
Course Title	Engineering Thermodynamics	Credit Hours	3.00

PRE-REQUISITE

ME 1101: Fundamental of Mechanical Engineering, PHY 1105: Physics-I, CHEM 1103: Chemistry-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course offers fundamental concepts of thermodynamics and its application to different fields. It also includes the 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 concepts discussed in the course are applied to address real life related problems in the field of steam cycles, air compressors, refrigeration and combustion modelling.

Students will get acquainted with ideal and real gas equations of state in this course. They will be able to analyze basic to complex level problems on various ideal thermodynamics cycles.

OBJECTIVE

- Introduce to one of the most powerful engineering principles - Thermodynamics: the science of transferring energy from one place to another place.
- Familiarize with the laws of thermodynamics and their applications.
- To analyze standard cycles such as reciprocating piston engines, gas turbine engines, vapor power cycles and other cycles used in power plants and refrigeration units.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Understand** the laws of thermodynamics to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines.	2	C2	1	2		ASG, CT, M, F
CO2	**Analyze** the efficiency and properties of thermodynamic cycles for heat engines, refrigerators, heat pumps and other important mechanical devices.	2	C4	1	2		F
CO3	**Distinguish** the interfaces between ideal and real thermodynamic cycles used in various power plant based applications.	6	C4	7	5	2	ASG, CT, M, F
CO4	**Discuss** thermodynamic properties of pure substances and environmental effects of	7	C2	7	5	1	CT, F

	control volume devices.						

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction to ideal gas
- Laws of Thermodynamics
- General Thermodynamics relations
- Vapor power cycles
- Mixture of gases and vapors
- Fuels and its properties

b. Detail Contents:

Macroscopic and Microscopic points of view, Definition of Thermodynamic terms, Heat, Work and their path dependence. Definition and suitability as thermodynamic fluid, Equation of state, various thermodynamic processes, Specific heats, Internal energy, Enthalpy. Statement and their corollaries, criterion of reversibility and irreversibility, Entropy, non-flow energy equation, internal energy, enthalpy, law of conservation of energy, perpetual motion machine of the first kind, Limitation of the first law of thermodynamics, heat engines and heat pumps, specific heats, relation between specific heats, application of the first law to some common closed system processes, the first law as applied to open system, steady flow energy equation, applications of the steady flow energy equation, non-steady flow process, perpetual motion machine of the second kind, thermodynamics temperature scale, inequality of Clausius, entropy, temperature-entropy diagrams for gases and vapors, entropy changes for a perfect gas undergoing various reversible processes, principle of increase of entropy. Exact differential, Maxwell's relations, derivation of some useful general thermodynamic relations, Gibbs -Helmholtz equation, third law of thermodynamics. Carnot cycle, Otto cycle, Diesel cycles, Dual cycle, Stirling cycles, Ericsson cycle, Joule cycle, Brayton cycles and their applications, representation of various cycles on a p-V and T-S planes, Cycle efficiency, Air compressor and blowers. Vapor power cycle, Carnot cycle, Rankine cycle, reheat cycle and Regenerative cycle, Binary cycle, Introduction to combined cycle, Calculations of cycle efficiency. Mixture of ideal gases, gravimetric and volumetric analysis, Dalton’s law of partial pressure, volume and entropy of gaseous mixtures, Isentropic process with gaseous mixtures, specific humidity, relative humidity, dew point, dry and wet bulb temperatures, adiabatic saturation, Construction of psychrometric chart and its uses. Types of fuels, Formation of coal and petroleum fuel, grading of coal, Calorific value of fuels and its measurement, Freezing point, Flash point, Boiling point, Viscosity of liquid fuels, Modern development of solid, liquid and gaseous fuels, Nuclear fuels.

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 to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines		2										
CO2	**Analyze** the efficiency and properties of thermodynamic cycles for heat engines, refrigerators, heat pumps and other important mechanical devices.		3										
CO3	**Distinguish** the interfaces between ideal and real thermodynamic cycles used in various power plant based applications.						1						
CO4	**Discuss** thermodynamic properties of pure substances and environmental effects of control volume devices.							2					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	2	Students will be able to apply the concepts of thermodynamic laws.
CO2-PO2	3	Students will be able to analyze basic to complex level problems on various thermodynamics cycles.
CO3-PO6	1	Students will have the basic knowledge of thermodynamic cycles to get an idea on the safety measures of a power plant.
CO4-PO7	2	Students will have the in-depth knowledge of thermal devises to attain environmental sustainability.

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, and problem solving.

COURSE SCHEDULE

Week		Lecture	Topics	ASG/CT/ M
1		1	Course overview, Introductory concepts and definitions: Introduction	
		2	Introductory concepts and definitions: Macroscopic and microscopic points of view, definition of thermodynamic terms.	
		3	Introductory concepts and definitions: Heat, work and their path dependence.	
2		4	Properties of a pure substances: Introduction	
		5	Properties of a pure substances: Simple/ hydrostatic system, phase of a pure substance.	
		6	Properties of a pure substances: Property diagrams for phase-change processes.	
3		7	Properties of a pure substances: Equilibrium state of a pure substance, P-V, T-V, P-T diagram	

		8	Work and Heat: Introduction	
		9	Work and Heat: work, work crossing the boundary of a system	CT-01
4		10	Work and Heat: Path function and point function, heat, comparison of heat & work	
		11	The first law of thermodynamics: Laws of thermodynamics.	
		12	The first law of thermodynamics: The first law of thermodynamics for a control mass undergoing a cycle.	
5		13	The first law of thermodynamics: First law of thermodynamics for a change in state of a control mass (closed system).	
		14	First law analysis for a control volume: Introduction, enthalpy, specific heat.	
		15	First law analysis for a control volume: Conservation of energy for a control volume, application of 1st law in flow processes.	
6		16	First law analysis for a control volume: First law as a rated equation.	
		17	The 2nd law of thermodynamics: Introduction, uses of 2nd law.	
		18	The 2nd law of thermodynamics: Kelvin Plank statement, Clausius statement	ASG-01
7		19	The 2nd law of thermodynamics: Heat engine, refrigerator, heat pump.	

		20	Entropy: Introduction	
		21	Entropy: Temperature-entropy diagrams for gases and vapors.	
8		22	Entropy: Entropy changes for a perfect gas undergoing various reversible processes, principle of increase of entropy.	M
		23	Otto cycle and diesel cycle: Introduction to IC engine.	
		24	Otto cycle and diesel cycle: Air standard Otto cycle.	
9		25	Otto cycle and diesel cycle: Air standard diesel cycle.	
		26	Irreversibility and availability: Process, reversible or ideal processes	
		27	Irreversibility and availability: Irreversible process (natural/real)	
10		28	Irreversibility and availability: Factors that render processes irreversible	
		29	Irreversibility and availability: Types of irreversibility	
		30	Vapor power system: Introduction, power system	
11		31	Vapor power system: Rankine cycle, comparison of Rankine cycle with Carnot cycle	
		32	Vapor power system: Effects of boiler and condenser pressures on the Rankine cycle. improving performance of Rankine cycle.	
		33	Gas power system: Introduction	CT-02
12		34	Gas power system: Air standard	

			Brayton cycle	
		35	Gas power system: Gas turbine irreversibility and losses	
		36	Refrigeration and Heat pump system: Introduction	
13		37	Refrigeration and Heat pump system: Vapor compression refrigeration system	
		38	Refrigeration and Heat pump system: Departures from the Carnot cycle, Bryton refrigeration system	
		39	Thermodynamic relations: Introduction	
14		40	Thermodynamic relations: Exact differential, Maxwell's relations.	ASG-02
		41	Thermodynamic relations: derivation of some useful general thermodynamic relations, Gibbs function and Helmohtzs, third law of thermodynamics.	
		42	Review class.	

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG,CT	20	
3	ASG,CT	30	
4	CT	30	
	Exam		
1	M, F	80	
2	F	100	
3	M, F	70	

	4	F	70		

REFERENCE BOOKS
• P.K. Nag, (2017). *Engineering Thermodynamics*. 6th Edition. India, McGraw Hill, ISBN-13: 978-9352606429. • R.K. Rajput, (2007). *A Textbook of Engineering Thermodynamics*. 4th edition. Laxmi Publications, India, ISBN-13: 978-8131800584. • Çengel, Y. A., & Boles, M. A. (2001). *Thermodynamics: An engineering approach*. Boston: McGraw-Hill, ISBN-13: 978-0073398174.

ME 2102: Engineering Thermodynamics Sessional

COURSE INFORMATION			
Course Code	ME 2102	Lecture Contact Hours	3.00
Course Title	Engineering Thermodynamics Sessional	Credit Hours	1.50
PRE-REQUISITE			
ME 1101: Fundamental of Mechanical Engineering, ME 2101: Engineering Thermodynamics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
In this course student will be able to understand fundamentals of thermodynamic systems and properties, laws and their applications in thermodynamic systems. The learning approach is to apply a synergistic process to theoretical knowledge and experimental results for the analysis of thermodynamic systems. This course will provide the essential tools required to study thermodynamic systems in applied thermodynamics, fuel testing, psychometric field and refrigeration units.			
OBJECTIVE			

- To learn fundamental concepts relevant to thermodynamics.
- To study about the concepts of work, power, and heat in thermodynamics; determine work and heat sign conventions; determine work involved with moving boundary systems (graphical and analytical methods).
- To apply the first law of thermodynamics for a closed system.
- To determine thermodynamic properties of pure substances
- To study the second law of thermodynamics, including why it is necessary, how it is defined (Kelvin-Planck and Clausius), the nature of irreversibility, and the Carnot cycle.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-pondin g PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Apply** knowledge of applied thermodynamics in the investigation of the mechanical properties of machines and in the design of machines and report the process and outcomes to a professional standard in oral and written form.	6	C3	7	5	1	Q, R, LT
CO2	**Demonstrate** thermodynamic properties of pure substance and environmental effects of control volume devices such as pumps, compressors, turbines, and heat exchangers.	7	P2	7	5	1	Q, R, LT

CO3	**Apply** the first law of thermodynamics for a control volume, including with turbines, compressors, nozzles, diffusers, heat exchangers, and throttling devices.	1	C3	1	1	1	Q, R, LT
CO4	**Gather** the experience which can be applied in their job field.	9	P3		5,6		Q, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Determination of the Flash Point of Liquid Fuel.
- Study of a Sling Psychrometer.
- Determination of the Calorific Value of Fuel.
- Study of a Steam Generator.
- Study of a Refrigeration Unit
- Study and Calibration of Pressure Gauge by Dead Weight Tester.

CO-PO MAPPING

No.	**Course Outcome**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Apply** knowledge of applied thermodynamics in the investigation of the mechanical properties of machines and in the design of machines and report the process and outcomes to a						2						

	professional standard in oral and written form.												
CO2	**Demonstrate** thermodynamic properties of pure substance and environmental effects of control volume devices such as pumps, compressors, turbines, and heat exchangers.							2					
CO3	**Apply** the first law of thermodynamics for a control volume, including with turbines, compressors, nozzles, diffusers, heat exchangers, and throttling devices.	3											
CO4	**Gather** the experience which can be applied in their job field.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Student will able to familiar with shop safety practices and acquaintance with molding, casting and different types of gas flames.
CO2-PO9	3	Student will able to solve problems according to operation of different types of hand and machine tools.
CO3-PO2	2	Students will be able to perform the experiments on lathe, Milling, Drilling machines.
CO4-PO4	3	Student will able to analyze and solve industrial problems related to machine shop.

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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01
Total		112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, co-operative and collaborative method, project based method

COURSE SCHEDULE

Week	Topics	Remarks
1	Determination of the Flash Point of Liquid Fuel.	
2	Study of a Sling Psychrometer.	
3	Determination of the Calorific Value of Fuel.	
4	Study of a Steam Generator.	
5	Study of a Refrigeration Unit	
6	Study of a Refrigeration Unit	
7	Study and Calibration of Pressure Gauge by Dead Weight Tester.	

8	Study and Calibration of Pressure Gauge by Dead Weight Tester.	
9	Revision Class	
10	Lab Test	
11	Revision Class	
12	Final Lab Report Submission	
13	Viva,	
14	Quiz	

ASSESSMENT STRATEGY		
Assessment Method		Grading
	Lab participation and Report	30%
	Lab Test	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS

- P.K. Nag, (2017). Engineering Thermodynamics. 6th Edition. India, McGraw Hill, ISBN-13: 978-9352606429.
- R.K. Rajput, (2007). A Textbook of Engineering Thermodynamics. 4th edition. Laxmi Publications, India, ISBN-13: 978-8131800584.
- Çengel, Y. A., & Boles, M. A. (2001). Thermodynamics: An engineering approach. Boston: McGraw-Hill, ISBN-13: 978-0073398174.

ME 2103: Engineering Mechanics-I

COURSE INFORMATION			
Course Code	ME 2103	Lecture Contact Hours	4.00
Course Title	Engineering Mechanics-I	Credit Hours	4.00

PRE-REQUISITE
MATH 1101: Mathematics-I, PHY 1105: Physics-I, MATH 1201: Mathematics-II, ME 1200: Mechanical Engineering Drawing-I
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course provides a procedure of analyzing a static and dynamic system under external forces by applying Newton's law and other theories into a dynamic system. Students will be able to understand basic kinematics concepts – displacement, velocity and acceleration and their angular counter parts. Knowledge gained in this course will be needed for understanding the movement of machine components and their design in subsequent courses of the program.
OBJECTIVE
• To learn about procedures of analyzing a dynamic system under external force • To applying Newton's law and other theories into a dynamic system • To explain basic kinematics concepts – displacement, velocity and acceleration and their angular counter parts • To create model physical structures and processes with calculus based techniques and produce a solution • To apply all of concepts of linear kinetics to systems in general plane motion
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Explain** basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts)	1	1	1	1	1	CT, M, F

CO2	**Synthesizing** Newtonian Physics with static & dynamics analysis to determine the complete load impact	2	1, 2	1,2, 6,7	1,5	1, 5, 6	CT, F
CO3	The student will be **able to** model physical structures and processes with calculus based techniques and produce a solution	4	2, 3	1,3	1,2	1, 2, 12	ASG, M, F
CO4	Students will be able to **apply** all of concepts of linear kinetics to systems in general plane motion;	2	4	3	1	3	CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction
- Equilibrium of Particle
- Centroids and Center of Gravity
- Analysis of Structure
- Law of Friction
- Kinematics of Particles
- Kinematics of Rigid Bodies
- Kinetics of Particles
- Kinetics of Rigid Bodies in Two and Three Dimension
- Energy and Momentum Methods
- Plane Motion of Rigid Bodies

b. Detail Contents:

Fundamental concept and principles of mechanics, Resultant of several concurrent forces, Resolution of forces into components. Free body diagram, principle of transmissibility of forces and force couple system.

Moment of a couple, equivalent couple, equivalent system of force couple systems, reduction of a system of forces. Centroids and CG of area and volume. Moment of inertia of area and mass, radius of gyration, parallel axes theorem, product of inertia, ellipsoid of inertia.

Analysis of Structure: trusses and frames. Equilibrium under frictional resistance, sliding friction, wedges and square threaded screw, Journal and thrust friction, rolling and belt frictions.

Rectilinear and curvilinear motion of particles, Determination of motion of a particle, motion of several particles, rectangular components of velocity and acceleration, Motion relative to frame in translation, tangential, normal, radial and transverse components.

Translation, Rotation about a fixed axis, General plane motion, Absolute velocity and acceleration, Angular momentum, Relative velocity and acceleration, Coriolis acceleration. Newton's second law of motion, linear and angular momentum, Radial and transverse components of motion, motion under a central force, Satellite motion, equation of orbit, conditions of orbiting and escape, cycle time, changing of orbit.

Application of the principle of impulse and momentum, Angular momentum and its rate of change, Direct and oblique central impact, eccentric impact.

Equation of motions for a plane body, constrained plane motion, motion of a rigid body in three dimensions, systems of rigid bodies.

Principle of work and energy and its application, Power and efficiency, Potential energy. Conservation of energy and its application to space mechanics.

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).	3											
CO2	**Synthesizing** Newtonian Physics with static & dynamics analysis to determine the complete load impact.		3										
CO3	**Employ** engineering measurements, units, and conversions to solve basic problems of mechanical				3								

	engineering discipline.												
CO4	**Apply** all of concepts of linear kinetics to systems in general plane motion.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will have basic knowledge of various core areas of mechanical engineering discipline
CO2-PO2	2	Students will employ their knowledge in using the modern tool
CO3-PO4	3	Students can apply their basic knowledge in various engineering problem
CO4-PO2	3	Students will employ their knowledge in the application field throughout their daily working life

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, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Course overview, Rectilinear and curvilinear motion of		

		particles		
	2	Fundamental concept and principles of mechanics		
	3	Resultant of several concurrent forces		
	4	Determination of the motion of a particle and that of several particles		
2	5	Rectangular components of velocity & acceleration		
	6	Resolution of forces into components		
	7			
	8	Motion relative to frame in translation; tangential, normal, radial, and transverse component		
3	9	Newton's second law of motion, linear and angular momentum	ASG-01	
	10	Free body diagram		
	11	Principle of transmissibility of forces and force-couple system	CT-01	Lecture 1-7
	12	Radial and transverse components of motion under a central force		
4	13	Rectilinear and curvilinear motion of particles		
	14	Fundamental concept and principles of mechanics		
	15	Resultant of several concurrent forces		
	16	Determination of motion of a particle motion of several particle		
5	17	The principle of work and energy and its application, Power and efficiency, Potential		

		energy		
	18	Equivalent system of forces, couple systems		
	19	Reduction of a system of forces		
	20	Conservation of energy and its application to space mechanics		
6	21			
	22	Principle of Impulse and momentum		
	23	Centroids and CG of area and volume	CT 2	Lecture 7-15
	24	Impulsive motion, Direct and oblique central Impact		
7	25	Translation, Rotation about a fixed axis		
	26	Moment of inertia of area and mass		
	27	Radius of gyration, parallel axes theorem		
	28	General plane motion about fixed point		
8	29	Absolute velocity and acceleration	M	
	30	Principle of work and energy and its application		
	31	Power and efficiency, Potential energy		
	32	Product of inertia, Ellipsoid of inertia.		
9	33	Relative velocity and acceleration, Coriolis acceleration		
	34	Translation, rotation about a fixed axis, absolute/ relative velocity		

	35	Trusses and frames		
	36			
10	37			
	38			
	39	Absolute/ Relative acceleration in plane motion		
	40	Instantaneous center of rotation.		
11	41	Equation of motions for a plane body		
	42	Angular momentum and its rate of change		
	43	D'Alemberts principle; constrained plane motion	CT-03	Lecture 23-32
	44	Principle of work and energy		
12	45	Conservation of energy and angular momentum		
	46	Product of inertia		
	47	Ellipsoid of inertia.		
	48	Relative velocity and acceleration, Coriolis acceleration		
13	49	Translation, rotation about a fixed axis, absolute/ relative velocity		
	50			
	51	Absolute/ Relative acceleration in plane motion		
	52	Instantaneous center of rotation.	ASG-02	
14	53	Rolling and belt frictions		
	54	Motion about a fixed point and axis		
	55	Motion of a gyroscope and Eulerian angles		

	56	Overall review		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
2	CT	30	
3	ASG	30	
4	CT	30	
	Exam		
1	M, F	80	
2	F	100	
3	M, F	70	
4	F	70	

REFERENCE BOOKS

- Beer, F. P., Johnston, E. R. Jr., Mazurek, D. F., Cornwell, P. J. & Eisenberg, E. R. (2013).*Vector Mechanics for Engineers*. 10th Edition McGraw Hill;
- Lemos, N. A. (2018). *Analytical Mechanics*. Cambridge University Press
- Faires, V. M. (1952). *Analytical mechanics*. 1st Edition. McGraw Hill
- Hibbeler, R. C. (1989). *Engineering Mechanics.* 6th Edition. McMillan.

ME 2104: Engineering Mechanics – I Sessional

COURSE INFORMATION

Course Code	ME 2104	Lecture Contact Hours	3.00
Course Title	Engineering Mechanics Sessional	Credit Hours	1.50

PRE-REQUISITE

ME 2103: Engineering Mechanics

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 theories of mechanics.

OBJECTIVE

- Demonstrate practical understanding on various laws used in engineering mechanics.
- Demonstrate practical understanding on various systems of rigid body mechanics.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	Be able to **demonstrate** practical understanding on various laws used in engineering mechanics	2	C2	3	1,2		Q, ASG, R, LT
CO2	Be able to **demonstrate** practical knowledge on various systems taught in the theory class	4	C2	3,4	2,3		Q, ASG, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

- Study of compression and tension spring and verification of Hook"s law.
- Study of parallel and series tension spring and determination of spring rate.
- Investigate the forces parallel and normal to a roller on an inclined plane.
- Investigate the static and kinetic frictional forces on different surfaces and determine the coefficient of friction.
- Investigate the theory that predicts kinetic frictional forces from the angle of the plane.
- Variation of Deflection of a simply supported Beam with Load, Beam Thickness and Material.
- Stiffness of the Strut Materials.
- Rockwell and Brinell Hardness test of different types of materials.
- Izod and Charpy Impact test of different types of materials.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **demonstrate** practical understanding on various laws used in engineering mechanics		3										
CO2	Be able to **demonstrate** practical knowledge on various systems taught in the theory class				2								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of matching	Justifications
CO1-PO2	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-PO4	2	Students will learn to analyze 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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01
	Total	112

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week	Topics
1	Study of compression and tension spring and verification of Hook‟s law
2	Study of parallel and series tension spring and determination of spring rate.
3	Investigate the forces parallel and normal to a roller on an inclined plane.

4	Investigate the static and kinetic frictional forces on different surfaces and determine the coefficient of friction.
5	Investigate the theory that predicts kinetic frictional forces from the angle of the plane
6	Variation of Deflection of a Simply supported beam with Load, Beam Thickness and Material.
7	Lab Test-II
8	Stiffness of the Strut Materials.
9	Rockwell and Brinell Hardness test of different types of materials.
10	Izod and Charpy Impact test of different types of materials.
11	Lab Test-II
12	Revision Class
13	Final Lab Report Submission
14	Viva, Quiz

ASSESSMENT STRATEGY

Assessment Method		Grading
Continuous Assessment	Lab participation and Report	30%
	Lab Test	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS

- Budynas, N. G. K. R. J. (2021). *Shigley's Mechanical Engineering Design.* 11th Edition. McGraw Hill.
- Khurmi, R. S., & Gupta, J.K. (2005). *Machine Design*. 25th Edition. S. Chand.
- Faries, V. M.,(1965*). Design of Machine Elements* 4th Edition. McMillan Coll.

ME 2111: NUMERICAL ANALYSIS

COURSE INFORMATION			
Course Code	ME 2111	Lecture Contact Hours	3.00
Course Title	Numerical Analysis	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course provides a prologue to the concepts of numerical analysis of mechanical systems and to introduce the students to different methods of solutions of linear equations.

The focus is to illustrate practical engineering problems of various applications and solve them using different mathematical methods for instance, iterative method, Newton-Raphson method, Gauss's method, Matrix method and so on.

The learning approach is to apply engineering and mathematical tools to learn about numerical differentiation and integration.

Students will achieve comprehension of the fundamental hypothetical premise of the numerical analysis methods and their application to a scope of issues of pertinence to solve practical engineering problems.

OBJECTIVE

- To familiarize students with the essential ideas of numerical analysis
- To make students acquainted with the numerical depiction of solutions of linear equations
- To familiarize students with the iterative and mathematical methods of problem solving
- To solve complex engineering problems using interpolation and finite difference methods
- To compute the numerical differentiation and integration
- To solve analytical and numerical complex problems

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxonomy**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	**Correlate** the use of numerical methods in scientific computing.	1	C4	2	5		ASG, CT, M, F
CO2	**Develop** conception of calculation and interpretation of errors in numerical methods.	2	C3	2	5		ASG, CT, M, F
CO3	**Apply** numerical interpolation and approximation of functions.	5	C3	2	5		ASG, CT, M, F
CO4	**Develop** concept of numerical integration and differentiation.	12	C5, C6	2	5		ASG, CT, M, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

- Fundamental concepts of numerical analysis
- Solutions of linear equations
- Numerical differentiation
- Numerical integration
- Solutions of differential equations by numerical methods
- Finite element method

b. Detail Contents:

Numerical Analysis: Solutions of linear equations: iterative method, Newton-Raphson method, Gauss's method, matrix method, iteration method.

Interpolation: Finite differences, interpolation formula, Newton's formula for forward and backward interpolation. Lagrange's interpolation formula, Stirling's interpolation formula, Gauss's central difference formula, Bessel's interpolation formula.

Numerical Differentiation: Use of interpolation formula, graphical method.

Numerical Integration: General formula for equidistant ordinates, trapezoidal rule, Simpson's rule, Gauss's formula. Use of Lagrange's interpolation, graphical integration.

Solutions of Differential Equations by Numerical Methods: Solution by Taylor’s series, Picard’s method, Euler’s method, Runga-Kutta method.

Finite Element Method: Introduction of finite element method in engineering, finite element modeling.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Correlate** the use of numerical methods in scientific computing.	3											
CO2	**Develop** conception of calculation and interpretation of errors in numerical methods.		3										
CO3	**Apply** numerical interpolation and approximation of functions.					3							

CO4	**Develop** concept of numerical integration and differentiation.												3

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will be aware of the use of different numerical methods in scientific computing.
CO2-PO2	3	Students will become familiar with calculation and interpretation of various errors in numerical methods.
CO3-PO5	3	Students will become acquainted with calculation and interpretation of errors in numerical methods.
CO4-PO12	3	Students will become familiar with numerical integration and differentiation.

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, and problem solving.	

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Introduction to Numerical Analysis		
	2	Accuracy in Numerical Analysis		
	3	Standard Method of representing errors		
2	4	Major sources of inaccuracy in Numerical Analysis		
	5	Error Accumulated in Arithmetic Operation-I		
	6	Error Accumulated in Arithmetic Operation-II		
3	7	Root Finding Methods: Graphical Method and Bisection Method		
	8	Root Finding Methods: Graphical Method and Bisection Method		
	9	Root Finding Methods: Newton Raphson Method	CT-01	Lectures 1-6
4	10	Root Finding Methods: Newton Raphson Method		
	11	Solution of Linear Equations: Gaussian Elimination		
	12	Solution of Linear Equations: Gauss Elimination		
5	13	Solution of Linear Equations: Jacobi method		
	14	Solution of Linear Equations: Jacobi method		
	15	Solution of Linear Equations: Overview		
6	16	Solution of Linear Equations: Overview		
	17	Numerical Differentiation		

	18	Numerical Differentiation	ASG-01	
7	19	Numerical Differentiation		
	20	Numerical Differentiation		
	21	Numerical Differentiation		
8	22	Numerical Differentiation	M	
	23	Numerical Differentiation		
	24	Numerical Differentiation		
9	25	Numerical Integration: Trapezoidal Rule		
	26	Numerical Integration: Simpson's 1/3 rule		
	27	Numerical Integration: Simpson's 3/8 rule		
10	28	Richardson‟s Extrapolation Scheme for Trapezoidal Rule		
	29	Richardson‟s Extrapolation Scheme for Simpson's Rule and Differentiation	CT-02	Lectures 22-27
	30	Truncation Error Estimation for Different Numerical Integration Method		
11	31	Truncation Error Estimation for Different Numerical Integration Method		
	32	Runge-Kutta Methods (RK)		
	33	Runge-Kutta Methods (RK)		
12	34	Runge-Kutta Methods (RK)		
	35	Classical 4th order R-K Method	ASG-02	
	36	Classical 4th order R-K Method		
13	37	Introduction of Finite element		

		method in Engineering		
	38	Introduction of Finite element method in Engineering		
	39	Review Class - 01		
14	40	Review Class - 02		
	41	Review Class - 03		
	42	Review Class - 04		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	70	
2	ASG, CT	70	
3	ASG, CT	70	
4	ASG, CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	
4	M, F	30	

REFERENCE BOOKS

- Chapra, S. C., & Canale, R. P. (2011). *Numerical methods for engineers* (Vol. 1221). New York: Mcgraw-hill.
- Hamming, R. (2012). *Numerical methods for scientists and engineers*. Courier Corporation.
- Isaacson, E., & Keller, H. B. (2012). *Analysis of numerical methods*. Courier Corporation.

ME 2112: Numerical Analysis Sessional

COURSE INFORMATION			
Course Code	ME 2112	Lecture Contact Hours	3.00
Course Title	Numerical Analysis Sessional	Credit Hours	1.50

PRE-REQUISITE
MATH-1101: Mathematics-I

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. The learning approach is to apply a synergistic approach to combine the knowledge of numerical integration, mathematics and software for the in-depth understanding of numerical analysis applications.

OBJECTIVE
• To understand the implications of digital number representation and digital arithmetic for computational science and engineering. • To develop and implement numerically stable and accurate algorithms for all the basic tasks of computational science and engineering. • To understand and get introduced to MATLAB.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	Be able to **interpret** the fundament- al principles of digital computing, including number representation and arithmetic operations.	1	C2	1	1	1	ASG, Q, R, LT
CO2	To be able to **demonstrate** error analysis for arithmetic operations.	2	C2	2	1	1	ASG, Q, R, LT
CO3	**Perceive** the propagation of errors through complex numerical algorithms using modern tools.	5	C5	6	2	1	ASG, Q, R, LT
CO4	**Illustrate** students to learn MATLAB coding.	12	C2	7	6	1	ASG, Q, R, LT
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT
a. Main Contents: • Background for matrix and vector operations and Introduction to MATLAB • Interactive computing with MATLAB • Script Function file and operators • Root Finding Methods • System of Linear Equations • Numerical Integration • Ordinary differential equations

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO) 1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **interpret** the fundamental principles of digital computing, including number representation and arithmetic operations.	3											
CO2	To be able to **demonstrate** error analysis for arithmetic operations.		3										
CO3	**Perceive** the propagation of errors through complex numerical algorithms.					3							
CO4	**Illustrate** students to learn MATLAB coding, a powerful Engineering tool which will help them to in their future carrier.												3

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Engineering knowledge is required to understand the fundamental principles of digital computing, including number representation and arithmetic operations.

CO2-PO2	3	Engineering knowledge is required to be able to demonstrate error analysis of arithmetic operations.
CO3-PO5	3	Modern tool usage is required to perceive the propagation of errors through complex numerical algorithms.
CO4-PO12	3	To be able to test for numerical stability analysis modern tool usage is compulsory. This is a lifelong lesson which, students will be able to apply later in their carrier.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities		**Engagement (hours)**
Face-to-Face Learning		
	Lecture	14
	Practical	28
	Total	42
Self-Directed Learning		
	Preparation of Lab Reports	10
	Preparation of Lab Test	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01
Total		112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, co-operative and collaborative method, project based method

COURSE SCHEDULE

Week	Topics	Remarks
1	Background for matrix and vector operations and Introduction to MATLAB	
2	Interactive computing with MATLAB	
3	Script function file and operators	
4	Root finding methods	
5	Root finding methods	
6	System of linear equations part 1	
7	Lab test – I	
8	System of linear equations part 2	
9	System of linear equations part 3	
10	Numerical integration	
11	Ordinary differential equations	
12	Lab test – II	
13	Project submission	
14	Quiz, viva	

ASSESSMENT STRATEGY

Assessment Method		Grading
	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS

- Steven Chapra, Raymond Canale- *Numerical Methods for Engineers*, Sixth Edition, ISBN-13: 978-0073397924
- E Balagurusamy- *Numerical Methods* :, ISBN-13: 978-0074633113
- Curtis F. Gerald, Patrick O. Wheatley- *Applied Numerical Analysis* 5th edition –ISBN-13: 9780201592900

ME 2100: Mechanical Engineering Drawing

COURSE INFORMATION			
Course Code	ME 2100	Lecture Contact Hours	3.00
Course Title	Engineering Drawing	Credit Hours	1.50

PRE-REQUISITE
N/A

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course will help the students to understand 2D & 3D graphical representation of a mechanical drawing or mechanical sketches which includes multiple views, symbols and other drawing details. It focuses on making the students able to get a decent idea about traditional technical drawing theory. This course includes practices which are utilized alongside the most up-to-date CAD applications, rapid prototyping, and 3D printing technologies.

OBJECTIVE

- To understand about different types of lines & use of different types of pencils in an Engineering drawing.
- To learn how to represents letters & numbers in drawing sheet.
- To know about different types of projection.
- To know projection of points, straight lines, solids etc.
- To get a clear idea about AutoCAD.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Familiarize** with different drawing equipment, technical standards and procedures for construction of geometric figure.	1	P1	1, 2, 3	1	1	R, Q, LT

CO2	**Learn** how to draw the shapes, angels and lines and others which is essential for engineers.	1	P3	1, 2, 3	1	1	R, Q, LT
CO3	**Understand** about the principle of projection and sectioning as well as the intersection, development of surface of body and fasteners.	1	C4	1, 2, 3	1	5	R, Q, LT
CO4	**Learn** to draw using AutoCAD and apply it in professional fields.	5	P1	1, 2, 3, 6		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:

- Introduction with drawing tools.
- Introduction to pictorial drawing.
- Introduction to orthographic view.
- Introduction to sectional view.
- Introduction to auxiliary view.
- Introduction to isometric view.
- Introduction to Auto CAD.
- 2D drawing & practice.
- 3D drawing & practice.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Familiarize** with different drawing equipment, technical standards and procedures for construction of geometric figure.	3											
CO2	**Learn** how to draw the shapes, angels and lines and others which is essential for engineers.	3											
CO3	**Understand** about the principle of projection and sectioning as well as the intersection, development of surface of body and fasteners.	3											
CO4	**Learn** to draw using AutoCAD and apply it in professional fields.					3							

Justification for CO-PO mapping:

Mapping	Level of Matching	Justification
CO1-PO1	3	Familiarize with different drawing equipment, technical standards and procedures for construction of geometric figure.
CO2-PO1	3	Learning how to draw the shapes, angels and lines and others which is essential for engineer
CO3-PO1	3	Understanding the principle of projection and sectioning as well as the intersection, development of surface of body and fasteners

CO4-PO4	3	Learning the main idea from assembly and detail of 2D & 3D drawing

TEACHING METHODOLOGY

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

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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01
Total		112

COURSE SCHEDULE

Week	**Experiments**	**Remarks**
1	Introduction to basic element of mechanical drawing	

2	Dimensioning: Direction of dimensioning, dimensioning of angle, limited space, circular feature, cylindrical holes, oblique dimensioning.	
3	Orthographic projection: types of projection, first & third angle projection, methods of projection views.	
4	Problem solving based on Orthographic views.	
5	Sectional view and conventions: generating sectional view, types of section and solution for example problem.	
6	Problem solving based on Sectional view.	
7	Auxiliary view: Generating auxiliary view.	
8	Problem solving based on auxiliary view.	
9	Pictorial drawing: introduction, perspective view & isometric view.	
10	Problem solving based on isometric view.	
11	AutoCAD 2D drawing.	
12	AutoCAD 3D drawing.	
13	Lab Test.	
14	Quiz	

ASSESSMENT STRATEGY		
Assessment Method		Grading
	Lab participation and Report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS

- Jay D. Helsel, (2008). *Mechanical Drawing: Board & CAD Techniques*.5th Edition. Glencoe/McGraw-Hill. ISBN: 9780078251023
- Green, P., & International Organization for Standardization. (2009). *The Mechanical Engineering Drawing Desk Reference: Creating and Understanding ISO Standard Technical Drawings.*6th Edition. Create Space. ISBN: 9781448613090
- Kyles, S. R. (2009). *AutoCAD Workbook for Architects and Engineers.* Chichester: John Wiley & Sons. 15th Edition. ISBN: 9781444309447

ME 2207: Engineering Metallurgy

COURSE INFORMATION			
Course Code	ME 2207	Lecture Contact Hours	3.00
Course Title	Engineering Metallurgy	Credit Hours	3.00

PRE-REQUISITE
CHEM 1203: Chemistry, ME 2209: Mechanics of Solid.

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course provides a prologue to the concept of metal and alloy, mechanical properties of metal and alloy, crystal structure and defects in a crystal structure, iron- iron carbide diagram, powder metallurgy and composite materials.

OBJECTIVE

- To familiarize students with the industrially significant properties of metals.
- To introduce crystal structure of metals, curves and iron carbide diagram.
- To provide basic knowledge of different heat treatment processes.
- To learn about production, properties and uses of various forms of iron and steels.
- To gather basic knowledge about powder metallurgy.
- To introduce composite materials, their importance and latest developments in material science.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	**Identify** different properties of metals and alloys.	1	C1	1,3	1		ASG, CT, M, F

CO2	**Draw** various curves, equilibrium diagrams related to metals and alloys.	1	C4	1,3	1		F
CO3	**Differentiate** among different heat treatment processes.	4	C2, C4	8	1		ASG, CT, M, F
CO4	**Apply** the knowledge of powder metallurgy and composite materials in future with the basic knowledge gathered from the course	1	C3	1,3	1		ASG, CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Metals and Alloys
- Crystal Structure of Metals
- Iron-Iron Carbide Equilibrium Diagram
- Heat Treatment
- Powder Metallurgy
- Production, Properties and Uses
- Production of Steels
- Production Methods Properties and Uses
- Composite Materials

b. Detail Contents:

Metals and Alloys: Industrially Significant properties of metals; Malleability, Ductility, Hardness, Toughness, Fatigue Resistance. Destructive and Non-Destructive Tests applicable to metal.

Crystal Structure of Metals: Types of crystal lattice, Solidification of metal and alloys, Nucleation, Grain growth, cooling curves, Variables affecting solidification.

Iron-Iron Carbide Equilibrium Diagram: Plain carbon steels and their microstructure; Crystal defeats, Dislocation theory.

Heat Treatment: Methods and effects of Hardening, Annealing, Normalizing, Quenching, Tempering, Austempering.

Powder Metallurgy: Introduction, Powder Metallurgy Process, Properties of metal powders, Characteristics. Mixing, Compacting, Sintering, Applications of power metallurgy.

Production, Properties and Uses: Ferrous materials, Pig iron, wrought iron, Cast iron, Types of cast iron.

Production of Steels: Their types, Bessemer and Open hearth processes, Alloy Steels, Carbon Steel.

Production Methods Properties and Uses: Copper, Aluminum, Nickel, Tin and Leads.

Composite Materials: Introduction to composite materials, importance of composite materials and uses, Latest developments in material science.

Metallurgical Aspect of Metal Joining: Surface treatments, Plating, Metal coating, Metal spraying.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** different properties of metals and alloys.	3											
CO2	**Draw** various curves, equilibrium diagrams related to metals and alloys.	3											
CO3	**Differentiate** among different heat treatment processes.				2								
CO4	**Enhance** the knowledge of powder metallurgy and composite materials in future with the basic knowledge gathered from the course.	1											

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to identify the science and engineering among different properties of metals and alloys.
CO2-PO1	3	Students will be able to develop different problem solving of metals and alloys by using curves and equilibrium diagram.
CO3-PO4	2	Students will be able to correlate the different heat treatment process in various engineering application.
CO4-PO1	3	Students will be able to apply the knowledge obtained on composite materials will be able to apply it on the real world problem solving while making composite 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	Lecture	Topics	CT	Remarks
1	1	Introduction of Metallurgy		
	2	Industrially Significant properties of metals; Malleability, Ductility		
	3	Hardness, Toughness, Fatigue Resistance		
2	4	Destructive and Non-Destructive Tests applicable to metal		
	5	Non-Destructive Tests applicable to metal		
	6	Crystal lattice		

3	7	Types of crystal lattice		
	8	Types of crystal lattice		
	9	Solidification of metal and alloys	CT-01	Lectures 1-6
4	10	Nucleation and grain growth		
	11	Iron-Iron carbide equilibrium diagram		
	12	Iron-Iron carbide equilibrium diagram		
5	13	Plain carbon steels and their microstructure		
	14	Plain carbon steels and their microstructure		
	15	Slow cooling of steel alloy		
6	16	Crystal defects		
	17	Heat treatment fundamental		
	18	Annealing, Normalizing	ASG-01	
7	19	Quenching, Tempering		
	20	Austempering, Hardening		
	21	Surface heat treatment		
8	22	Introduction, Powder Metallurgy Process	M	
	23	Properties and Characteristic of metal powders		
	24	Advantages and disadvantages of Powder metallurgy		
9	25	Application of powder metallurgy		
	26	Production, Properties and Uses: Ferrous materials, Pig iron		
	27	Production, Properties and Uses: wrought iron, Cast iron, Types of cast iron		
10	28	Production of Steels		

	29	Bessemer and Open hearth processes,		
	30	Alloy Steels, Carbon Steel.		
11	31	Production Methods Properties and Uses: Copper, Aluminum,		
	32	Production Methods Properties and Uses: Copper, Aluminum		
	33	Production Methods Properties and Uses: Nickel, Tin and Leads	CT-02	Lectures 23-32
12	34	Production Methods Properties and Uses: Nickel, Tin and Leads		
	35	Introduction to composite materials		
	36	Importance of composite materials and uses	ASG-02	
13	37	Production method of composite materials		
	38	Hybrid composite materials		
	39	Latest developments in materials science		
14	40	Revision		
	41	Revision		
	42	Revision		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	20	
3	ASG, CT	30	
4	ASG, CT	30	
	Exam		
1	M, F	80	
2	F	100	

	3	M, F	70	
	4	F	70	

REFERENCE BOOKS
• Avner S. H. (2014). *Introduction to Physical Metallurgy.* 2nd Edition. New Delhi: Tata Mcgraw Hill. • Shackelford, J. F. (1996). *Introduction to Materials Science for Engineers*. 6th Edition. Upper Saddle River, N.J: Prentice Hall.

ME 2208: Engineering Metallurgy SESSIONAL

COURSE INFORMATION			
Course Code	ME 2208	Lecture Contact Hours	1.50
Course Title	Engineering Metallurgy Sessional	Credit Hours	0.75
PRE-REQUISITE			
CHEM 1103: Chemistry-I, CHEM 1104: Chemistry Sessional, CHEM 1203: Engineering Chemistry, ME 2207: Engineering Metallurgy			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS /RATIONALE			
This course provides an experimental knowledge to the concepts of sample preparation for metallography, microstructure analysis of different types of materials, properties of materials, and heat treatment processes. Upon completion of this course, students will have the competence to explain microstructure, properties, destructive and non-destructive tests of materials with practical knowledge. The learning approach is to apply a synergistic process to theoretical knowledge and experimental results for the analysis of material properties. Students will achieve comprehension of the knowledge to perform metallurgical analysis required to ensure that a material has the required properties for engineering applications.			
OBJECTIVE			
• To know the principles of metallurgical engineering. • To learn the processes to prepare a specimen for metallographic analysis. • To analyze the microstructure of different types of materials. • To experiment independently maintaining all the safety procedures of the laboratory.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcome**	**Corres-ponding PO**	**Bloom's Taxo-nomy**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Relate** metallurgical concept to prepare a specimen for tests.	1	C2	1	1		Q, R, LT
CO2	**Experiment** with modern tools.	5	C3	6			Q, R, LT
CO3	**Plan** effectively to work individually and in group.	9	C5	5	5,6		Q, R, LT
CO4	**Examine** materials with the knowledge of destructive and non-destructive tests.	2	C4	1,4	2		Q, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

- Study of sample preparation for metallographic analysis.
- Microstructure analysis of mild steel.
- Microstructure analysis of annealed mild steel.
- Rockwell and Brinell Hardness test of different types of materials.
- Determine the thickness of a plate by using Ultrasonic thickness gauge.

CO-PO MAPPING

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

CO1	**Relate** metallurgical concept to prepare a specimen for tests.	3											
CO2	**Experiment** with modern tools.					3							
CO3	**Plan** effectively to work individually and in group.									3			
CO4	**Examine** materials with the knowledge of destructive and non-destructive tests.		3										

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of matching**	**Justifications**
CO1-PO1	3	Students will be able to demonstrate the steps of sample preparation for metallographic test.
CO2-PO5	3	Students will be able to conduct experiment with modern tools.
CO3-PO9	3	Students will be able to plan effectively to work individually and in group
CO4-PO2	3	Students will be able to assess the usefulness of materials through different tests.

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	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
	Total	79

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week	Topics
1	Study of sample preparation for metallographic analysis.
2	Microstructure analysis of mild steel.
3	Microstructure analysis of annealed mild steel.
4	Rockwell and Brinell Hardness test of different types of materials.
5	Determine the thickness of a plate by using Ultrasonic thickness gauge.
6	Compression test of wooden block.
7	Final Lab Report Submission, Lab Test
8	Viva, Quiz

ASSESSMENT STRATEGY

Assessment Method		Grading
Continuous Assessment	Lab participation and Report	30%
	Lab Test	30%

Lab Quiz, viva	40%
Total Marks	100%

REFERENCE BOOKS
• Avner S. H. (2014). *Introduction to Physical Metallurgy*. 2nd Edition. New Delhi: Tata Mcgraw Hill. • Shackelford, J. F. (1996). *Introduction to Materials Science for Engineers*. 6th Edition. Upper Saddle River, N.J: Prentice Hall.

ME 2209: Mechanics of Solids

COURSE INFORMATION			
Course Code	ME 2209	Lecture Contact Hours	3.00
Course Title	Mechanics of Solids	Credit Hours	3.00
PRE-REQUISITE			
PHY 1105: Physics-I, ME 2103: Engineering Mechanics-I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts and standards of deformable solids with the effect of internal forces and associated changes in the geometry of the components involved. The focus is to illustrate practical engineering applications. Students will obtain an in-depth knowledge about stress-strain behavior and different mechanical properties of materials. Upon completion of this course, students will have the competence to explain the behavior of materials in various engineering applications such as beams and columns. The learning approach is to apply a synergistic process to theoretical analyses and experimental results for engineering design. Students will achieve comprehension of the properties of materials used; strength, which will determine whether the components can sustain under loading conditions and stiffness, which will determine whether the extent of deformations subjected to are acceptable.			
OBJECTIVE			
• To introduce about the mechanical properties of materials and to determine them. • To characterize and estimate the magnitude of combined stresses in individual members and in complete structures. • To analyze various situations involving structural members subjected to combined stresses by the application of Mohr's circle.			

- To determine and analyze the deflection at any point on a beam/column subjected to different loading combinations.
- To determine torsion in circular section; stress in thin & thick cylinder and spheres due to external and internal pressures.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	**Understand** the types of loads and stresses in different loaded members and develop skills to determine them.	1	C2	1	1		CT, ASG, M
CO2	**Identify** the magnitude of safe loads and stresses to operate individual members and structures without failure.	2	C3	1,4	2	5	F, M
CO3	**Analyze** the deflection at any point on a beam subjected to a combination of loads and clear understanding of shear force and bending moment diagram.	4	C4	8	4		CT, ASG, F, M
CO4	**Assess** the deflections and deformations of loaded flexural members.	3	C5	5	3		CT, ASG, F, M

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Simple Stress and Strain
- Modulus of Elasticity and Rigidity
- Statically Determinate Beams
- Statically Indeterminate Beams
- Torsion
- Combined Stresses and Strains
- Column Theory

b. Detail Contents:

Introduction and analysis of internal forces: Tension, compression, shear stress, axial stress in composites, shearing, bending, centrifugal and thermal stresses, strain and deformation, stress-strain diagram, elasticity and elastic limits,

Definition of some mechanical properties of materials: Poisson's ratio, volumetric strain and bulk modulus; relation between modulus of elasticity and bulk modulus, statically indeterminate members; stresses in thin walled pressure vessels.

Introduction to different types of loading and supports; shear force and bending moment diagram, various types of stresses in beams, flexure formula, economic sections, shearing stress in beam, general shear formula, deflection of beams, elastic curve, method of double integration, area moment and super-position methods, shearing stress and deflection in composite beams.

Redundant supports in propped and restrained beams, solution by double integration. Area moment and superposition methods, design of restrained beams, continuous beams, three moment equation, determination of support reactions of continuous beam, shear and moment diagram.

Torsion formula, angle of twist of solid and hollow shaft, torsional stiffness and equivalent shaft, classed coil helical spring.

Principal stresses and principal planes combined axial and bending stresses, stress at a point, stress on inclined cutting planes. Analytical method for the determination of stresses on oblique section, Mohr's circle, and application of Mohr's circle to combined loading. Transformation of strain components; strain rosette; relation between modulus of rigidity and modulus of elasticity.

Introduction to elastic stability, Euler's formula for central load and different end conditions, modes of failure and critical load, slenderness ratio and classification of columns, empirical formula for columns, secant formula for columns with eccentric loading.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the types of loads and stresses in different loaded members and develop skills to determine them.	3											

CO2	**Identify** the magnitude of safe loads and stresses to operate individual members and structures without failure.		3										
CO3	**Analyze** the deflection at any point on a beam subjected to a combination of loads and clear understanding of shear force and bending moment diagram.				3								
CO4	**Assess** the deflections and deformations of loaded flexural members.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will have the basic understanding of different types of loads and stresses in loaded members in engineering applications.
CO2-PO2	2	It is essential to identify the characteristics of individual members and structures without failure.
CO3-PO4	3	Students will be able to analyze shear force and bending moment diagram based on the combination of loads applied.
CO4-PO3	3	Students will be able to assess loaded flexural members.

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	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Introduction		
	2	Analysis of internal forces		
	3	Tension, compression, shear stress, axial stress in composites		
2	4	Shearing, bending		
	5	Centrifugal and thermal stresses, strain and deformation		
	6	Stress-strain diagram		
3	7	Elasticity and elastic limits		
	8	Definition of some mechanical properties of materials		
	9	Poission's ratio, volumetric strain and bulk modulus	CT-01	Lectures 1-6
4	10	Relation between modulus of elasticity and bulk modulus, statically indeterminate members		
	11	Stresses in thin walled pressure vessels		
	12	Introduction, different types of loading and supports		
5	13	Shear force and bending moment diagram		
	14	Various types of stresses in beams, flexure formula		
	15	Economic sections, shearing stress in beam		
6	16	General shear formula		
	17	Deflection of beams, elastic curve		
	18	Method of double integration	ASG-01	
	19	Area moment and super-position methods		

7	20	Shearing stress and deflection in composite beams		
	21	Redundant supports in propped and restrained beams, solution by double integration	M	
8	22	Area moment and superposition methods, design of restrained beams, continuous beams		
	23	Three moment equation, determination of support reactions of continuous beam		
	24	Shear and moment diagram		
9	25	Torsion formula		
	26	Angle of twist of solid and hollow shaft		
	27	Torsional stiffness and equivalent shaft		
10	28	Classed coil helical spring		
	29	Principal stresses and principal planes		
	30	Combined axial and bending stresses		
11	31	Stress at a point, stress on inclined cutting planes		
	32	Analytical method for the determination of stresses on oblique section Mohr's circle		
	33	Application of Mohr's circle to combined loading	CT-02	Lectures 23-32
12	34	Application of Mohr's circle to combined loading		
	35	Transformation of strain components		
	36	Strain rosette		
13	37	Introduction to elastic stability		
	38	Euler's formula for central load and different end conditions		
	39	Modes of failure and critical load	ASG-02	
14	40	Slenderness ratio and classification of columns		

	41	Empirical formula for columns		
	42	Secant formula for columns with eccentric loading		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT, ASG	**20**	
3	CT, ASG	**30**	
4	CT, ASG	**30**	
	Exam		
1	M	**80**	
2	F, M	**100**	
3	F, M	**70**	
4	F, M	**70**	

REFERENCE BOOKS

- Strength of Materials (4th ed.). Pytel, A. & Singer, F. L., Harper Collins Inc., 1987; ISBN: 0-06-350599-1
- Mechanics of Materials. Beer and Johnston; McGraw- Hill, 2009; ISBN: 0073529389
- Mechanics of Materials (9th ed.). Hibbeler, R. C., Pearson Prentice Hall, 2014; ISBN: 10: 0-13-3254429

ME 2210: Mechanics of solids Sessional

COURSE INFORMATION			
Course Code	ME 2210	Lecture Contact Hours	1.50
Course Title	Mechanics of Solids Sessional	Credit Hours	0.75
PRE-REQUISITE			
ME 2103- Engineering Mechanics, ME 2104- Engineering Mechanics-I Sessional			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course provides an experimental knowledge to the concepts and standards of deformable solids with the effect of internal forces and associated changes in the geometry of the components involved. The focus is to illustrate stress and strain in different types of structure/machine under different loading conditions. Upon completion of this course, students will have the competence to explain simple and compound stresses due to forces, stresses and deflection in beams due to bending and torsion in circular section with practical knowledge. The learning approach is to apply a synergistic process to theoretical analyses and experimental results for engineering design. Students will achieve comprehension of the knowledge to perform engineering calculations required to ensure that a structural member meets strength, stiffness and stability requirements.			
OBJECTIVE			
• To instill a basic knowledge of the statistical aspects of mechanics of solid materials. • To develop the formal theory of solid mechanics: the equilibrium, kinematic, and constitutive equations. • To introduce the atomistic mechanisms underlying the mechanical behavior of materials. • To establish process - structure - property - performance relationships in materials engineering.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	**Explain** mechanical properties of materials used in different applications.	2	C2	3, 4	2	4	LT, Q, R
CO2	**Solve** practical problems through evaluating the relationship between stress and strain. experiments to demonstrate the fundamentals of fluid dynamics.	3	C3	5	3	2	LT, Q, R
CO3	**Examine** the effect of load on structural members and machine parts	4	C4	8	4	1	LT, Q, R
CO4	**Plan** effectively to work individually and in group	9	C5	5	5, 6		LT, Q, R

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiment:

1. Variation of deflection of a simply supported beam with load, beam thickness and material.
2. Determination of stiffness of the strut materials.
3. Izod and Charpy Impact test of different types of materials.
4. Torsion test of carbon steel and brass.
5. Tensile test of 16 mm diameter rod.
6. Compression test of wooden block

CO-PO MAPPING													
No.	**Course Learning Outcome**	**Programming Outcomes (PO)**											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** mechanical properties of materials used in different applications.		3										
CO2	**Solve** practical problems through evaluating the relationship between stress and strain			2									
CO3	**Examine** the effect of load on structural members and machine parts				3								
CO4	**Plan** effectively to work individually and in group									3			

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Correspondinglevel of matching**	**Justification**
CO1-PO2	**3**	Students will be able to explain mechanical properties of materials used in different applications.
CO2-PO3	**3**	It is necessary to relate the real life situations with the experimental knowledge.
CO3-PO4	**3**	Students will be able to analyze the effect of load on structural members and machine parts.
CO4-PO9	**3**	Appropriate plan is required to work effectively individually and in group.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning		
	Lecture	7
	Practical	14
	Total	21
Self-Directed Learning		
	Preparation of Lab Reports	5
	Preparation of Lab Test	10
	Preparation of Presentation	5
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	7
	Final Quiz	1
Total		79

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative Method.

COURSE SCHEDULE	
Week-1	Variation of deflection of a simply supported beam with load, beam thickness and material.
Week-2	Determination of stiffness of the strut materials.
Week-3	Izod and Charpy Impact test of different types of materials.
Week-4	Torsion test of carbon steel and brass.
Week-5	Tensile test of 16 mm diameter rod.
Week-6	Compression test of wooden block.
Week-7	Final Lab Report Submission, Lab test
Week-8	Oral Exam, Quiz

ASSESSMENT STRATEGY		
Component		**Grading**
Continuous Assessment (60%)	Lab participation and Report	30%
	Lab test	30%
Lab quiz, Oral exam		40%
Total Marks		100%

REFERENCE BOOKS

- Singer, F. L., & Pytel, A. (1980). *Strength of materials*. New York: Harper & Row.
- Beer, F. P., E Russell Johnston, Dewolf, J. T., & Mazurek, D. F. (2015). *Mechanics of materials*. New York, Ny: Mcgraw-Hill Education.
- Hibbeler, R. C., & Kai Beng Yap. (2018). *Mechanics of materials* (10th ed.). Harlow Pearson.

ME 3101: Heat Transfer –I

COURSE INFORMATION			
Course Code	ME 3101	Lecture Contact Hours	3.00
Course Title	Heat Transfer-I	Credit Hours	3.00

PRE-REQUISITE

ME 2101: Engineering Thermodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides a prologue to the concepts and standards of heat transfer processes and essential theoretical basis of heat transfer equipment design and its application to a range of problems of relevance practical engineering. The focus is to acquainted students with the basic ideas of heat and mass transfer, and their application to engineering problems. The learning approach of this course is to apply the knowledge of thermodynamics to the systems that lack thermal equilibrium. Students will obtain an in-depth knowledge of one- and two-dimensional steady state conduction, unsteady state conduction, radiation, forced and natural convection, multiphase heat transfer and mass transfer. Upon completion of this course, students will have the competence to compute the effects of surface geometry, orientation, shape and bulk liquid velocity on heat transfer.
OBJECTIVE
• Understand and solve problems in heat and mass transfer using basic material properties. • Distinguish the influences of different types of fluid flow and heat transfer on the engineering systems and calculate appropriate dimensionless parameters in these situations. • Interpret different aspects of boiling and condensation and their implications. • Solve problems related to extended surfaces and complex geometries. • Carry out basic heat exchanger analysis.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Compare** different modes of heat and mass transfer used in engineering systems.	1	C4	1, 4	1		ASG, CT, F. M, Q
CO2	**Explain** the fundamentals of two-phase heat and mass transfer with their applications in engineering systems.	1	C2	1, 4	1		ASG, CT, F, M, Q
CO3	**Analyse** different heat transferring surfaces and inspect their behaviour.	3, 9	C4	1, 10	5, 6		ASG, F, M, R
CO4	**Examine** the behaviour of various engineering systems like heat	4	C4	8	4		ASG, CT, F, M, Q

	exchangers, and various heat transferring surfaces.						

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Fundamental Concept.
- Conduction.
- Radiation.
- Convection.
- Heat Transfer with Change of Phase.
- Heat Exchanger.
- Mass Transfer.

b. Detail Contents:

Basic modes of heat transfer; General conduction equation; Steady state conduction in different geometries and composite structures; Thermal contact resistance; Unsteady heat conduction in solids; Laws of radiation heat transfer; Radiation shape factor; Radiation interchange between two surfaces; Gas radiation; Heat and momentum transfer associated with laminar and turbulent flows of fluids in forced convection; Velocity and thermal boundary layer developments in tubes (ducts) and over flat plate; Natural convection heat transfer; Heat transfer mechanism with change of phase; Boiling and condensation: mechanism and heat transfer correlations; Mechanism of mass transfer by diffusion, convection and change of phase; Analogy between heat and mass transfer.

CO-PO MAPPING

No.	Course Outcome	Programming Outcomes (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO 1	**Compare** different modes of heat and mass transfer used in engineering systems.	3											

CO 2	**Explain** the fundamentals of two-phase heat and mass transfer with their applications in engineering systems	3											
CO 3	**Analyze** different heat transferring surfaces and inspect the behavior.			2						2			
CO 4	**Examine** the behavior of various engineering systems like heat exchangers, and various heat transferring surfaces.				3								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Corresponding level of matching	Justification
CO1-PO1	3	Students will be able to explain different modes of heat and mass transfer.
CO2-PO1	3	Students will be able to relate the application of heat transfer in two phase systems.

CO3-PO3	2	Students will be able to model various heat transfer surfaces and systems.
CO3-PO9	2	Students will be able to inspect different heat transfer surfaces and systems individually and in group.
CO4-PO4	3	Students will be able to examine the behaviour of heat transfer in different engineering systems and surfaces.

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, Quiz, Assignment, Case study

COURSE SCHEDULE

Week	Lecture	Topic	ASG/CT/M	Remarks
1	1	Course introduction - learning objectives, learning activities and assessment methods		
	2	Basic modes of heat transfer-1		
	3	Basic modes of heat transfer-2		
2	4	General conduction equation		
	5	Steady state conduction in different geometries		
	6	Steady state conduction in composite structures		
3	7	Thermal contact resistance		
	8	Unsteady heat conduction in solids-1		

	9	Unsteady heat conduction in solids-2		
4	10	Laws of radiation heat transfer-1		
	11	Laws of radiation heat transfer-2		
	12	Radiation shape factor	CT-01	Lectures 2-9
5	13	Radiation interchange between two surfaces-1		
	14	Radiation interchange between two surfaces-2		
	15	Gas radiation		
6	16	Forced convection: Introduction		
	17	Forced convection: Laminar flow		
	18	Forced convection: Turbulent flow		
7	19	Forced convection: Inside tube and duct		
	20	Forced convection: Across cylinder, sphere		
	21	Forced convection: Tube bank	ASG-01	
8	22	Natural convection: Introduction		
	23	Natural convection: Vertical plate		
	24	Natural convection: Cylinder		
9	25	Velocity and thermal boundary layer: Flat plate		
	26	Velocity and thermal boundary layer: Tubes (ducts)	M	
	27	Phase change and heat transfer mechanism		
10	28	Boiling curve and boiling regime		
	29	Internal flow boiling: vertical and horizontal		
	30	Boiling: heat transfer and pressure drop correlations		

11	31	Introduction to dropwise and film condensation		
	32	Film condensation on vertical plates		
	33	Condensation: correlations	CT-02	Lectures 25-31
12	34	Application of boiling and condensation-1		
	35	Application of boiling and condensation-2		
	36	Application of boiling and condensation-3		
13	37	Mechanism of mass transfer by diffusion		
	38	Mass convection		
	39	Binary mixture, Dimensionless number	ASG-02	
14	40	Diffusion coefficient		
	41	Analogy between heat and mass transfer		
	42	Recap		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Q, ASG, CT	30	
2	Q, ASG, CT	30	
3	ASG, R	30	
4	Q, ASG, CT	30	
	Exam		
1	M, F	70	
2	M, F	70	
3	M, F	70	
4	M, F	70	

REFERENCE BOOKS

- Cengel, Y. A. (2014). *Heat and mass transfer: a practical approach*. Mcgraw-Hill.
- Holman, J. P. (2010). *Heat Transfer* (10th ed.). Mcgraw Hill Higher Education.
- Nag, P. K. (2011). *Heat and mass transfer*. Tata Mcgraw-Hill.

ME 3103: Engineering Mechanics –II

COURSE INFORMATION			
Course Code	ME 3103	Lecture Contact Hours	3.00
Course Title	Engineering Mechanics-II	Credit Hours	3.00
PRE-REQUISITE			
ME 2103- Engineering Mechanics-I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts of machines and mechanism used in engineering fields. The focus is to illustrate the basic concepts of different mechanisms in different applications. Students will obtain an in-depth knowledge about flywheel, governor, cam-follower, balancing mass and energy system, vibration etc. Upon completion of this course, students will have the competence to understand principles of different mechanism systems as well as will be able identify their practical uses. The learning approach is to build the basics of machine, mechanism and vibration concepts. Students will achieve comprehension of the working principle of different machines and will gain the knowledge to connect systems based on their understanding in engineering fields.			
OBJECTIVE			
• Students will be familiarized with the ideas of machine and mechanisms. • Students will be able to comprehend the principles governors, gears and gear trains, fly wheel, cam-follower, and mass-balancing. • Students will be able to solve different mathematical problems for diverse machines and mechanisms. • Students will be able to realize the concept of vibrations, resonance and oscillations. • Students will be able to correlate their theoretical knowledge to the practical examples of machines that can enhance their lateral thinking.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Define** and **analyze** different mechanisms in theoretical and real-life applications	1	C4	1	1		ASG, CT, M, F
CO2	**Perform** theoretical and mathematical explanation of machines.	2	C2	2	1,2		ASG, CT, M, F
CO3	**Interpreting** the principles of machines and bringing to an understand-ble conclusion	2	C4	2	2		ASG, CT, M, F
CO4	**Compare** different concepts to identify their appropriate uses in practical uses.	1	C2	2	1		ASG, CT, M, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Machine an Mechanism
- Rotating and Reciprocating Mass Balancing
- Flywheel
- Gear
- Gear Train
- Governor
- Cam and Follower
- Vibration
- Shafts

b. Detail Contents:

Machine and Mechanism: Kinematic chain, degree of freedom, mobility, inertia and kinetic energy of rotation and reciprocating parts.

Rotating and Reciprocating Mass and Balancing: Rotating and reciprocating masses, balancing of in-line engines, principle of direct and reverse cranks in balancing problems, balancing machines.

Flywheel: Turning moment diagram, fluctuation of energy and speed, fly wheel.

Gear: Law of gearing forms of tooth and types of gear, gear trains and their arrangements, analytical and tabular methods of simple, compound and epicyclic gear trains, compound epicyclic trains and their applications, torque transfer by gear train.

Governor: Types of governor and governing, working principles of different types of governor, controlling force curves, governor stability, sensitiveness, effort and power of governor.

Cam and follower: Cam and follower, various profiles of cams and their motions.

Vibration: Free, forced and damped vibration of systems having one degree of freedom, beat, resonance and transient phenomena in forced vibration, vehicle suspension, vibration absorber.

Shaft: Torsional oscillation of shafts, whirling of shafts, transverse vibration of shafts.

CO-PO MAPPING

No.	**Course Outcome**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Define** and **analyze** different mechanisms in theoretical and real life applications	3											

CO2	**Perform** theoretical and mathematical explanation of machines.		3										
CO3	**Interpreting** the principles of machines and bringing to an understandable conclusion		3										
CO4	**Compare** different concepts to identify their appropriate uses in practical uses.	3											

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to correlate the basic working principles of the different mechanism systems.
CO2-PO2	3	Students will be able to solve different mathematical and theoretical problems.
CO3-PO2	3	Students will be able to analyze different principles both theoretically and mathematically.
CO4-PO1	3	Students will be able to acknowledge different machine concepts.

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	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction: degree of freedom, machine, mechanism, kinematic chain		
	2	Inertia and kinetic energy of rotating and reciprocating parts		
	3	Balancing of a single rotating mass		
2	4	Balancing of masses rotating in a single plane		
	5	Balancing of masses rotating in different planes		
	6	Balancing of a reciprocating mass, partial balancing, direct and reverse cranks-I		
3	7	Balancing of a reciprocating mass, partial balancing, direct and reverse cranks-II		
	8	Balancing of in-line engines, balancing machines		
	9	Problems on balancing	CT-01	Lectures 1-6
4	10	Turning moment diagram, speed fluctuation & flywheel		
	11	Problems on turning moment diagrams		
	12	Law of gearing, forms of tooth and types of gears		
5	13	Different gear train arrangements and torque transfer		
	14	Speed ratio of gear trains		
	15	Epicyclic gear trains: simple and compound		
6	16	Problems on gear trains		

	17	Governor: types and working principles		
	18	Governor: controlling force, stability and sensitivity	ASG-01	
7	19	Governor: effort and power; problem		
	20	Theory review		
	21	Problem review		
8	22	Cam and follower	M	
	23	Various profiles of cams and their motions-I		
	24	Various profiles of cams and their motions-II		
9	25	Free vibration of systems with one degree of freedom		
	26	Damped vibration for one degree freedom		
	27	Forced vibration for one degree of freedom		
10	28	Beat, resonance and transient phenomena in forced vibration-I		
	29	Beat, resonance and transient phenomena in forced vibration-II	CT-02	Lectures 25-28
	30	Beat, resonance and transient phenomena in forced vibration-III		
11	31	Torsional oscillation of shafts		
	32	Whirling of shafts		
	33	Transverse vibration of shafts		
12	34	Simple pendulum treated by energy method		
	35	Simple situation of vibration with two degree of freedom having elastic constraints	ASG-02	
	36	Torsional oscillation of shafts with multi rotors		
13	37	Self-excited vibration		
	38	Vibration measurement and measuring instruments		

	39	Vibration isolation & transmissibility, isolator materials		
14	40	Vehicle suspension, vibration absorber		
	41	Review class		
	42	Review class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	70	
2	ASG, CT	70	
3	ASG, CT	70	
4	ASG, CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	
4	M, F	30	

REFERENCE BOOKS

- Khurmi, R. S. and Gupta, Theory *of Machines. (S. I. Units)*, J. K. Eurasia Publishing house (Pvt) Ltd., ISBN: 9788121925242.
- Hannah J. and Stephens, *Mechanics of Machines*, R.C. Bujicor pdf. 1997. (4nd Ed.), ISBN: 9788176496797.
- Rattan, S. S. McGraw Hill, *Theory of Machines*. (5th Ed.). 2019, ISBN: 9789353166335.
- Bevan, T., Pearson, *Theory of Machines*, (3rd Ed.). 1986, ISBN: 978-8131729656.
- Inman, D. J, *Engineering Vibration*. Printice-Hall; 2014, (4th Ed.), ISBN: 9780132871693.
- Thompson, W., Pearson, *Vibration*. (5th Ed.). 1965, ISBN: 978-0136510680.

ME 3104: Engineering Mechanics –II Sessional

COURSE INFORMATION			
Course Code	ME 3104	Lecture Contact Hours	3.00
Course Title	Engineering Mechanics-II Sessional	Credit Hours	1.50
PRE-REQUISITE			
ME 2104- Engineering Mechanics-I Sessional			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts of different Machines and Mechanism used in Engineering fields. The focus is to illustrate the basic concepts of different mechanisms in these fields. Students will obtain an in-depth knowledge in how these mechanisms work. Upon completion of this course, students will have the competence to understand principles of different mechanism systems as well as will be able identify their practical uses. The learning approach is to work with the basic of few machine and mechanism concepts.			
OBJECTIVE			
• To understand different basic mechanics techniques. • To become skilled at different mechanics techniques and applications. • To make students understand the use of practical examples of machines.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Define** and **analyze** different mechanisms in practical applications.	1	C1	1		1	ASG, R, Q, LT
CO2	**Interpret** the Gyroscopic law in different applications.	2	C2	1		1	ASG, R, Q, LT
CO3	**Analyze** the critical speed of a shaft.	3	C4	1		1	ASG, R, Q, LT
CO4	**Explain** about the compression and tension in spring.	1	C2	1		1	ASG, R, Q, LT
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT
a. Experiments: • Investigation the forces parallel and normal to a roller on an inclined plane. • Determination of spring rate of compression and tension spring. • Experimental verification of gyroscope laws. • Comparison of co-efficient of friction of various materials belt. • Determination of critical speed of a shaft by whirling shaft apparatus.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	10	11	12
CO1	To define and analyze different mechanisms in practical applications.	3											
CO2	Interpret the Gyroscopic law in different applications.		3										
CO3	Analyze the critical speed of a shaft.			3									
CO4	Explain about the compression and tension in spring.	3											

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to correlate the basic working principles of the different machine systems
CO2-PO2	3	Students will be able to understand gyroscopic law in procedures by analyzing complex engineering problems.
CO3-PO3	3	The students will attain the knowledge to calculate the way of critical speed to contribute to health and safety issue.

CO4-PO1	3	Students will be able to acknowledge forces acting on spring processes.

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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01
Total		112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, co-operative and collaborative method, project based method

COURSE SCHEDULE

Week	**Topics**	**Remarks**
1	Investigation the forces parallel and normal to a roller on an inclined plane.	
3	Determination of spring rate of compression and tension spring.	

5	Experimental verification of gyroscope laws.	
7	Comparison of co-efficient of friction of various materials belt.	
9	Determination of critical speed of a shaft by whirling shaft apparatus.	
11	Review Class	
13	Investigation the forces parallel and normal to a roller on an inclined plane.	
14	Determination of spring rate of compression and tension spring.	

ASSESSMENT STRATEGY

Assessment Method		Grading
	Lab participation and report	30%
	Labtest-1, Labtest-2	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS

- Khurmi, R. S. and Gupta, Theory *of Machines. (S. I. Units)*, J. K. Eurasia publishing house (Pvt) Ltd., ISBN: 9788121925242.
- Hannah J. and Stephens, *Mechanics of Machines,* R.C. Bujicor pdf. 1997. (4^{nd} Ed.), ISBN: 9788176496797.
- Rattan, S. S. McGraw Hill, *Theory of Machines*. (5^{th} Ed.). 2019, ISBN: 9789353166335.
- Bevan, T., Pearson, *Theory of Machines,* (3^{rd} Ed.). 1986, ISBN: 978-8131729656.
- Inman, D. J, *Engineering Vibration*. Printice-Hall; 2014, (4^{th} Ed.), ISBN: 9780132871693.
- Thompson, W., Pearson, *Vibration*. (5^{th} Ed.). 1965, ISBN: 978-0136510680.

ME 3105: Fluid Mechanics –I

COURSE INFORMATION			
Course Code	ME 3105	Lecture Contact Hours	3.00
Course Title	Fluid Mechanics-I	Credit Hours	3.00
PRE-REQUISITE			
ME 2101: Engineering Thermodynamics, ME 2103- Engineering Mechanics.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			

SYNOPSIS/RATIONALE

This course provides an introductory perception in the working principle of fluid mechanics.

The focus is to impart core understanding of fluid in both stationary and dynamic states. Students will get acquainted with the main variables for static and dynamics of fluids, fluid flow regimes, forces acting on bodies floating and submerged in fluid, and dimensional analysis. The knowledge gathered during this course will help students in further understanding of theoretical and experimental fluid mechanics.

The learning approach is to apply a synergistic approach to combine the knowledge of thermodynamics, fluid statics and fluid dynamics for the in-depth understanding of flow physics in all types of thermofluid applications.

Students will achieve comprehension of basic variables of fluids and the physics of static and dynamic states of fluids. The knowledge shared within this course will act as the cornerstone for further understanding of theoretical and experimental fluid mechanics. Students will get acquainted with the basic principle of fluid sensors and actuators which could be further developed through visiting the Mechatronics course.

OBJECTIVE

- To familiarize students with the terminology associated with fluid mechanics.
- To understand about the dimensional analysis.
- To develop perception about fluid statics.
- To get acquainted with the concepts of kinematics of fluid.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Correlate** the theoretical engineering knowledge to proceed for the analysis of fluid systems.	2	C4	4	1		ASG, CS, CT, F, M, Q
CO2	**Develop** conception of dimensional analysis with fluid flow problems.	1	C3	4	5		ASG, CS, Q, CT, F
CO3	**Apply** the use of different empirical equations to solve fluid system problems.	3	C2, P2, A2	1, 5	1, 2, 3, 5	1	ASG, CS, CT, F, M, Q
CO4	**Develop** creative thinking ability and a deep perception and intuitive feel for fluid flow measurement, and gain competence in working professionally in this area.	4	C6	2, 4, 8	1, 3, 7		ASG, CS, CT, F, M, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Fundamentals of fluid mechanics.
- Fluid statics.
- Kinematics of flow.
- Dimensional analysis.

b. Detail Contents:

Introduction: Fundamental concepts, viscosity, compressibility and elasticity, surface tension and capillarity, vapour pressure, manometer.

Fluid Statics: Pressure at a point, pressure gradient, pressure on flat and curved surfaces immersed in fluids, center of pressure. Buoyancy and flotation, meta-center and metacentric height, stability of submerged and floating bodies, fluid containers subjected to constant acceleration and rotation.

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. Euler's equation and Bernoulli's equation. Hydraulic grade line and energy grade line. Energy equation with or without losses, comparison of energy equation with Bernoulli's equation, kinetic energy correction factor. Transient flow in emptying of tank and flow between connected vessels. Flow measuring devices. Flow through sharp edged orifice, the pitot tube, the Venturi-meter, the flow nozzle and orifice meter, notches and sharp crested weirs. Momentum equation for inertial control volume, application of momentum principle for incompressible fluids in variable area duct. Impact of jet on fixed and moving vanes. Application of momentum principle for jet propulsion and propellers. Momentum correction factor: Force caused by a flow round a pipe-bend, force at nozzle and reaction of a jet, force on solid body in a flowing fluid.

Dimensional Analysis: Fundamental & derived units, Dimensional homogeneity, Buckingham theorem, significance of dimensionless numbers, Application of dimensional analysis in fluid flow problems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Correlate** the theoretical engineering knowledge to proceed for the analysis of fluid systems.		3										
CO2	**Develop** conception of dimensional analysis with fluid flow problems.	3											

CO3	**Apply** the use of different empirical equations to solve fluid system problems.			3									
CO4	**Develop** creative thinking ability and a deep perception and intuitive feel for fluid flow measurement, and gain competence in working professionally in this area.				3								

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	3	Students will be able to correlate the theoretical engineering knowledge to proceed for the analysis of complex engineering problems pertaining to fluid systems.
CO2-PO1	3	Students will be able to develop basic conception of dimensional analysis to characterize fluid systems.
CO3-PO3	3	Students will attain competence in the use of different empirical equations to solve fluid system problems with conflicting boundary conditions.
CO4-PO4	3	Students will be able to develop creative thinking ability of solving complex problems related to fluid flow measurement, thus enabling themselves to work in professional capacity in this field.

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, and problem solving.	

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Course overview, introduction to fluid mechanics.		
	2	Viscous and inviscid fluid.		
	3	Fluid elasticity and compressiblity.		
2	4	Surface tension and capillarity.		
	5	Vapour pressure, gauge pressure, absolute pressure.		
	6	Manometer.		
3	7	Pressure at a point, pressure on flat surfaces immersed in fluids.		
	8	Pressure on curved surfaces immersed in fluids, pressure gradient.		
	9	Center of pressure. Buoyancy and flotation-I.	CT-01	Lectures 1-6
4	10	Buoyancy and flotation-II.		
	11	Metacenter and metacentric height-I.		
	12	Metacenter and metacentric height-II.		
5	13	Stability of submerged and floating bodies.		
	14	Fluid containers subjected to constant acceleration and rotation.		
	15	Velocity and acceleration of fluid particles, types of fluid flow.		
6	16	Systems and control volumes; one- and two-dimensional flow.		
	17	Continuity equation. Euler’s equation and Bernoulli's equation.		
	18	Hydraulic grade line, energy grade line.	ASG-01	

7	19	Energy equation with or without losses, comparison of energy equation with Bernoulli's equation.		
	20	Energy equation and kinetic energy correction factor.		
	21	Transient flow in emptying of tank and flow between connected vessels.		
8	22	Flow measuring devices.	M	
	23	Flow through sharp edged orifice.		
	24	The Venturi-meter, flow nozzle and orifice meter.		
9	25	Pitot tube.		
	26	Notches and sharp crested weirs.		
	27	Momentum equation for inertial control volume.		
10	28	Application of momentum principle for incompressible fluids in variable area duct.		
	29	Impact of jet on fixed and moving vanes.	CT-02	Lectures 22-27
	30	Application of momentum principle for jet propulsion and propellers.		
11	31	Momentum correction factor.		
	32	Force caused by a flow round a pipe-bend.		
	33	Force at nozzle.		
12	34	Reaction of a jet.		
	35	Force on solid body in a flowing fluid.	ASG-02	
	36	Fundamental & derived units.		
13	37	Buckingham theorem.		
	38	Dimensional homogeneity.		
	39	Dimensionless Numbers-I.		
14	40	Dimensionless Numbers-II.		
	41	Significance of dimensionless numbers.		
	42	Application of dimensional analysis in fluid flow problems.		

ASSESSMENT STRATEGY				
	CO	Assessment Method	(100%)	Remarks
		Class Assessment		
	1	ASG, CS, CT	70	
	2	ASG, CS, CT	70	
	3	ASG, CS, CT	70	
	4	ASG, CS, CT	70	
		Exam		
	1	M, F	30	
	2	F	30	
	3	M, F	30	
	4	M, F	30	

REFERENCE BOOKS

- White, F. M., & Xue, H. (2021). *Fluid mechanics*. 7th Edition. New York, NY : McGraw Hill LLC, ISBN 978-0-07-352934-9
- RAJPUT, R. K. (2015). *Textbook of fluid mechanics & hydraulic machines in si units*. 6th Edition. S. Chand & Company Pvt. Ltd., New Delhi-110055, India, ISBN: 978-93-854-0137-4
- Çengel, Y. A., & Cimbala, J. M. (2014). *Fluid mechanics: Fundamentals and applications*. 3rd Edition. McGraw Hill Education Private Limited, Tamil Nadu, India, ISBN: 978-93-392-0465-5
- Bansal, R. K. (2017). *A Textbook of Fluid Mechanics and Hydraulic Machines*. 9th Edition, Laxmi Publications Private Limited, New Delhi-110002, India, ISBN: 9788131808153
- Khurmi, R. S. (2008). *A textbook of hydraulics, fluid mechanics and hydraulic machines (In SI Units):* 2nd Edition, S. Chand & Company Pvt. Ltd., New Delhi-110055, ISBN: 81-219-0162-6

ME 3106: Fluid Mechanics –I Sessional

COURSE INFORMATION			
Course Code	ME 3106	Lecture Contact Hours	1.50
Course Title	Fluid Mechanics-I Sessional	Credit Hours	0.75

PRE-REQUISITE

ME 2101: Engineering Thermodynamics, ME 2103- Engineering Mechanics, ME 3105: Fluid Mechanics-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course illustrates the practical engineering problems based on the fundamental principle of fluid mechanics. The learning objectives of this course will be obtained by using simple experimental equipment while maintaining good laboratory practice, analyzing and disseminating the results. The basic theoretical knowledge of thermodynamics and mechanics will be combined in this course for understanding theoretical background of an experiment, performing an experiment and analyzing the experimental results. In this way, students will obtain practical skills to verify theoretical knowledge via experiments. Understanding of this course will pave the way for a more detailed knowledge of fluid mechanics.

OBJECTIVE

- To demonstrate the fundamentals of fluid dynamics in relation to engineering applications.
- To practice the safety precautions while working in a fluid laboratory.
- To write a scientific report following a template.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Apply** safety precautions while	6	C3	7		4	Q, LT

	performing the experiments.						
CO2	**Conduct** experiments to demonstrate the fundamentals of fluid dynamics.	1, 4	C3	1, 8		2	Q, R, LT
CO3	**Write** a report following a given template that includes theoretical background, materials, methods and data analysis.	10	C5	1		1	R

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Theory:

Introduction to fluid mechanics laboratory, a good laboratory practice and a format of report writing.

Experiment:

- Investigation on Bernoulli’s theorem.
- Study the characteristics of flow through an open channel (Rectangular notch).
- Study the characteristics of flow through an open channel (Triangular notch).
- Determination of Metacentric height of a floating body.

CO-PO MAPPING

No.	Course Learning Outcome	Programming Outcomes (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Apply** safety precautions while performing the experiments.						2						
CO2	**Conduct** experiments to demonstrate the fundamentals of fluid dynamics	3			2								

CO3	**Write** a report following a given template that includes theoretical background, materials, methods and data analysis.									2			

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Corresponding level of matching**	**Justification**
CO1-PO6	**2**	Implementing safety precautions while using laboratory equipment will acquaint students with the professional engineering practice.
CO2-PO1	**3**	In order to demonstrate the practical applications of the behaviour of fluid, the fundamental knowledge of fluid dynamics would be required.
CO2-PO4	**2**	Students will practice suitable experimental protocol while conducting the experiments and analyze data to conclude the findings.
CO3-PO10	**2**	Students will be able to disseminate theoretical aspects of the experiments, data collection procedure and analysis of the results in the lab-report.

TEACHING LEARNING STRATEGY		
Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning		
	Lecture	7
	Practical	14
Self-Directed Learning		
	Preparation of Lab Reports	5
	Preparation of Lab Test	10
	Preparation of Presentation	5
	Preparation of Quiz	10

	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	7
	Final Quiz	1
Total		79

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative Method.

COURSE SCHEDULE

Week-1	Introduction to fluid mechanics lab., good laboratory practice and report writing.
Week-3	Investigation on Bernoulli's theorem
Week-5	Study the characteristics of flow through an open channel (Rectangular notch).
Week-7	Study the characteristics of flow through an open channel (Triangular notch).
Week-9	Quiz
Week-10	Exp. 04: Determination of Metacentric height of a floating body.
Week-11	Feedback on the report
Week-12	Final submission
Week-14	Oral Exam, Quiz

Assessment Strategy

Component		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Lab test	30%
Lab quiz, Oral exam		40%
Total Marks		100%

REFERENCE BOOKS

• Victor Lyle Streeter. (1971). *Fluid mechanics*. New York: Mcgraw-Hill. • ÇengelY. A., & Cimbala, J. M. (2020). *Fluid mechanics: fundamentals and applications*. Singapore: Mcgraw-Hill Education. • White, F. M. (2017). *Fluid mechanics*. New Delhi, India: Mcgraw-Hill Education. • Islam, M. Q. and Mandal, A. C. (2006), "Fluid Mechanics Through Worked Out Problems", IUT, Bangladesh.

ME 3113: MACHINE DESIGN –I

COURSE INFORMATION			
Course Code	ME 3113	Lecture Contact Hours	3.00
Course Title	Machine Design-I	Credit Hours	3.00
PRE-REQUISITE			
ME 2209: Mechanics of Solids			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts and standards of machine design, basic requirements for the design of machine elements and machines, approach to design, design methods and procedures, system design cycle. The focus is to illustrate Simple and combined stress; material and their properties, manufacturing considerations in design. The learning approach is to apply engineering principles to design machine elements. Students will achieve comprehension of the fundamental hypothetical premise of design of machines and their application to a scope of issues of pertinence to practical engineering.			
OBJECTIVE			
• To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical • Applying scientific principles and concepts to the design of basic mechanical components and systems • Improving problem solving and decision-making abilities			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	**Correlate** the engineering knowledge in designing a machine element	1	C4	5	1		ASG, CT, M, F
CO2	**Develop** the basic knowledge about machine design	1	C3	5	1		ASG, CT, M, F
CO3	**Apply** the knowledge to understand the practical constraints of reality while designing a machine	2	C2	5	1		ASG, CT, M, F
CO4	**Develop** the practice to work professionally in the area of manufacturing and designing machine	3	C5	5	1		ASG, CT, M, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

- Introduction:
- Stress Analysis
- Theories of failure
- Joints
- Springs
- Columns
- Shaft Design
- Key and Key ways

b. Detail Contents:

Introduction: Objectives of machine design, basic requirements for the design of machine elements and machines, approach to design, design methods and procedures, system design cycle.

Stress Analysis: Simple and combined stress; material and their properties, manufacturing considerations in design.

Theories of Failure: Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.

Joints: Power screw, screwed joints, riveted joints, welded joints, gaskets and gasket joints.

Springs: Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.

Columns: Design of column with central and eccentric loading.

Shaft Design: Design for fully reverse banding and steady torsion. Design for fluctuating banding and fluctuating torsion. Shaft deflection.

Key and Keyways: Types of keys, stresses in keys, key design, stress concentration in keyways.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Correlate** the engineering knowledge in designing a machine element	3											
CO2	**Develop** the basic knowledge about machine design	3											

CO3	**Apply** the knowledge to understand the practical constraints of reality while designing a machine		3										
CO4	**Develop** the practice to work professionally in the area of manufacturing and designing machine			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will have the engineering knowledge in designing a machine
CO2-PO1	3	Students will understand the basic knowledge about machine design
CO3-PO2	3	Students will analyze the practical constraints of reality while designing a machine
CO4-PO3	3	Students will work professionally in the area of manufacturing machine

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, and problem solving.	

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Overview of the course		
	2	**Introduction:** Objectives of machine design, basic requirements for the design of machine elements and machines		
	3	**Introduction:** approach to design, design methods		
2	4	**Stress Analysis:** Simple and combined stress; material and their properties.		
	5	**Stress Analysis:** Simple and combined stress; material and their properties.		
	6	**Stress Analysis:** Simple and combined stress; material and their properties.		
3	7	**Stress Analysis:** Simple and combined stress; material and their properties.		
	8	**Stress Analysis:** Simple and combined stress; material and their properties.		
	9	**Stress Analysis:** Simple and combined stress;	CT-01	Lectures 4-9

		material and their properties.			
4	10	**Theories of Failure:** Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	11	**Theories of Failure:** Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	12	**Theories of Failure:** Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
5	13	**Theories of Failure:** Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	14	**Theories of Failure:** Failure of			

		ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	15	**Theories of Failure:** Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
6	16	Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	17	Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	18	Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.	ASG-01		

7	19	Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	20	Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
	21	Failure of ductile materials and failure of brittle materials. Variable loads and stress concentration, notch sensitivity, fatigue and fatigue failure.			
8	22	Spring: Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.	M		
	23	Spring: Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.			
	24	Spring: Design of compression, extension and torsional springs in static and dynamic loading, leaf			

		spring.			
9	25	Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.			
	26	Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.			
	27	Design of compression, extension and torsional springs in static and dynamic loading, leaf spring.			
10	28	Columns: Design of column with central and eccentric loading.			
	29	Columns: Design of column with central and eccentric loading.	CT-02	Lectures 22-27	
	30	Columns: Design of column with central and eccentric loading.			
11	31	Columns: Design of column with central and eccentric loading.			
	32	Columns: Design of column with central and eccentric loading.			
	33	Power screw			

		design			
12	34	Power screw design			
	35	Power screw design	ASG-02		
	36	Welded joints			
13	37	Welded joints			
	38	Welded joints			
	39	Review Class – 01			
14	40	Review Class – 02			
	41	Review Class – 03			
	42	Review Class - 04			

ASSESSMENT STRATEGY				
	COs	**Assessment Method**	**(100%)**	**Remarks**
		Class Assessment		
	1	ASG, CT	70	
	2	ASG, CT	70	
	3	ASG, CT	70	
	4	ASG, CT	70	
		Exam		
	1	M, F	30	
	2	M, F	30	
	3	M, F	30	
	4	M, F	30	
REFERENCE BOOKS				

- Budynas, R. G., & Nisbett, J. K. (2011). *Shigley's mechanical engineering design* (Vol. 9). New York: McGraw-Hill.

ME 3114: Machine Design-I Sessional

COURSE INFORMATION			
Course Code	ME 3114	Lecture Contact Hours	1.50
Course Title	Machine Design-I Sessional	Credit Hours	0.75
PRE-REQUISITE			
ME 3113: Machine Design-I			
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			
• To emphasize on applying Mechanical Engineering design theory to identify and quantify machine elements in the design of commonly used Mechanical devices. • To apply scientific principles and concepts to the design of basic mechanical components and systems. • To improve problem solving and decision-making abilities			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	**Relate** the engineering knowledge in designing a machine	3	C1	5	3		Q, ASG, R, LT
CO2	**Encourage** creative thinking and development of a deeper understanding and intuitive feel for machineries	2	C4	2,3	2		Q, ASG, R, LT
CO3	To know how to **select** different mechanical elements in different application	4	C2	8	2		Q, ASG, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

- Study of simple stress.
- Study of combined stress.
- Study of Variable loads and stress concentration
- Study of Power screw, screwed joints
- Study of different springs.
- Study of Shaft deflection

CO-PO MAPPING

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

CO1	**Relate** the engineering knowledge in designing a machine			3									
CO2	**Encourage** creative thinking and development of a deeper understanding and intuitive feel for machineries		3										
CO3	To know how to **select** different mechanical elements in different application				2								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of matching	Justifications
CO1-PO3	3	Students will be able to find the most stressed point in a machine component.
CO2-PO2	3	Students will be able to design mechanical springs, couplings, gears, belts, springs, bearings, brakes, clutches to solve engineering problems
CO3-PO4	2	Students will be able to apply the knowledge obtained to asses engineering problems and find solutions based on machine design problems

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	05

	Reports	
	Preparation of Lab Test	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
	Total	79

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week	Topics
1	Study of simple stress.
3	Study of combined stress.
5	Study of Variable loads and stress concentration.
7	Study of Power screw, screwed joints.
9	Study of different springs.
11	Study of Shaft deflection.
12	Lab Test.
13	Final Lab Report Submission
14	Lab Quiz

ASSESSMENT STRATEGY

Assessment Method		Grading
Continuous Assessment	Lab participation and Report	30%

	Lab Test	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS

- Budynas, N. G. K. R. J. (2021). *Shigley's Mechanical Engineering Design.* 11th Edition. McGraw Hill.
- Khurmi, R. S., & Gupta, J.K. (2005). *Machine Design*. 25th Edition. S. Chand.
- Faries, V. M. (1965*). Design of Machine Elements* 4th Edition. McMillan Coll.

ME 3116: Capstone Project

COURSE INFORMATION			
Course Code	ME 3116	Lecture Contact Hours	3.00
Course Title	Capstone Project	Credit Hours	1.50

PRE-REQUISITE

MATH 1101: Mathematics-I, EEE 1159: Basic Electrical Engineering, MATH 1201: Mathematics-II, CSE 1271: Computer Programming, MATH 2101: Mathematics-III, HUM 2117: Economics, ME 2101: Engineering Thermodynamics, ME 2103: Engineering Mechanics-I, ME 2111: Numerical Analysis, ME 2207: Engineering Metallurgy, ME 2209: Mechanics of Solids, EEE 2259: Electrical Machines and Electronics Technology, HUM 2219: Accounting, and MATH 2201: Mathematics-IV.

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course provides a prologue to engineering project planning and execution. In this course students are required to design of a small electro-mechanical or instrumentation system. Use of locally available prospects materials will be emphasized. The capstone course requires students to draw upon all previous course works and cultivate new skills in order to solve complex design problems associated with an assigned group project. The system design would involve the stages of concept building, engineering calculations, fabrication, presentation and demonstration of product.

The focus is to be given in project management for solving engineering problems to meet sustainable socio-economic development goals.

The learning approach is to have active participation in the planning, executing and managing of real-life engineering problems. Lectures will be provided in the technical and project management aspects of the individual project selected.

Students will achieve comprehension of employing their knowledge gathered to practical problem solving. Furthermore, students will practice collection of new information and development of skill sets to enable them into solving complex engineering problems.

OBJECTIVE

- To enable the students in designing a small electro-mechanical or instrumentation system.
- To enable the students with the competence to employ their engineering skills and knowledge along with their societal and environmental know-how to find solutions to real life problems.
- To impart the student in-depth practical knowledge and skills within specialist sub-disciplines of the practice area.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Practice** employment of technical know-how in solving real-life problems.	1	C3, P1	1, 3, 4	1	1, 2, 3	D, PR, Pr, Q, R
CO2	**Employ** knowledge in basic science and engineering to solve complex real-life problems.	2	C3, P1	1, 2, 3, 4	2	1, 2, 3	D, PR, Pr, Q, R
CO3	**Solve** real life complex engineering problems with multivariate boundary conditions using knowledge acquired in the field of mechanical engineering.	3	C5, P2	5	3	1, 2, 3	D, PR, Pr, Q, R
CO4	**Investigate** real life problems and analyze solution techniques to synthesize solution to complex engineering problems.	4	C4	8	4	1, 2, 3	D, PR, Pr, Q, R
CO5	**Employ** modern tools in designing solutions to complex engineering problems.	5	C3, A2	6		4, 5	D, PR, Pr, Q, R
CO6	**Employ** societal and ethical know-how in sustainable development of electro-mechanical	6	C6, P3, A2	7	5,6	4, 5	D, PR, Pr, Q, R

	solutions to solve real-life problems.						
CO7	**Practice** sustainable development of electro-mechanical solutions to solve real-life problems.	7	C6, P2, A1	7	5	2, 3, 4, 5	D, PR, Pr, Q, R
CO8	**Employ** ethical considerations in the solution of real-life engineering problems with conflicting boundary conditions.	8	C3, A3	7	5, 6	4, 5	D, PR, Pr, Q, R
CO9	**Practice** teamwork and adapt skills to contribute as individual and in team towards solution of complex engineering problems.	9	C3		6	1	D, PR, Pr, Q, R
CO 10	**Practice** communication skills in managing and solving real-life complex engineering problems.	10	C4			1, 2, 3, 4, 5	D, PR, Pr, Q, R
CO 11	**Employ** project management and communication skills in building a culture of teamwork to successful attainment of set goals.	11	C3			1	D, PR, Pr, Q, R

CO 12	**Practice** correlating engineering know-how and the **adaptation** of soft and hard skills in a culture of life-long learning of solving complex real-life problems.	12	C3	8	6, 7	4, 5	D, PR, Pr, Q, R

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction to engineering project management.
- Introduction to capstone projects on electro-mechanical systems.

b. Detail Contents:

Students will be assigned real-life problems, and will have to solve the problems by employing their technical know-how on multidisciplinary topics. Students will be distributed in groups, and will act in various capacities ranging from group leader to executive members. The approach towards a solution of the given tasks will depend on the group's collective perception of the problem definition and the project management, communication and teamwork skills of the individual group members. Students will practice the search and acquiring of knowledge both in and out of textbooks for finding the solutions of any give problem.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Practice** employment of technical know-how in solving real-life problems.	3											
CO2	**Employ** knowledge in basic science and engineering to solve complex real-life problems.		3										

CO3	**Solve** real life complex engineering problems with multivariate boundary conditions using knowledge acquired in the field of mechanical engineering.			3									
CO4	**Investigate** real life problems and analyze solution techniques to synthesize solution to complex engineering problems.				3								
CO5	**Employ** modern tools in designing solutions to complex engineering problems.					3							
CO6	**Employ** societal and ethical know-how in sustainable development of electro-mechanical solutions to solve real-life problems.						3						
CO7	**Practice** sustainable development of electro-mechanical solutions to solve real-life problems.							3					
CO8	**Employ** ethical considerations in the solution of real-life engineering problems with conflicting boundary conditions.								3				
CO9	**Practice** teamwork and adapt skills to contribute as individual and in team towards solution of complex engineering problems.									3			
CO 10	**Practice** communication skills in managing and solving real-life complex engineering problems.										3		
CO 11	**Employ** project management and communication skills in building a culture of teamwork to successful attainment of set goals.											3	

CO 12	**Practice** correlating engineering know-how and the **adaptation** of soft and hard skills in a culture of life-long learning of solving complex real-life problems.												3

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will practice employment of technical know-how in solving real-life problems.
CO2-PO2	3	Students will develop the competence of synthesizing solutions to complex engineering problems based on their multidisciplinary knowledge on the basic science and engineering.
CO3-PO3	3	Students will learn to employ knowledge in basic science and engineering to solve complex real-life problems.
CO4-PO4	3	Students will investigate real life problems and analyze solution techniques to synthesize solution to complex engineering problems.
CO5-PO5	3	Students will practice employing modern tools in designing solutions to complex engineering problems.
CO6-PO6	3	Students will employ societal and ethical know-how in sustainable development of electro-mechanical solutions to solve real-life problems.
CO7-PO7	3	Students will practice sustainable development of electro-mechanical solutions to solve real-life problems.
CO8-PO8	3	Students will employ ethical considerations in the solution of real-life engineering problems with conflicting boundary conditions.
CO9-PO9	3	Students will practice teamwork and adapt skills to contribute as individual and in team towards solution of complex engineering problems.

CO10-PO10	3	Students will practice communication skills in managing and solving real-life complex engineering problems.
CO11-PO11	3	Students will practice employment of project management and communication skills in building a culture of teamwork to successful attainment of set goals.
CO12-PO12	3	Students will adapt the culture of correlating engineering know-how and the adaptation of soft and hard skills in a culture of life-long learning of solving complex real-life problems.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning		
	Lecture	08
	Practical	34
	Total	42
Self-Directed Learning		
	Preparation of project tasks	40
	Preparation of project report	20
	Preparation of presentations	08
	Total	68
Formal Assessment		
	Project demonstration	01
	Presentation and quiz	01
	Total	02
Total		112

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE	
Week	**Lecture/Activity**
1	Course overview. Introductory class on project management, engineering ethics and team-working skill development. Group distribution.
2	Workshop on engineering project management. Task assignment.
3	Project meeting -I.

4	Project work day-I.
5	Project work day-II.
6	Project work day-III.
7	Introduction to technical report writing. Project Meeting -II.
8	Project work day-IV.
9	Project work day-V.
10	Project Meeting -III.
11	Project work day-VI.
12	Project work day-VII.
13	Project demonstration.
14	Presentation and quiz.

ASSESSMENT STRATEGY

Components		Grading
Continuous assessment (60%)	Project meetings	20%
	Project participation	40%
Project demonstration		20%
Project presentation and quiz		10%
Project report		10%
Total Marks		100%

REFERENCE BOOKS

- Smith, N. J. (Ed.). (2002). *Engineering project management*. Ames, IA: Blackwell Science. ISBN: 9780470708989
- Fleddermann, C. B. (1999). *Engineering ethics*. Upper Saddle River, NJ: Prentice Hall. ISBN: 9780132145213
- Dubbel, H. (2013). *Dubbel-Handbook of mechanical engineering*. Springer Science & Business Media. ISBN: 9780387198682
- Collins, S., Ghey, J., & Mills, G. (1989). *The professional engineer in society*. Jessica

Kingsley Publishers. ISBN: 9781853025013

- Tulgan, B. (2015). *Bridging the soft skills gap: How to teach the missing basics to today's young talent*. John Wiley & Sons. ISBN: 9781118725641
- Pfeiffer, W. S., & Adkins, K. E. (2012). *Technical communication fundamentals*. Boston: Prentice Hall. ISBN: 9780132374576

ME 3201: Heat Transfer –I

COURSE INFORMATION			
Course Code	ME 3201	Lecture Contact Hours	3.00
Course Title	Heat Transfer-II	Credit Hours	3.00
PRE-REQUISITE			
ME 2101: Engineering Thermodynamics, ME 3101: Heat Transfer-I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course aims to introduce the theoretical basis of heat transfer equipment design and their applications. The focus is to impart a clear understanding of designing and applications of single- and multi-phase heat exchangers to students. This course will also provide students with the knowledge of advanced thermo-fluids systems such as passive cooling system, additively manufactured heat exchangers etc. The learning strategy of this course is to apply the combined knowledge of fundamental engineering thermodynamics and heat transfer in designing of heat transfer equipment. On successful completion of this course, students will be able to interpret the influences of different configurations of fluid flow path, extended surfaces on the performance of a heat exchangers. Students will also have the competence to analyze various kinds of heat exchangers and will be acquainted with the advanced heat transfer equipment.			
OBJECTIVE			
• Determine the cooling performance of a range of heat exchangers and establish insights on the heat exchanger analysis in terms of heat capacity ratios. • Design and analyse various kinds of heat exchangers. • Compute the performance of boiler, evaporator, condenser and cooling tower. • Explain the advanced passive cooling and heat transfer systems.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corresponding PO**	**Bloom's Taxonomy**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	**Understand** the fundamentals and selection criterion of heat exchangers.	1	C2	1			ASG, CT, F. M, Q
CO2	**Design**, analyze and select various types of heat exchangers.	3	C4, C6	3, 5	1		ASG, CT, F. M, Q
CO3	**Analyze** the applications of multiphase heat transfer equipment.	2	C4	5	1		ASG, CT, F, Q
CO4	**Explain** the advanced passive cooling and heat transfer systems.	1, 7	C2	7			ASG, F, Q, R

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Main Contents

- Concept of thermal system design.
- Heat transfer from finned surface.
- Basic thermal design methods of heat exchangers.
- Fouling of heat exchangers.
- Heat transfer mechanism with change of phase.
- Two phase heat transfer equipment.
- Thermo-electric cooling, direct liquid cooling.
- Thermal systems with internal heat source.
- Advanced topics on heat exchangers.

Detail Contents

Concept of Thermal System Design: Heat transfer requirements, mechanical design, design parameters, materials, cost and economics, safety and reliability, choice and availability, optimization, cyclic service.

Heat Transfer from Finned Surface: Basic fin design, types of fins, fin performance, efficiency of fins, equation of heat transfer from fins, analysis of unsteady heat conduction.

Heat Exchangers: Parallel flow, counter flow, cross flow, shell-and-tube, mixed and unmixed, single and multiple pass heat exchangers. Thermo-fluid characteristics and sizing of heat exchangers, fouling of heat exchangers, performance of heat transfer equipment, the log mean temperature difference, effectiveness-NTU method; F correction factor.

Two-phase Heat Transfer Equipment: Boiler, Evaporator, Condenser, Cooling tower.

Thermal Systems with Internal Heat Source: Modelling of thermal equipment.

Advanced Topics on Heat Exchangers: Micro-channel heat exchangers, additive manufacturing of heat exchangers, heat exchangers in fluid machinery, aerospace and electromechanical applications.

CO-PO MAPPING

No.	**Course Outcome**	**Programming Outcomes (PO)**											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the fundamentals and selection criterion of heat exchangers.	3											
CO2	**Design**, analyze and select various types of heat exchangers.			3									

CO3	**Analyze** the applications of multiphase heat transfer equipment.		3										
CO4	**Explain** the advanced passive cooling and heat transfer systems	2						2					

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Corresponding level of matching**	**Justification**
CO1-PO1	3	Students will perceive the fundamentals and selection criterion of heat exchanging equipment.
CO2-PO3	3	In order to select the right heat exchangers, students will analyze the design parameters and the selection criterion of the heat exchangers.
CO3-PO2	3	Students will able to solve complex engineering problems related to multiphase heat transfer equipment.
CO4-PO1	3	Students will acquire the knowledge of advanced cooling systems and the compact heat exchangers.
CO4-PO7	2	Students will be able to identify the techniques for reducing GHG emissions and consumption of power and material.

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, Quiz, Assignment, Case study				
COURSE SCHEDULE				
Week	**Lecture**	**Topic**	**ASG/CT/M**	**Remarks**
1	1	Course overview		
	2	Heat exchangers: Applications and classifications-1		
	3	Heat exchangers: Applications and classifications-2		
2	4	Review of heat transfer, fluid flow and dimensionless parameter		
	5	Fundamentals of extended surface heat transfer		
	6	Fouling, performance of heat transfer equipment		
3	7	Problem solving: Overall heat transfer coefficient		
	8	Problem solving: Extended surfaces and fouling factor		
	9	Heat Exchangers: Energy balance		
4	10	Heat Exchangers: Log-mean temperature difference.	CT-01	Lectures 2-8
	11	Heat Exchangers: Effectiveness-NTU method, F correction factor.		
	12	Pinch point analysis		
5	13	Cross flow heat exchanger with one fluid mixed		
	14	Cross flow heat exchanger with both fluid mixed		
	15	Problem solving: Heat transfer-1.		

6	16	Problem solving: Heat transfer-2	ASG-02	
	17	Design of a double pipe heat exchanger: Pipe geometry		
	18	Design of a double pipe heat exchanger: Fluid velocity and friction factor.		
7	19	Design of shell and tube heat exchanger: Shell and tube parameters		
	20	Design of shell and tube heat exchanger: Fluid properties, fluid velocities		
	21	Design of plate heat exchangers		
8	22	Tube-fin heat exchangers	M	
	23	Fin selection		
	24	Regenerator		
9	25	Heat transfer augmentation: Bulk liquid velocity, extended surfaces, inserts		
	26	Air- and water-cooled heat exchanger		
	27	Problem solving: Heat exchanger design-1		
10	28	Problem solving: Heat exchanger design-2		
	29	Passive cooling system, Thermosyphon, Heat pipe		
	30	Boiler	CT-02	Lectures 19-27
11	31	Evaporator, Condenser		
	32	Cooling tower-1		
	33	Cooling tower-2		
12	34	Thermal systems with internal heat generation		
	35	Modelling of thermal equipment		

	36	Compact heat exchangers		
13	37	Micro-channel heat exchangers		
	38	Additive manufacturing of heat exchangers		
	39	Heat exchangers in fluid machinery	ASG-02	
14	40	Heat exchangers in aerospace and electromechanical applications		
	41	Recap class-1		
	42	Recap class-2		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Q, ASG, CT	30	
2	Q, ASG, CT	30	
3	Q, ASG, CT	30	
4	Q, ASG, R	30	
	Exam		
1	M, F	70	
2	M, F	70	
3	F	70	
4	F	70	

REFERENCE BOOKS

- Holman, J. P. (2010). *Heat Transfer* (10th ed.). Mcgraw Hill Higher Education.
- Özışık, M. N. (1985). *Heat transfer: a basic approach*. Mcgraw-Hill.
- Penoncello, S. G. (2019). *Thermal energy systems: design and analysis*. Boca Raton, Fla. Taylor Et Francis, Crc Press.

ME 3202: Heat Transfer Sessional

COURSE INFORMATION			
Course Code	ME 3202	Lecture Contact Hours	3.00
Course Title	Heat Transfer Sessional	Credit Hours	1.50

PRE-REQUISITE

ME 3101: Heat Transfer-I, ME 3201: Heat Transfer-II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course offers to experimentally validate the theoretical knowledge of heat transfer mechanism such as conduction, radiation, boiling and condensation which will enable students to design heat exchangers. Students will conduct experiment following appropriate safety regulations, will apply data analysis technique to derive the conclusions. Thereby students will achieve the skills to demonstrate the theoretical knowledge via table-top experiments and transfer the knowledge to solve the practical problems of heat transfer.

OBJECTIVE

- To validate the basics of heat transfer in relation to heat exchangers.
- To conduct experiments and quantify the measurement uncertainties using data analysis technique.
- To practice the safety precautions.
- To write scientific reports.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assessment Methods
CO1	**Implement** good laboratory practice during performing experiments.	6	C3, P1	6		4	Q, LT

CO2	**Conduct** experiments to demonstrate the fundamentals of heat transfer.	1, 4	C3, P2	1		1	Q, R, LT
CO3	**Quantify** the measurement uncertainties by analyzing experimental results.	2	C5, P3	2		1	Q, R, LT
CO4	**Write** a report following a given template that includes theoretical background, materials, methods and data analysis.	10	C5	1		1	R
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT

- Study of Linear Heat Conduction by using TD1002 and to determine the thermal conductivity of metal specimen.
- Study of heat exchanger to determine the efficiency, LMTD and heat transfer co-efficient of the heat exchanger.
- Study heat transfer in different pool boiling regimes.
- Study the variation of Nusselt number with temperature during condensation.
- Determine Inverse Square Law, Cosine Law, Transmittance, Absorbance (Light).
- Determine Inverse Square Law, Cosine Law, Transmittance, Absorbance (Heat).

CO-PO MAPPING													
No.	**Course Outcome**	**Programming Outcomes (PO)**											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Implement** good laboratory practice during performing experiments.						2						
CO2	**Conduct** experiments to demonstrate the fundamentals of heat transfer.	3											
CO3	**Quantify** the measurement uncertainties by analyzing experimental results.		2										
CO4	**Write** a report following a given template that includes theoretical background, materials, methods and data analysis.										2		

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Corresponding level of matching**	**Justification**
CO1-PO6	2	In order to perform experiments, practice of safety precautions and proper use of experimental devices in the context of health, quality and management would be required.

CO2-PO1	3	Students will be able to apply the fundamental knowledge of heat transfer while investigating the heat transfer related problems.
CO3-PO2	2	The analytical skills of a student will be improved by interpreting the computed values of different experimental parameters and comparing known values with measured values.
CO4-PO10	2	Students will improve their communication skills by disseminating experimental results and scientific outcome.

TEACHING LEARNING STRATEGY		
Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning		
	Lecture	14
	Practical	28
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 Method

COURSE SCHEDULE	
Week-1	Introduction to good laboratory practice, course outline and format of report writing.

Week-2	Exp. 01.a: Study of Linear Heat Conduction by using TD1002.
Week-3	Exp. 01.b: determine the thermal conductivity of metal specimen.
Week-4	Exp. 02.a: Study of heat exchanger to determine the efficiency, LMTD and heat transfer co-efficient of the heat exchanger (Counter-current).
Week-5	Exp. 02.a: Study of heat exchanger to determine the efficiency, LMTD and heat transfer co-efficient of the heat exchanger (Co-current).
Week-6	Quiz-1
Week-7	Exp. 03.a: Study heat transfer in pool boiling regimes (low heat flux).
Week-8	Exp. 03.b: Study heat transfer in pool boiling regimes (high heat flux).
Week-9	Exp. 04: Study the variation of Nusselt number with temperature during condensation.
Week-10	Exp. 05: Determine Inverse Square Law, Cosine Law, Transmittance, Absorbance (Light).
Week-11	Exp. 06: Determine Inverse Square Law, Cosine Law, Transmittance, Absorbance (Heat).
Week-12	Feedback on report
Week-13	Final report submission
Week-14	Oral exam, Final Quiz

ASSEMENT STRATEGY

Component		Grading
Continuous Assessment (60%)	Lab participation and Report	30%
	Lab test	30%
Lab Quiz		20%
Oral Exam		20%

Total Marks	100%

REFERENCE BOOKS

- Çengel, Y. A., & Ghajar, A. J. (2020). *Heat and mass transfer: fundamentals & applications*. New York, Ny: Mcgraw-Hill Education.
- Bergman, T. L., & Incropera, F. P. (2011). *Fundamentals of heat and mass transfer 7e: heat transfer*. Hoboken, Nj: Wiley Custom Learning Solutions.
- Mandal, A. C, Islam, M. Q., Saha, S. and Rashid, M. A. R. (2010), *Heat Transfer Laboratory Practice*, BUET, Bangladesh.

ME 3205: Fluid Mechanics –II

COURSE INFORMATION			
Course Code	ME 3205	Lecture Contact Hours	3.00
Course Title	Fluid Mechanics-II	Credit Hours	3.00

PRE-REQUISITE

ME 2101: Engineering Thermodynamics, ME 2111: Numerical Analysis, and ME 3105: Fluid Mechanics- I.

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course provides an in-depth knowledge in the working principle of fluid mechanics.

The focus is to impart core understanding of fluids in dynamic states. Students will get acquainted with the basic of ideal flow, incompressible viscous flow in pipes and open channels, boundary layer theory and turbulent flows. The knowledge gathered during this course will help students in further understanding of theoretical and experimental fluid mechanics.

The learning approach is to apply a synergistic approach to combine the knowledge of thermodynamics, fluid statics and fluid dynamics for the in-depth understanding of flow physics in all types of thermofluid applications.

Students will achieve comprehension of basic fluid mechanics of flow in pipes, and open channels. The knowledge shared within this course will act as the cornerstone for further understanding of fluidics, fluid machines, turbomachinery and tribology.

OBJECTIVE

- To familiarize students with the terminology associated with fluid dynamics.
- To familiarize students with the underpinning physics of ideal flow.
- To acquaint students about the incompressible viscous flow.
- To introduce the students to the concepts of boundary layer and turbulent flows.
- To familiarize students with flows through pipings and open channels.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods

CO1	**Understand** the basic concepts of fluid mechanics in terms of pipe and channel flow, and the concepts of Magnus effect, hydraulic jump and aerodynamic lift.	1	C2	1, 2	1		ASG, CS, CT, F, M, Q
CO2	**Analyze** the nature of compressible and incompressible fluids in pipe and channel flow.	2	C3	1, 3, 4	1		ASG, CS, CT, F, Q
CO3	**Design** various types of economical sections.	3	C4	1, 2, 5	1, 5, 6, 7, 8		ASG, CS, CT, F, Q
CO4	**Analyze** and **Investigate** different types of flow like rotational flow, irrotational flow, stream line flow, laminar flow, and turbulent flow.	4	C4	8	1, 3, 8		ASG, CS, CT, F, M, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Ideal fluid flow.

- Incompressible viscous flow.
- Boundary layer theory.
- Open channel flow.

b. Detail Contents:

Incompressible Viscous Flow: Viscous flow in pipes, laws of fluid friction. Froude's experiment, Darcy-Weisbech equation. Chezy's, Manning's and Hazen-william's formulae; Laminar flow, shear and pressure gradient in laminar flow, Hagen-Poiseuille's law. Laminar flow through inclined pipes, annulus and parallel plates. Shear stresses in turbulent flow. Eddy viscosity, expression for friction factor in turbulent flow. Energy correction factors for laminar and turbulent pipe flow. Moody chart and its use. Flows in pipe network. Pipe line system design.

Boundary Layer Theory: General concept, boundary layer thickness, characteristics of boundary layer, boundary layer on a flat plate with zero pressure gradient, friction drag due to boundary layers, effect of pressure gradient, transition for flat plate flow. Separation, wake behind a cylinder. Flow around submerged objects, airfoil.

Open Channel Flow: Chezy's equation, Manning's formula, optimum shape of flow cross section, specific energy and critical depth, Froude number and its significance in channel flow, hydraulic jump.

Ideal Fluid Flow: Rotational and irrotational motions, circulation and vorticity, velocity potential, stream function, relationship between stream function and velocity potential, stream lines, equipotential lines and flow-nets, vortex motion, free and forced vortex motion, doublet, simple flows, superposition of simple flows, flow around a cylinder with and without circulation, Magnus effect and aerodynamic lift, outline of Navier Stokes equation.

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 of fluid mechanics in terms of pipe and channel flow, and the concepts of Magnus effect, hydraulic jump and aerodynamic lift.	3											
CO2	**Analyze** the nature of compressible and incompressible fluids in pipe and channel flow.		3										
CO3	**Design** various types of economical sections.			3									

CO4	**Analyze** and **Investigate** different types of flow like rotational flow, irrotational flow, stream line flow, laminar flow, and turbulent flow.				3								

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will be able to correlate the basic concepts of fluid mechanics in terms of pipe and channel flow, Magnus effect, hydraulic jump and aerodynamic lift.
CO2-PO2	3	Students will be able to analyze complex engineering problems pertaining to flow physics of compressible and incompressible flows in pipes and channels.
CO3-PO3	3	Students will attain competence in designing economical sections for open channel flow for real-life cases.
CO4-PO4	3	Students will obtain the basic knowledge regarding analysis and investigation of complex engineering problems on different types of flows like rotational flow, irrotational flow, stream line flow, laminar flow, and turbulent flow.

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, and problem solving.
COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Course overview, ideal fluid flow: rotational and irrotational motions-I.		
	2	Ideal fluid flow: rotational and irrotational motions-II.		
	3	Potential flow-I.		
2	4	Stream lines, equipotential lines and flow-nets.		
	5	Elementary flows and derived flows under potential flow theory.		
	6	Flow around a cylinder with and without circulation, Magnus effect.		
3	7	Flow around submerged objects, airfoil.		
	8	Aerodynamic lift.		
	9	Incompressible viscous flow-I.	CT-01	Lectures 1-6
4	10	Incompressible viscous flow-II.		
	11	Boundary layer theory: general concept.		
	12	Integral boundary layer values.		
5	13	Friction drag due to boundary layers.		
	14	Effect of pressure gradient on boundary layer.		
	15	Boundary layer separation.		

6	16	Wake behind a cylinder.		
	17	Navier Stokes equations-I.		
	18	Navier Stokes equations-II.	ASG-01	
7	19	Circulation and vorticity.		
	20	Vortex motion-I.		
	21	Vortex motion-II.		
8	22	Pipe flow boundary layer, entrance length and developed region.	M	
	23	Laminar flow through inclined pipes.		
	24	Turbulent flow through inclined pipes.		
9	25	Flow through annulus and between parallel plates.		
	26	Flows in pipe network, major and minor losses.		
	27	Chezy's equation, Manning's formula, and Moody diagram for pipe flow.		
10	28	Pipe line system design-I.		
	29	Pipe line system design-II.	CT-02	Lectures 22-27
	30	Pipe line system design-III.		
11	31	Introduction to open channel flow.		
	32	Bernoulli's equation, hydraulic and energy grade lines.		
	33	Compound and complex open channels.		
12	34	Chezy's equation for open channel flow.		

	35	Manning's Formula for open channel flow.		
	36	Froude's number and its significance in open channel flow.		
13	37	Flow regimes in open channel.		
	38	Hydraulic jump.	ASG-02	
	39	Specific energy and critical depth in open channel flow.		
14	40	Optimum shape of flow cross section-I.		
	41	Optimum shape of flow cross section-II.		
	42	Optimum shape of flow cross section-III.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	40	
2	ASG, CS, CT	50	
3	ASG, CS, CT	50	
4	ASG, CS, CT	40	
	Exam		
1	M, F	60	
2	F	50	
3	F	50	
4	M, F	60	

REFERENCE BOOKS

- White, F. M., & Xue, H. (2021). *Fluid mechanics*. 7th Edition. New York, NY : McGraw Hill LLC, ISBN 978-0-07-352934-9
- Schlichting, H., & Gersten, K. (2017). *Boundary layer theory: With 22 tables*. 9th Edition. Berlin [u.a.: Springer. ISBN: 978-3-662-52917-1
- Wu, J.-Z., Ma, H.-Y., & Zhou, M.-D. (2010). *Vorticity and vortex dynamics.* 1st Edition. Berlin: Springer. ISBN: 978-3-540-29027-8
- Rajput, R. K. (2015). *Textbook of fluid mechanics & hydraulic machines in si units*. 6th Edition. S. Chand & Company Pvt. Ltd., New Delhi-110055, India, ISBN: 978-93-854-0137-4
- Çengel, Y. A., & Cimbala, J. M. (2014). *Fluid mechanics: Fundamentals and applications*. 3rd Edition. McGraw Hill Education Private Limited, Tamil Nadu, India, ISBN: 978-93-392-0465-5
- Bansal, R. K. (2017). *A Textbook of Fluid Mechanics and Hydraulic Machines*. 9th Edition, Laxmi Publications Private Limited, New Delhi-110002, India, ISBN: 9788131808153
- Khurmi, R. S. (2008). *A textbook of hydraulics, fluid mechanics and hydraulic machines (In SI Units):* 2nd Edition, S. Chand & Company Pvt. Ltd., New Delhi-110055, ISBN: 81-219-0162-6

ME 3206: Fluid Mechanics-II Sessional

COURSE INFORMATION			
Course Code	ME 3206	Lecture Contact Hours	1.50
Course Title	Fluid Mechanics-II Sessional	Credit Hours	0.75

PRE-REQUISITE
ME 3205: Fluid Mechanics-II.

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course provides a practical perception of fluid mechanics. The focus is to impart core understanding of the theories and concepts learned in ME 3205 by experiments. Students will be able to understand the different fluid flow, Bernoulli's equation to solve various problem, application of jet trajectory, flow characteristics of different types of channels.

OBJECTIVE

- To familiarize students with the terminology associated with fluid mechanics.
- To teach the students how to solve various problem using Bernoulli's equation.
- To provide a demonstration how to measure metacentric height of a floating body.
- To teach the students how to measure the center of pressure of a partially and a fully submerged object.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Understands the basic concepts/principles of open channel (Triangular	1	C1	1	1		Q, LT, ASG, R, LR, Pr.

	notch), center of pressure of a floating body						
CO2	Determination of Coefficient of Velocity and Discharge, Metacentric height of a floating body, center of pressure of a partially or fully submerged object	2	C5	4	2		Q, LT, ASG, LR, Pr.
CO3	Analyze the characteristics of flow through an open channel (Triangular notch), characteristics of flow through an open channel (Rectangular)	4	C4	8	4		Q, LT, ASG, LR, Pr.
CO4	Applying the knowledge in various engineering field for improvement of different fluid machineries.	3	C3	2	6		Q, LT, ASG, LR, Pr.

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

- Study about the characteristics of flow through an open channel (Triangular notch)
- Study about the characteristics of flow through an open channel (Rectangular).
- Determination of Coefficient of Velocity and Discharge, Under Constant Head and Under Varying Head from Jet Trajectory

- Study about determination of Metacentric height of a floating body.
- Determination of center of pressure of a partially or fully submerged object.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Understands the basic concepts/principles of open channel (Triangular notch), center of pressure of a floating body	3											
CO2	Determination of Coefficient of Velocity and Discharge, Metacentric height of a floating body, center of pressure of a partially or fully submerged object		3										
CO3	Analyze the characteristics of flow through an open channel (Triangular notch), characteristics of flow through an open channel (Rectangular)				3								
CO4	Applying the knowledge in various engineering field for improvement of different fluid machineries.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to understand the basic concept of different fluid mechanics terminology.

CO2-PO2	3	Student will be able to determine $C_{d.}$ $C_{v.}$ metacentric height and center of pressure of floating body.
,CO3-PO4	3	Students will be able to analyze the flow characteristics for different systems.
CO4-PO3	3	Students will be able to develop different novel instruments for fluid mechanics field.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning		
	Lecture	07
	Practical	14
Self-Directed Learning		
	Preparation of Lab Reports	05
	Preparation of Lab Test	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
		Total =79

TEACHING METHODOLOGY

Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE

Week	Topics	Remarks
1	Study about the characteristics of flow through a triangular notch.	
3	Study about the characteristics of flow through a rectangular open channel.	
5	Determination of coefficient of velocity and discharge under constant head and under varying head from jet trajectory.	

7	Lab test -01.	
9	Study about determination of metacentric height of a floating body.	
11	Determination of center of pressure of a partially submerged object.	
12	Determination of center of pressure of a fully submerged object.	
13	Lab test -02.	
14	Final lab report submission and quiz.	

ASSESSMENT STRATEGY

Assessment method	Grading
Lab Report, project and presentation	30%
Labtest-1, Labtest-2	30%
Lab Quiz, Final	40%
Total	100%

REFERENCE BOOKS

- Yunus A. Cengel, and John M. Cimbala, *Fluid Mechanics.* 3rd Edition, McGraw Hill Education Private Limited, Tamil Nadu, India, ISBN: 9789339204655.
- Rajput R.K. *Fluid Mechanics And Hydraulic Machines*, 6th Edition, S. Chand & Company Pvt. Ltd., New Delhi-110055, India, ISBN: 978-93-854-0137-4.

ME 3207: Measurement, Instrumentation and Quality Control

COURSE INFORMATION			
Course Code	ME 3207	Lecture Contact Hours	3.00
Course Title	Measurement, Instrumentation and Quality Control	Credit Hours	3.00

PRE-REQUISITE

MATH 2201: Mathematics-IV, HUM 2117: Economics, HUM 2219: Accounting.

CURRICULUM STRUCTURE

Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course offers instruments capabilities, different measuring instruments used for linear and angular measurement, concept of limits and fits for engineering applications, study control chart techniques in quality control. The learning strategy is to introduce the students to calibration of measuring instruments and also design inspection gauges. In this course, student will understand the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries, process and assess the quality of measured data engineering.
OBJECTIVE
• To determine capabilities and capacities of measuring instruments. • To understand different measuring instruments used for linear and angular measurement. • To introduce concept of limits and fits for engineering applications. • To study various comparative measurements. • To study control chart techniques in quality control. • To study purpose and use of sampling and its benefits in management.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Demonstrate** the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.	5	C2	6			ASG, M, F
CO2	**Apply** techniques to maintain quality in engineering products and gather, classify, select measurement data in laboratory works.	4	C3	8	4		F
CO3	**Develop** knowledge of the exact measurements of selected physical quantity and the evaluation of metrological measurements.	1	C4	1	1	1	ASG, CT, M, F

CO4	**Correlate** the organizational structures of metrology and testing laboratory in the world. Understand the principles of quality management, quality tools, SQC.	1	C4	1	1	1	CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Measurement
- Instrumentation
- Quality Control
- Quality Assurance Programs

b. Detail Contents:

Basic Principles of Measurement: Measuring and recording methods, instrument calibration; measurement of displacement, pressure, temperature, heat-flux, flow, motion and vibration, force, torque, strain, etc.; data acquisition, analysis and processing, sources of error in measurements, error analysis.

Techniques: Techniques for maintaining standards, allowances and tolerance. Types of tolerance, grades of manufacturing accuracy, limits and fits, types of fits. Basic hole system and basic shaft system, selective assembly and interchangeable manufacturing, limit gauges, Taylor's principle of limit gauging. Sensors for measuring stress, Strain, Pressure, Temperature, Position, Velocity etc., Signal conditioning techniques using Wheatstone bridge, Operational amplifiers. Objectives, quality and quality assurance, TQM; concepts and tools, statistical quality control (SQC), concepts of control charts, control charts for variables and attributes e.g. X, R, C , P etc. charts, drawing of control charts and selection of subgroups, acceptance sampling and sequential sampling. ISO, SA standards, requirements and certification procedure.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Demonstrate** the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.					2							
CO2	**Apply** techniques to maintain quality in engineering products and gather, classify, select measurement data in laboratory works.				3								
CO3	**Develop** knowledge of the exact measurements of selected physical quantity and the evaluation of metrological measurements.	3											
CO4	**Correlate** the organizational structures of metrology and testing laboratory in the world. Understand the principles of quality management, quality tools, SQC.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	2	Students will develop the ability to build up modern statistical tools to evaluate a quality problem in their working place.
CO2-PO4	3	Students will be able to investigate quality problems, sensors problems with statistical data.

CO3-PO1	3	The students will attain the knowledge to understand measurements of selected physical quantity and the evaluation of metrological measurements.
CO4-PO1	3	Students will have an ability to analyze the organizational structures of metrology

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, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction to measurement and quality control		
	2	Metrology, measurement and instruments		
	3	Methods of measurement, errors		
2	4	Measurement of displacement, pressure, temperature, heat flux, flow, motion, force, torque		
	5	Tolerance		
	6	Limit, Fit, Gauge		
3	7	Introduction to Quality Control	CT-01	Lecture 1-6
	8	Quality Assurance Program		

	9	Quality Tools		
4	10	Quality Cost		
	11	Quality Control: Introduction		
	12	Quality Control: TQM		
5	13	Quality Control: 7 tools of Total Quality Management		
	14	Quality Control: Check sheet, Histogram		
	15	Quality Control: Pareto Chart, Flow Chart		
6	16	Quality Control: Cause-and-Effect Diagram/Fishbone diagrams/Ishikawa diagrams, Control charts	ASG-01	
	17	Quality Control: TQM wheel		
	18	Quality Control: Kaizen Methodology, PDCA cycle		
7	19	Quality Control: Quality Circle, Quality function development		
	20	Quality Control: Brainstorming, Benchmarking		
	21	Quality Control: SQC		
8	22	Quality Control: Mean, Variance, Standard deviation	M	
	23	Acceptance Sampling and Sequential Sampling		
	24	Normal Distribution		
9	25	Standard Normal Distribution Problems		

	26	Operational Characteristic Curve		
	27	Control Charts: Control Charts for Attributes; Control Charts for Variables		
	28	Control Charts: Control Charts for Variables: $\bar{X}$ Chart (Math)		
10	29	Control Charts: Control Charts for Variables: R Chart (Math)	CT-02	Lectures 22-27
	30	Control Charts: Control Charts for Attributes: P chart, np Chart (Math)		
	31	Control Charts: Control Charts for Attributes: C Chart (Math)		
11	32	Control Charts: Control Charts for Attributes: U Chart (Math)		
	33	Probability Distribution Functions: Some discrete probability distributions: Binomial Distribution.		
	34	Probability Distribution Functions: Some discrete probability distributions: Poisson Distribution and Hypergeometric Distribution.		
12	35	Probability Distribution Functions: Some continuous probability distributions: Normal, Exponential, Gamma and Weibull distribution	ASG-02	
	36	Practice Problems on Binomial Probability Distribution		

13	37	Control Charts: Classification and terms		
	38	Practice Problems on Hypergeometric Distribution		
	39	Practice Problems on Poisson Distribution		
14	40	Practice Problems on Continuous Distribution		
	41	Review class		
	42	Review class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG	20	
3	ASG, CT	30	
4	CT	30	
	Exam		
1	M, F	80	
2	F	100	
3	M, F	70	
4	F	70	

REFERENCE BOOKS

- Er. R.K. Jain, (2009). *Engineering Metrology.* 1st Edition, Khanna Publisher, India. ISBN-13: 978-8174091536.
- Anand K Bewoor & Vinay A Kulkarni. (2009). *Metrology and Measurement.* 1st Edition, Noida, Uttar Pradesh, India, Mc Graw Hill India, ISBN-13: 978-0070140004.
- R. C. Gupta (2012). *Statistical Quality Control and Quality Management.* 9th Edition, Khanna Publishers, India. ISBN-13: 978-8174091116.
- Walpole, R. E., & Myers, R. H. (1985). *Probability and statistics for engineers and scientists*. New York: Macmillan.
- Lind, D. A., Marchal, W. G., & Wathen, S. A. (2008). *Statistical techniques in*

business & economics. Boston: McGraw-Hill/Irwin.

ME 3208: Measurement Instrumentation and Quality Control Sessional

COURSE INFORMATION			
Course Code	ME 3208	Lecture Contact Hours	3.00
Course Title	Measurement Instrumentation and Quality Control Sessional	Credit Hours	0.75
PRE-REQUISITE			
ME 3207: Measurement, Instrumentation and Quality Control			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ME 3207. In the second part, students will design simple systems using the principles learned in ME 3207.			
OBJECTIVE			
• To get acquainted with vernier calipers, Filler Gauge, Bore Gauge, Flat Plate, Steel Tape, Dial Gauge, Bevel Protector • To determine the taper angle of the given specimen • Check the angle using Bevel Protractor • To determine linearity of pressure and vacuum gauge			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	An ability to apply **knowledge** of various tools and techniques used to determine geometry and dimensions of components in engineering applications and used quality tools to produce quality product.	5	C3	1	1,2		R, Q, LT
CO2	Student will **understand** principle of engineering meteorology, measurement standards and instruments	3	C1	1	1,2		R, Q, LT
CO3	An ability to **understanding** of Quality Control Techniques and its applications in engineering industries	4	C3	1	1,2		R, Q, LT
CO4	Student will be able to **perform** the job of an inspector and help the industries to produce quality products	10	C4	1	1,2		R, Q, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

- Vernier calipers, Filler Gauge, Bore Gauge, Flat Plate, Steel Tape, Dial Gauge, Bevel Protector
- Taper angle of the given specimen
- Bevel Protractor
- Linearity of pressure and vacuum gauge

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	An ability to apply **knowledge** of various tools and techniques used to determine geometry and dimensions of components in engineering applications and used quality tools to produce quality product.					3							
CO2	Student will **understand** principle of engineering meteorology, measurement standards and instruments			3									
CO3	An ability to **understanding** of Quality Control Techniques and its applications in engineering industries				3								
CO4	Student will be able to **perform** the job of an inspector and help the industries to produce quality products										3		

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO5	3	Students will have ability to apply knowledge of various tools and techniques used to determine geometry and dimensions of components in engineering applications.
CO2-PO3	3	Student will understand principle of engineering meteorology
CO3-PO4	3	Students will understand Quality Control Techniques
CO4-PO10	3	Student will be able to perform the job of an inspector and help the industries to produce quality products

TEACHING LEARNING STRATEGY		
Teaching and Learning Activities		**Engagement (hours)**
Face-to-Face Learning		
	Lecture	07
	Practical	14
Self-Directed Learning		
	Preparation of Lab Reports	05
	Preparation of Lab Test	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
		Total = 79

COURSE SCHEDULE		
Weeks	**Intended topics to be covered**	**Remarks**

1	Study about different types of Measuring Instruments	
3	Study about different types of Measuring Instruments	
5	Measurement of taper angle using Sine bar and Slip Gauges	
7	Lab Test - 1	
9	Calibration of Pressure Gauge	
11	Pressure and Vacuum Gauge calibration	
12	Lab Test - 2	
13	Final Submission	
14	Lab Quiz	

ASSESSMENT STRATEGY				
	COs	**Assessment Method**	**(100%)**	**Remarks**
		Class Assessment		
	1	R, Q	70	
	2	R, Q	70	
	3	R, Q	70	
	4	R, Q	70	
		Exam		
	1	LT	30	
	2	LT	30	
	3	LT	30	

	4	LT	30	

REFERENCE BOOKS
• Jain, R. K., Jain, R. K., & Jain, R. K. (1986). *Engineering metrology*. Khanna Pub.

ME 3213: Machine Design – II

COURSE INFORMATION			
Course Code	ME 3213	Lecture Contact Hours	3.00
Course Title	Machine Design-II	Credit Hours	3.00
PRE-REQUISITE			
ME 3113: Machine Design-I			
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			
• Students should be able to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems • Students should be able to applying scientific principles and concepts to the design of basic mechanical components and systems • Students should be able to improving problem solving and decision making capabilities • Students should be capable of apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components • Students should be able to demonstrate the variety of mechanical components available and realize the need for continuous learning			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Discuss** safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design	1	C2	1,3	1,2		ASG, F, CT, M
CO2	**Calculate** the load, stress, factor of safety for different mechanical elements.	2	C4	1,2,3	2		ASG, F, CT, M
CO3	**Design** mechanical bearing, gears, belts, brakes, clutches	3	C6	5	3		ASG, F, CS, M, CT
CO4	**Identify** different mechanical elements in different application	4	C4	8	1		ASG, F, CS, M, CT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Rolling-contact bearing
- Journal and plane surface bearing
- Different types of gear
- Clutches and brakes
- Flexible power transmitting elements

b. Detail Contents:

Design and Selection: Design and selection of sliding contact bearing, antifriction (ball and roller) bearing, journal and plane surface bearings. Design of spur (loading and stresses), helical, bevel and worm gears. Design and selection of flexible power transmission elements: belt (flat, v-belt, vv belt), chain (single and multi-strand) and rope drives. Design of brake and clutches.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Discuss** safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design	3											
CO2	**Calculate** the load, stress, factor of safety for different mechanical elements.		3										
CO3	**Design** mechanical bearing, gears, belts, brakes, clutches			2									
CO4	**Identify** different mechanical elements in different application				2								

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification

CO1-PO1	3	Understanding factor of safety under different loading types will enhance their engineering knowledge
CO1-PO2	3	Student can understand factor of safety, reliability for different cases.
CO3-PO3	2	Students will be able to design mechanical gears, belts, bearings, brakes, clutches to solve engineering problems
CO4-PO4	2	Students will be able to select mechanical components in engineering 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, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction to bearing types, rolling contact bearing, bearing life		
	2	Bearing load life at rated reliability, bearing survival: reliability vs life		
	3	Relating load, life and reliability		
2	4	Combined radial and thrust loading, variable loading		
	5	Selection of ball and cylindrical roller bearing		
	6	Selection of tapered roller		

		bearing		
3	7	Introduction to journal and plane surface bearing		
	8			
	9		CT-01	Lectures 1-6
4	10	Study on lubrication		
	11	Design consideration and lubrication chart		
	12	Steady state condition in self contained bearing		
5	13	Introduction of different types of gear		
	14	Gear nomenclature, conjugate action and involute profiles		
	15	Gear inference, contact ratio, formation of teeth; tooth system and gear train		
6	16	Force analysis of spur gear		
	17	Force analysis of helical gear		
	18	Design of spur gear	ASG-01	
7	19			
	20	Design of helical gear		
	21			
8	22	Force analysis of bevel gear	M	
	23	Force analysis of worm gear		
	24	Design of bevel gear		
9	25			
	26	Design of worm gear		
	27			

10	28	Static analysis of clutches and brakes		
	29	Internal expanding rim clutches and brakes	CT-02	Lectures 22-27
	30	External contracting rim clutches and brakes		
11	31	Band type clutches and brakes		
	32	Disk brakes		
	33	Frictional contact axial clutches		
12	34	Introduction to different type of belts		
	35	Flat and round belt drives	ASG-02	
	36			
13	37	V belt and V belt drives		
	38	Chain drives		
	39	Rope drives		
14	40	Revision		
	41			
	42			

ASSESSMENT STRATEGY

	CO	Assessment Method	(100%)	Remarks	
		Class Assessment			
	1	ASG, CT	20		
	2	ASG, CT	20		
	3	ASG, CT, CS	30		
	4	ASG, CT, CS	30		
		Exam			
	1	M, F	80		

	2	M, F	80	
	3	M, F	70	
	4	M, F	70	

REFERENCE BOOKS
• Budynas, N. G. K. R. J. (2021). *Shigley's Mechanical Engineering Design.* 11th Edition. McGraw Hill. • Khurmi, R. S., & Gupta, J.K. (2005). *Machine Design*. 25th Edition. S. Chand. • Faries, V. M.,(1965*). Design of Machine Elements* 4th Edition. McMillan Coll.

ME 3214: Machine Design-II Sessional

COURSE INFORMATION			
Course Code	ME 3214	Lecture Contact Hours	1.50
Course Title	Machin Design-II Sessional	Credit Hours	0.75
PRE-REQUISITE			
ME 3213: Machine Design-II			
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			
• To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems. • Applying scientific principles and concepts to the design of basic mechanical components and systems. • Improving problem solving and decision-making abilities. To learn fundamental concepts relevant to thermodynamics. • To teach students how to apply the concepts of stress analysis, theories of failure and			

material science to analyze, design and/or select commonly used machine components.

- To illustrate to students the variety of mechanical components available and emphasize the need to continue learning

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	**Relate** the engineering knowledge in designing a machine	3	C1	5	3		Q, ASG, R, LT
CO2	**Encourage** creative thinking and development of a deeper understanding and intuitive feel for machineries	2	C4	2,3	2		Q, ASG, R, LT
CO3	**To know** how to select different mechanical elements in different application	4	C2	8	2		Q, ASG, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

- Study of bearing (Ball & Roller)
- Study of bearing (Journal & Plane surface bearing)
- Study of Spur gear & Worm gear.
- Study of Helical & Bevel gear.
- Study of various types of belts.
- Study of brake and clutches

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Relate** the engineering knowledge in designing a machine			3									
CO2	**Encourage** creative thinking and development of a deeper understanding and intuitive feel for machineries		3										
CO3	**To know** how to select different mechanical elements in different application				2								

Justification for CO-PO mapping:

Mapping	Level of matching	Justifications
CO1-PO3	3	Students will be able to find the most stressed point in a machine component.
CO2-PO2	3	Students will be able to design mechanical springs, couplings, gears, belts, springs, bearings, brakes, clutches to solve engineering problems
CO3-PO4	2	Students will be able to apply the knowledge obtained to asses engineering problems and find solutions based on machine design problems

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	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
Total		79

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week	Topics
1	Study of bearing (Ball & Roller)
3	Study of bearing (Journal & Plane surface bearing).
5	Study of Spur gear & Worm gear.
7	Study of Helical & Bevel gear.
9	Study of various types of belts
11	Study of brake and clutches
12	Lab Test
13	Final Lab Report Submission
14	Lab Quiz

Components	Grading

Continuous Assessment (60%)	Lab participation and Report	30%
	Lab Test	30%
Lab Quiz		40%
Total Marks		100%

REFERENCE BOOKS

- Budynas, N. G. K. R. J. (2021). *Shigley's Mechanical Engineering Design.* 11th Edition. McGraw Hill.
- Khurmi, R. S., & Gupta, J.K. (2005). *Machine Design*. 25th Edition. S. Chand.
- Faries, V. M.,(1965*). Design of Machine Elements* 4th Edition. McMillan Coll.

ME 4101: Internal Combustion Engines

COURSE INFORMATION

Course Code	ME 4101	Lecture Contact Hours	3.00
Course Title	Internal Combustion Engines	Credit Hours	3.00

PRE-REQUISITE

ME 1101: Fundamental of Mechanical Engineering, ME 2101: Engineering Thermodynamics, ME 3101: Heat Transfer-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course will provide the students with advanced knowledge regarding operation, design and thermodynamic analysis of Internal Combustion Engines. The focus is to illustrate practical engineering application in these fields. Students will obtain in depth knowledge in different types of IC engine, working principles of SI and CI engines, thermodynamics of fuel, fuel metering system, engine inlet and exhaust system, compressor and turbines.

OBJECTIVE

- To analyze the performance of internal combustion engines.
- To study the effect of thermodynamics, combustion, heat transfer, friction, and other factors on engine power, efficiency, and emissions.
- To design and investigate the operations of different types of engines.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Design** different parts of modern internal combustion engines.	3	C6	5	3		PR, ASG
CO2	**Apply** mathematical equations to solve problem related to testing of IC engine.	1	C3	1, 2	1	5	ASG, CT, M, F
CO3	**Identify** the effects of thermodynamics, combustion, heat transfer, friction and other factors on engine power, efficiency and emissions.	1	C3	1, 3	1		ASG, CT, M, F
CO4	**Analyze** environmental and fuel economy challenges along with future internal combustion engine technology and market trends.	7	C4	7			ASG, CT, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT
a. Main Contents: • Introduction • Fuels • Combustion • Fuel metering • Air capacity of engines • Performance and design • Compressors and turbines **a. Detail Contents:** **Introduction:** Basic engine types, their operation and testing; Idealized cycles and processes. **Fuels:** IC engine fuels, their properties and tests. **Combustion:** SI engine, CI engine and gas turbine; Equilibrium charts; Exhaust gas analysis and air pollution. **Fuel metering:** SI engines, CI engines. **Air capacity of engines:** Two and four stroke cycles, naturally aspirated and supercharged. **Performance and design:** Performance of supercharged engines and un-supercharged engines, design considerations, application of principle of similitude of similitude in engine design. **Compressors and turbines:** Compression processes, volumetric efficiency, multistage compression, intercooling; various types of compressors and gas turbines.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Design** different parts of modern internal combustion engines.			2									
CO2	**Apply** mathematical equations to solve problem related to testing of IC engine.	3											
CO3	**Identify** the effects of thermodynamics, combustion, heat transfer,	3											

	friction and other factors on engine power, efficiency and emissions.												
CO4	**Analyze** environmental and fuel economy challenges along with future internal combustion engine technology and market trends						2						

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO3	2	Apply engineering fundamentals and specifications to design modern internal combustion engines.
CO2-PO1	3	Students will be able to analyze engine performance using principles of mathematics and engineering sciences.
CO3-PO1	3	Students will have the knowledge of factors affecting engine power, efficiency and emissions.
CO4-PO7	2	Students will be able to select and apply techniques to withstand the environmental and economic challenges.

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	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction to IC engines and their types		
	2	Basic engine operation and their testing		
	3	Basic engine operation and their testing		
2	4	Introduction to ideal model of engine cycles		
	5	Ideal cycle, fuel air cycle and actual cycle		
	6	Causes of the difference between fuel-air cycle and actual cycle		
3	7	IC engine fuel		
	8	Effect of fuel volatility, detonation and pre ignition characteristic of fuel		
	9	Knock ratings of fuels, octane number measurement, Fuel sensitivity, fuel additives	CT-01	Lectures 1-6
4	10	Combustion in SI engine		
	11	Knock in SI engine and factors affecting knock in SI engine		
	12	Knock in SI engine and factors affecting knock in SI engine		
5	13	Combustion in CI engine		

	14	Knock in CI engine and factors affecting knock in CI engine		
	15	Knock in CI engine and factors affecting knock in CI engine		
6	16	Equilibrium chart and exhaust gas analysis and air pollution		
	17	Equilibrium chart and exhaust gas analysis and air pollution		
	18	Equilibrium chart and exhaust gas analysis and air pollution	ASG-01	
7	19	Introduction to fuel metering system		
	20	Requirement for metering and mixing		
	21	Carburetion and throttling	M	
8	22	Electronic fuel injection system		
	23	CI engine fuel injection system		
	24	Fuel injector, nozzle, fuel spray structure and characteristic		
9	25	Air capacity of engines: two stroke cycles		
	26	Air capacity of engines: four stroke cycles		
	27	Air capacity of engines: naturally aspirated and supercharged		

10	28	Performance and design: performance of supercharged engines.		
	29	Performance and design: performance of supercharged engines.		
	30	Performance and design: performance of un-supercharged engines		
11	31	Performance and design: performance of un-supercharged engines.		
	32	Performance and design: design considerations, application of principle of similitude of similitude in engine design.		
	33	Performance and design: design considerations, application of principle of similitude of similitude in engine design.	CT-02	Lectures 23-32
12	34	Compressors and turbines: compression processes, volumetric efficiency.		
	35	Compressors and turbines: compression processes, volumetric efficiency.		
	36	Compressors and turbines: multistage	ASG-02	

		compression, intercooling.		
13	37	Compressors and turbines: multistage compression, intercooling.		
	38	Compressors and turbines: various types of compressors and gas turbines.		
	39	Compressors and turbines: various types of compressors and gas turbines.		
14	40	Revision		
	41	Revision		
	42	Revision		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, PR	100	
3	ASG, CT	30	
4	ASG, CT	30	
	Exam		
2	M, F	100	
3	M, F	70	
4	F	70	

REFERENCE BOOKS

- Heywood, J. B. (1988). *Internal Combustion Engine Fundamentals*. 3rd Edition. New York: McGraw-Hill.
- Stone, R. (1992). *Introduction to Internal Combustion Engines*. 6th Edition. Basingstoke, England: Macmillan.

ME 4102: Internal Combustion Engines Sessional

COURSE INFORMATION			
Course Code	ME 4102	Lecture Contact Hours	3.00
Course Title	Internal Combustion Engines Sessional	Credit Hours	1.50

PRE-REQUISITE
ME 2101: Engineering Thermodynamics, ME 2102: Engineering Thermodynamics Sessional, ME 4101: Internal Combustion Engines

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course presents the concepts and practical knowledge of internal combustion engines based upon the fundamental engineering sciences of thermodynamics, gas dynamics, heat transfer and mechanics. Students will achieve a hands-on experience on working of different parts of an internal combustion engine and their maintenance procedure. This Course enables students to understand the fuel system of an IC engine, lubricating system of an IC engine, ignition system of an IC engine, cooling system of an IC engine, starting system of an IC engine and exhaust system of an IC engine.

OBJECTIVE

- To understand the working principle of an internal combustion engine.
- To distinguish between the working principle of petrol and diesel engine.
- To know the applications of IC engine in practical fields.
- To study the functions and operations of different parts of IC engine.
- To learn to maintain proper safety measures to run an engine.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Understand** proper functioning of an internal	1	C2	1			Q, R, LT

	combustion engine and thermodynamic parameters relating to it.						
CO2	**Conduct** analytical techniques to engine related problems and performance analysis of different parts of internal combustion engines.	2	P2	3	1,2		Q, R, LT
CO3	**Acquire** an idea of applications of IC engine in automotive, railways, power, and marine	3	P2	5	2		Q, R, LT
CO4	**Introduce** environmental effects and fuel economy challenges facing the internal combustion engine .	7	C5	7			Q, R, LT
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

- Study about the classifications and main parts of an IC engine.
- Study about the working principle of a C.I. engine. (2 & 4 stroke)
- Study about the working principle of a S.I engines. (2 & 4 stroke)
- Study about the Fuel system of an IC engine.
- Study Lubricating system of an IC engine.
- Study about the Ignition system of an IC engine.
- Study about the Cooling system of an IC engine.
- Study about the Starting system of an IC engine.
- Study about the Exhaust system of an IC engine.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** proper functioning of an internal combustion engine and thermodynamic parameters relating to it.	3											
CO2	**Conduct** analytical techniques to engine related problems and performance analysis of different parts of an internal combustion engines.		3										
CO3	**Acquire** an idea of applications of IC engine in automotive, railways, power, and marine			3									
CO4	**Introduce** environmental effects and fuel economy challenges facing the internal combustion engine .							3					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be apply engineering fundamental and engineering specification to internal combustion engines.
CO2-PO2	3	Students will be able to analyze engine performance using principles of mathematics and engineering sciences
CO3-PO3	3	Students will develop solution for factors affecting engine power, efficiency and emissions with appropriate consideration for health safety and environmental consideration.
CO4-PO7	3	Students will select and apply techniques to withstand the environmental and economic 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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01

Total		112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, co-operative and collaborative method, project-based method

COURSE SCHEDULE

Week	Topics	Remarks
1	Study about the classifications and main parts of an IC engine.	
2	Study about the working principle of a C.I. engine. (2 & 4 stroke)	
3	Study about the working principle of a S.I engines. (2 & 4 stroke)	
4	Study about the Fuel system of an IC engine.	
5	Study Lubricating system of an IC engine.	
6	Study about the Ignition system of an IC engine.	
7	Study about the Starting system of an IC engine.	
8	Study about the Cooling system of an IC engine.	
9	Study about the Exhaust system of an IC engine.	
10	Review Class	
11	Lab Test	
12	Final Lab Report Submission	
13	Viva	
14	Quiz	

ASSESSMENT STRATEGY

Assessment Method		Grading
	Lab Participation and Report	30%

	Lab Test	30%
Lab Quiz, Viva		40%
Total		100%

REFERENCE BOOKS
• Heywood, J. B. (1988). *Internal combustion engine fundamentals*. New York: McGraw-Hill. • Stone, R. (1992). *Introduction to internal combustion engines*. Basingstoke, England: Macmillan.

ME 4105: Fluid Machinery

COURSE INFORMATION			
Course Code	ME 4105	Lecture Contact Hours	3.00
Course Title	Fluid Machinery	Credit Hours	3.00
PRE-REQUISITE			
ME 2101: Engineering Thermodynamics, ME 2111: Numerical Analysis, ME 3105: Fluid Mechanics- I, ME 3113: Machine Design-I, ME 3213: Machine Design-II, and ME 3205: Fluid Mechanics- II.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides an in-depth knowledge in the working principle of the different fluid machines and turbomachines. The focus is to impart core understanding of the different components of fluid machines and turbomachines with detailed design steps for the blade rows of positive and negative work turbomachines. The learning approach is to apply a synergistic approach to combine the knowledge of basic fluid mechanics, thermodynamics and heat transfer to analyze, design and set the working conditions of fluid machines and turbomachines. Students will achieve comprehension of the multi-physics working principle of different fluid machines and turbomachinery and will gain the competence to design systems based on their understanding in the overall system behavior and control strategies.			
OBJECTIVE			

- To familiarize the students with the correlations of basic physical principles with retrospect to the working principles of fluid machineries.
- To acquaint the students about the design and performance analyses of the major fluid machines and turbomachines.
- To introduce the students to compressible flow, secondary flows, unsteady flow, and gas dynamics.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Assess** the performance of fan, compressor, pump, turbine and other fluid machineries.	4	C6	1, 4, 6, 8	1, 2, 4		ASG, CS, CT, F, M, Q
CO2	**Employ** modern design tools and **conceptualize** components of fluid machines and turbomachi-neries for using in the different industrial processes, automobiles, power-plants, aviation and space industries.	5	C6, P2	3, 5, 6, 7, 8	1, 2, 3, 4, 5, 6	3, 4	ASG, CS, CT, F, M, Q
CO3	**Understand** working principles of centrifugal pumps, reciprocating pumps, gas turbines, hydroturbines, compressors, turbochargers, superchargers, and torque-converters.	1	C1, A1, P1	1, 3, 4	1, 2, 5, 6		ASG, CS, CT, F, Q

CO4	**Design** mechanical systems containing fluid machines and turbomachines for power generation and energizing fluids.	3	C6, P2	4, 5, 6	1, 2, 3, 5, 6	1, 2, 3	ASG, CS, M, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction to Fluid Machinery
- Reciprocating pumps.
- Centrifugal pumps.
- Compressors and blowers.
- Unsteady flow.
- Gas dynamics.
- Hydraulic turbines.
- Gas turbines.
- Wind turbines.
- Unsteady flow.
- Gas dynamics.
- Fluid machines.

b. Detail Contents:

Introduction to Fluid Machinery: Introduction to roto-dynamic and positive displacement machinery; Euler's pump turbine equation.

Reciprocating Pumps: Working principle of reciprocating pump. Types of reciprocating pumps, work done by reciprocating pump, coefficient of discharge, slip, cavitation of reciprocating pumps, effect of acceleration of piston on velocity and pressure in the suction and delivery pipes, indicator diagrams, effect of air vessels on suction and delivery line.

Centrifugal Pumps: Work done and efficiency of centrifugal pumps, advantage over reciprocating pumps, types of centrifugal pumps, minimum starting speed, least diameter of impeller, limitation of suction lift, characteristics curves, priming, troubles and remedies, specific speed and model testing, pumps in series and in parallel, deep tube well, multistage pumps, turbine pump, selection of pumps, introduction to Impeller design.

Compressor and Blower: Types and working principles, axial flow pumps, jet pump, single and double jet pump, fan, blower.

Unsteady Flow: Introduction, inertia pressure, water hammer, surge tanks.

Gas Dynamics: One dimensional compressible fluid flow, energy relation for isentropic and isothermal flow, pressure wave propagation, Mach cone, stagnation properties, converging diverging nozzles, subsonic and supersonic flow, normal shock relations, Fanno line and Rayleigh line.

Turbines: 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, cavitation of turbines.

Fluid Machines: Torque converter and fluid couplings, hydraulic crane.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Assess** the performance of fan, compressor, pump, turbine and other fluid machineries.				3								
CO2	**Employ** modern design tools and **conceptualize** components of fluid machines and turbomachineries for using in the different industrial processes, automobiles,					3							

	power-plants, aviation and space industries.												
CO3	**Understand** working principles of centrifugal pumps, reciprocating pumps, gas turbines, hydroturbines, compressors, turbochargers, superchargers, and torque converters.	3											
CO4	**Design** mechanical systems containing fluid machines and turbomachines for power generation and energizing fluids.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO4	3	The students will be able to analyze the performance of fan, compressor, pump, turbine and other fluid machineries and solve complex engineering problems related to the working principles of fluid machines and turbomachineries.
CO2-PO5	3	The students will employ their knowledge in designing and conceptualizing components of fluid machines and turbomachineries for using in the different industrial processes, automobiles, power-plants, aviation and space industries. Students will use design strategies and numerical methods for designing the individual system components.
CO3-PO1	3	The students will attain the knowledge of the working principles of centrifugal pumps, reciprocating pumps, gas turbines, hydroturbines, compressors, turbochargers, superchargers, and torque-converters.
CO4-PO3	3	The students will gain the competence in solving complex engineering design problems of mechanical systems containing fluid machines and turbomachines for power generation and energizing fluids.

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

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Course overview, introduction to positive displacement fluid machinery, working principle of reciprocating pump.		
	2	Types of reciprocating pumps, work done by reciprocating pump.		
	3	Coefficient of discharge, slip, cavitation of reciprocating pumps.		
2	4	Effect of acceleration of piston on velocity and pressure in the suction and delivery pipes.		
	5	Indicator diagrams, Effect of air vessels on suction and delivery line.		
	6	Introduction to roto-dynamic fluid machinery; Euler's pump turbine equation.		
3	7	Introduction to centrifugal pumps, advantages over reciprocating pumps, types of centrifugal pumps.		
	8	Work done and efficiency of centrifugal pumps.		
	9	Minimum starting speed, least diameter of impeller.	CT-01	Lectures 1-6
4	10	Limitation of suction lift.		
	11	Characteristics curves.		
	12	Priming, troubles and remedies.		
5	13	Specific speed and model testing.		

	14	Pumps in series and in parallel, deep tube well.		
	15	Multistage pumps, turbine pump.		
6	16	Selection of pumps.		
	17	Introduction to impeller design.		
	18	Introduction to compressor and blowers, types and working principles.	ASG-01	
7	19	Axial flow pumps, jet pump.		
	20	Single and double jet pump.		
	21	Fan, blower.		
8	22	Introduction to unsteady flow.	M	
	23	Inertia pressure.		
	24	Water hammer, surge tanks.		
9	25	Introduction to gas dynamics.		
	26	One dimensional compressible fluid flow.		
	27	Energy relation for isentropic flow.		
10	28	Energy relation for isothermal flow		
	29	Pressure wave propagation, Mach cone.	CT-02	Lectures 22-27
	30	Stagnation properties, Converging diverging nozzles.		
11	31	Subsonic and supersonic flow.		
	32	Normal shock relations, Fanno line and Rayleigh line.		
	33	Euler's pump turbine equation,		

		degrees of reaction.		
12	34	Impulse and reaction turbine classification.		
	35	Performance of Pelton wheel.		
	36	Introduction to Francis turbine, working principle of Francis turbine.		
13	37	Introduction to Kaplan turbine, working principle of Kaplan turbine.		
	38	Characteristic curves.	ASG-02	
	39	Governing of turbines, Selections and model test of turbine.		
14	40	Cavitation of turbines.		
	41	Torque converter and fluid couplings.		
	42	Hydraulic crane.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	50	
2	ASG, CS, CT	50	
3	ASG, CS, CT	30	
4	ASG, CS, CT	80	
	Exam		
1	M, F	50	
2	M, F	50	
3	F	70	
4	M	20	

REFERENCE BOOKS

- Modi, P. N., & Seth, S. M. (2011). *Hydraulics and fluid mechanics: Including hydraulic machines (in SI units)*. Nai Sarak, Delhi: Standard Book House. 14th Edition. ISBN: 9788189401269.
- Cumpsty, N. A. (2004). *Compressor aerodynamics*. Malabar, Fla: Krieger Pub. ISBN: 9781575242477
- Dixon, S. L. (2005). *Fluid mechanics, thermodynamics of turbomachinery*. Amsterdam: Elsevier-Butterworth-Heinemann. ISBN: 9780080470627.
- Bansal, R. K. (2017). *A Textbook of Fluid Mechanics and Hydraulic Machines*. Laxmi Publications. ISBN-13: 978-8131808153, ISBN-10: 8131808157
- Islam, Q. (1998). *Hydraulic Machines Through worked Out Problems*. DAERS, BUET. ISBN: 984-31-0261-4

ME 4106: Fluid Machinery Sessional

COURSE INFORMATION			
Course Code	ME 4106	Lecture Contact Hours	1.50
Course Title	Fluid Machinery sessional	Credit Hours	0.75

PRE-REQUISITE

ME 4105: Fluid Machinery.

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course provides a practical perception of fluid machinery.

The focus is to impart core understanding of the theories and concepts learned in ME 4105 by experiments.

Students will be able to learn the working principles of impulse turbines, reaction turbines, reciprocating pumps, centrifugal Pumps, pumps in series, pumps in parallel and cavitation.

OBJECTIVE

- To familiarize students with the terminology associated with fluid machinery.
- To teach the students on correlations of basic physical principles with respect to the working principles of fluid machineries.
- To provide a performance analysis of the major fluid machines.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom'sTaxono-my	KP	CP	CA	Assessment Methods
CO1	**Understand** the basic concept of compressor, pump and turbine.	1	C1	1	1		LT, LR, Q, Pr, PR, F
CO2	**Analyze** the performance of compressor, pump, turbine and other fluid machineries.	2	C4	4	2		LT, LR, Q, Pr, PR, F
CO3	**Design** the new conceptualize turbo-machineries for using in the different industrial processes.	3	C3	5	3		LT, LR, Q, Pr, PR, F
CO4	**Apply** the gained knowledge in fluid machinery field to develop different novel instruments.	3	C3	5	7		LT, LR, Q, Pr, PR, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

- Study of introduction to centrifugal pump characteristics.
- Performance test of a single centrifugal pump.
- Performance test of centrifugal pumps connected in series.
- Performance test of centrifugal pumps connected in parallel.
- Study of propeller turbine characteristics.
- Performance test of a Pelton wheel and Francis turbine.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)										
		1	2	3	4	5	6	7	8	9	10	11
CO1	Understand the basic concept of compressor, pump and turbine.	3										
CO2	Analyze the performance of compressor, pump, turbine and other fluid machineries.		3									
CO3	Design the new conceptualize turbo-machineries for using in the different industrial processes.			3								
CO4	Apply the gained knowledge in fluid machinery field to develop different novel instruments.			3								

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of	Justification

	Matching	
CO1-PO1	3	Students will be able to understand the basic concept of different fluid machineries.
CO2-PO2	3	Student will be able to compare the theoretical and actual performance of different machineries.
CO3-PO3	3	Students will be able to apply the fluid machinery related knowledge to design new conceptualize turbo-machineries.
CO4-PO3	3	Students will be able to develop different novel instruments.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	07
Practical	14
Self-Directed Learning	
Preparation of Lab Reports	05
Preparation of Lab Test	10
Preparation of Presentation	05
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	07
Final Quiz	01
	Total =79

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE		
Week	**Topics**	**Remarks**
1	Study of introduction to centrifugal pump characteristics.	
3	Performance test of a single centrifugal pump.	
5	Performance test of centrifugal pumps connected in series.	
7	Lab test -01.	
9	Performance test of centrifugal pumps connected in parallel.	
11	Study of propeller turbine characteristics.	
12	Performance test of a Pelton wheel and Francis turbine.	
13	Lab test -02.	
14	Final lab report submission and quiz.	

ASSESSMENT STRATEGY	
Assessment method	**Grading**
Lab Report, project and presentation	30%
Labtest-1, Labtest-2	30%
Lab Quiz, Final	40%
Total	100%

REFERENCE BOOKS

- Bansal R.K. Fluid *Mechanics And Hydraulic Machines*. Laxmi Publications (January 1, 2005). ISBN: 8131808157.
- Rajput, R. K. *Fluid Mechanics and Hydraulic Machines*. S Chand Publication. ISBN: 9789385401374.

ME 4117: Refrigeration and Air Conditioning

COURSE INFORMATION			
Course Code	ME 4117	Lecture Contact Hours	3.00
Course Title	Refrigeration & Air	Credit Hours	3.00

	Conditioning		

PRE-REQUISITE
ME 2101: Engineering Thermodynamics, ME 2103- Engineering Mechanics
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course provides an introductory perception in the working principle of refrigeration and air conditioning cycle. Students will get acquainted with refrigeration cycle related terms. The knowledge gathered during this course will help students in further understanding of theoretical and experimental topics. It will also help them in such a way that different design related problems and load calculation related problems can be conducted by them. The knowledge shared within this course will act as the cornerstone for further understanding of various refrigeration system related terminology which could be further developed through visiting various refrigeration workshop.
OBJECTIVE
• To familiarize students with the terminology associated with refrigeration and air conditioning. • To understand about the basic principles of psychometric and applied psychometrics. • To get acquainted with load calculation and elementary duct design. • To develop perception about refrigerant, vapor compression refrigeration and multi-stage vapor compression system.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	**Be familiar** with various refrigeration and air conditioning terminologies	P-01	1	4	1	3	ASG, CT, M, F
CO2	**Understand** various types of refrigeration system	P-07	2	6	1	3	ASG, CT, M, F
CO3	**Gain** proper knowledge on basic psychometric chart.	P-01	1	3	1	3	ASG, CT, M, F
CO4	**Able** to perform load calculation and elementary duct design.	P-03,09	4	3	1	3	ASG, CT, M, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction
- Refrigerant
- Vapor compression refrigeration system
- Vapor absorption refrigeration system
- Window type air conditioning system
- Split type air conditioning system
- Low temperature refrigeration system

- Air-conditioning load calculation
- Lift, Elevator & Escalator

b. Detail Contents:

Introduction: Applications of refrigeration. Method of producing refrigeration. Steady-flow energy equation. Car not cycle and reversed Carnot cycle. Coefficient of performance

Refrigerants: Classification and designation of refrigerants, Primary and secondary refrigerants, Azeotropes, Desirable properties of refrigerants, Applications of specific refrigerants

Vapor Compression Refrigeration Systems: Simple vapor compression refrigeration cycle. P-H and T-S diagrams. Actual cycle and its analysis

Vapor Absorption Refrigeration System: Simple and practical absorption refrigeration systems, Coefficient of performance, Absorbent- refrigerant combinations, Comparison of vapor-compression and absorption refrigeration system

Low Temperature Refrigeration: Vapor compressor-Cascade system, Liquefaction of gas - Air and Helium

Refrigeration and Air Conditioning Controls: Reasons for use of controls in refrigeration and air conditioning systems, Pneumatic, Hydraulic, Electric and electronic controls

Air Conditioning Load Calculations

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Be familiar** with various refrigeration and air conditioning terminologies	2											
CO2	**Understand** various types of refrigeration system							3					
CO3	**Gain** proper knowledge on basic psychometric chart.	3											

CO4	**Able** to perform load calculation and elementary duct design.			3						3			

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	2	Students will be familiar with the terminology associated with refrigeration.
CO2-PO7	3	Students will learn the terminology associated with air conditioning.
CO3-PO1	3	Students will be able to apply basic principles of psychometric and applied psychometric.
CO4-PO3	3	Students will be able to perform load calculation and elementary duct design.
CO4-PO9	3	Students will be able to perform load calculation and elementary duct 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, and problem solving.

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Introduction to refrigeration system		
	2	Introduction to refrigeration system		
	3	Compressor		
2	4	Condenser		
	5	Evaporator		
	6	Superheating & sub-cooling		
3	7	T-S & P-h diagram		
	8	Introduction to psychometric chart		
	9	Refrigerant	CT-01	Lectures 1-6
4	10	Desirable properties of refrigerants		
	11	Classification of refrigerants		
	12	Leak detection methods		
5	13	Introduction to vapor absorption system		
	14	Vapor absorption system		
	15	Difference between vapor compression & vapor absorption system		
6	16	Merits & demerits of the system		

	17	Properties of air and water-vapor mixture		
	18	Psychometric chart and its construction	ASG-01	
7	19	Various psychometric processes		
	20	Combined heat and mass transfer between a wetted surface and moist air		
	21	Cascade system		
8	22	Liquefaction of gas - Air	M	
	23	Liquefaction of gas - Helium		
	24	Introduction to Conditioned Air Distribution Systems		
9	25	Duct types, Materials and constructions		
	26	Duct layout and design, Fan selection		
	27	Chilled/Hot Water Distribution Systems		
10	28	Direct and reversed systems, Pipe layout and design, Pump selection		
	29	Air Conditioning Load Calculations	CT-02	Lectures 22-27
	30	Thermal comfort. Comfort chart,		
11	31	Inside and outside design conditions		

	32	Heat transmission coefficients for building structures		
	33	Heating and cooling load items and their calculations		
12	34	Air Conditioning Basics		
	35	Air Conditioning Basics	ASG-02	
	36	Load Calculation		
13	37	Load Calculation		
	38	Load Calculation		
	39	Introduction to lift		
14	40	Review Class		
	41	Review Class		
	42	Review Class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
2	CT	20	
3	CT	20	
	Exam		
1	M, F	80	
2	F	80	
3	M, F	80	
4	F	100	

REFERENCE BOOKS
• Ameen, A. (2006). *Refrigeration and air conditioning*. PHI Learning Pvt. Ltd. • Stoecker, W. F., & Jones, J. W. Refrigeration and air conditioning, 1982. *Mc GrawHill Book Co, New York*.

ME 4000 Project /Thesis

COURSE INFORMATION			
Course Code	ME 4000	Lecture Contact Hours	3.00
Course Title	Project/Thesis	Credit Hours	3.00
PRE-REQUISITE			
MATH 1101: Mathematics-I, EEE 1159: Basic Electrical Engineering, MATH 1201: Mathematics-II, CSE 1271: Computer Programming, MATH 2101: Mathematics-III, HUM 2117: Economics, ME 2101: Engineering Thermodynamics, ME 2103: Engineering Mechanics-I, ME 2111: Numerical Analysis, ME 2207: Engineering Metallurgy, ME 2209: Mechanics of Solids, EEE 2259: Electrical Machines and Electronics Technology, HUM 2219: Accounting, MATH 2201: Mathematics-IV, ME 3101: Heat Transfer-I, ME 3103 Engineering Mechanics-II, ME 3105: Fluid Mechanics-I, ME 3113: Machine Design-I, HUM 3111: Sociology, HUM 3113: Engineering Ethics, ME 3201, Heat Transfer-II, ME 3205: Fluid Mechanics-II, ME 3207: Measurement Instrumentation and Quality Control, ME 3213: Machine Design-II; and IPE 3207: Production Process.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides an in-depth exposure to engineering project and thesis. In this course students are required to conduct basic research on electro-mechanical system. The project/thesis works require students to draw upon all previous courseworks and cultivate new skills in order to solve complex design problems associated with an assigned group project.			
The system design would involve the stages of concept building, engineering calculations, fabrication, presentation and demonstration of the result. The focus is to be given in project management for solving engineering problems to meet sustainable socio-economic development goals. The learning approach is to have active participation in the planning, executing and managing of real-life engineering problems. Students will be distributed among groups, and will be assigned to supervisors to guide them. Students will achieve comprehension of employing their knowledge gathered into scientific research and practical problem solving. Furthermore, students will practice collection of new information, scientific literature review, and development of skill sets to enable them into solving complex engineering problems.			
OBJECTIVE			

- To make the students capable of performing research on the core fields of mechanical and allied engineering.
- To facilitate the students into employing their technical know how for the in-depth research on state-of-the art engineering problems.
- To provide the students a gateway to a lifelong learning approach for acquiring the knowledge and skillsets required for completion of preset project tasks.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corre s-pon-ding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Practice** employment of technical know-how in solving real-life scientific and technical problems on topics of core engineering fields.	1	C3, P1	1, 3, 4	1	1, 2, 3	D, PR, Pr, Q, R
CO2	**Employ** knowledge in basic science and engineering to solve complex real- life problems.	2	C3, P1	1, 2, 3, 4	2	1, 2, 3	D, PR, Pr, Q, R
CO3	**Solve** real-life scientific and complex engineering problems with multivariate boundary conditions using knowledge acquired in the fields of mechanical	3	C5, P2	5	3	1, 2, 3	D, PR, Pr, Q, R

	and allied engineering.						
CO4	**Investigate** real-life problems and analyze solution techniques to synthesize solution to scientific and complex engineering problems.	4	C4	8	4	1, 2, 3	D, PR, Pr, Q, R
CO5	**Employ** modern tools in designing solutions to scientific and complex engineering problems.	5	C3, A2	6		4, 5	D, PR, Pr, Q, R
CO6	**Employ** societal and ethical know-how in sustainable development of electro-mechanical solutions to solve real-life problems.	6	C6, P3, A2	7	5,6	4, 5	D, PR, Pr, Q, R
CO7	**Practice** sustainable development of electro-mechanical solutions to solve real-life problems.	7	C6, P2, A1	7	5	2, 3, 4, 5	D, PR, Pr, Q, R

CO8	**Employ** ethical considerations in the solution of real-life scientific topics and engineering problems with conflicting boundary conditions.	8	C3, A3	7	5, 6	4, 5	D, PR, Pr, Q, R
CO9	**Practice** teamwork and adapt skills to contribute as individual and in team towards solution of scientific and complex engineering problems.	9	C3		5, 6	1	D, PR, Pr, Q, R
CO 10	**Practice** communication skills in managing and solving real-life scientific topics and complex engineering problems.	10	C4			1, 2, 3, 4, 5	D, PR, Pr, Q, R
CO 11	**Employ** project management and communication skills in building a culture of teamwork to	11	C3		6	1	D, PR, Pr, Q, R

	successful attainment of set goals.						
CO 12	**Practice** correlating engineering know-how and the **adaptation** of soft and hard skills in a culture of life-long learning of conducting core scientific research and solving complex real-life problems.	12	C3	8	6, 7	4, 5	D, PR, Pr, Q, R

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction to scientific research.
- Introduction to application-based engineering solution and/or technology development.

b. Detail Contents:

Students will be assigned research topics on core engineering topics, and/or real-life engineering problems, and will have to solve the problems by employing their technical know-how on multidisciplinary topics. Students will be distributed in groups, and will act in various capacities ranging from group leader to executive members. The approach towards completion of the given tasks will depend on the group's collective perception of the problem definition, the ethical standpoint, and its sustainable design approach. Students will employ their technical know how, project management, communication and teamwork skills for finding solutions to real-life complex problems. Students will have an introduction to scientific research methods, and will learn to review scientific documents for idea generation, employ appropriate techniques, resources and modern engineering and

IT tools to conduct research, and practice presentation and documentation of scientific and technical projects.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Practice** employment of technical know-how in solving real-life scientific and technical problems on topics of core engineering fields.	3											
CO2	**Employ** knowledge in basic science and engineering to solve complex real- life problems.		3										
CO3	**Solve** real-life scientific and complex engineering problems with multivariate boundary conditions using knowledge acquired in the fields of mechanical and allied engineering.			3									
CO4	**Investigate** real-life problems and analyze solution techniques to synthesize solution to scientific and complex engineering problems.				3								
CO5	**Employ** modern tools in designing solutions to scientific and complex engineering problems.					3							
CO6	**Employ** societal and ethical know-how in sustainable development of electro-mechanical						3						

	solutions to solve real-life problems.												
CO7	**Practice** sustainable development of electro-mechanical solutions to solve real-life problems.							3					
CO8	**Employ** ethical considerations in the solution of real-life scientific topics and engineering problems with conflicting boundary conditions.								3				
CO9	**Practice** teamwork and adapt skills to contribute as individual and in team towards solution of scientific and complex engineering problems.									3			
CO10	**Practice** communication skills in managing and solving real-life scientific topics and complex engineering problems.										3		
CO11	**Employ** project management and communication skills in building a culture of teamwork to successful attainment of set goals.											3	
CO12	**Practice** correlating engineering know-how and the **adaptation** of soft and hard skills in a culture of life-long learning of conducting core scientific research and solving complex												3

	real-life problems.												

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will practice employment of technical know-how in solving real-life scientific and technical problems.
CO2-PO2	3	Students will develop the competence of synthesizing solutions to complex engineering problems based on their multidisciplinary knowledge on the basic science and engineering.
CO3-PO3	3	Students will learn to employ knowledge in basic science and engineering to solve scientific and complex real-life problems.
CO4-PO4	3	Students will investigate real-life problems and analyze solution techniques to synthesize solution to complex engineering problems.
CO5-PO5	3	Students will practice employing modern tools in designing solutions to scientific and complex engineering problems.
CO6-PO6	3	Students will employ societal and ethical know-how in sustainable development of electro-mechanical solutions to solve real-life problems.
CO7-PO7	3	Students will practice sustainable development of electro-mechanical solutions to solve real-life problems.
CO8-PO8	3	Students will employ ethical considerations in the solution of real-life scientific topics and engineering problems with conflicting boundary conditions.
CO9-PO9	3	Students will practice teamwork and adapt skills to contribute as individual and in team towards employing scientific research methodology and solving complex engineering problems.

CO10-PO10	3	Students will practice communication skills in conducting basic scientific research and managing and solving real-life complex engineering problems.
CO11-PO11	3	Students will practice employment of project management and communication skills in building a culture of teamwork to successful attainment of set goals.
CO12-PO12	3	Students will adapt the culture of correlating engineering know-how and the adaptation of soft and hard skills in a culture of life-long learning of conducting scientific research and solving complex real-life problems.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning		
	Lecture/meeting	10
	Practical	32
	Total	42
Self-Directed Learning		
	Preparation of project tasks	54.5
	Preparation of project report	20
	Preparation of presentations	04
	Total	78.5
Formal Assessment		
	Project demonstration	01
	Presentation and quiz	01
	Total	02
Total		122.5

TEACHING METHODOLOGY

Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE

Week	Lecture/Activity
1	Course overview. Introductory class on project management, engineering ethics and team-working skill development. Group distribution.
2	Workshop on conducting scientific research and engineering project management. Task assignment.
3	Project meeting and project work day-I.

4	Project meeting and project work day-II.
5	Project meeting and project work day-III.
6	Project meeting and project work day-IV.
7	Project meeting and project work day-V. Introduction to technical report writing.
8	Project meeting and project work day-IV.
9	Project meeting and project work day-VII.
10	Project meeting and project work day-VIII.
11	Project meeting and project work day-IX.
12	Project meeting and project work day-X.
13	Project demonstration.
14	Presentation and quiz.

ASSESSMENT STRATEGY

Components		Grading
Continuous assessment (60%)	Project meetings	10%
	Project participation	40%
Project demonstration		15%
Project presentation and quiz		10%
Project report		25%
Total Marks		100%

REFERENCE BOOKS

- Deb, D., Dey, R., & Balas, V. E. (2019). *Engineering Research Methodology: A Practical Insight for Researchers*. Springer. ISBN: 9789811329470
- Smith, N. J. (Ed.). (2002). *Engineering project management*. Ames, IA: Blackwell Science. ISBN: 9780470708989
- Fleddermann, C. B. (1999). *Engineering ethics*. Upper Saddle River, NJ: Prentice Hall. ISBN: 9780132145213

- Dubbel, H. (2013). *Dubbel-Handbook of mechanical engineering*. Springer Science & Business Media. ISBN: 9780387198682
- Collins, S., Ghey, J., & Mills, G. (1989). *The professional engineer in society*. Jessica Kingsley Publishers. ISBN: 9781853025013
- Tulgan, B. (2015). *Bridging the soft skills gap: How to teach the missing basics to today's young talent*. John Wiley & Sons. ISBN: 9781118725641
- Pfeiffer, W. S., & Adkins, K. E. (2012). *Technical communication fundamentals*. Boston: Prentice Hall. ISBN: 9780132374576

ME 4217: Power Plant Engineering

COURSE INFORMATION			
Course Code	ME 4217	Lecture Contact Hours	3.00
Course Title	Powerplant Engineering	Credit Hours	3.00
PRE-REQUISITE			
ME 2101- Engineering Thermodynamics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course will familiarize students with the terminology associated with power production processes. They will be taught with different types power generation technologies like diesel engine power plant, solar, hydro, wind, and nuclear power plant. This course will introduce them with different types of power plant accessories. They will be familiarized with various variable load problems and power plant economics			
OBJECTIVE			
• To familiarize students with the terminology associated with Power Production processes. • Teach students with different types power generation technologies like Diesel Engine Power Plant, Solar, Hydro, Wind, and Nuclear Power Plant. • To understand about different types of Power Plant accessories. • Teach students how to design electrical power transmission system. • To get acquainted with various variable load problems and power plant economics.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxonomy**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	**Understand** the role and necessity of power station in modern life	P-06	1	7	1	1	Q, ASG, F
CO2	**Design** different devices of various power plants	P-03	2	5	3	1	Q, ASG, F
CO3	**Learn** about power distribution system from power station to consumption place	P-01	1	4	2	1	Q, ASG, F
CO4	**Maintain** different parts of power station and distribution section	P-07	4	7	1	1	Q, ASG, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

- Introduction
- Variable Load Problems
- Power plant Economics
- Diesel Engine Power plants
- Steam Power plant
- Hydro-electric Power plant
- Gas Turbine Power plant
- Nuclear Power plant

b. Detail Contents:

Introduction: Sources of energy, Types of power plants and its modern trend, Survey of power plants in Bangladesh.

Variable Load Problems: Principle of optimization, its application to power system planning and design and technical operation.

Power plant Economics: Theory of tariffs Instrumentation in power plants, Selection of plants, Advantages, Disadvantages and comparisons of different types of power plant.

Diesel Engine Power Plants: Scope, Arrangements, Air fuel system, Cooling system and lubrication system, Starting methods.

Steam Power Plants: Furnaces, Stokers and burners, Fuels, Fuel handling, Combustion equipment, Boilers, Steam turbines, reheat, regenerative, superposed, binary and combined cycles

Hydro-electric Power Plants: Types of operation, Site selection, Turbine selection, Seasonal and intermittent plants, components of the plant, Efficiency, Governing of water turbines.

Gas Turbine Power Plants: Scope, Cycle analysis, Installation, Intercooling, Regeneration and reheating, governing and maintenance.

Nuclear Power Plant: types of reactors, layout of nuclear power plant, waste disposal.

Power Plant Accessories: Draft systems, Chimney design, Water-cooling systems, Water conditioning and industrial water treatment.

Electrical Power Transmission: Basic concepts, types of transmission and distribution systems, instrumentation in power plants.

Solar Energy: Availability of solar energy, solar devices, direct production of electricity, solar thermal energy conservation system.

CO-PO MAPPING

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

CO1	**Understand** the role and necessity of power station in modern life						2						
CO2	**Design** different devices of various power plants			3									
CO3	**Learn** about power distribution system from power station to consumption place	2											
CO4	**Maintain** different parts of power station and distribution section							3					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO6	2	Students will understand the role and necessity of power station in modern life
CO2-PO3	3	Students will be able to design different devices of various power plants
CO3-PO1	2	Students will learn about power distribution system from power station to consumption place
CO4-PO7	3	Students will learn to maintain different parts of power station and distribution section

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, and problem solving.	

COURSE SCHEDULE				
Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction: Sources of energy-I		
	2	Types of power plants and its modern trend		
	3	Survey of power plants in Bangladesh		
2	4	Variable Load Problems: Principle of optimization -I		
	5	Variable Load Problems: Principle of optimization-II		
	6	Its application to power system planning and design and technical operation-I		
3	7	Power Plant Economics: Theory of tariffs		
	8	Power Plant Economics: Theory of tariffs Instrumentation in power		

		plants-II			
	9	Advantages, Disadvantages and comparisons of different types of power plant	CT-01	Lectures 1-6	
4	10	Diesel Engine Power Plants: Scope, Arrangements			
	11	Air fuel system			
	12	Cooling system and lubrication system			
5	13	Steam Power Plants: Furnaces			
	14	Stokers and burners			
	15	Fuels, Fuel handling, Combustion equipment			
6	16	Boilers			
	17	Steam turbines-reheat, regenerative, superposed, binary and combined cycles-I			
	18	Steam turbines-	ASG-01		

		reheat, regenerative, superposed, binary and combined cycles-II			
7	19	Evaporators and cooling towers			
	20	Gas loop and water loop, Steam piping and insulations			
	21	Condenser			
8	22	Hydro-electric Power Plants: Types of operation, Site selection	M		
	23	Turbine selection			
	24	Seasonal and intermittent plants, components of the plant			
9	25	Gas Turbine Power Plants: Scope, Cycle analysis			
	26	Installation			
	27	Intercooling, Regeneration and reheating			
10	28	Power Plant Economics: Theory of			

		tariffs Instrumentation in power plants-II			
	29	Nuclear Power Plant: types of reactors-I	CT-02	Lectures 22-27	
	30	Nuclear Power Plant: types of reactors-II			
11	31	Waste disposal			
	32	Power Plant Accessories: Draft systems			
	33	Chimney design			
12	34	Water conditioning and industrial water treatment			
	35	Electrical Power Transmission: Basic concepts	ASG-02		
	36	Types of transmission and distribution systems			
13	37	Solar Energy: Availability of solar energy			

	38	Solar devices		
	39	Direct production of electricity		
14	40	Review class		
	41	Review class		
	42	Review class		

ASSESSMENT STRATEGY				
	COs	**Assessment Method**	**(100%)**	**Remarks**
		Class Assessment		
	1	ASG, CS, CT	70	
	2	ASG, CS, CT	70	
	3	ASG, CS, CT	70	
	4	ASG, CS, CT	70	
		Exam		
	1	M, F	30	
	2	M, F	30	
	3	M, F	30	
	4	M, F	30	

REFERENCE BOOKS

- G. R. Nagpal, G. R (2007). *Power Plant Engineering*. 15th Edition, Khanna Publishers, Delhi-110006, India, ISBN: 81-7409-155-6

ME 4218: Power Plant Engineering Sessional

COURSE INFORMATION

Course Code	ME 4218	Lecture Contact Hours	1.50
Course Title	Power Plant Engineering sessional	Credit Hours	0.75

PRE-REQUISITE
ME 4217: Power Plant Engineering.
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course introduces the study of power plants. 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
• To introduce the students about designing, operating and maintaining the various parts of a power plant along with environmental safety associated with it. • To teach the students on theoretical and practical training. • To provide a wide range of opportunity of power sector in Bangladesh.
LEARNING OUTCOMES & GENERIC SKILLS

No.	**Course Outcomes**	**Corresponding PO**	**Bloom'sTaxono-my**	**KP**	**CP**	**CA**	**Assessment Methods**
CO1	Relate between advanced knowledge of thermodynamics and the key features of a power plant.	1	C5	1	1		LT, LR, Q, Pr, PR, F

CO2	Illustrate thermodynamic cycles in practical and to investigate theoretical and actual efficiencies.	1	C3	1	1		LT, LR, Q, Pr, PR, F
CO3	Construct and know the solutions to improve the efficiency of power plants.	7	C4	7	5		LT, LR, Q, Pr, PR, F
CO4	Develop knowledge about power plant equipment‘s and environmental safety.	4	C1	8	4		LT, LR, Q, Pr, PR, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

- Study about different parts of a steam generator.
- Study about mountings of a boiler.
- Study about accessories of a boiler.
- Investigation on boiler trial and heat balance sheet of a boiler.
- Determination of boiler efficiency.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Relate between advanced knowledge of thermodynamics and the key features of a power plant.	3											

CO2	Illustrate thermodynamic cycles in practical and to investigate theoretical and actual efficiencies.	3											
CO3	Construct and know the solutions to improve the efficiency of power plants.							3					
CO4	Develop knowledge about power plant equipment's and environmental safety.				3								

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to understand the basic concept of different power plants.
CO2-PO1	3	Student will able to compare the theoretical and actual value of efficiencies in the laboratories.
CO3-PO7	3	Students will gain ethical value by studying different harmful effect on environment by power plant emission
CO4-PO4	3	Students will be able to learn about the safety which is needed in operating the various equipment in a power plant.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning		
	Lecture	07
	Practical	14
Self-Directed Learning		
	Preparation of Lab Reports	05
	Preparation of Lab Test	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
		Total = 79

TEACHING METHODOLOGY

Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE		
Week	**Topics**	**Remarks**
1	Study about different parts of a steam generator.	
3	Study about mountings of a boiler.	
5	Study about accessories of a boiler.	
7	Lab Test -01.	
9	Investigation on boiler trial and heat balance sheet of a boiler.	
11	Determination of boiler efficiency.	
12	Lab Test -02.	
13	Final lab report Submission.	
14	Quiz.	

ASSESSMENT STRATEGY

Assessment method	Grading
Lab Report, project and presentation	30%
Labtest-1, Labtest-2	30%
Lab Quiz, Final	40%
Total	100%

REFERENCE BOOKS

- G. R. Nagpal S.C. SHARMA. *Power Plant Engineering.* 6th Edition. New Delhi: Khanna Publishers, 2012. ISBN: 9788174093097.
- Rajput, R. K. *Power Plant Engineering*. Laxmi Publications (January 1, 2007). ISBN: 8131802558.

ME 4219: Automobile Engineering

COURSE INFORMATION			
Course Code	ME 4219	Lecture Contact Hours	3.00
Course Title	Automobile Engineering	Credit Hours	3.00

PRE-REQUISITE

ME 2101: Engineering Thermodynamics, ME 4101- Internal Combustion Engines
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course will make the student conversant with fundamentals of automobile systems. It will help them to develop competencies in performance analysis of vehicles. It will also make the student conversant with automobile safety, electrical system and vehicle maintenance.
OBJECTIVE
• To acquaint the students about different components and systems of automobile. • To familiarize thestudents with the working principle of various parts of automobile. • To make students able to develop strong base for understanding of future development in automobile industry.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	**Be familiar** with different components and systems of automobile.	1	C1	1	1	3	ASG,CS,CT, F,M,Q, F
CO2	**Understand** about working principle of various parts of automobile	1	C1, C2	1,2	1,5	3	ASG,CS,CT, F,M,Q, F
CO3	**Be able** to handle technical and management problems in automobile industry	6	C2, C3	7	1,2	3	ASG,CS,CT, F,M,Q, F
CO4	**Develop** creative thinking ability and a deep perception on recent automotive technologies, and gain competence in working professionally in this area.	7	C4	7	1	3	ASG,CS,CT, F,M,Q, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

- Engine.
- Transmission.
- Chassis.
- Automotive control system.
- Automotive air conditioning system.
- Automotive Cooling system.
- Recent advancement in automobiles.

b. Detail Contents:

Chassis: Frame and body, suspension system, springs, wheels and tires.

Engine: Types, comparison, rating and specification, constructional details of automobile engine, engine mounting, engine cooling and lubricating systems, exhaust system, emission control.

Transmission: Clutch, gear box, propeller shaft, universal joint, final drive, differential, rear axle and front axle, over drive, under drive.

Automobile Control System: Steering system, brakes and braking system, speed control and governing. Automatic control system.

Automobile Electrical System: Battery and its maintenance, battery charging, generator and charging system, the cutout starting system, Bendix drive and Solenoid drive, self-starter, lighting and wiring system.

Ignition System: Components, ignition timing and ignition advance, magnetos, carburetion and fuel injection system, firing order.

Repair and Maintenance: Servicing, tuning, overhauling, inspection and testing, trouble shooting, safety measures.

Recent Advancement in Automobiles: EFI system, variable valve timing, automatic clutch and gearchange, pollution.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Be familiar** with different components and systems of automobile.	3											
CO2	**Understand** about working principle of various parts of automobile	3											

CO3	**Able** to handle technical and management problems in automobile industry						3						
CO4	**Develop** creative thinking ability and a deep perception on recent automotive technologies, and gain competence in working professionally in this area.							3					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will have basic knowledge of various core areas of mechanical engineering discipline.
CO2-PO1	3	Students will learn to systematically formulate various fundamental and applied concepts of engineering devices based on pure science.
CO3-PO6	3	Students can apply their basic knowledge in various engineering problem.
CO4-PO7	3	Students will learn to perform basic calculations to solve simple engineering problems.

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

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	General classification of motor vehicles, layout and main components,		
	2	specification of an automobile		
	3	Performance of an automobile		
2	4	calculation of total loads		
	5	tructive effort and propulsive power		
	6	Frame and body		
3	7	suspension system		
	8	springs, wheels and tires		
	9	Types, comparison, rating and specification	CT-01	Lectures 1-6
4	10	constructional details of automobile engine		
	11	engine mounting		
	12	engine cooling		
5	13	lubricating systems		
	14	exhaust system, emission control		
	15	Clutch, gear box,		

		propeller shaft		
6	16	universal joint, final drive, differential		
	17	rear axle and front axle		
	18	over drive, under drive	ASG-01	
7	19	Steering system		
	20	brakes and braking system		
	21	speed control and governing		
8	22	Automatic control system	M	
	23	Battery and its maintenance, battery charging		
	24	generator and charging system		
9	25	the cutout starting system		
	26	Bendix drive and Solenoid drive		
	27	self-starter lighting and wiring system		
10	28	Components, ignition timing		
	29	ignition advance	CT-02	Lectures 22-27
	30	magnetos, carburetion and fuel injection system		
11	31	firing order		
	32	Servicing, tuning, overhauling		

	33	inspection and testing		
12	34	trouble shooting, safety measures		
	35	EFI system	ASG-02	
	36	variable valve timing		
13	37	automatic clutch and gear change		
	38	pollution control		
	39	Production, processing		
14	40	conversion of petrol engines to CNG vehicles		
	41	conversion of diesel engines to CNG vehicles		
	42	Review class		

ASSESSMENT STRATEGY				
	COs	**Assessment Method**	**(100%)**	**Remarks**
		Class Assessment		
	1	ASG, CS, CT	70	
	2	ASG, CS, CT	70	
	3	ASG, CS, CT	70	
	4	ASG, CS, CT	70	
		Exam		
	1	M, F	30	
	2	M, F	30	
	3	M, F	30	

	4	M, F	30	

REFERENCE BOOKS

- Heywood, J. B. (2019). *Internal combustion engine fundamentals.* McGraw-Hill Education. ISBN: 9781260116113
- Hossay, P. (2020). *Automotive innovation: The science and engineering behind cutting-edge automotive technology*. CRC Press. ISBN: 9780429877308
- Crolla, D. (2009). *Automotive engineering: Powertrain, chassis system and vehicle body*. Oxford, UK: Butterworth-Heinemann. ISBN: 978-1-85617-577-7
- Singh k, (2007). *Automobile Engineering*. 7th Edition. Standard Publishers. ISBN: 9788186308257
- Winner, H., Prokop, G., & Maurer, M. (2018). *Automotive systems engineering: II.* Springer. ISBN: 9783319616070
- Crolla, D., Foster, D. E., Kobayashi, T., & Vaughan, N. (2019). *Encyclopedia of automotive engineering*. John Wiley & Sons Inc.. ISBN: 9781786842497

ME 4233: Mechatronics

COURSE INFORMATION			
Course Code	ME 4233	Lecture Contact Hours	3.00
Course Title	Mechatronics	Credit Hours	3.00

PRE-REQUISITE
MATH 1101: Mathematics-I, EEE 1159: Basic Electrical Engineering, MATH 1201: Mathematics-II, CSE 1271: Computer Programming, ME 2101: Engineering Thermodynamics, ME 2111: Numerical Analysis, MATH 2101: Mathematics-III, EEE 2259: Electrical Machines and Electronics Technology, MATH 2201: Mathematics-IV, ME 3105: Fluid Mechanics- I, ME 3113: Machine Design-I, ME 3213: Machine Design-II, ME 3205: Fluid Mechanics- II, and ME 4105: Fluid Machinery.
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course provides a prologue to the concepts and standards of mechatronics system and mechatronic design approach in modern mechanical, aerospace, robotics and control Engineering fields. The focus is to illustrate practical engineering applications in these fields. Students will obtain an in-depth knowledge in sensorics, actuatorics, system modelling, and control system design of a mechatronic system. Upon completion of this course, students will have the competence to design mechatronic system controlled with the help of programmable logic controllers (PLCs). The learning approach is to apply a synergistic approach to mechanical, electrical and software engineering principles to analyze, design and control modern mechatronic systems. Students will achieve comprehension of the multi-physics working principle of any mechatronic system and will gain the competence to design systems based on their understanding in the overall system behavior and control strategies.
OBJECTIVE
• To familiarize students with the essential ideas of mechatronic system. • To make students acquainted with the understanding in sensorics, actuatorics, and control system. • To familiarize students with system modelling.

- To build the competence of the students in incorporating the knowledge of numerical analysis in the design of control systems.
- To enable the students to analyze the performance of different components of a mechatronic system.
- To familiarize the students with programming in programmable logic controllers and to integrate the PLCs in the control system design.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Assess** the performance of mechatronic system components like sensors, actuators, control systems.	2	C5, A1, P1	1,4, 6	2	1	ASG, CS, CT, F, M, Q
CO2	**Analyze** and **synthesize** mechatronic systems for using in aviation and space industries.	4	C6	1, 4, 5, 8	4	2, 3	ASG, CS, CT, Q
CO3	**Understand** system models and **design** control algorithms of mechatronic systems.	3	C3	1, 2, 4, 5	3		ASG, CS, CT, F, M, Q
CO4	**Develop** process control systems with PLCs.	5	C6, P2	4, 5, 6, 7, 8	5, 6	1, 2, 3	ASG, CS, CT, F, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT
a. Main Contents:

- Mechatronics system.
- Sensors and transducers.
- Actuation systems.
- System modelling and control.
- Control systems design.
- Programming logic controllers.

b. Detail Contents:

Mechatronics: Introduction to Mechatronics systems, measurement systems and control systems, open and closed loop systems.

Sensors and Transducers: Introduction to sensors and transducers, sensor characteristics, classification of sensor. Sensors for displacement, position, proximity, velocity, motion, force. Torque and tactile sensors. Pressure, temperature, light sensors. Ultrasonic sensors; range sensors.

Actuation Systems: Linear and rotary actuators. AC and DC motors, stepper motor, servo motor. Fluid power actuators, smart actuators.

System Modeling and Control: Introduction to signals, systems and controls. System representation: Transfer function form, block diagram form. Linearization of nonlinear systems; time delays; measurement of system performances. Modeling of mechanical, electrical, fluid and thermal systems. Rotational-transnational systems, electromechanically systems.

Control Systems Design: Introduction. Classical design: transfer functions, frequency response analysis, root locas, bode plots, state-space design. Proportional-integral-derivative (PID) control, digital control, robust control, intelligent control.

Programming Logic Controllers: Introduction to PLC, basic structure, input/output processing; PLC programming, applications of PLC.

CO-PO MAPPING

No.	**Course Outcome**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Assess** the performance of mechatronic system components like sensors, actuators, control systems.		3										

CO2	**Analyze** and **synthesize** mechatronic systems for using in aviation and space industries.				3								
CO3	**Understand** system models and **design** control algorithms of mechatronic systems.			3									
CO4	**Develop** process control systems with PLCs.					3							

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	3	Students will develop the ability to correlate the role of different system components like sensors, actuators, control systems in the analysis of complex engineering problems related to overall system performance of mechatronic systems.
CO2-PO4	3	Students will be able to analyze and synthesize mechatronic systems for using in aviation and space industries.
CO3-PO3	3	Students will attain the competence of understanding system models and designing control algorithms of real-life mechatronic systems.
CO4-PO5	3	Students will gain the ability of developing process control systems using the standard programming language of modern PLCs.

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, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Course overview, introduction to Mechatronic systems.		
	2	Measurement systems and control systems.		
	3	Open and closed loop systems.		
2	4	Introduction to sensors and transducers.		
	5	sensor characteristics, classification of sensor.		
	6	Sensors for displacement, position.		
3	7	Proximity and velocity sensors.		
	8	Motion and force sensors.		
	9	Torque and tactile sensors.	CT-01	Lectures 1-6
4	10	Pressure sensors.		
	11	Temperature sensors.		
	12	Light sensors.		

5	13	Ultrasonic sensors.		
	14	Range sensors.		
	15	Introduction to actuation systems.		
6	16	Linear and rotary actuators.		
	17	AC and DC motors.		
	18	Stepper motor, servo motor.	ASG-01	
7	19	Fluid power actuators, smart actuators.		
	20	System Modeling and Control: Introduction to signals, systems and controls.		
	21	System representation: transfer function form, block diagram form.		
8	22	Linearization of nonlinear systems, time delays.	M	
	23	Measurement of system performances.		
	24	Modeling of mechanical, electrical, fluid and thermal systems.		
9	25	Rotational-transnational systems.		
	26	Electromechanical systems.		
	27	System transfer functions-I.		
10	28	System transfer functions-II.		
	29	Frequency response analysis-I.	CT-02	Lectures 22-27
	30	Frequency response analysis-II.		
11	31	Root locas, bode plots, state-space design-I.		

	32	State-space design-II.		
	33	Proportional-integral-derivative (PID) control-I.		
12	34	Proportional-integral-derivative (PID) control-II.		
	35	Digital control, robust control, intelligent control.	ASG-02	
	36	Introduction to PLC.		
13	37	Basic structure, input/output processing of PLC.		
	38	Applications of PLC.		
	39	PLC programming- I.		
14	40	PLC programming- II.		
	41	PLC programming- III.		
	42	PLC programming- IV.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	60	
2	ASG, CS, CT	100	
3	ASG, CS, CT	50	
4	ASG, CS, CT	50	
	Exam		
1	M, F	40	
3	M, F	50	
4	M, F	50	

REFERENCE BOOKS

1. Bolton, W. (2018). *Mechatronics: Electronic control systems in mechanical and electrical engineering*. Pearson. 6th Edition. ISBN- 978-1-292-07668-3
2. Ogata, K. (2010). *Modern control engineering*. Upper Saddle River, NJ: Prentice Hall. 5th Edition. ISBN- 9780136156734
3. Alciatore, D. G., & Histand, M. B. (2019). *Introduction to mechatronics and measurement systems*. McGraw-Hill. 4th Edition. ISBN 978-0-07-338023-0
4. Irwin, J. D., & Wilamowski, B. M. (2016). *The industrial electronics handbook*. CRC Press. 2nd Edition. ISBN- 978-1-4398-0287-8

Optional-I Courses (For Level-4 Term-I)

ME 4121: Renewable Energy Technology

COURSE INFORMATION			
Course Code	ME 4121	Lecture Contact Hours	3.00
Course Title	Renewable Energy Technology	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			

This course provides a prologue to the concepts and standards of reserves of non-renewable fuels, prospects of renewable energy, and its sources and pattern of usage, characteristics of renewable sources: intermittent, low power density etc,use of renewable in small-scale systems.

The focus is to illustrate practical engineering applications in these fields. Students will obtain an in-depth knowledge in current technology: wind wave, tidal, passive and active solar, biological and examples of devices; Energy management, interaction of non-technical requirements (social, economic, political, environment) in engineering design and innovation; Case-study.

OBJECTIVE

1. To introduce renewable energy technologies and emphasize exploration of principles and concepts as well as the application of renewable energy technologies (RET).
2. To Explores topics such as energy consumption, the pros and cons of renewable energy, energy production and cons, energy conversion, environmental issues and concerns, electrical grid, biomass and bio fuels, geothermal, wind, power, solar power, nuclear power, and hydropower systems.

LEARNING OUTCOMES & GENERIC SKILLS

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

CO1	**Identify** the issues existing in the energy industry regarding conventional and non-conventional energy sources.	6	C4	7	2		Q, ASG, F
CO2	**Identify** the issues existing in the energy industry and their effect on the environment.	7	C4	7	2		Q, ASG, F
CO3	**Understanding** of the theory behind various renewable energy sources	1	C2	1			Q, ASG, F
CO4	**Analyze** of the case studies of various renewable energy projects that is shaping today's world	2	C4, C5	8	4		Q, F, CS
CO5	**Apply** the fundamentals of renewable energy to design various renewable energy devices.	3	C3	1-5			Q, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Content

1. Sources of Energy
2. Energy Conversion Techniques
3. Energy Extraction
4. Energy Converting Devices and Storage

b. Detail Content

Sources of Energy: Energy cycle, Non renewable energy sources, Coal, Oil, Natural gas, Nuclear fuel, Oil shale and tar sands, Renewable energy sources, Solar, Biomass, Wind hydropower, Geothermal, Waves, Ocean thermal and tidal. Energy Conversion Techniques: Solar thermal conversion, Semiconductor devices, Biochemical and Thermo-chemical conversion of biomass, Wind energy conversion, Hydropower, Ocean thermal energy conversion. Energy Extraction: Geothermal, Waves, Tides, Nuclear fission and fusion. Energy Converting Devices and Storage: Thermoelectric, Thermo-ionic converters, Fuel cells, Magneto hydrodynamics, Storage of solar energy, Demand of energy storage in stationary and transport applications. Economic and environmental aspects of energy sources

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify the issues existing in the energy industry regarding conventional and non-conventional energy sources						3						
CO2	**Identify** the issues existing in the energy industry and their effect on the environment.							3					
CO3	Understanding of the theory behind various renewable energy sources	3											
CO4	Investigation of the case studies of various renewable energy projects that is shaping today's world				3								
CO5	Apply the fundamentals of renewable energy to design various renewable energy devices		3	3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO6	3	Identifying the issues in current energy issues will help to grow societal responsibility in the students
CO2-PO1	3	Renewable energy theories will include knowledge from mathematics, physics and chemistry.
CO3-PO4	3	Students will learn to use advanced energy knowledge to investigate on the current world energy issues with the case studies
CO4-PO2	2	Students will learn to analyse problems on the renewable energy systems
CO4-PO3	3	Students will learn to design various renewable energy devices

TEACHING LEARNING STRATEGY

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

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Weeks	Lectures	Topics	CT	Remarks
1	1	Introduction to Renewable Energy Technology		
	2	Sources of Energy		
	3	Introduction to non renewable		

			energy sources		
	2	4	Coal, Oil, Natural gas, Nuclear fuel, Oil shale and tar sands		
		5	Introduction to Renewable		
		6	Solar		
	3	7	Solar thermal conversion-I		
		8	Solar thermal conversion-II		
		9	Solar thermal conversion-III	CT-01	Lecture 1-6
	4	10	Sun Earth Geometric Relation-I		
		11	Sun Earth Geometric Relation-II		
		12	Semiconductor devices-I		
	5	13	Semiconductor devices-II		
		14	Storage of solar energy		
		15	Storage of solar energy-II		
	6	16	Geothermal-I		
		17	Introduction to Energy Conversion Techniques- Geothermal-II		
		18	Geothermal-III	CT-02	Lectures 7-15
		19	Biomass		
	7	20	Bio-chemical and Thermo-chemical		
		21	Conversion of biomass		
	8	22	Biomass-II		
		23	Nuclear Energy		
		24	Nuclear fission and fusion		
	9	25	Nuclear Energy Conversion Techniques-I		
		26	Nuclear Energy Conversion Techniques-II	Mid Term	
		27	Nuclear Energy Conversion Techniques-III		
	10	28	Wind Energy		
		29	Wind Energy-II		
		30	Energy extraction Techniques-Wind Energy-III		
	11	31	Hydropower-I		
		32	Hydropower-II		
		33	Hydropower-III		
	12	34	Hydropower-IV	CT-03	Lectures 23-33
		35	Waves and Tides		
		36	Ocean thermal and tidal		
	13	37	Ocean thermal energy conversion		
		38	Introduction to energy converting devices-Waves		
		39	Introduction to energy converting devices-Tides		
	14	40	Demand of energy storage in stationary and transport applications.		
		41	Review Class-01		
		42	Review Class-01		

ASSESSMENT STRATEGY

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

REFERENCE BOOKS

1. Energy Resources and Policy – R. C. Dorf
2. Alternative Energy Sources: A Strategy Planning guide – R. T. Sheahan

ME 4123: Energy Resources and Utilization

COURSE INFORMATION				
Course Code	ME 4123		Lecture Contact Hours	3.00
Course Title	Energy Resources & Utilization		Contact Hours	3.00
PRE-REQUISITE				
None				
CURRICULUM STRUCTURE				
Outcome Based Education (OBE)				
SYNOPSIS/RATIONALE				

This course is designed to provide student a general overview of energy sources, conversion, storage and utilization. Several renewable energy sources such as wind power, hydro-power, solar power, geothermal energy, wave energy will be covered in this course. The learning approach would be to theoretically and statistically compare different energy sources in terms of cost, efficiency, disposal and health hazards etc. Upon successful completion of this course, students will be able to justify the feasibility of using a particular energy source on a given condition.

OBJECTIVE

- To understand the theoretical working principles of different energy sources.
- To compare the usage of the renewable energy sources with the respective conditions.
- To analyse the feasibility of the application of the energy sources, energy conversion and recovery considering the societal and the environmental impact.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Illustrate** the working principles of the energy sources.	1	C2	1	1		Q, ASG, F
CO2	**Demonstrate** the advantages and disadvantages in the use of different energy sources.	1	C2	1	1		Q, ASG, F
CO3	**Develop** a model of the energy sources and their corresponding constraints.	2, 6	C3	3	2		Q, ASG, F
CO4	**Evaluate** a specific case and suggest a method to enhance the energy performance.	4	C5	8	4		Q, ASG, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT
e. Main Contents: • Resources. • Source and Conversion. • Application of Solar Energy. • Utilization. • Environmental Impact. **f. Detail Contents:** The energy cycle of the earth, The energy scope, A study of available energy resources for the world and energy demand, Levels of extraction and technically feasible extraction. Review of current conversion, Systems Bio-energy, Hydro-power, Wind power, Types of wind energy collectors, Storage system application, Geo-thermal energy: Sources, Disposal of used Geo-thermal fluids, Application, Geo-thermal power cycle, Tidal energy: Sources, Schemes for power generation, Ocean Thermal Energy Conversion (OTEC), Concepts of favorable location wave energy, Wave energy extractors, Solar energy: Introduction, Sun-Earth angles, Solar angle of incidence, Solar time, Solar radiation, Estimation and measuring instruments, Energy storage, Collectors, Solar pond design technique. Heating, Cooling, Power generation, Pumping, Desalination, etc. Efficiencies of conversion system in current use, Matching of energy sources to application Hybrid & Stored energy system, Waste heat rejection and Utilization. Aspects of air and thermal pollution and waste disposal problems arising from conversion systems.

CO-PO MAPPING

No.	Course Outcomes	Programming Outcomes (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Illustrate** the working principles of the energy sources.	3											
CO2	**Demonstrate** the advantages and disadvantages in the use of different energy sources.	3											
CO3	**Develop** a model of the energy sources and their corresponding		2				2						

	constraints.												
CO4	**Evaluate** a specific case and suggest a method to enhance the energy performance.				2								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Corresponding level of matching	Justification
CO1-PO1	3	Students will gain knowledge on the working principles of different energy sources and their applications.
CO2-PO1	3	Students will compare the advantages and disadvantages of different energy sources in terms of efficiency, cost, environmental impact, health hazard etc.
CO3-PO2	2	In order to develop a model of the energy sources and their constraints, students will list down the constraints of different energy sources and compare them.
CO3-PO6	2	Impact of long-term use of the energy sources on the environment, society and health will be analyzed using the model.
CO4-PO4	2	A particular case study will be performed to evaluate the practical aspects of using an energy source.

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, Quiz, Assignment

COURSE SCHEDULE

Week	Lecture	Topic	ASG/CT/M	Remark

				s
1	1	Introduction of course outline		
	2	The energy cycle of the earth, energy scope, available energy resources		
	3	Extraction, energy dilemma		
2	4	Form of energy		
	5	Review of current conversion		
	6	Fossil-fueled power plants		
3	7			
	8	Nuclear-fueled power plants		
	9	Systems Bio-energy		
4	10	Hydroelectric power		
	11	Wind power, types of wind energy collectors		
	12		CT-01	Lecture 2-9
5	13	Geo-thermal energy: sources		
	14	Disposal of used geo-thermal fluids		
	15	Application of geo-thermal fluids		
6	16	Geo-thermal power cycle		
	17	Tidal energy: Sources, schemes for power generation		
	18	Ocean Thermal Energy Conversion (OTEC)	ASG-01	
7	19	Concepts of favorable location wave energy		
	20	Wave energy extractors		
	21	Solar energy: Introduction, sun-earth angles		
8	22	Solar angle of incidence, solar time		

	23	Solar radiation		
	24	Estimation and measuring instruments		
9	25	Storage system application	M	
	26	Energy storage: Electrostatic, magnetic, electrochemical, mechanical energy storage		
	27	Solar thermal power plants		
10	28	Solar collectors		
	29	Photovoltaic power		
	30	Solar pond design technique		
11	31	Solar heating and cooling		
	32	Active and passive heating and cooling		
	33	Concentrated solar power	CT-02	Lecture 22-30
12	34	Efficiencies of conversion system		
	35	Matching of energy sources to application		
	36	Hybrid energy system		
13	37	Stored energy system		
	38	Waste heat rejection and utilization		
	39	Aspects of air and thermal pollution	ASG-02	
14	40	Waste disposal problems arising from conversion systems		
	41	Review class-1		
	42	Review class-2		

ASSEMENT STRATEGY

	CO	**Assessment Method**	**(100%)**	**Remarks**	
		Class Assessment			

	1	Q, CT	30		
	2	Q, CT	30		
	3	Q, ASG	100		
	4	Q, ASG, R	30		
		Exam			
	1	M, F	70		
	2	M, F	70		
	3	F	70		

REFERENCE BOOKS
• Sørensen, B. (2017). *Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning*. London: Academic Press. • Fay, J. A., & Golomb, D. (2012). *Energy and the environment: scientific and technological principles*. New York: Oxford University Press. • Nelson, V., & Starcher, K. (2016). *Introduction to renewable energy*. Boca Raton: Crc Press, Taylor & Francis Group. • Hodgson, P. E. (1997). *Energy and environment*. London: Bowerdean Pub. Co.

ME 4125: Materials Handling

COURSE INFORMATION			
Course Code	ME 4125	Lecture Contact Hours	3.00
Course Title	Materials Handling	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			

This course provides a prologue to the concepts and standards of different material handling processes used in industrial sectors.

The focus is to illustrate practical engineering applications in these fields. Students will obtain an in-depth knowledge of the theories of materials handling systems and processes to test the efficiency. Upon completion of this course, students will have the competence to analyze material handling problems, design of different conveyers and test different packages.

The learning approach is to apply a synergistic approach to production of materials and the mechanics to handle the materials processing.

Students will achieve comprehension of the principle of different handling processes and will gain the competence to design systems based on their understanding in the overall behavior and strategies.

OBJECTIVE

- To understand and be able to complete different charts i.e. assembly chart, route sheet, operations process chart, from-to chart etc. with regard to a specific product.
- To identify equipment requirements for a specific process.
- To understand the benefit of an efficient material handling system.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Compare** fundamental principles of material handling systems.	1	C2	1	1		ASG, CT, F. M, Q
CO2	**Develop** understanding of special concepts in material handling.	2	C3	1, 4	2		ASG, CT, F, M, Q
CO3	**Examine** analytical processes for the study of different material handling equipment.	2	C4	1, 4	2		ASG, F, M, R
CO4	**Understand** fundamental principles of packaging.	1	C2	1	1		ASG, CT, F, M, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

- **Main Contents:**
- Analysis of materials handling problems
- Efficiency of material handling systems
- General theory of conveyors
- Packaging
- Testing procedure of packages

- **Detail Contents:**

Importance and scope of material handling; Classification of materials - unit load and bulk loads; Analysis of material handling problems - system concept, selection and classification of conveying equipment; Efficiency of material handling systems; General theory of conveyors; Computer controlled material handling (AGV, ASRS etc); Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors; Operation and selection of industrial truck loads. Packaging: packaging materials, layout for packaging; Testing procedure of packages - vibration test, drop test; Performance limit; Testing machines. Storage and warehousing, Sorting, Automated warehousing.

CO-PO MAPPING

No.	Course Outcome	Programming Outcomes (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Compare** fundamental principles of material handling systems.	3											
CO2	**Develop** understanding of special concepts in material handling.		3										
CO3	**Examine** analytical processes for the study of different material handling equipment.		3										

CO4	**Understand** fundamental principles of packaging.	3			3								

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Corresponding level of matching	Justification
CO1-PO1	3	Developing integral form of Material handling system with knowledge of physics and mathematics.
CO2-PO2	2	Students will have the knowledge of basic research and development principles regarding the topics.
CO3-PO2	3	Application of the system structure will enable the students to analyze problems that arise in various engineering sectors.
CO4-PO1	3	Application of theories and their industrial approach will help students to understand the packaging principles better.

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, Quiz, Assignment, Case study

COURSE SCHEDULE

Week	Lecture	Topic	ASG/CT/M	Remarks
1	1	Importance and scope of material handling		
	2	Importance and scope of material handling		

	3	Classification of materials - unit load and bulk loads		
2	4	Classification of materials - unit load and bulk loads		
	5	Analysis of material handling problems - system concept		
	6	Analysis of material handling problems - system concept		
3	7	Selection and classification of conveying equipment;		
	8	Selection and classification of conveying equipment;		
	9	Selection and classification of conveying equipment;	CT-01	Lectures 1-6
4	10	Efficiency of material handling systems		
	11	Efficiency of material handling systems		
	12	General theory of conveyors		
5	13	General theory of conveyors		
	14	Computer controlled material handling (AGV, ASRS etc)		
	15	Computer controlled material handling (AGV, ASRS etc)		
6	16	Computer controlled material handling (AGV, ASRS etc)		
	17	Computer controlled material handling (AGV, ASRS etc)		
	18	Computer controlled material handling (AGV, ASRS etc)	ASG-01	
7	19	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;		

	20	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;		
	21	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;		
8	22	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;	M	
	23	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;		
	24	Description and design of belt, chain, flight, screw, pneumatic and hydraulic conveyors;		
9	25	Operation and selection of industrial truck loads		
	26	Packaging: packaging materials,		
	27	Layout for packaging		
10	28	Layout for packaging		
	29	Testing procedure of packages		
	30	Vibration test, drop test		
11	31	Vibration test, drop test		
	32	Performance limit		
	33	Performance limit	CT-02	Lectures 23-32
12	34	Testing machines		
	35	Testing machines		
	36	Storage and warehousing		
13	37	Storage and warehousing		
	38	Sorting,		

	39	Automated warehousing	ASG-02	
14	40	Review Class-I		
	41	Review Class-II		
	42	Review Class-III		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
3	ASG	30	
4	CT	30	
	Exam		
1	M, F	80	
2	M, F	100	
3	M, F	70	
4	F	70	

REFERENCE BOOKS

- Apple, J. M. (n.d.). *Material handling systems design.* Chichester: Wiley, [19]77.
- Kulwiec, R. A., & Material Handling Institute. (1983). *Advanced material handling*. Pittsburgh, Pa.: The Institute.
- Soroka, W. (2009). *Fundamentals of packaging technology*. Naperville, Ill.: Institute Of Packaging Professionals.

ME 4131: Petroleum Engineering

COURSE INFORMATION			
Course Code	ME 4131	Lecture Contact Hours	3.00
Course Title	Petroleum Engineering	Credit Hours	3.00

PRE-REQUISITE
N/A

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course will provide an overview of hydrocarbon reserves in Bangladesh, classification of rocks and hydrocarbon deposits and their genesis, 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, vertical and direction drilling, well logging and interpretation, cracking and steaming, well completion and cementation.

OBJECTIVE

- To introduce with the sources of energy & overview of hydrocarbon reserves in Bangladesh.
- To introduce with the origin, deposit & accumulation process of hydrocarbon reserves.
- To analysis & prediction of reservoir performance.
- To be familiar with drilling rigs and their types.
- To study about rig moving equipment.
- To study about rig components and their auxiliaries.
- To introduce with classification of drilling.
- To study about the details of well logging.
- To study about the importance of well completion & cementation.

LEARNING OUTCOMES & GENERIC SKILLS

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

CO1	Introduce students with the origin, deposit & accumulation process of hydrocarbon reserves.	1	C1	1	1		Q, ASG, CT, M, F
CO2	To be familiar with drilling rigs and their types, rig components, rig moving equipment, well completion & cementation.	5	C2	6	5		Q, ASG, CT, M, F
CO3	Utilizing the knowledge of petroleum engineering in the practical world.	12	C3	3	2		Q, ASG, CT, M, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT
a. Main Contents: • Origin of hydrocarbon • Reserve of hydrocarbon • Drilling • Classification of drilling • Drilling rigs • Drilling fluid • Well logging • Well completion • Well cementation **b. Detail Contents:** **Introduction:** An overview of hydrocarbon reserves in Bangladesh, Classification of rocks and hydrocarbon deposits and their genesis. **Geophysical Exploration of Oil and Gas**: Origin, accumulation, composition and behavior of hydrocarbon reserves, Analysis and prediction of reservoir performance. **Rigs:** 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 Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Introduce students with the origin, deposit & accumulation process of hydrocarbon reserves.	3											

	CO2	To be familiar with drilling rigs and their types, rig components, rig moving equipment, well completion & cementation.					3							
	CO3	Utilizing the knowledge of petroleum engineering in the practical world.												3

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

TEACHING LEARNING STRATEGY

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

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Weeks	Lectures	Topics	CT	Remarks
1	1	Importance of Energy		
	2	Sources of various types of fuels.		
	3	Overview of hydrocarbon reserve in Bangladesh		
2	4	Classification of rocks		
	5	Genesis of rocks & other hydrocarbon deposits		
	6	Origin, accumulation & composition of		
3	7	hydrocarbon reserves		
	8	Importance of Energy		
	9	Sources of various types of fuels.	CT-01	Lectures 1-8
4	10	Behaviour of hydrocarbon reserves		

	11	Drilling rigs and their types		
	12	Classification of drilling		
5	13	Rig components & their auxiliaries		
	14	Details of drilling fluid		
	15	Classification and characteristics of drilling fluid		
6	16	Introduction to air drilling		
	17	Classification of air drilling		
	18	Details of air drilling		
7	19	Introduction to vertical drilling	ASG-01	Lectures 9-18
	20	Introduction to directional drilling		
	21	Application of directional drilling		
8	22	Tools used in directional drilling	M	
	23	Introduction to horizontal drilling		
	24	Introduction to well logging		
9	25	Classification of well logging		
	26	Comparison between LWD & WD		
	27	Introduction to Mud Pulse Telemetry		
10	28	Introduction to well completion & cementation		
	29	Factors need to be considered in well completion	CT-02	Lectures 22-29
	30	Classification of well completion		
11	31	Details of well completion process		
	32	Introduction to Drilling problems		
	33	Details of drilling problems		
12	34	Classification of drilling problems		
	35	Introduction to cracking		
	36	Introduction to steaming	ASG-02	Lectures 30-36
13	37	Details of cracking & steaming		
	38	Details of cracking & steaming		
	39	Details of cracking & steaming		
14	40	Revision		

	41	Revision		
	42	Revision		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Q, ASG, CT	40	
2	Q, ASG, CT	40	
3	Q, ASG, CT	60	
	Exam		
1	M, F	60	
2	M, F	60	
3	M, F	40	

REFERENCE BOOKS

- R.S. Khurmi.Elements of Petroleum Refinery Engineering.

ME 4133: Composite Materials

COURSE INFORMATION			
Course Code	ME 4133	Lecture Contact Hours	3.00
Course Title	Composite Materials	Credit Hours	3.00

PRE-REQUISITE

ME 2207: Engineering Metallurgy, ME 2209: Solid Mechanics

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course focuses on fibre-reinforced composites, especially polymer matrix composites, and covers design, manufacture, testing and through-life performance of composite structures. The topics covered in the course are: design, advanced manufacturing processes, micromechanical modelling, mechanical properties, fracture and fatigue, durability, repair and non-destructive evaluation of composites. The course enables the student to obtain knowledge, skills and attitudes needed for the optimum design and manufacture of advanced composite components. It will also engender ethical thinking and discernment pertaining to the judicious and eco-friendly use of such composites.

OBJECTIVE
• 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. • To gain understanding of fibre-reinforced polymer composites in terms of their design, manufacture, testing and through-life performance. • To obtain knowledge in the current applications of advanced composites, especially glass and carbon fibre reinforced polymer matrix type. • To develop ethical judgement in application of composites and demonstrate ethical behaviour

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	**Apply** the concepts of solid mechanics and analyze the design, manufacture and characterization of fibre- reinforced composites.	1	C3	1,2	1		ASG, CT, M, F
CO2	**Understand** the design, manufacture, performance and service life of fibre- reinforced	2	C2	3,4	1,2		ASG, CT, M, F

	polymer matrix composites						
CO3	**Understand** the modern application of advanced composites, especially glass and carbon fibre reinforced polymer matrix types.	6,7	C5	7	5		ASG, CT, M, F
CO4	**Demonstrate** ethical consideration and judgement in the eco-friendly applications of composites and towards class norms.	8	C4, C5	7			ASG, CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Fibrous composites
- Reinforcement type
- Ply strength
- Failure criteria
- Layered laminates
- Laminate stiffness
- Laminate strength
- Residual stress
- Thin walled
- Composite section
- Inter laminar stress
- .Hole in laminate
- .Bucking of laminate

b. Detail Contents:

Introduction to composites (definition, types of reinforcements and matrices, types of composites, application of composites, effect on environment, recycling), Manufacturing processes, Micromechanical analysis of a lamina (volume and mass fraction, density, elastic moduli, Strength hygrothermal properties), Macromechanical analysis of a lamina (stiffness and compliance, stress- strain relation, hygrothermal stresses, failure theories of lamina), Laminated composites (stress- strain relation, stiffness and compliance, hygrothermal analysis, failure analysis), Design of composite components

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Apply** the concepts of solid mechanics and analyze the design, manufacture and characterization of fibre-reinforced composites	2											
CO2	**Understand** the design, manufacture, performance and service life of fibre-reinforced polymer matrix composites		3										
CO3	**Understand** the modern application of advanced composites, especially glass and carbon fibre reinforced polymer matrix types.						2						
CO4	Demonstrate ethical consideration and judgement in the eco-friendly applications of composites and towards class norms								2				

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	2	Analyzing the design, manufacture and characterization of fibre- reinforced composites will enable the students to gain knowledge about Reinforced composite

CO2-PO2	3	Understanding the design, manufacture, performance of fibre reinforced composites will allow them to solve complex problems
CO3-PO6	2	Students will learn about the application of advanced composite that which will help them in professional career.
CO4-PO8	2	Students will know how to apply advanced composite for an eco-friendly environment

TEACHING LEARNING STRATEGY

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

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	**Lecture**	**Topics**	**CT**	**Remarks**
1	1	Introduction		
	2	Fibrous composites		
	3	Fibrous composites		
2	4	Fibrous composites		
	5	Reinforcement types		
	6	Reinforcement types		
3	7	Reinforcement types		
	8	Ply strength		
	9	Ply strength	CT-01	Lectures 1-6
4	10	Ply strength		
	11	Failure criteria		

	12	Failure criteria		
5	13	Failure criteria		
	14	Layered laminate		
	15	Layered laminate		
6	16	Layered laminate		
	17	Laminate stiffness		
	18	Laminate stiffness	ASG-01	
7	19	Laminate stiffness		
	20	Laminate Strength		
	21	Laminate Strength		
8	22	Laminate Strength	M	
	23	Residual stress		
	24	Residual stress		
9	25	Residual stress		
	26	Thin-walled		
	27	Thin-walled		
10	28	Thin-walled		
	29	Composite section		
	30	Composite section		
11	31	Composite section		
	32	Inter laminar stresses		
	33	Inter laminar stresses	CT-02	Lectures 23-32
12	34	Inter laminar stresses		
	35	Hole in laminate		
	36	Hole in laminate	ASG-02	
13	37	Hole in laminate		
	38	Bucking of laminates		

	39	Bucking of laminates		
14	40	Bucking of laminates		
	41	Revision		
	42	Revision		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	20	
2	ASG, CT	20	
3	ASG, CT	30	
4	ASG, CT	30	
	Exam		
1	M, F	80	
2	M, F	80	
3	M, F	70	
4	F	70	

REFERENCE BOOKS

- Derek H. (1995). *An introduction to composite materials*. 5th Edition. Cambridge University Press.
- Autar K. K. (1997). *Mechanics of composite Materials*. 6th Edition. CRC Press.

ME 4135: Railway Engineering

COURSE INFORMATION

Course Code	ME 4135	Lecture Contact Hours	3.00
Course Title	Railway Engineering	Credit Hours	3.00

PRE-REQUISITE
N/A
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course introduces various types of systems (fuel, lubrication, cooling), brake system, engine control, truck assembly, horsepower calculation, wheel slip calculation and passenger alarm communication system. The course aims to equip the students with basic tools and methodologies for locomotive and carriage system of railway engineering.
OBJECTIVE
• To introduce the students with basic tools and methodologies for locomotive and carriage system of railway engineering. • To teach the students how to calculate the horsepower and slip of the wheel for locomotive and carriage system.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom'sTaxono-my	KP	CP	CA	Assessment Methods
CO1	Comprehensive, theory- based knowledge of different locomotive and carriage systems.	1	C1	4	1		ASG, CT, M, F
CO2	In-depth understanding of working principle for different locomotive and carriage systems.	10	C2	2	6		ASG, CT, M, F
CO3	Standardization and calculation of horsepower and wheel slip.	2	C5	3	2		ASG, CT, M

CO4	Analysis for improvement of different locomotive and carriage systems.	3	C4	5	3		ASG, CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Locomotive.
- Carriage.

b. Detail Contents:

Locomotive: Definition of locomotive, classification, working principles, different types of systems (fuel, lubrication, cooling, air), brake system, engine control, truck assembly, electrical equipment, excitation and power control system, load test and horsepower standardization, high potential test, troubleshooting, horsepower calculation and wheel slip, load regulator, engine governor, traction motor, generator, auxiliary generator, electrical control cabinet.

Carriage: Definition of carriage, types, description of carriage, power car, structure, under frame, bogie, load distribution, air brake system, distributor of valve, wheel profile, wheel defects, schedule of dimensions, axle load, passenger alarm communication system.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Comprehensive, theory-based knowledge of different locomotive and carriage systems.	3											
CO2	In-depth understanding of working principle for different locomotive and carriage systems.										3		

CO3	Standardization and calculation of horsepower and wheel slip.		3										
CO4	Analysis for improvement of different locomotive and carriage systems.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to understand the basic concept of different locomotive and carriage systems.
CO2-PO10	3	Students will be able to learn the working principle for different locomotive and carriage systems.
CO3-PO2	3	Students will attain the knowledge of standardization and calculation of horsepower and wheel slip.
CO4-PO3	3	Students will be able to develop a knowledge for improvement of different locomotive and carriage 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, and problem solving.

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**CT/ASG**	**Remarks**
1	1	Definition of locomotive system.		
	2	Classification of locomotive system.		
	3	Working principle of locomotive system.		
2	4	Description of fuel system.		
	5	Description of lubrication system.		
	6	Description of cooling system.		
3	7	Description of brake system.		
	8	Description of engine control system.		
	9	Description of truck assembly.	CT-01	Lectures 1-9
4	10	Electrical equipment and excitation.		
	11	Power control system.		
	12	Load test and horsepower standardization.		
5	13	High potential test.		
	14	Troubleshooting.		
	15	Horsepower calculation and wheel slip.		
6	16	Load regulator.		
	17	Engine governor.		

	18	Traction motor and generator.	ASG-01		
7	19 20	Auxiliary generator. Electrical control cabinet.			
	21	Electrical control cabinet.			
8	22	Definition of carriage.	M		
	23	Types of carriage.			
	24	Description of carriage.			
9	25	Power car.			
	26	Superstructure.			
	27	Under frame.			
10	28	Bogie.			
	29	Load distribution			
	30	Air brake system.	CT-02	Lectures 22-30	
11	31	Distributor valve.			
	32	Wheel profile.			
	33	Wheel defects.			
12	34	Schedule of dimensions.			
	35	Axle load.			
	36	Axle load.			
13	37	Passenger alarm communication system.			

	38	Passenger alarm communication system.	ASG-02	
	39	Revision.		
14	40	Revision.		
	41	Revision.		
	42	Revision.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	40	
2	ASG, CT	40	
3	ASG, CT	60	
4	ASG, CT	40	
	Exam		
1	M, F	60	
2	M, F	60	
3	M	40	
4	F	60	

REFERENCE BOOKS

- S. C. Rangwala (2017). *Railway Engineering*. Charotar Publication. ISBN-10: 9385039245, ISBN-13: 978-9385039249.
- M. M. AGARWAL SATISH CHANDRA (2013*). Railway Engineering*. OXFORD UNIVERSITY PRESS; 2nd edition (January 1, 2013), ISBN-10: 9780198083535, ISBN-13: 978-0198083535.

ME 4137: Advanced Thermodynamics

COURSE INFORMATION			
Course Code	ME 4137	Lecture Contact Hours	3.00
Course Title	Advanced Thermodynamics	Credit Hours	3.00

PRE-REQUISITE

ME 2101 – Engineering Thermodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to demonstrate the advanced topics in engineering thermodynamics and covers both the classical and statistical thermodynamics. The students will perceive the detail understandings of entropy, thermodynamic properties of substances, microscopic approach to thermodynamics and a few applications of engineering thermodynamics such as elastic system, magnetic system and fuel cells. This course will follow both the active and passive learning approach, i.e., students will absorb the presented information and learn through solving complex engineering problems in groups. Upon successful completion of students will be able to evaluate the thermodynamics aspect of a thermal device based on advanced knowledge.

OBJECTIVE

- To employ classical and statistical approach to explain the engineering thermodynamics.
- To determine entropy of mixing, entropy generation and work loss in mixing.
- To evaluate thermodynamic properties of pure fluids and mixtures.
- To assess feasibility of using H_2 fuel cells.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Correspon ding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Infer** the states of thermodynamic and mechanical	1	C2	1	1		CT, F, M, Q

	equilibrium of a system.						
CO2	**Determine** entropy of mixing, entropy generation and work loss in mixing.	2	C3	2	2		ASG, CT, F, M, Q
CO3	**Evaluate** thermodynamic properties of pure fluids and mixtures.	2	C5	2	2		ASG, CT, F, M, Q
CO4	**Improve** the efficiency of energy utilization of a process.	3, 9	C6	5	3		ASG, F, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

g. Main Contents:

- Basic Concepts.
- Entropy.
- Equations of State.
- Thermodynamic Relationships.
- Fundamentals of Statistical Thermodynamics.
- Quantum Statistics.
- Application of Engineering Thermodynamics.

h. Detail Contents:

Introduction to classical and statistical viewpoints in thermodynamics; Concepts of equilibrium, stability, reversibility, irreversibility and availability; Concepts of entropy; Principle of increase of entropy; Calculation of entropy changes; Statistical interpretation; Entropy of mixing; Absolute entropy; Entropy flow and entropy production; Properties of pure substances; Ideal gases; Ideal gas mixtures of constant composition; Ideal gas mixtures of variable compositions; Thermodynamic potentials: Helmholtz free energy functions, Gibbs free energy function; Application of free energy functions; Transformations and thermodynamic potentials; Maxwell relations; Phase transitions; The Clausius-Clapeyron equation; Statistical mechanics: fundamental principles, energy states and levels; Thermodynamic probability: Bose-Einstein statistics, Fermi-Dirac statistics; Thermodynamic properties of a system; Special Topics: elastic systems, fuel cells, magnetic systems, thermo-electricity.

CO-PO MAPPING

No.	**Course Outcomes**	**Programming Outcomes (PO)**											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Infer** the states of thermodynamic and mechanical equilibrium of a system.	3											
CO2	**Determine** entropy of mixing, entropy generation and work loss in mixing.		3										
CO3	**Evaluate** thermodynamic properties of ideal gas and mixtures.		3										
CO4	**Improve** the efficiency of energy utilization of a process.			2						2			

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Corresponding level of matching**	**Justification**
CO1-PO1	3	In order to comprehend the thermodynamic and mechanical equilibrium states, a clear knowledge of engineering fundamentals on the respective topics and mathematics would be required.
CO2-PO2	3	Students will solve the complex engineering problems on entropy generation and destruction of work.

CO3-PO2	3	Interpretation of thermodynamic properties of pure fluids, mixtures and phase equilibrium will be ensured through formulating and analyzing complex engineering problems.
CO4-PO3	2	In order to develop solutions of energy utilization of processes, students will investigate and optimize chemically reactive, magnetic and thermo-electric systems.
CO4-PO9	2	Students will learn to adopt diversity and act as a leader or a team member while working in the group projects.

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, Quiz, Assignment, Project Based Method

COURSE SCHEDULE

Week	Lecture	Topic	CT/ASG	Remarks
1	1	Course introduction - learning objectives, learning activities and assessment methods		
	2	Introduction to classical and statistical viewpoints in thermodynamics		
	3	Basics of equilibrium		
2	4	Concepts of stability and availability		
	5	Reversibility and irreversibility-1		
	6	Reversibility and irreversibility-2		

3	7	Recap: Concepts of entropy		
	8	Entropy generation: Cycles and devices-1		
	9	Entropy generation: Cycles and devices-2		
4	10	Irreversibility and Entropy of an isolated system		
	11	Mechanisms of Entropy generation and entropy-minimization	CT-01	Lectures 2-9
	12	Entropy evaluation of ideal gases, incompressible liquids		
5	13	Entropy during phase change		
	14	Entropy of a mixture		
	15	Entropy balance for an open system		
6	16	Maxima and minima principles		
	17	Problem solving		
	18	Properties of pure fluids: Maxwell relations	ASG-01	
7	19	Properties of pure fluids: Generalized relations		
	20	Pure fluids: Evaluation of thermodynamic properties		
	21	Pure fluids: Vapor/liquid equilibrium curve		
8	22	Pure fluids: Throttling process		
	23	Molal and pure properties	M	
	24	Ideal gas mixture, ideal gas solution		
9	25	Molal Properties Using the Equations of State		
	26	Problem solving		
	27	Phase Equilibrium: Introduction		

10	28	Phase Equilibrium: Single component system		
	29	Phase Equilibrium: Mixtures, P-T diagrams		
	30			
11	31	Chemical Equilibrium		
	32	Statistical mechanics: Fundamental principles		
	33	Statistical mechanics: Energy states and levels	CT-02	Lectures 23-30
12	34	Thermodynamic probability: Introduction		
	35	Thermodynamic probability: Bose-Einstein statistics		
	36	Thermodynamic probability: Fermi-Dirac statistic		
13	37	Advanced steam- and gas-turbine power plants		
	38	Magnetic refrigeration		
	39	Storage systems: Sensible and latent heat		
14	40	Fuel cells	ASG-02	
	41	Thermo-electricity: Peltier effect, Seebeck effect, Thomson effect		
	42	Review class-1		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	Q, CT	30	
2	Q, ASG, CT	30	
3	Q, ASG, CT	30	

	4	Q, ASG, R	30		
		Exam			
	1	M, F	70		
	2	M, F	70		
	3	M, F	70		
	4	F	70		

REFERENCE BOOKS

- Bejan, A. (2017). *Advanced engineering thermodynamics*. Hoboken, New Jersey John Wiley Et Sons Inc.
- Annamalai, K., Kanwar, I., & Jog, M. A. (2011). *Advanced Thermodynamics Engineering*. Crc Press.
- Tien, C. L., & Lienhard, J. H. (1979). *Statistical thermodynamics*. Washington; London: Hemisphere.

ME 4139: Combustion and Pollution

COURSE INFORMATION			
Course Code	ME 4139	Lecture Contact Hours	3.00
Course Title	Combustion and Pollution	Credit Hours	3.00

PRE-REQUISITE

ME 2101: Engineering Thermodynamics, ME 3105: Fluid Mechanics I, ME 4101: Internal Combustion Engines

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
• To analyze the production of pollutants in combustion systems, Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants. • To develop an understanding of the basic principles and concepts of advanced fuel combustion and control process.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxo- nomy	KP	CP	CA	Assess-ment Methods
CO1	**Recognize** the ongoing role of combustion, both of fossil and bio-fuels, in providing a more sustainable energy source for society, and the environmental challenges to be met to achieve this.	1	C1	1,3,			ASG, CT, M, F
CO2	**Explain** the responsibility of engineers to the community in terms of providing a safe healthy environment.	2	C3	1, 5			ASG, CT, M, F
CO3	**Design** the technology and the logic behind after-treatment of pollutants.	3	C5	5, 7			ASG, CT, M, F
CO4	**Identify** design trade-off between increasing engine performance and maintaining low emission characteristics.	2	C5	3,4	1		ASG, CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR –

Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

b. Main Contents:

- Introduction to combustion
- Chemistry and kinetics of reactions
- Explosions and fuel oxidation
- Detonation
- Pollution control by modification of combustion parameters

b. Detail Contents:

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 green house gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants. Pollution control: post-engine exhaust treatment for emission control -thermal reactors, exhaust gas re-circulation, catalysis; Pollution control by modification of combustion parameters; Other pollution control strategies.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recognize** the ongoing role of combustion, both of fossil and bio-fuels, in providing a more sustainable energy source for society, and the environmental challenges to be met to achieve this	3											
CO2	**Explain** the responsibility of engineers to the community in terms of providing a safe healthy environment.		3										
CO3	**Design** the technology and the logic behind after-			3									

	treatment of pollutants.												
CO4	**Identify** design trade-off between increasing engine performance and maintaining low emission characteristics.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
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-PO3	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

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Lecture	Topics	CT	Remarks
1	1	Introduction to combustion		
	2	Introduction to combustion		
	3	Introduction to combustion		
2	4	Heat of reaction, adiabatic flame temperature, heating values		
	5	Heat of reaction, adiabatic flame temperature, heating values		
	6	Heat of reaction, adiabatic flame temperature, heating values		
3	7	chemical composition of products of combustion; Chemistry and kinetics of reactions		
	8	chemical composition of products of combustion; Chemistry and kinetics of reactions		
	9	chemical composition of products of combustion; Chemistry and kinetics of reactions	CT-01	Lectures 1-6
4	10	Reaction rate and flame propagation		
	11	Reaction rate and flame propagation		
	12	Structure of laminar premixed flames		
5	13	Structure of laminar premixed flames		
	14	Explosions and fuel		

		oxidation		
	15	Explosions and fuel oxidation		
6	16	Detonation; Combustion in internal and external combustion engines		
	17	Detonation; Combustion in internal and external combustion engines		
	18	Detonation; Combustion in internal and external combustion engines	ASG-01	
7	19	Detonation; Combustion in internal and external combustion engines		
	20	Detonation; Combustion in internal and external combustion engines		
	21	Detonation; Combustion in internal and external combustion engines		
8	22	Production of pollutants in combustion systems	M	
	23	Production of pollutants in combustion		
	24	Production of pollutants in combustion systems		
9	25	Production of pollutants in combustion systems		
	26	Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants		

	27	Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants		
10	28	Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants		
	29	Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants		
	30	Emissions of greenhouse gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants		
11	31	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas recirculation, catalysis		
	32	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas recirculation, catalysis		
	33	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas recirculation, catalysis	CT-02	Lectures 23-32
12	34	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas		

		recirculation, catalysis		
	35	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas recirculation, catalysis		
	36	Pollution control: post-engine exhaust treatment for emission control – thermal reactors, exhaust gas recirculation, catalysis	ASG-02	
13	37	Pollution control by modification of combustion parameters; other pollution control strategies		
	38	Pollution control by modification of combustion parameters; other pollution control strategies		
	39	Pollution control by modification of combustion parameters; other pollution control strategies		
14	40	Revision		
	41	Revision		
	42	Revision		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	20	
2	ASG, CT	20	
3	ASG, CT	30	
4	ASG, CT	30	

		Exam			
	1	M, F	80		
	2	M, F	80		
	3	M, F	70		
	4	F	70		

REFERENCE BOOKS
• Charles E. B.(2006). *Industrial Combustion Pollution and Control. 4th Edition.* McGraw-Hill International. • Borman G. L. & Ragland K. W (2004). *Combustion Engineering*. 5th Edition. McGraw-Hill International.

ME 4141: Multi-phase Flow

COURSE INFORMATION			
Course Code	ME 4141	Lecture Contact Hours	3.00
Course Title	Multi-phase Flow	Credit Hours	3.00
PRE-REQUISITE			
ME 3105: Fluid Mechanics-I, ME 3205: Fluid Mechanics-II			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course aims to provide students with a clear understanding of the fundamental physics of multiphase flow. It covers the study of discrete phase such as particles, droplets or bubbles in a continuous phase. Thus, students will get acquainted with both the Eulerian-Eulerian (two fluid) and the Eulerian-Lagaragian (discrete particles) models. The learning approach requires the prior knowledge of fluid mechanics and machinery for a clear understanding of theory and problems of this course. Students will internalize the information given by the course instructor and will solve complex engineering problems in groups. By the end of the course, students will be able to evaluate the complex mechanisms of multiphase flow and apply the knowledge to develop a model of two-phase flow system.			

OBJECTIVE

- To explain the interactions of particle, bubble and droplet dynamics.
- To characterize the effects of bubbles on the liquid velocity field and the impact of particles on the turbulence.
- To interpret a numerical model (Eulerian-Eulerian or Eulerian-Lagrangian) of multiphase flow dynamics.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Understand** the interactions of particle, bubble and droplet dynamics.	1	C2	1	1		ASG, CT, F, M, Q
CO2	**Analyse** the influences of bubbles on the liquid velocity field.	2	C4	2	2		ASG, CT, M, F, Q
CO3	**Evaluate** the effects of particles on the turbulence.	2	C5	2	2		ASG, F, M, Q, R
CO4	**Apply** the knowledge of particle bubble and droplet dynamics in developing a numerical model of multiphase flow.	5, 7	C3	5,7	3		ASG, CT, M, F, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents

- Two fluid equations.
- Flow around a spherical particle in uniform and in non-uniform flow.
- Particle-fluid interactions.

- Homogeneous turbulence and solid particles.
- Bubble or droplet deformation.
- Cavitation.
- Chaotic dynamics of particle dispersion.

b. Detail Contents

Introduction to fluid phases.

Stokes flow around a spherical particle and Oseen correction. Equation of motion for a small spherical particle in a non-uniform flow, the Basset-Boussinesq-Oseen equation. Other forces exerted by the carrier flow on a bubble/droplet/particle immersed in it. Saffman Lift, Bjerknes force, thermophoresis, etc. Particle dynamics. Inertial effects.

Two Fluid Models. Turbulence modulation by particles.

Droplet/bubble deformation and breakup. Bubble dynamics. Cavitation. Droplet collisions and coalescence.

CO-PO MAPPING

No.	**Course Outcomes**	**Programming Outcomes (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Understand** the interactions of particle, bubble and droplet dynamics.	3											
CO2	**Analyse** the influences of bubbles on the liquid velocity field.		3										
CO3	**Evaluate** the effects of particles on the turbulence.		2										
CO4	**Apply** the knowledge of particle, bubble and droplet dynamics in developing a numerical model of multiphase flow.					2		2					

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Corresponding level of matching**	**Justification**

CO1-PO1	3	Students will gain knowledge of the particle, bubble and droplet dynamics and their interactions.
CO2-PO2	3	Students will analyze complex engineering problems related to the influences of bubbles on the liquid velocity.
CO3-PO2	2	Students will review a couple of articles on the influences of particles on turbulence and evaluate the findings of an article.
CO4-PO5	2	In order to model the multiphase flow dynamics and implementing the knowledge of particle, bubble and droplet dynamics, students will use a modern numerical tool.
CO4-PO7	2	Development of a numerical model of multiphase flow optimizes the industrial processes and promotes environment friendly industries.

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, Quiz, Assignment

COURSE SCHEDULE

Week	Lecture	Topic	ASG/CT/M	Remarks
1	1	Introduction, syllabus, course description		
	2	Introduction: Gas-solid, liquid-solid, gas-liquid, three-phase flows		
	3	Conservation equations, dimensionless number and basic terms		
2	4	Multiscale consideration of		

		multiphase flows		
	5	Particle equation of motion		
	6	Classification of fluid-particulate forces		
3	7	Flow around a sphere		
	8	Particle equation of motion-1		
	9	Particle equation of motion-2		
4	10	Drag force on a sphere		
	11	Particle dynamics in a uniform velocity		
	12	Oseen approximation		
5	13	Particle dynamics in a non-uniform flow-1	CT-01	Lecture 2-10
	14	Particle dynamics in a non-uniform flow-2		
	15	The Basset-Boussinesq-Oseen equation.		
6	16	Particle motion: non-spheres, blowing effect		
	17	Particle motion: Lift forces, torque		
	18	Other forces acting on a particle in a non-uniform flow		
7	19	Thermophoresis-1		
	20	Thermophoresis-2		
	21	Particle-Fluid interaction	ASG-01	
8	22	Particle dispersion by turbulence		
	23	Turbulence modulation by particles-1		
	24	Turbulence modulation by particles-2		

9	25	Cavitation	M	
	26	Stable and unstable cavitation		
	27	Bubble dynamics		
10	28	Bubble growth and collapse: Rayleigh-Plesset equation		
	29	Stability of gas bubbles		
	30	Bubble growth: Thermal controlled		
11	31	Bubble growth: Mass diffusion		
	32	Oscillating bubbles		
	33	Two-Fluid equations	CT-02	Lecture 25-32
12	34	Dispersed particles in a fluid of continuous phase		
	35	Droplet/bubble deformation		
	36	Marangoni effects on deformation		
13	37	Bubble breakup		
	38	Droplet breakup		
	39	Collisions and coalescence: Bubble		
14	40	Collisions and coalescence: Droplet	ASG-02	
	41	Review class-1		
	42	Review class-2		

ASSESSMENT STRATAEGY

	COs	**Assessment Method**	**(100 %)**	**Remarks**	
		Class Assessment			

	1	Q, CT	30		
	2	Q, ASG, CT	30		
	3	Q, ASG	30		
	4	Q, ASG, R	30		
		Exam			
	1	M, F	70		
	2	F	70		
	3	M, F	70		
	4	F	70		

REFERENCE BOOKS

- Crowe, C. T., Schwarzkopf, J. D., Sommerfeld, M., & Al, E. (2012). *Multiphase flow handbook with droplets and particles*. Boca Raton (Fla.); London: Taylor & Francis / Crc Press, Cop.
- Michaelides, E. E., Crowe, C. T., Schwarzkopf, J. D., Crc Press, & Taylor. (2017). *Multiphase flow handbook*. Boca Raton Etc.: Crc Press/Taylor & Francis Group, Cop.
- Brennen, C. E. (2009). *Fundamentals of multiphase flow*. Cambridge: Cambridge University Press.

Optional-II Courses (For Level-4 Term-II)

ME 4237: Aerodynamics

COURSE INFORMATION			
Course Code	ME 4237	Lecture Contact Hours	3.00
Course Title	Aerodynamics	Credit Hours	3.00

PRE-REQUISITE

ME 2101: Engineering Thermodynamics, ME 3105: Fluid Mechanics- I, ME 3113: Machine Design-I, ME 3213: Machine Design-II, ME 3205: Fluid Mechanics- II, and ME 4105: Fluid Machinery.

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course provides a basic understanding in the aerodynamics of lifting devices in light of their utilization in aerospace Engineering. The focus is to illustrate practical engineering applications in these fields. Students will obtain an in-depth knowledge in airfoil section, wings, lift attenuation devices, propulsion system, maneuvering and navigation, and stability in the overall flight regime of any aeronautical system. Upon completion of this course, students will have the competence to asses the performance of the components of aeronautical system and come up with designs for advanced solutions in aerospace engineering. The learning method is to apply a synergistic approach to basic principles of thermodynamics, heat transfer, fluid mechanics and fluid machinery to comprehend, analyze, design and control modern aerodynamic systems. Students will achieve comprehension of the multi-physics working principle of any aerodynamic system and will gain the competence to design and develop new components for advanced aerodynamic systems.
OBJECTIVE
• To understand the correlations of basic physical principles with retrospect to the working principles of lifting devices.
• To gain knowledge about the design and performance analyses of the major aeronautical systems & devices.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	**Assess** the basic aerodynamics of lifting devices, and **apply** the knowledge in **designing** lifting devices.	4	C5, A1	5, 8	3, 4	2, 3	ASG, CS, CT, F, M, Q
CO2	**Assess** the performance of aeronautical systems.	6	C5, A1	4, 7	1, 5	1	ASG, CS, CT, Q

CO3	**Design** and **synthesize** components of aeronautical systems for using in aviation and space industries.	3	C6	5	1, 3, 6		ASG, CS, CT, F, Q
CO4	**Develop** aeronautical systems on the basis of preset performance and stability characteristics.	7	C6	5, 7, 8	1, 2, 5, 6		ASG, CS, CT, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- History of aerodynamics.
- Potential flow.
- Airfoil, wings and other aerodynamic shapes.
- Forces for flow around aerodynamic shapes.
- Propulsion system.
- Elements of airplane performance.
- Principles of stability and control.

b. Detail Contents:

History: History of Aeronautical Engineering.

Airfoils, Wings and Other Aerodynamic Shapes: Airfoil nomenclature. Lift, drag and moment coefficients, finite wing, flaps.

Elements of Airplane Performance: Power & thrust required for level, gliding, flight and altitude effects on power available, rate of climb, gliding flight, take off & landing performances.

Principles of Stability & Control: Static stability, dynamic stability, control, navigation.

Propulsion: Jet propulsion, turbojet engine, turbofan engine, ramjet engine, rocket jet

engine.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Assess** the basic aerodynamics of lifting devices, and **apply** the knowledge in **designing** lifting devices.				3								
CO2	**Assess** the performance of aeronautical systems.						3						
CO3	**Design** and **synthesize** components of aeronautical systems for using in aviation and space industries.			3									
CO4	**Develop** aeronautical systems on the basis of preset performance and stability characteristics.							3					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO4	3	Students will be able to solve complex engineering problems and design lifting devices meeting multivariate boundary conditions.
CO2-PO6	3	Students will employ their knowledge in assessing complex engineering problems to assess the performance of aeronautical systems in terms of economical solution, pollution, and safety of operations.
CO3-PO3	3	Students will be able to design lifting devices, propulsion systems and control systems for using in aviation and space industries.

CO4-PO7	3	Students will be able to meet the environmental aspects of sustainable design approach for the different components of aerospace engineering.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	122.5
TEACHING METHODOLOGY	
Class lecture, pop quiz, case study, and problem solving.	

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Introduction to aerodynamics.		
	2	History of aeronautical engineering.		
	3	Potential flow-I.		
2	4	Potential flow-II.		
	5	Potential flow-III.		
	6	Potential flow-IV.		
3	7	Viscous flow-I.		
	8	Viscous flow-II.		
	9	Airfoils, wings and other aerodynamic shapes.	CT-01	Lectures 1-6
4	10	Airfoil nomenclature.		
	11	Airfoil lift, drag and moment coefficients.		
	12	Finite wing-I.		
5	13	Finite wing-II.		
	14	Aerodynamic lift-I.		
	15	Aerodynamic lift-II.		
6	16	Aerodynamic drag-I.		
	17	Aerodynamic drag-II.		
	18	Numerical methods-I.	ASG-01	
7	19	Numerical methods-II.		

	20	Numerical methods-III.			
	21	Flaps, slats, lifting devices -I.			
8	22	Flaps, slats, lifting devices -II.	M		
	23	Introduction to jet propulsion.			
	24	Propeller engine-I.			
9	25	Propeller engine-II.			
	26	Turbojet engine-I.			
	27	Turbojet engine-II.			
10	28	Turbojet engine-III.			
	29	Turbofan engine.	CT-02	Lectures 22-27	
	30	Ramjet engine, Rocket jet engine.			
11	31	Power & thrust required for level, gliding, flight-I.			
	32	Power & thrust required for level, gliding, flight-II.			
	33	Altitude effects on power available.			
12	34	Rate of climb, gliding flight-I.			
	35	Rate of climb, gliding flight-II.	ASG-02		
	36	Take off & landing performance-I.			
13	37	Take off & landing performance-II.			

	38	Principles of stability & control.		
	39	Static stability.		
14	40	Dynamic stability.		
	41	Control systems.		
	42	Navigation.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	70	
2	ASG, CS, CT	100	
3	ASG, CS, CT	60	
4	ASG, CS, CT	100	
	Exam		
1	M, F	30	
3	F	40	

REFERENCE BOOKS

- Anderson, J. D. (2016). *Introduction to flight*. Newyork McGraw-Hill, 8th Edition. ISBN-10:0078027675, ISBN-13: 9780078027673
- Anderson, J. D. (2007). *A history of aerodynamics and its impact on flying machines (Cambridge Aerospace Series, Band 8)*. Cambridge: Cambridge Univ. Press. ISBN-10: 0521669553, ISBN-13: 978-0521669559
- Anderson, J. D. (2016). *Fundamentals of aerodynamics*. McGraw-Hill, 8th Edition. ISBN-10: 1259251349, ISBN-13: 978-1259251344
- Raymer, D. P. (2018). *Aircraft design: A conceptual approach*. American Institute of Aeronautics and Astronautics. ISBN: 9781624104909
- Hill, P. G., Peterson, C. R., & Dorling Kindersley. (2014). *Mechanics and thermodynamics of propulsion*. New Delhi: Dorling Kindersley. ISBN: 9788131729519
- Megson, T. H. G., & Elsevier (Amsterdam). (2017). *Aircraft structures for engineering students.* Elsevier/Burtterworth-Heinemann. ISBN: 9780081009147
- Houghton, E. L., Carpenter, P. W., & Valentine, D. T. (2017). *Aerodynamics for engineering students*. Elsevier/Burtterworth-Heinemann. ISBN: 0750651113

ME 4241: Robotics

COURSE INFORMATION			
Course Code	ME 4241	Lecture Contact Hours	3.00
Course Title	Robotics	Credit Hours	3.00
PRE-REQUISITE			
MATH 1101: Mathematics-I, EEE 1159: Basic Electrical Engineering, MATH 1201: Mathematics-II, CSE 1271: Computer Programming, MATH 2101: Mathematics-III, EEE 2159: Electrical Machines, MATH 2201: Mathematics-IV, EEE 2259: Introduction to Analog and Digital Electronics, ME 2101: Thermodynamics, ME 3105: Fluid Mechanics- I, ME 2111: Numerical Analysis, ME 3113: Machine Design-I, ME 3213: Machine Design-II, ME 3205: Fluid Mechanics- II, and ME 4105: Fluid Machinery.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts, standards and mechatronic design approach in modern robotic systems. The focus is to illustrate practical engineering applications in the field of robotics. Students will obtain an in-depth knowledge in sensorics, actuatorics, system modelling, and control system design of a robotic system. Upon completion of this course, students will have the competence to design system components and control mechanism in robotic systems. The learning approach is to apply a synergistic approach to mechanical, electrical and software engineering principles to analyze, design and control modern robotic systems. Students will achieve comprehension of the multi-physics working principle of any robotic system and will gain the competence to design systems based on their understanding in the overall system behavior and control strategies.			
OBJECTIVE			
• To familiarize students with the essential ideas of robotic systems. • To make students acquainted with the understanding in sensorics, actuatorics, manipulators, drive and control systems of robotic applications. • To familiarize students with system kinematics and dynamics of robotics applications. • To build the competence of the students in incorporating the knowledge of numerical analysis in the design and control of robotics systems. • To enable the students to analyze the performance of different components of a robotic system.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**

CO1	Assess the performance of robotic systems.	2	C2	1, 2, 4	1	1	ASG, CS, CT, F, M, Q
CO2	Design and conceptualize robotic systems for using in household devices, production, aviation and space industries.	3	C3, C5	5	1, 3, 5, 6, 7	2, 3, 5	ASG, CS, CT, F, M, Q
CO3	Understand the concept of system models and design control algorithms of robotic systems.	5	C6, P2, A2	6	1, 2, 4, 6, 7	1, 2	ASG, CS, CT, F, M, Q
CO4	Understand the working principles of robotic system components and control systems.	1	C3	4	1		ASG, CS, CT, F, M, Q

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

- Introduction to robotics.
- Robotics actuators.
- Robot vision.
- Kinematics of robot.
- Dynamics of robot.
- Robotics system control.

b. Detail Contents:

Introduction: Classification of robot systems, Pick and place devices, Continuous path manipulators, Telechirs, Wabots, Artificial grippers, Load capacities, Working volume and limits to accuracy of performance characteristics, Robot vision, actuators, Obstacle avoidance, Movements strategies, Specific examples of robot applications and limitations of performance.

Programming and Response: Point to point programming, Higher level languages to teach mode programming, Space and tool co-ordinates, Computer office line programming, Programming for flexible manufacture, Human factors in the management of robot systems.

Kinematics of Robot Arms: Kinematics description of multi-degree of freedom manipulators, Joint co-ordinates, Task co-ordinates, Transformation of co-ordinate systems, Kinematics models, Industrial task description and translation of robot requirements.

Dynamics: Dynamic equation for six degree of freedom robot arms, Lagrange and Newton Euler Viewpoints, Nonlinear systems of equations with time varying efficient, Real time dynamics and associated problems, Dynamic models predicted limits to performance in industrial tasks.

Control: Motion resolves, Passive complaint devices, Positive feed forward techniques in obstacle avoidance control, force feedback for gripper and arm control, Vision control for location in automated assembly.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Assess the performance of robotic systems.		3										
CO2	Design and conceptualize robotic systems for using in household devices, production, aviation and space industries.			3									
CO3	Understand the concept of system models and design control algorithms of robotic systems.					3							
CO4	Understand the working principles of robotic system components and control systems.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification

CO1-PO2	3	Students will develop the ability to correlate the role of different parameters in the overall system performance of a robotic system, thus gain the competence to analyze complex engineering problems pertaining to robotic systems operations.
CO2-PO3	3	Students will be able to design different components of robotic systems viz. sensors, actuators, manipulators, drive and control systems for real life problem solutions.
CO3-PO5	3	Students will have an ability to understand the concept of system models and design control algorithms of robotic systems using modern design tools.
CO4-PO1	3	Students will learn the basic principles of the core components of different robotic system components and control 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, and problem solving.

COURSE SCHEDULE

Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Course overview, introduction to robotics.		
	2	Pick and place devices, Continuous path manipulators.		
	3	Telechirs, Wabots.		
2	4	Artificial grippers, Load capacities.		
	5	Working volume and limits to accuracy of performance characteristics.		
	6	Robot vision-I.		

3	7	Robot vision-II.		
	8	Actuators-I.		
	9	Actuators-II.	CT-01	Lectures 1-6
4	10	Obstacle avoidance, Movements strategies.		
	11	Different robotic applications and limitations of performance-I.		
	12	Different robotic applications and limitations of performance-II.		
5	13	Point to point programming.		
	14	Higher level languages to teach mode programming-I.		
	15	Higher level languages to teach mode programming-II.		
6	16	Higher level languages to teach mode programming-III.		
	17	Space and tool co-ordinates.		
	18	Computer office line programming.	ASG-01	
7	19	Programming for flexible manufacture.		
	20	Human factors in the management of robotic systems.		
	21	Kinematics description of multi-degree of freedom manipulators.		
8	22	Joint co-ordinates, task co-ordinates.	M	
	23	Transformation of co-ordinate systems.		
	24	Kinematics models-I.		
9	25	Kinematics models-II.		
	26	Kinematics models-III.		
	27	Industrial task description and translation of robot requirements-I.		
10	28	Industrial task description and translation of robot requirements-II.		

	29	Dynamic equation for six degree of freedom robot arms.	CT-02	Lectures 22-27
	30	Lagrange and Newton Euler Viewpoints.		
11	31	Nonlinear systems of equations with time varying efficient-I.		
	32	Nonlinear systems of equations with time varying efficient-II.		
	33	Real time dynamics and associated problems-I.		
12	34	Real time dynamics and associated problems-II.		
	35	Dynamic models predicting limits to performance in industrial tasks-I.	ASG-02	
	36	Dynamic models predicting limits to performance in industrial tasks-II.		
13	37	Motion resolves-I.		
	38	Motion resolves-II.		
	39	Passive complaint devices.		
14	40	Positive feed forward techniques in obstacle avoidance control.		
	41	Force feedback for gripper and arm control.		
	42	Vision control for location in automated assembly.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	50	
2	ASG, CS, CT	70	
3	ASG, CS, CT	70	
4	ASG, CS, CT	50	
	Exam		
1	M, F	50	
2	M, F	30	

3	M, F	30	
4	M, F	50	

REFERENCE BOOKS

- Lynch, K. M., & Park, F. C. (2017). *Modern Robotics.* Cambridge University Press. ISBN: 9781107156302
- Siciliano, B., & Khatib, O. (Eds.). (2016). *Springer handbook of robotics*. Springer. ISBN: 9783319325507
- Corke, P. (2017). *Robotics, vision and control: fundamental algorithms in MATLAB®.* Springer. ISBN: 9783642201448
- Bolton, W. (2018). *Mechatronics: Electronic control systems in mechanical and electrical engineering*. Pearson. 6th Edition. ISBN- 978-1-292-07668-3
- Ogata, K. (2010). *Modern control engineering*. Upper Saddle River, NJ: Prentice Hall. 5th Edition. ISBN- 9780136156734
- Alciatore, D. G., & Histand, M. B. (2019). *Introduction to mechatronics and measurement systems.* McGraw-Hill. 4th Edition. ISBN 978-0-07-338023-0
- Irwin, J. D., & Wilamowski, B. M. (2016). *The industrial electronics handbook*. CRC Press. 2nd Edition. ISBN- 978-1-4398-0287-8

ME 4245: Servomechanism and Control Engineering

COURSE INFORMATION			
Course Code	ME 4245	Lecture Contact Hours	3.00
Course Title	Servomechanism and Control Engineering	Credit Hours	3.00

PRE-REQUISITE
MATH 1101: Mathematics-I, EEE 1159: Basic Electrical Engineering, MATH 1201: Mathematics-II, CSE 1271: Computer Programming, ME 2101: Engineering Thermodynamics, ME 2111: Numerical Analysis, MATH 2101: Mathematics-III, EEE 2259: Electrical Machines and Electronics Technology, MATH 2201: Mathematics-IV, ME 3105: Fluid Mechanics- I, ME 3113: Machine Design-I, ME 3213: Machine Design-II, ME 3205: Fluid Mechanics- II, and ME 4105: Fluid Machinery.
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course provides a detailed overview of modern servomechanism and control techniques. The focus is to illustrate the core concepts and the practical engineering applications in these fields. Students will obtain an in-depth knowledge in system modelling, and control system design of hydraulic, pneumatic, mechanical, electrical and electro-mechanical systems. Upon completion of this course, students will have the competence to model real-life static and dynamic systems and design control techniques for them. The learning approach is to apply a synergistic approach to mechanical, electrical and software engineering principles to analyze, design and control modern mechatronic systems. Students will achieve comprehension of the multi-physics working principle of any mechatronic system, be able to analyze their performance, and will gain the competence to design control strategies for those systems.
OBJECTIVE
• To familiarize the students with the modeling of electro-mechanical systems. • To introduce students to the concepts of modern control systems. • To enable the students to interpret, analyze and design control systems for electro-mechanical applications. • To introduce the students to the basics of interconnected power systems of Bangladesh.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods

CO1	Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.	2	C5, A1, P1	1, 4, 6	1, 3, 4		ASG, CS, CT, F, M, Q
CO2	Characterize any system in Laplace domain to illustrate different specifications of the system using transfer function concept.	3	C2, C3	1, 2, 4, 5	1, 2, 5, 6		ASG, CS, CT, F, M, Q
CO3	Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.	4	C6	1, 4, 5, 8	2, 3, 4		ASG, CS, CT, F, M, Q
CO4	Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.	5	C6, P2	4, 5, 6, 8	5, 6		ASG, CS, CT, F, M, Q
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT

a. Main Contents:

- Introduction to control system.
- Representation of control components and systems.
- Modeling of feedback systems.
- Time response of first, second and higher order systems using classical and Laplace transform approaches.
- System stability analysis via Routh's stability criterion.
- Frequency response analysis.
- Interconnected power system.

b. Detail Contents:

Orientation of control system, open loop and feedback control system, representation of control components and systems, block diagrams, transfer functions, modeling of mechanical, hydraulic, pneumatic, electrical and electro-mechanical control components, modeling of feedback systems, block diagram algebra and single flow graphs.

Time response of first, second and higher order systems using classical and Laplace transform approaches, system stability analysis via Routh's stability criterion, basic actions and system type classification, system analysis, preliminary design by root locus method, frequency response analysis, use of Bode plot, polar plots, Nichols chart, M and Loci, gain adjustment, correlation between time and frequency response-margin. Interconnected power system, its development in Bangladesh, introduction to modern control theory. Introduction to digital computer control.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.		3										
CO2	Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.			3									

CO3	Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.				3								
CO4	Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.					3							

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO2	3	Students will be able to categorize different types of systems and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.
CO2-PO3	3	Students will be able to characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.
CO3-PO4	2	Students will interpret different physical and mechanical systems in terms of electrical system and analyze their performance.
CO3-PO5	3	Students will be able to construct equivalent electrical models with the help of modern design softwares for analysis of system 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, and problem solving.

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Course overview, introduction to control system.		
	2	Open loop and feedback control system.		
	3	Representation of control components and systems.		
2	4	Representation of control components and systems.		
	5	Block diagrams, transfer functions modeling of electro-mechanical systems-I.		
	6	Block diagrams, transfer functions modeling of electro-mechanical systems-II.		
3	7	Hydraulic control components.		
	8	Pneumatic, control components.		
	9	Electrical control components.	CT-01	Lectures 1-6
4	10	Servo control-I.		
	11	Servo control-II.		
	12	Servo control-III.		
5	13	Digital computer control-I.		
	14	Digital computer control-II.		
	15	Introduction to modern control theory-I.		
6	16	Introduction to modern control theory-II.		
	17	Modeling of feedback control systems-I.		
	18	Modeling of feedback control systems-II.	ASG-01	
7	19	Interference and error-I.		
	20	Interference and error-II.		
	21	Signal processing-I.		
8	22	Signal processing-II.	M	
	23	Block diagram algebra and single flow graphs.		
	24	Transient system.		

9	25	Time response of first, second and higher order systems using classical method.		
	26	Time response of first, second and higher order systems using Laplace transform-I.		
	27	Time response of first, second and higher order systems using Laplace transform-II.		
10	28	System stability analysis via Routh's stability criterion-I.		
	29	System stability analysis via Routh's stability criterion-II.	CT-02	Lectures 22-27
	30	Basic actions types.		
11	31	Basic system types.		
	32	System analysis.		
	33	Preliminary design by root locus method-I.		
12	34	Preliminary design by root locus method-II.		
	35	Preliminary design by root locus method-III.	ASG-02	
	36	Frequency response analysis.		
13	37	Use of Bode plot and polar plots-I.		
	38	Use of Bode plot and polar plots-II.		
	39	Use of Nichols chart, M and Joci.		
14	40	Gain- adjustment.		
	41	Correlation between time and frequency response-margin.		
	42	Interconnected power system and its development in Bangladesh.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	20	
2	ASG, CS, CT	20	
3	ASG, CS, CT	20	
4	ASG, CS, CT	20	

	Exam		
1	M, F	80	
2	M, F	80	
3	M, F	80	
4	M, F	80	

REFERENCE BOOKS
• Bolton, W. (2018). Mechatronics: *Electronic control systems in mechanical and electrical engineering*. Pearson. 6th Edition. ISBN- 978-1-292-07668-3 • Ogata, K. (2010). *Modern control engineering*. Upper Saddle River, NJ: Prentice Hall. 5th Edition. ISBN- 9780136156734 • Alciatore, D. G., & Histand, M. B. (2019). *Introduction to mechatronics and measurement systems.* McGraw-Hill. 4th Edition. ISBN 978-0-07-338023-0 • Irwin, J. D., & Wilamowski, B. M. (2016). *The industrial electronics handbook.* CRC Press. 2nd Edition. ISBN- 978-1-4398-0287-8 • Haykin, S. (2016). *Signals and systems.* John Wiley. ISBN: 9781118061220 • James, H. M., Nichols, N. B., Phillips, R. S. (1965). *Theory of servomechanisms*. New York: Dover Publications.

ME 4247: Energy and Environment

COURSE INFORMATION			
Course Code	ME 4247	Lecture Contact Hours	3.00
Course Title	Energy and Environment	Credit Hours	3.00
PRE-REQUISITE			
ME 1101: Fundamentals of Mechanical Engineering			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			

This course provides a perception in the field of energy and environment. The focus is to understand the different sources of energy and energy conversion with storage. It also indicates the environmental impact due to energy conversion. Furthermore, it will introduce different energy economic tools and techniques. Students will learn about the correlation between energy and environmental economics along with the usages of different types of energy.
OBJECTIVE
To provide a deep understanding of the issues of energy conversion and usages. To learn about the different tools and techniques with respect to energy. To analyze the consequences of today's environmental impacts, economics and management of energy conversion.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corresponding PO**	**Bloom'sTaxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	Describe the knowledge of conventional and renewable energy and their applications.	1	C1	1	1		ASG, CT, M
CO2	Explain different tools and techniques of energy conversion and energy storage.	5	C2	2	6		ASG, CT, F
CO3	Demonstrate the optimization of energy principle.	6	C3	7	5		ASG, CT, M
CO4	Analyze the impact of energy conversion with environmental economics and management.	7	C4	7	5		ASG, CT, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Energy sources and conversion.

Energy-principles and optimization.

Environmental Impact.

b. Detail Contents:

Energy sources and conversion: Energy sources and utilization; Principles of energy conversion and storage.

Energy-principles and optimization: Building thermal energy-principles and optimization; Energy economy tools and techniques.

Environmental Impact: Environmental impacts of energy conversion;

Environmental economics and management; Case studies.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Describe the knowledge of conventional and renewable energy and their applications.	3											
CO2	Explain different tools and techniques of energy conversion and energy storage.					3							
CO3	Demonstrate the optimization of energy principle.						3						

CO4	Analyze the impact of energy conversion with environmental economics and management.							3					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to understand the basic concept of energy and application.
CO2-PO5	3	Students will be able to learn different techniques for energy conversion and storage.
CO3-PO6	3	Students will attain the knowledge of optimization for different energy techniques.
CO4-PO7	3	Students will be able to develop a knowledge regarding the environmental impact due to energy conversion.

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, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Energy sources and utilization.		
	2	Energy sources and utilization.		

	3	Energy sources and utilization.			
2	4	Energy sources and utilization.			
	5	Energy sources and utilization.			
	6	Energy sources and utilization.			
3	7	Principles of energy conversion and storage.			
	8	Principles of energy conversion and storage.			
	9	Principles of energy conversion and storage.	CT-01	Lectures 1-9	
4	10	Principles of energy conversion and storage.			
	11	Principles of energy conversion and storage.			
	12	Principles of energy conversion and storage.			
5	13	Building thermal energy- principles and optimization.			
	14	Building thermal energy- principles and optimization.			
	15	Building thermal energy- principles and optimization.			
6	16	Building thermal energy- principles and optimization.	ASG-01		
	17	Building thermal energy- principles and optimization.			
	18	Building thermal energy- principles and optimization.			

7	19	Building thermal energy-principles and optimization.			
	20	Building thermal energy-principles and optimization.			
	21	Building thermal energy-principles and optimization.			
8	22	Energy economy tools and techniques.	M		
	23	Energy economy tools and techniques.			
	24	Energy economy tools and techniques.			
9	25	Energy economy tools and techniques.			
	26	Energy economy tools and techniques.			
	27	Energy economy tools and techniques.			
10	28	Environmental impacts of energy conversion.			
	29	Environmental impacts of energy conversion.			
	30	Environmental impacts of energy conversion.	CT-02	Lectures 22-30	
11	31	Environmental impacts of energy conversion.			
	32	Environmental impacts of energy conversion.			
	33	Environmental impacts of energy conversion.			
12	34	Environmental economics and management; Case studies.			
	35	Environmental economics and management; Case studies.			

	36	Environmental economics and management; Case studies.		
13	37	Environmental economics and management; Case studies.		
	38	Environmental economics and management; Case studies.		
	39	Environmental economics and management; Case studies.	ASG-02	
14	40	Revision.		
	41	Revision.		
	42	Revision.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	60	
2	ASG, CT	40	
3	ASG, CT	60	
4	ASG, CT	40	
	Exam		
1	M	40	
2	F	60	
3	M	40	
4	F	60	

REFERENCE BOOKS

Michel André, Zissis Samaras. Energy and Environment. 1st Edition. Printed ISBN 9781786300263.

Robert A. Ristinen, Jack J. Kraushaar, Jeffrey Brack. Energy and the Environment. 3rd Edition. ISBN: 978-1-119-23958-1.

ME 4249 Fluidics

COURSE INFORMATION			
Course Code	ME 4249	Lecture Contact Hours	3.00
Course Title	Fluidics	Credit Hours	3.00

PRE-REQUISITE
PHY 1105: Physics-I, MATH 1101: Mathematics-I, EEE 1159: Basic Electrical Engineering, PHY 1205: Physics-II, MATH 1201: Mathematics-II, CSE 1271: Computer Programming, ME 2101: Engineering Thermodynamics, ME 2111: Numerical Analysis, MATH 2101: Mathematics-III, EEE 2259: Electrical Machines and Electronics Technology, MATH 2201: Mathematics-IV, ME 3105: Fluid Mechanics- I, ME 3113: Machine Design-I, ME 3213: Machine Design-II, ME 3205: Fluid Mechanics- II, and ME 4105: Fluid Machinery.
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
SYNOPSIS/RATIONALE
This course provides an in-depth knowledge in the working principle of micro and nano fluidics in hydraulic and pneumatic components and systems. The focus is to impart core understanding of the different components of fluid transmission lines, actuators, power supplies, fluid motors, fluid system modelling, stability and control. The learning approach is to apply a synergistic approach to combine the knowledge of basic fluid mechanics, and thermodynamics to analyze, design and set the working conditions of micro and nano-scale fluidic components and systems. Students will achieve comprehension of the multi-physics working principle of different fluidic system components, and will gain the competence to design systems based on their understanding in the overall system behavior and control strategies.
OBJECTIVE
To introduce the concept of micro and nano fluidics. To explore the fundamental theories underpinning the physics of liquid and particle transport at micro and nano scales. To get acquainted with the working principles of fluid transmission lines, fluid power system and fluid actuators. To acquire the knowledge on the working principles of system modeling and control of fluid transmission lines, fluid power system and servo-control mechanism.

LEARNING OUTCOMES & GENERIC SKILLS

No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	Assess the performance of fluidic system components like transmission system, actuators, power system, and control systems.	2	C5, A1, P1	1,4, 6	1,3,4		ASG, CS, CT, F, M, Q
CO2	Understand system models and design control algorithms for fluidic systems.	3	C2, C3	1,2, 4,5	1,2,5,6		ASG, CS, CT, F, M, Q
CO3	Analyze and synthesize micro and nano fluidic systems for using in process control, aviation and space industries.	4	C5, C6	1, 4, 5, 8	2, 3, 4		ASG, CS, CT, F, M, Q
CO4	Develop fluid power system, servo-control mechanism, fluid actuators and fluid transmission lines for modern engineering applications.	5	C6, P2	4, 5, 6, 7, 8	5, 6		ASG, CS, CT, F, M, Q
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

- Hydraulic and pneumatic systems and components.
- Fluid transmission lines.
- Fluid power systems.
- Fluid actuation systems.
- Compressibility and leakage.
- System modelling.
- Stability and control.

b. Detail Contents:

Hydraulic and pneumatic components and systems; servo-control valves; fluid transmission lines; actuators; fluids; power supplies and fluid motors; compressibility and leakage; system modelling, stability and compensation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Assess the performance of fluidic system components like transmission system, actuators, power system, and control systems.		3										
CO2	Understand system models and design control algorithms for fluidic systems.			3									
CO3	Analyze and synthesize micro and nano fluidic systems for using in process control, aviation and space industries.				3								
CO4	Develop fluid power system, servo-control mechanism, fluid actuators and fluid transmission lines for modern engineering applications.					3							

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	**Level of Matching**	**Justification**
CO1-PO2	3	Students will be able to analyze complex engineering problems pertaining to the performance of fluidic system components like transmission system, actuators, power system, and control systems.
CO2-PO3	3	Students will be able to comprehend system models of fluidic systems, and design control algorithms for them.
CO3-PO4	2	Students will have competence of analyzing and synthesizing micro and nano fluidic systems for multivariate constrained process control, aviation and space industries.
CO4-PO5	3	Students will have the capability to employ state-of-the-art design tools in the design and analysis of fluid power system, servo-control mechanism, fluid actuators and fluid transmission lines for modern engineering 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, and problem solving.

COURSE SCHEDULE				
Week	**Lecture**	**Topics**	**ASG/CT/M**	**Remarks**
1	1	Course overview, introduction to fluidics.		
	2	Conservation equations.		
	3	Navier Stokes equations -I.		
2	4	Navier Stokes equations -II.		
	5	Energy equations.		
	6	Types of flow-I.		
3	7	Types of flow-II.		
	8	Flow through pipes-I.		
	9	Flow through pipes-II.	CT-01	Lectures 1-6
4	10	Gas dynamics-I.		
	11	Gas dynamics-II.		
	12	Secondary flows-I.		
5	13	Secondary flows-II.		
	14	Pipeline design-I.		
	15	Pipeline design-II.		
6	16	Hydraulic systems and components-I.		
	17	Hydraulic systems and components-II.		
	18	Hydraulic systems and components-III.	ASG-01	
7	19	Pneumatic systems and components-I.		
	20	Pneumatic systems and components-II.		
	21	Pneumatic systems and components-III.		
8	22	Fluid power systems-I.	M	
	23	Fluid power systems-II.		
	24	Fluid power systems-III.		

9	25	Fluid actuation systems-I.		
	26	Fluid actuation systems-II.		
	27	Fluid actuation systems-III.		
10	28	Fluid actuation systems-IV.		
	29	Fluid actuation systems-V.	CT-02	Lectures 22-27
	30	Fluid actuation systems-VI.		
11	31	Fluid compressibility.		
	32	Fluid leakage.		
	33	Fluid system modelling-I.		
12	34	Fluid system modelling-II.		
	35	Fluid system modelling-III.	ASG-02	
	36	Fluid system modelling-IV.		
13	37	Fluid system stability-I.		
	38	Fluid system stability-II.		
	39	Fluid system control-I.		
14	40	Fluid system control-II.		
	41	Fluid system control-III.		
	42	Fluid system control-IV.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	70	
2	ASG, CS, CT	70	
3	ASG, CS, CT	70	
4	ASG, CS, CT	100	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	

REFERENCE BOOKS
• Nguyen, N.-T., Wereley, S. T., & Shaegh, S. A. M. (2019). *Fundamentals and applications of microfluidics*. Artech. ISBN: 9781630813659 • Kirshner, J.M., & Katz, S. (1975). *Design Theory of Fluidic Components.* ISBN: 9780323148238 • Kleinstreuer, C. (2013). *Microfluidics and Nanofluidics: Theory and Selected Applications*. Wiley. ISBN: 978-1-118-41527-6 • Ogata, K. (2010). *Modern control engineering.* Upper Saddle River, NJ: Prentice Hall. 5th Edition. ISBN- 9780136156734 • James, H. M., Nichols, N. B., Phillips, R. S. (1965). *Theory of servomechanisms.* New York: Dover Publications.

ME 4251 Design of Fluid Machines

COURSE INFORMATION			
Course Code	ME 4251	Lecture Contact Hours	3.00
Course Title	Design of Fluid Machines	Credit Hours	3.00
PRE-REQUISITE			
ME 2101: Engineering Thermodynamics, ME 2111: Numerical Analysis, ME 3105: Fluid Mechanics- I, ME 3113: Machine Design-I, ME 3213: Machine Design-II, ME 3205: Fluid Mechanics- II, and ME 4105: Fluid Machinery.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides an in-depth knowledge in the working principle of the different fluid machines and turbomachines. The focus is to impart core understanding of the different components of fluid machines and turbomachines with detailed design steps for the blade rows of positive and negative work turbomachines. The learning approach is to apply a synergistic approach to combine the knowledge of basic fluid mechanics, thermodynamics and heat transfer to analyze, design and set the working conditions of fluid machines and turbomachines. Students will achieve comprehension of the multi-physics working principle of different fluid machines and turbomachinery and will gain the competence to design systems based on their understanding in the overall system behavior and control strategies.			
OBJECTIVE			
To get the students acquainted with the correlations of basic physical principles with retrospect to the working principles of fluid machineries. To learn about the design and performance analyses of the major fluid machines.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	**Course Outcomes**	**Corres-ponding PO**	**Bloom's Taxono-my**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	Assess the performance of fan, compressor, pump, turbine and other fluid machineries.	4	C6	1, 4, 6, 8	1, 2, 4	1	ASG, CS, CT, F, M, Q
CO2	Design and conceptualize components of fluid machines and turbomachi-neries for using in the different industrial processes, automobiles, power-plants, aviation and space industries.	3	C6, P2	4,5,6	1, 2, 3, 5, 6	1, 2, 3	ASG, CS, CT, F, M, Q
CO3	Design blade rows of centrifugal pumps, gas turbines, hydroturbines, compressors, turbochargers, superchargers, and torque converters.	5	C6, P2	6	2, 3, 4, 5, 6	1, 2, 3	ASG, CS, CT, F, M, Q
CO4	Synthesize solutions to construct blade rows for turbomachi-nery applications.	3	C6, P2	4, 5, 6	1, 2, 3, 5, 6	1, 2, 3	ASG, CS, CT, F, M, Q
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

Introduction to fluid machinery.

Similarity concepts.

Design of pumps.

Design of fans, blowers and compressors.

Design of hydraulic turbines.

Design of gas turbines.

Design of wind turbines.

Unsteady flow.

Gas dynamics.

Performance characteristics.

Cavitation and surging.

b. Detail Contents:

General theory of fluid machines, similarity considerations to fluid machines, pumps, fans, blowers and compressors: design considerations; cascade fluid mechanics, including effects of viscosity, compressibility and three-dimensional flow, performance characteristics and limitations, cavitation and surging.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Assess the performance of fan, compressor, pump, turbine and other fluid machineries.				3								
CO2	Design and conceptualize components of fluid machines and turbomachineries for using in the different industrial processes, automobiles, power-plants, aviation and space industries.			3									
CO3	Design blade rows of centrifugal pumps, gas turbines, hydroturbines, compressors,					3							

	turbochargers, superchargers, and torque converters.												
CO4	Synthesize solutions to construct blade rows for turbomachinery applications.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO4	3	Students will be able to solve complex engineering problems pertaining to the performance analysis of fan, compressor, pump, turbine and other fluid machineries.
CO2-PO3	3	Students will employ their knowledge in designing and conceptualizing components of fluid machines and turbomachineries to match the multivariate design constraints in industrial processes, automobiles, power-plants, aviation and space industries.
CO3-PO5	3	The students will attain the competence of implementing modern design tools in designing blade rows of centrifugal pumps, gas turbines, hydroturbines, compressors, turbochargers, superchargers, and torque converters.
CO4-PO3	3	Students will gain the competence in synthesizing complex engineering design solutions of constructing blade rows for turbomachinery 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, and problem solving.

COURSE SCHEDULE				
Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Course overview, introduction to fluid machines.		
	2	Conservation equations.		
	3	Navier Stokes equations -I.		
2	4	Navier Stokes equations -II.		
	5	Energy equations.		
	6	Gas dynamics-I.		
3	7	Gas dynamics-II.		
	8	Introduction to roto-dynamic fluid machinery.		
	9	The fluid machinery stage.	CT-01	Lectures 1-6
4	10	Flow field within fluid machinery stage-I.		
	11	Flow field within fluid machinery stage-I.		
	12	Euler's pump-turbine equation-I.		
5	13	Euler's pump-turbine equation-II.		
	14	Velocity triangle-I.		
	15	Velocity triangle-II.		
6	16	Velocity triangle-III.		
	17	Velocity triangle-IV.		
	18	Velocity triangle-V.	ASG-01	
7	19	Velocity triangle-VI.		
	20	Fluid machine types.		
	21	Selection criteria of fluid machines-I.		
8	22	Selection criteria of fluid machines-II.	M	
	23	Selection criteria of fluid machines-III.		
	24	Selection criteria of fluid machines-IV.		
9	25	Secondary flows-I.		
	26	Secondary flows-II.		
	27	Design of single-stage turbomachines' blade rows-I.		

10	28	Design of single-stage turbomachines' blade rows-II.		
	29	Design of single-stage turbomachines' blade rows-III.	CT-02	Lectures 22-27
	30	Design of single-stage turbomachines' blade rows-IV.		
11	31	Design of single-stage turbomachines' blade rows-V.		
	32	Design of single-stage turbomachines' blade rows-VI.		
	33	Design of multi-stage turbomachines' blade rows-I.		
12	34	Design of multi-stage turbomachines' blade rows-II.		
	35	Construction of blade rows-I.	ASG-02	
	36	Construction of blade rows-II.		
13	37	Construction of blade rows-III.		
	38	Construction of blade rows-IV.		
	39	Performance curves-I.		
14	40	Performance curves-II.		
	41	Machine and system integration-I.		
	42	Machine and system integration-II.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	70	
2	ASG, CS, CT	70	
3	ASG, CS, CT	70	
4	ASG, CS, CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	

	4	M, F	30		

REFERENCE BOOKS
Denton, J (1999). Developments in Turbomachinery Design. Wiley. ISBN: 9781860582370 Dixon, S. L., Hall, C. (2010). Fluid Mechanics and Thermodynamics of Turbomachinery. Butterworth-Heinemann. ISBN: 9781856177931 Islam, Q. (1998). Hydraulic Machines Through worked Out Problems. DAERS, BUET. ISBN: 984-31-0261-4 Cumpsty, N. A. (2004). Compressor aerodynamics. Malabar, Fla: Krieger Pub. ISBN: 9781575242477 Gorla, R. S. R., & Khan, A. A. (2003). Turbomachinery: Design and theory. ISBN: 9780824709808 Hansen, M. O. L. (2015). Aerodynamics of Wind Turbines. Earthscan. ISBN: 978-1-84407-438-9

ME 4253: Theory of Structures

COURSE INFORMATION			
Course Code	ME 4253	Lecture Contact Hours	3.00
Course Title	Theory of Structures	Credit Hours	3.00
PRE-REQUISITE			
ME 2103: Engineering Mechanics-I, ME 2209: Mechanics of Solids, ME 3103: Engineering Mechanics-II, ME 3113: Machine Design-I, ME 3213: Machine Design-II			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts and standards of different structures. The focus is to illustrate practical engineering applications in these fields. Students will obtain an in-depth knowledge in different structural behaviors. Upon completion of this course, students will have the competence to explain the behavior of joints in different structures. The learning approach is to apply a synergistic process to theoretical analyses and experimental results for structural joints. Students will achieve comprehension of properties of the joints used in structures and the methods to analyze.			
OBJECTIVE			

Introduce different structures. To characterize the joints in different structures. To analyze various situations in structures using Finite element method.
LEARNING OUTCOMES & GENERIC SKILLS

No.	**Course Outcomes**	**Corresponding PO**	**Bloom's Taxonomy**	**KP**	**CP**	**CA**	**Assess-ment Methods**
CO1	Understand different types of joints in structures.	1	C2	1	1		Q, ASG, F, M
CO2	Analyze the behavior of joints in different structures.	2	C3	1,4	2		Q, ASG, F, M
CO3	Understand the basic principles of Finite element method.	1	C2	1,4	1		Q, ASG, F, M
CO4	Apply the knowledge of Finite element method in structure analysis.	3	C4	5	3		Q, ASG, F, M

(ASG – Assignment, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Preliminaries; Elements stiffness matrices; Pin-joint structures; 2-D rigid joint structures; Elastic plane element structures; Mixed elements 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	Understand different types of joints in structures.	3											
CO2	Analyze the behavior of joints in different structures.		3										
CO3	Understand the basic principles of Finite element method.	3											

CO4	Apply the knowledge of Finite element method in structure analysis.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will have the basic understanding of different types of joints in structures.
CO2-PO2	3	Students will be able to analyze the behavior of joints in different structures.
CO3-PO1	3	It is important to understand the basic principles of Finite element method in modern era.
CO4-PO3	3	Students will be able to apply the knowledge of Finite element method in structure 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	Lecture	Topics	ASG/CT/M	Remarks
1	1	Preliminaries		
	2	Preliminaries		
	3	Preliminaries		
2	4	Preliminaries		
	5	Elements stiffness matrices		

	6	Elements stiffness matrices		
3	7	Elements stiffness matrices		
	8	Elements stiffness matrices		
	9	Pin-joint structures	CT-01	Lectures 1-6
4	10	Pin-joint structures		
	11	Pin-joint structures		
	12	Pin-joint structures		
5	13	2-D rigid joint structures		
	14	2-D rigid joint structures		
	15	2-D rigid joint structures		
6	16	2-D rigid joint structures		
	17	Elastic plane element structures		
	18	Elastic plane element structures	ASG-01	
7	19	Elastic plane element structures		
	20	Elastic plane element structures		
	21	Mixed elements structures	M	
8	22	Mixed elements structures		
	23	Mixed elements structures		
	24	Mixed elements structures		
9	25	Elastic stability of 2-D rigid joint structures		
	26	Elastic stability of 2-D rigid joint structures		
	27	Elastic stability of 2-D rigid joint structures		
10	28	Elastic stability of 2-D rigid joint structures		
	29	Frequency of rigid joint structures		

	30	Frequency of rigid joint structures		
11	31	Frequency of rigid joint structures		
	32	Frequency of rigid joint structures		
	33	Finite element method	CT-02	Lectures 23-32
12	34	Finite element method		
	35	Finite element method		
	36	Finite element method		
13	37	Finite element method		
	38	Finite element method		
	39	Finite element method	ASG-02	
14	40	Review Class-I		
	41	Review Class-II		
	42	Review Class-III		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
2	ASG	30	
3	CT	30	
	Exam		
1	F	80	
2	M, F	70	
3	M, F	70	
4	M, F	100	

REFERENCE BOOKS

Khurmi, R.S. (1990). Theory of Structures. S Chand & Co, ISBN: 8121905206

Pandit, G. S. (1999). Theory of Structures. McGraw- Hill, ISBN: 0074634984

ME 4255: Noise and Vibration

COURSE INFORMATION			
Course Code	ME 4255	Lecture Contact Hours	3.00
Course Title	Noise and Vibration	Credit Hours	3.00

PRE-REQUISITE
ME 3103- Engineering Mechanics-II

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course provides a prologue to the concepts of Sound waves and vibrations used in engineering fields. The focus is to illustrate the basic concepts of sound waves. Students will obtain an in-depth knowledge in sound transmission, absorption and silencer etc. Upon completion of this course, students will have the competence to understand principles of machine foundation systems as well as will be able identify their practical uses. The learning approach is to build the basic of sound and vibration concepts by combining the knowledge of mechanics, waves and vibration applications.

OBJECTIVE
To familiarize students with the ideas of waves and vibration. To familiarize students with sound sources, sound transmission, sound absorption. To make students acquainted with the concept of silencer, machine foundation and vibrations. To make students understand the use of practical examples of beam and plate vibrations.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assessment Methods
CO1	Define and analyze different sound waves.	1	C4	1,2	1		ASG, CT, M, F
CO2	Perform theoretical explanation of sound transmission	2	C2	1,2,3	1,2		ASG, CT, M, F

	systems and acoustics.						
CO3	Interpreting the principles of sound absorption, silencer design.	2	C4	2,8	1,2,4		ASG, CT, M, F
CO4	Compare different concepts of random vibration, vibration isolation, vibration absorption etc.	1	C2	2,4	1,2		ASG, CT, M, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Sound waves

Acoustics

Silencer

Vibration

b. Detail Contents:

Sound waves: Sound waves, sound sources, mechanism of sound absorption, sound transmission through walls and structures.

Acoustics: Acoustics of large and small rooms.

Silencer: Design of silencers.

Vibration: Vibration isolation, machine foundation design, vibration absorption, random vibration, beam and plate vibrations.

CO-PO MAPPING

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

CO1	Define and analyze different sound waves.	3											
CO2	Perform theoretical explanation of sound transmission systems and acoustics.		3										
CO3	Interpreting the principles of sound absorption, silencer design.		3										
CO4	Compare different concepts of random vibration, vibration isolation, vibration absorption etc.	3											

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to correlate the basic working principles of different sound wave systems.
CO2-PO2	2	Students will be able to solve different theoretical problems.
CO3-PO2	3	Students will be able analysis different principles.
CO4-PO1	3	Students will be able to acknowledge different concepts.

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	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction: Sound waves		
	2	Sound waves		
	3	Sound waves		
2	4	Different sound sources and variations		
	5	Sound transmission through wall and structures		
	6	Sound transmission through wall and structures		
3	7	Sound transmission through wall and structures		
	8	Sound transmission through wall and structures		
	9	Sound transmission through wall and structures	CT-01	Lectures 1-6
4	10	Mechanism of sound absorption		
	11	Mechanism of sound absorption		
	12	Mechanism of sound absorption		
5	13	Mechanism of sound absorption		
	14	Introduction: acoustics		
	15	Acoustics of large and small rooms		
6	16	Acoustics of large and small rooms		
	17	Acoustics of large and small rooms		
	18	Introduction: silencer	ASG-01	
7	19	Design of silencers		
	20	Design of silencers		
	21	Design of silencers		

8	22	Introduction: machine foundation system	M	
	23	Machine foundation design		
	24	Machine foundation design		
9	25	Introduction: vibration		
	26	Vibration isolation		
	27	Vibration isolation		
10	28	Whirling of shafts		
	29	Whirling of shafts	CT-02	Lectures 25-28
	30	Vibration absorption		
11	31	Vibration absorption		
	32	Vibration absorption		
	33	Vibration absorption		
12	34	Random vibration		
	35	Random vibration	ASG-02	
	36	Random vibration		
13	37	Random vibration		
	38	Beam and plate vibrations		
	39	Beam and plate vibrations		
14	40	Beam and plate vibrations		
	41	Problem class		
	42	Problem class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CS, CT	70	
2	ASG, CS, CT	70	
3	ASG, CS, CT	70	
4	ASG, CS, CT	70	
	Exam		
1	M, F	30	

	2	M, F	30	
	3	M, F	30	
	4	M, F	30	

REFERENCE BOOKS
S. Graham Kelly, Mechanical Vibrations, ISBN: 978-1439062128 M. P. Norton, Fundamentals of Noise and Vibration Analysis for Engineers, ISBN: 978-0521499132

List of Core Courses: Arts and Science

CHEM 1203: Engineering Chemistry

COURSE INFORMATION			
Course Code	CHEM 1203	Lecture Contact Hours	4.00
Course Title	Engineering Chemistry	Credit Hours	4.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
To learn the basic concepts of inorganic, organic and physical chemistry. This course also offers the fundamentals of various chemical industry & introduce the students with the use, property, manufacturing process, waste management of leading chemical industries, corrosion and its prevention.			
OBJECTIVE			
To introduce the student with the basic concepts of inorganic, physical and organic chemistry. To familiarize students with the properties, raw materials, manufacturing process and application of Fertilizer, Paper, Sugar, Glass, Ceramic, Cement, Refractories, Plastic, Fiber, Paint based industries. To introduce students with different types of chemical corrosion and their prevention. To make students conscious about environmental pollution from industrial wastes and treatment of waste.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Be able to define the different parameter and concepts regarding atomic structure, periodic properties of elements, chemical bonding, selective organic reactions etc.	1	C1, C2, C3	1,3			Q, ASG, F
CO2	Understand the phase rule, colligative properties, chemical kinetics and equilibrium, thermochemistry, pH and buffer, electrical properties of solution.	2	C1, C2	1,2			Q, ASG, F
CO3	Understand the phase rule, colligative properties, chemical kinetics and equilibrium, thermochemistry, pH and buffer, electrical properties of solution.	1	C2	2			Q, ASG, F
CO4	Be able to define corrosion, their types and properties. Use of surface coating materials. Understand the parameters of industrial waste and treatment	2	C1, C2	1			Q, ASG, F

	process of waste water.						

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Fundamental concept of atomic structure, chemical bonding, periodic properties, selective organic reactions.

Introduction to phase rule, phase diagram, colligative properties, chemical kinetics & equilibrium, thermochemistry, pH and buffer, electrical properties of solution.

Basic properties and manufacturing process of Fertilizer, Sugar, Paper, Glass, Ceramic, Cement, Refractory, Plastic and fiber etc.

Introduction to corrosion, surface coating materials, industrial waste and treatment process of waste water.

b. Detail Contents:

Different atom models, Quantum numbers, Electronic configuration, Periodic Classification of Elements: Periodic properties of elements, Properties and uses of noble gases. Chemical Bonding: Types, properties, Lewis theory, VBT, MOT), Hybridization and shapes of molecules, Selective organic reactions such as- addition, substitution, oxidation- reduction, alkylation and polymerization.

Phase Rule: Phase diagram of mono component system. Solutions and Their Classification: Unit expressing concentration, Colligative properties of dilute solutions, Thermochemistry, Chemical kinetics, Chemical equilibrium, pH and buffer solutions, and Electrical properties of solution.

Basic properties, raw materials, classification and manufacturing process of Fertilizer, Sugar, Paper, Glass, Ceramic, Cement, Refractory, Plastic and fiber, Rubber etc.

Industrial wastes and treatment process: Characterization of industrial wastes, types, treatment process, Purification of industrial flue gases, purification of gases from aerosols, Effluents of industrial units and their purification, solid industrial wastes, Introduction to chemical corrosion, direct chemical corrosion, Electrochemical Corrosion, Factors affecting chemical corrosion, Galvanic corrosion, Atmospheric corrosion, Open-air corrosion, Corrosion in contact to soil, Prevention of corrosion.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to define the different parameter and concepts regarding atomic structure, periodic properties of elements, chemical bonding, selective organic reactions etc.	3											
CO2	Understand the phase rule, colligative properties, chemical kinetics and equilibrium, thermochemistry, pH and buffer, electrical properties of solution.		2										
CO3	Understand the phase rule, colligative properties, chemical kinetics and equilibrium, thermochemistry, pH and buffer, electrical properties of solution.	3											
CO4	Be able to define corrosion, their types and properties. Use of surface coating materials. Understand the parameters of industrial waste and treatment process of waste water.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to know about the introductory concepts of atomic structure, periodic properties of elements, chemical bonding, selective organic reactions etc.
CO2-PO2	2	Students will able to learn about phase rule, colligative properties, chemical kinetics and equilibrium, thermochemistry, pH and buffer, electrical properties of solution.

CO3-PO1	3	Students will able to understand the basic properties and manufacturing process of Fertilizer, Sugar, Paper, Glass, Ceramic, Cement, Refractory, Plastic and fiber, Rubber etc.
CO4-PO2	3	Students will be able to define corrosion, use of surface coating materials, the parameters of industrial waste and treatment process of waste water.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	56
Self-Directed Learning	100
Formal Assessment	7.5
Total	163.5
TEACHING METHODOLOGY	
Class lecture, pop quiz, case study, and problem solving.	

COURSE SCHEDULE				
Weeks	Lectures	Topics	CT	Remarks
1	1	Atomic Models		
	2	Quantum numbers and electronic configuration		
	3,4	Periodic properties of elements		
2	5,6	Chemical Bonding ; Lewis theory, VBT, MOT		
	7	Hybridization and shape of molecule		
	8	Selective organic reactions	CT-01	Lecture 1-8
3	9	Phase rule and phase diagram		
	10	Colligative properties of solutions		
	11, 12	Chemical kinetics: Reaction rate		
4	13,14	Chemical Equilibrium		
	15	pH and Buffer solution		
	16	Thermochemistry		
5	17	Fertilizer: Source and classification		
	18,19	Properties and manufacture of fertilizer		
	20	Introduction to Paper industry	ASG-01	Lectures 9-20
6	21	Manufacturing of Pulp		
	22,23	Introduction and manufacturing of Sugar		
	24	Crystallization, recovery of sugar from molasses		
	25	Introduction and manufacturing of glass		

7	26	Properties and application of glass in chemical industries		
	27,28	Fundamental of ceramic industry, manufacturing process		
8	29	Properties and classification of ceramic products		
	30	Types of cement, properties, raw materials		
	31,32	Manufacturing process, settling of cement.	M	Lectures 21-32
9	33	Types of fiber, raw materials, applications		
	34	Manufacturing processes of synthetic fibers		
	35,36	Source of natural rubber, chemical treatment of latex, raw materials		
10	37	Raw materials, properties and manufacture of refractory materials		
	38,39	Introduction to paints, varnishes, metallic, non-metallic and organic protective coatings		
	40	Properties of Paints, Paint Failure,		
11	41	Introduction to chemical corrosion		
	42	Electrochemical and atmospheric corrosion	CT-02	Lectures 9-20
	43,44	Prevention methods of corrosion		
12	45,46	Characterization of industrial wastes		
	47	Classification of industrial wastes,		
	48	Ecological problems of chemical technology		
13	49	Purification of industrial flue gases,		
	50,51	Solid industrial wastes and their treatment		
	52	Water quality parameters: BOD,COD,TDS		
14	53,54	Discussion of question pattern for final exam	ASG-02	
	55	Revision for final exam		
	56	Revision for final exam		

ASSESSMENT STRATEGY

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

REFERENCE BOOKS
Engineering Chemistry by B Sivasankar Industrial Chemistry- B.K. Sharma Principles of Physical Chemistry – Haque and Nawab General Chemistry: Essential Concepts by Raymond Chang

CHEM 1204 Chemistry Sessional

COURSE INFORMATION			
Course Code Course Title	CHEM 1204 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			

To familiarize the students with experimentation of acid and base neutralization, dilution, concentration of mixture, titration and various concentration units of solution. To make students proficient in redox titration specially Iodimetric and Iodometric titration. To develop students’ ability in estimating metal ion content, purity of metal or to check the percentage of impurity of different substances in any given sample.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom’s Taxonomy	KP	CP	CA	Assessment Methods
CO1	Be able to understand and explain the different parameters regarding acid and base neutralization, titration, dilution of solution, key words like primary standard substances, secondary standard substances, different concentration units, indicator, equivalent weights and so on.	1	C1, C2, C3	1,2			R,Q, T
CO2	Be able to perform redox titration and further apply the basic of Iodimetric and Iodometric titration in determining BOD, COD	2 ,3	C2,C3	1,2,5			R,Q, T

	value of a water sample.						
CO3	Be able to calculate the purity of a sample, metal ion content by titrimetric methods.	3	C2, C3	1,2			R,Q, T, Pr

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Quantitative chemical analysis in the field of inorganic and physical chemistry such as:

Acid-base titration, Redox titration, Iodometric and Iodimetric titration.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand and explain the different parameters regarding acid and base neutralization, titration, dilution of solution, key words like primary standard substances, secondary standard substances, different concentration units, indicator, equivalent weights and so on.	3											
CO2	Be able to perform redox titration and further apply the basic of Iodimetric and Iodometric titration in determining BOD, COD value of a water sample.		3	2									
CO3	Be able to calculate the purity of a sample, metal ion content by titrimetric methods.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).		
JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO1	3	Students will able to understand different parameters regarding acid and base neutralization, titration, various concentration units and mathematical problems regarding mixture of acids and bases.
CO2-PO2	3	Students will get the hand on experience of redox titration for example Iodimetric and Iodometric titration.
C02-PO3	2	Students will be able to apply the knowledge of iodine based titration to elucidate important water quality parameter like BOD, COD which is beneficial for environmental consideration.
CO3-PO2	3	Students will get adequate experience to apply titrimetric knowledge to calculate purity of sample, metal ion content in water other ores etc. which will help them engineering basics,

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 for the Lab Test	10
Preparation for a 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
Week-2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid (C2H2O4.2H2O) Solution.
Week-3	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.
Week-4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na2CO3) Solution.
Week-5	Standardization of Oxalic Acid (C2H2O4.2H2O) Solution with Standard Sodium Hydroxide (NaOH) Solution.
Week-6	Standardization of Sodium Thiosulphate (Na2S2O3.5H2O) Solution with Standard Potassium Dichromate (K2Cr2O7) Solution.
Week-7	Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate (CuSO4.5H2O) (Blue Vitriol). Solution by Iodometric Method with Standard Sodium Thiosulphate (Na2S2O3.5H2O) Solution.
Week-8	Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate (Blue Vitriol) (CuSO4 .5H2O) Solution by Iodometric method with Standard Sodium Thiosulphate (Na2S2O3.5H2O) Solution.
Week-9	Standardization of Potassium Permanganate (KMnO4) Solution with Standard Oxalic Acid dihydrate (C2H2O4 .2H2O) Solution.
Week-10	Determination of Ferrous (Fe2+) Content in a Solution with Standard Potassium Permanganate (KMnO4) Solution.
Week-11	Determination of Ferrous (Fe2+) Content in a Solution with Standard Potassium Permanganate (KMnO4) Solution.
Week-12	Practice Lab
Week-13	Lab Test
Week-14	Quiz Test

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	25%
1-4	Report Writing/ Programming	15%
1-4	Mid-Term Evaluation (Exam/Project/assignment)	20%
1-4	Final Evaluation (Exam/Project/assignment)	30%
1-4	Viva Voce / Presentation	10%
	Total	100%

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

TEXT AND REFERENCE BOOKS

G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Vogel's Textbook of Quantitative Chemica Analysis, 5th Edition, Longman Scientific & Technical, 1989

G. D. Christian., Analytical Chemistry, 6th Edition, Wiley India Pvt. Limited, 2007

A. Jabbar Mian and M. Mahbubul Haque-Practical Chemistry

MATH 1101: Mathematics-I

COURSE INFORMATION			
Course Code	MATH 1101	Lecture Contact Hours	3.00
Course Title	Mathematics-I	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			

This course is designed to introduce the students with the basic concepts of differential calculus, integral calculus and coordinate geometry. The focus is to illustrate engineering applications of these principles comparable to differential calculus, integral calculus and coordinate geometry. The learning approach is how the students can deal the engineering problems related to this course. Students will achieve comprehension of the fundamental knowledge from this course and they will be able to apply it in the branch of engineering.
OBJECTIVE
To familiarize students with the concepts of differential calculus. To make students acquainted with the application of differential calculus. To familiarize students with the integral calculus. To be able to solve integration related problem. To make students able to solve geometry related problem. To interpret the result geometrically.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Define the basic terminology and theorems associated with differentiation, integration, and coordinate geometry.	1	C1	2			CT, ASG, M, F
CO2	Find the differentiation, integration, maxima and minima of different types of functions and also find area enclosed by curves and arc length of a curve.	1	C1	2			CT, ASG, M, F
CO3	Describe General equations of second degree and their reduction to standard forms and analyze conic sections:	1	C1, C4	2			CT, ASG, M, F

	Circles, Parabolas, Ellipses Hyperbolas, conicoides, sphere and ellipsoid etc.						
CO4	Apply the acquired concepts of differentiation, Integration, co-ordinate geometry to solve problems arising in mathematics and engineering.	1	C3	2			CT, ASG, M, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

Differential Calculus

Integral Calculus

Coordinate geometry

b. Detail Contents:

Limit, continuity and differentiability, successive differentiation of various types of functions, Leibnit'z theorem, Rolle's theorem, Mean Value theorem, expansion in finite and infinite forms, Lagrange's form of remainder, Cauchy's form of remainder (expansion of remainder), expansions of functions differentiation and integration, indeterminate form, Cartesian differentiation, Euler's theorem, tangent and normal, sub tangent and subnormal in Cartesian and polar coordinates, maxima and minima of functions of single variables, curvature, asymptotes.

Definition of integrations, integration by the method of substitution, integration by parts, standard integrals, integration by the method of successive reduction, definite integrals and its use in summing series, Walli's formula, improper integrals, beta function and gamma function, multiple integral and its application, area, volume of solid revolution, area under a plain curve in Cartesian and polar coordinates, area of the region enclosed by two curves in Cartesian and polar coordinates, arc lengths of curves in Cartesian and polar coordinates.

Two Dimensions:

Transformation of co-ordinates, equation of conics, its reduction to standard forms, pair of straight lines, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, circles and system of circles, orthogonal circles, radical axis and its properties, radical centers, coaxial circles and limiting points, equations of parabola, ellipse in Cartesian and polar coordinates.

Three Dimensions:

System of coordinates, projection, direction cosines, equations of planes and lines, angle between lines and planes, distance from a point to a plane, co-planner lines. Shortest distance between two given straight lines, standard equation of conicoides, sphere and ellipsoid.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Define the basic terminology and theorems associated with differentiation, integration, and coordinate geometry.	3											

CO2	Find the differentiation, integration, maxima and minima of different types of functions and also find area enclosed by curves and arc length of a curve.	3											
CO3	Describe General equations of second degree and their reduction to standard forms and analyze conic sections: Circles, Parabolas, Ellipses Hyperbolas, conicoides, sphere and ellipsoid etc.	3											
CO4	Apply the acquired concepts of differentiation, integration, co-ordinate geometry to solve problems arising in mathematics and engineering.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to define the terminology and theorems associated with differentiation, integration and coordinate geometry.
CO2-PO1	3	Students will be able to find differentiation, integration the rate of change, length or area related problem.
CO3-PO1	3	Students will be able to classify the general equation of second degree into different conics and conicoides.
CO4-PO1	3	Students will be able to apply the knowledge of mathematics to solve engineering problems.

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

Formal Assessment	5.5
Total	122.5
TEACHING METHODOLOGY	
Class lecture, pop quiz, case study, and problem solving.	
COURSE SCHEDULE	

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Function, Limit.		
	2	Continuity.		
	3	Differentiability.		
2	4	Rolle’s Theorem.		
	5	Cauchy’s mean value theorem (Lagrange‟s mean value theorem as a special case).		
	6	Taylor‟s and Maclaurin‟s theorems with remainders.		
3	7	Taylor‟s and Maclaurin‟s theorems with remainders.		
	8	Indeterminate forms.		
	9	Partial derivatives and their geometrical interpretation.	CT-01	Lectures 1-6
4	10	Euler’s theorem.		
	11	Tangent and normal.		
	12	Sub tangent and subnormal in Cartesian coordinates.		
5	13	Maxima and minima of functions of single variables.		
	14	Maxima and minima of functions of single variables.		
	15	Curvature.	CT-02	Lectures 7-14
6	16	Curvature.		
	17	Asymptotes.		
	18	Definition of integrations.		
7	19	Integration by the method of substitution.		

	20	Integration by parts.		
	21	Standard integrals.		
8	22	Integration by the method of successive reduction,	M	
	23	Definite integrals and its use in summing series.		
	24	Definite integrals and its use in summing series.		
9	25	Walli's formula.		
	26	Improper integrals.		
	27	Beta function and Gamma function.		
10	28	Beta function and Gamma function.		
	29	Multiple integral and its application.	CT-03	Lectures 25-29
	30	Multiple integral and its application.		
11	31	Area, volume of solid revolution.		
	32	Area of the region enclosed by two curves in Cartesian and polar coordinates.		
	33	Pair of straight lines, homogeneous equations of second degree, angle between straight lines.		
12	34	General equation of second degree.		
	35	Circles and system of circles, orthogonal circles.		
	36	Radical axis and its properties, radical centers, Coaxial circles and limiting points.		
13	37	Transformation of co-ordinates, equation of conics, its reduction to standard forms		
	38	Equations of planes and lines, angle between lines and planes.		

	39	Distance from a point to a plane.		
14	40	Equation of straight line.		
	41	Shortest distance between two given straight lines		
	42	Standard equation of conicoides, sphere and ellipsoid		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	70	
2	CT	70	
3	CT	70	
4	CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	
4	M, F	30	

REFERENCE BOOKS

Calculus – Howard Anton

A text Book of Differential Calculus – Rahman and Bhattachrjee.

Differential Calculus – Shanti Narayan.

Differential Calculus – Dr. B. D. Sharma.

Differential Calculus – Das and Mukhajee.

Integral Calculus – Rahman and Bhattacharjee.

Integral Calculus – Abu Eusuf.

Integral Calculus – Das and Mukhajee.

A text book on of coordinate geometry with vector analysis-Rahman and Bhattachrjee

MATH 1201: Mathematics-II

COURSE INFORMATION			
Course Code	MATH 1201	Lecture Contact Hours	3.00
Course Title	Mathematics-II	Credit Hours	3.00
PRE-REQUISITE			
MATH 1101: Mathematics-I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course is combined with two parts of mathematics-1. Vector analysis and 2. Matrices. Vector analysis includes introduction to vectors, vector calculus, space curve, surface, Gradient, Divergence and Curl, line integral, surface integral, Green's, Stoke's and Gauss's Theorem. Matrices includes various kinds of matrices, matrix operations, solving system of linear equations using matrix, Vector Space, eigenvalues, eigenvectors.			
OBJECTIVE			
Introducing students to the fundamentals of vector and matrix. Exposing students to mathematical applications of vector and matrix handling diverse problems which occur in real life situations.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Student will learn Vector, Product of vectors, Gradient, Divergence, Curl,Vector Valued Function, unit tangent vector, unit principal	1,2	C1, C2, C3	2	1		T, ASG, F

	normal vector, Binormal vector, Curvature and Torsion, Frenet-Serret Formulas, Surface as vector valued function.						
CO2	Student will learn Line Integral, work integral, Green's Theorem, surface integral, Flux integral, Divergence Theorem, volume integral, Stoke's Theorem to evaluate work and flux in complex engineering problems.	1,2	C1, C2, C3	2	1		T, ASG, F
CO3	Student will learn Matrix, Inverse Matrix, row echelon matrix, elementary row operations, solving System of Linear Equations, Determinant.	1,2	C1, C2, C3	2	1		T, ASG, F
CO4	Student will learn Vector space, Linear dependence and independence vectors, Basis and Dimension,	1,2	C1, C2, C3	2	1		T, ASG, F

	Row space, column space and rank, Null space and nullity, Eigenvalue, Eigenvectors, Eigenspace, Quadratic forms.						

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Vector Analysis: Definition of vector, Equality of direction ratios and vectors, Addition and

multiplication of vectors, Triple products and multiple products, Differentiation of vectors,

Gradient of scalar functions, Divergence and curl of point functions, Physical significance of

gradient, divergence and curl, integration of vectors (line, surface and volume integrals);

Green's, Stoke's and Gauss's theorem and their application.

Matrices: Definition of matrix, algebra of matrices, multiplication of matrices, transpose of a

matrix, inverse of matrix, rank and elementary transformation of matrices, solution of linear

equations, linear dependence and independence of vectors, quadratic forms, matrix

polynomials, determination of characteristic roots and vectors, null space and nullity of matrix,

characteristic subspace of matrix.

CO-PO MAPPING

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

CO1	Student will learn Vector, Product of vectors, Gradient, Divergence, Curl,Vector Valued Function, unit tangent vector, unit principal normal vector, Binormal vector, Curvature and Torsion, Frenet-Serret Formulas, Surface as vector valued function.	3	3										
CO2	Student will learn Line Integral, work integral, Green’s Theorem, surface integral, Flux integral, Divergence Theorem, volume integral, Stoke’s Theorem to evaluate work and flux in complex engineering problems.	3	3										
CO3	Student will learn Matrix, Inverse Matrix, row echelon matrix, elementary row operations, solving System of Linear Equations, Determinant.	3	3										
CO4	Student will learn Vector space, Linear dependence and independence vectors, Basis and Dimension, Row space, column space and rank, Null space and nullity, Eigenvalue, Eigenvectors, Eigenspace, Quadratic forms.	3	3										
(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).													
JUSTIFICATION FOR CO-PO MAPPING													

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to know about vector, vector valued function, vector differential operator.
CO1-PO2	3	Students will be able to solve problems involving gradient, divergence and curl, finding tangent vector to a space curve and normal vector and tangent plane to surface, curvature and torsion of a space curve.
CO2-PO1	3	Students will be able to learn about line integral, surface integral and some important theorems.
CO2-PO2	3	Students will be able to solve work and flux problem in a vector field.
CO3-PO1	3	The students will attain the knowledge to understand matrix and matrix operations
CO3-PO2	3	Students will have an ability to solve system of linear equations, finding inverse of a non-singular matrix.
CO4-PO1	3	Students will learn the general vector space, eigenvalues and eigenvectors of a matrix.
CO4-PO2	3	Students will be able to find rank, eigenvalues and eigenvectors of a matrix to solve 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, and problem solving.	

CLASS SCHEDULE			
Week	Lectures	CT/ASG/M	Remarks
01	1.Vector		

	2. Dot Product	CT-01	Lecture #01-09
	3. Cross Product		
02	4. Gradient and Directional Derivative, Divergence and Curl		
	5. Laplacian Operator		
	6. Vector Valued Function Arc length parameter,		
03	7. unit tangent vector, unit normal vector, Binormal vector		
	8.Curvature and Torsion		
	9. Frenet-Serret Formulas		
04	10. Surface	ASG-01	Lecture #10-18
	11. Line Integral of Scalar field w.r.to s, Line Integral of Scalar field w.r.to x,y,z 12. Line Integral of Vector Field		
05	13. Green’s Theorem 14. Surface integral of scalar field over parametric surface 15. Surface integral of scalar field over non-parametric surface		
06	16. (Flux Integral) Surface integral of vector field over parametric surface 17. (Flux Integral) Surface integral of vector field over non-parametric surface 18. Divergence Theorem or Gauss’s Theorem		
07	19. Problems on Divergence theorem 20. Stoke’s Theorem 21. Relation Between Stoke’s Theorem and Green’s Theorem		
08	22. Matrix 23. Operations on Matrix 24. Inverse Matrix	M	

09	25. Row Echelon Matrix, Reduced row echelon matrix, elementary row operations 26. System of Linear Equations: Homogeneous System of Linear Equations 27. Non-homogeneous system of linear equations		
10	28. Gaussian elimination and back substitution, Gauss-Jordan elimination 29. Cramer’s Rule, Inverse of coefficient matrix. 30. Determinant		
11	31. Inverse matrix by elementary row operations 32. Vector space 33. Vector subspace	CT-02	Lecture #28-36
12	34. Linear combination, Linear dependence and independence vectors 35. Basis and Dimension 36. Row space, column space and rank		
13	37. Null space and nullity 38. Eigenvalue Eigenvectors (Characteristic roots and vectors) 39. Eigenspace (Characteristic subspace)	ASG-02	
14	40. Matrix polynomial 41. Kayley-Hamilton Theorem 42. Quadratic forms		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks

	Class Assessment		
1	CT	20	
2	CT	20	
3	CT	20	
4	CT	20	
	Exam		
1	M, F	80	
2	M, F	80	
3	F	80	
4	F	80	

REFERENCE BOOKS
Calculus – Howard Anton Elementary Linear Algebra – Howard Anton Matrices – ML. Khanna Vector Analysis – Schaum's Series Vector Analysis – M. D. Raisinghania. Matrices and Linear Transformations – Mohammad Iman Ali.

MATH 2101 Mathematics-III

COURSE INFORMATION			
Course Code	MATH 2101	Lecture Contact Hours	3.00
Course Title	Mathematics-III	Credit Hours	3.00
PRE-REQUISITE			
MATH 1101, MATH 1201			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			

Background of arising Differential Equations and Introduction, Differential Equation of first order and first degree, Solution of exact and linear Differential Equations of first order and first degree, Differential Equation of first order but higher degree, Solution of higher order Differential Equation by various Method, Introduction to PDE, Linear Partial Differential Equations, Linear Partial Differential Equations with constant coefficients, Non-linear Partial Differential Equations, Application of Differential Equations. The learning approach is to apply engineering principles to performance analysis and forecast of differential equation. Students will achieve comprehension of the fundamental hypothetical premise of the differential equation and their application to a scope of issues of pertinence to practical engineering.
OBJECTIVE
To Identify the type of a given differential equation and select and apply the appropriate analytical technique for finding the solution of first order and selected higher order ordinary differential equations. To teach students to evaluate first order differential equations including separable, homogeneous, exact, and linear. Introduce students to how to solve second order and higher order linear differential equations. Learn Solving procedure of nonhomogeneous equations. To familiarize with solving technique of differential equations using variation of parameters. To teach students to solve linear systems of ordinary differential equations. Introduce students to partial differential equations. Introduce students to how to solve linear and non-linear Partial Differential with different methods. Introduce students to some physical problems in Engineering that results in partial differential equations.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-pondingPO	Bloom’s Taxonomy	KP	CP	CA	Assessment Methods

CO1	Explain the concept of differential equation. Explains the meaning of solution of a differential equation. Solve first-order ordinary differential equations. Solve exact and Bernoulli differential equations. Converts separable and homogeneous equations to exact differential equations by integrating factors.	2	C1	2			Q, ASG, F
CO2	Find solution of higher-order linear differential equations. Solve the homogeneous linear differential equations with constant coefficients	1	C1	2	2		Q, ASG, F
CO3	Uses the method "variations of parameters" to find to solution of higher-order linear differential equations with variable coefficients. Uses the operator method to solve linear systems with constant coefficients	2	C2	2	2		Q, ASG, F

CO4	Solves the homogeneous non-linear systems with constant coefficients. Generate solutions of linear and non-linear partial differential equation by different methods.	2	C2	5	2		Q, ASG, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Background of arising Differential Equations and Introduction.

Differential Equation of first order and first degree.

Solution of exact and linear Differential Equations of first order and first degree.

Differential Equation of first order but higher degree

Introduction to PDE.

Linear Partial Differential Equations and Linear Partial Differential Equations with constant coefficients.

Non-linear Partial Differential Equations.

b. Detail Contents:

Background of arising Differential Equations and Introduction: What is Differential equation and why we need it? Differential equation in various field, Types of Differential equation

Degree and Order of Ordinary differential Equation, General solution and Particular Solution, Formulation of Differential Equations, Solutions of Differential Equation. Differential Equation of first order and first degree and its solutions: standard forms, Solvable by separating variable, Homogeneous Differential Equation, exact and linear Differential Equation, Bernoulli DE. Differential Equation of first order but higher degree: Equation solvable for p, y, x, Linear Differential Equation with constant coefficients, Introduction to PDE: Definition and examples, Method of forming Partial Differential Equations, Linear

Partial Differential Equations and Linear Partial Differential Equations with constant coefficients: Lagrange’s equation, method of multipliers,

Method of finding complementary function and particular integral. Non-linear Partial Differential Equations: Partial Differential Equation non-linear in p and q, Charpit’s and Monge’s method.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Explain the concept of differential equation. Explains the meaning of solution of a differential equation. Solve first-order ordinary differential equations. Solve exact and Bernoulli differential equations. Converts separable and homogeneous equations to exact differential equations by integrating factors.		3										
CO2	Find solution of higher-order linear differential equations. Solve the homogeneous linear differential equations with constant coefficients	3											
CO3	Uses the method "variations of parameters" to find to solution of higher-order linear differential equations with variable coefficients. Uses the operator method to solve linear systems with constant coefficients		2										

C04	Solves the homogeneous non-linear systems with constant coefficients. Generate solutions of linear and non-linear partial differential equation by different methods.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	3	Students will get clear theoretical knowledge about first order differential equations including separable, homogeneous, exact, linear.
CO2-PO1	3	The students will attain the knowledge to understand higher order and higher degree differential equation.
CO3-PO2	2	Students will have an ability to determine solution of higher order linear differential equation.
CO4-PO2	3	Students will learn to how to solve linear and non-linear partial differential equations by various 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

Weeks	Lectures	Topics	CT/ASG/M	Remarks
1	1	Background of arising Differential Equations and Introduction: What is Differential equation and why we need it? Differential equation in various field Types of Differential equation		
	2	Degree and Order of Ordinary differential Equation General solution and Particular Solution		
	3	Formulation of Differential Equations Solutions of Differential Equation		
2	4	Differential Equation of first order and first degree Standard forms		
	5	Solvable by separating variable		
	6	Transformation of some equations in the form in which variables are separable		
3	7	Homogeneous Differential Equation Equation reducible to homogenous form		
	8	Linear differential equation		
	9	Bernoulli differential equation	CT-01	Lecture 1-6
4	10	Solution of exact and linear Differential Equations of first order and first degree Exact differential equation Integrating factor Linear equations of first order		
	11	Equation reducible to the Exact form		

	12	Equation reducible to linear form (Brenoulli Equation)		
5	13	Differential Equation of first order but higher degree Equation solvable for p		
	14	Equation solvable for y		
	15	Equation solvable for x		
6	16	Clairaut's Equation		
	17	Linear Differential Equation with constant coefficients (Real and distinct roots)		
	18	Linear Differential Equation with constant coefficients (Real and equal roots)	ASG-01	Lectures 9-17
7	19	Linear Differential Equation with constant coefficients (Complex roots)		
	20	Homogeneous Linear Differential Equation and its application		
	21	Solution of higher degree Differential Equation by various Method Frobenious methods		
8	22	Bessel's functions	M	
	23	Legendre's polynomials		
	24	Introduction to PDE Definition and Examples		
9	25	Method of forming Partial Differential Equations		
	26	Linear Partial Differential Equations Lagrange's equation		
	27	Method of Multipliers		Lectures 20-26

10	28	Linear Partial Differential Equations with constant coefficients Homogeneous and non-homogeneous Partial Differential Equations with constant coefficients	CT-02	
	29	Operator method		
	30	Operator method		
11	31	Method of finding complementary function		
	32	Method of finding particular integral		
	33	Method of variation of parameters		
12	34	Equation reducible to linear Differential Equation with constant coefficients		
	35	Non-linear Partial Differential Equations, Partial Differential Equation non-linear in p and q		
	36	Charpit's Method		
13	37	Monge's Methods	ASG-02	Lectures 28-36
	38	Application of Differential Equations, Solution of various wave equation		
	39	Boundary and initial value problems solution		
14	40	Review class		
	41	Review class		
	42	Review class		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT	20	
2	ASG, CT	30	
3	ASG, CT	20	

4	ASG, CT	20	
	Exam		
1	MID, Final Exam	80	
2	MID, Final Exam	70	
3	MID, Final Exam	80	
4	MID, Final Exam	80	

REFERENCE BOOKS
Introduction to Ordinary Differential Equations- Shepley L. Ross Ordinary and Partial Differential Equations- M.D. Raisinghania Advanced Engineering Mathematics- H.K. Das Differential Equations – Dr. B.D. Sharma

MATH 2201 Mathematics –IV

COURSE INFORMATION			
Course Code	MATH 2201	Lecture Contact Hours	3.00
Course Title	Mathematics-IV	Credit Hours	3.00
PRE-REQUISITE			
MATH 1101: Mathematics-I, MATH 1201: Mathematics-II, MATH 2101: Mathematics-III			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The main objective of this course is to introduce the students with the basic concepts of complex variables, complex integration and statistical probability. Upon the effectively accomplishment of this course students will be bright to know the complex number system, theory of numbers, and can solve associated problems arising in engineering. Student will able to know the Laplace transform and inverse Laplace transforms of derivatives, integrals and periodic functions. Students will get the sound knowledge on Fourier series, Fourier Transform, and Fourier Integral through analyzing the signal. Also, students will be able to solve probability related real life problems. In Statistical signal processing, lot of research is based on complex analysis. Many techniques and methods are transformed to complex			

domain. With the successfully completion of this course the student will able relate complex information to statistical phenomena in engineering mathematics.
OBJECTIVE
To equip the students with in-depth basic concepts and knowledge on complex variable. To familiarize students with the terminology associated with finding the Laplace transform of a function using the definition. Teach students to Use the translation theorems to find Laplace transforms To familiarize students with the Laplace transform of derivatives, integrals and periodic functions. Teach students how to Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients. To familiarize students with fundamental mathematical properties of the Fourier transform including linearity, shift, symmetry, scaling, modulation and convolution.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres- ponding PO	Bloom's Taxono- my	KP	CP	CA	Assess- ment Methods
CO1	Describe the basic terminology of Probability theorem, complex variables and complex function, and Laplace transform hence explain the complex differentiation and integration with the concept of various complex problem.	1	C1,C2				ASG,T, F
CO2	Extract the Laplace and inverse Laplace transforms hence solve the differential equation with the assist of inverse Laplace transform. As well as interpret the Convolution theorem by solving	1	C2, C3				ASG, Q, T, F

	inverse Laplace transform.						
CO3	Articulate the Fourier series, Fourier Transformations and Fourier Integral	1	C1, C3				ASG, Q, M, F
CO4	Convert the functions in Fourier series, Fourier Transformations and Fourier Integral with input functions, such as: continuous, piecewise continuous, unit step, impulse and periodic.	1,2	C2, C3, C4				Q, M,F
CO5	Calculate and apply the statistical probability and analyze the theoretical probability related problems arising in engineering mathematics.	1,2	C2, C3, C4				Q, M,F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Statistics Analysis

Fourier Analysis

Complex Variable

Laplace Transform

b. Detail Contents:

Statistical Analysis: Regression and correlation analysis, curve fitting, method of least square, elementary probability theory, random variable, probability distribution function, moment generating function, binomial distribution, negative binomial distribution, geometric distribution, Poisson distribution, normal distribution, exponential distribution, physical significance and practical examples of such distributions, law of large number and central limit theorem, estimation, hypothesis testing.

Fourier Analysis: Real and complex form. Finite transform: Fourier integral, Fourier transforms and their uses in solving boundary value problems.

Complex Variables: Complex number system, general functions of a complex variable, limits and continuity of a function of complex variable and related theorems, complex function, differentiation and the Cauchy-Riemann equations. Line integral of a complex function, Cauchy's integral formula, Liouville's theorem, Taylor's and Laurent's theorem, singular residues, Cauchy's residue theorem.

Laplace Transform: Definition, Laplace transforms of some elementary functions, sufficient conditions for existence of Laplace transform, inverse Laplace transforms, Laplace transforms of derivatives, the unit step function, periodic function, some special theorems on Laplace transform, partial fraction, solutions of differential equations by Laplace transform, evaluation of improper integral.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Describe the basic terminology of Probability theorem, complex variables and complex function, and Laplace transform hence explain the complex differentiation and integration with the concept of various complex problem.	3	3										
CO2	Extract the Laplace and inverse Laplace transforms hence solve the differential equation with the assist of inverse Laplace transform. As well as interpret the Convolution theorem by solving inverse Laplace transform.	3	3										
CO3	Articulate the Fourier series, Fourier Transformations and Fourier Integral	3											

CO4	Convert the functions in Fourier series, Fourier Transformations and Fourier Integral with input functions, such as: continuous, piecewise continuous, unit step, impulse and periodic.	3	3										
CO4	Calculate and apply the statistical probability and analyze the theoretical probability related problems arising in engineering mathematics.	3	3										

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

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to define terminology of basic complex variables, complex functions and related theorem.
CO1-PO2	3	Students will be able to evaluate the complex differentiation and integration and can solve it.
CO2-PO1	3	Students will be able to know the Laplace transform and inverse Laplace transforms hence solve the differential equation with the assist of inverse Laplace transform
CO2-PO2	3	Students will able to find the Convolution theorem by solving inverse Laplace transform
CO3-PO1	3	Students will able to know the fundamental properties of the Fourier transform including linearity, shift, symmetry, scaling, modulation and convolution. Also, student will able to convert the function to Fourier series and integral
CO4-PO1	3	Students will have the ability to convert the time domain to frequency domain of any types of periodic function.
CO4-PO2	3	Students will have the ability to develop any function to Fourier integral and they can solve any multi valued function arise in engineering problems.
CO5-PO1	3	Students can apply the acquired knowledge to solve statistical problem and theoretical probability. Based on the knowledge of probability students will be able to formulate different engineering problem and can solve it. As well as students will

		have the sound knowledge to develop correlation and regression.
CO5-PO2	3	Students will be able to relate complex information to statistical phenomena in engineering mathematics and they will have the knowledge on identify the hypothesis

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	Lecture	Topics	CT/ASG/M	Remarks
1	1	Elementary probability theory, random variable		
	2	Probability distribution function		
	3	Binomial distribution		
2	4	Normal distribution		
	5	Poisson distribution		
	6	Poisson distribution related problem solving		
3	7	Correlation analysis		
	8	Regression		
	9	Curve fitting	CT-01	Lectures 1-6
4	10	Method of Least square		
	11	Estimation theory		
	12	Estimation theory related problems solving		

5	13	Basic concept of hypothesis , Text of hypothesis related problems solving		
	14	Test for Specified value of a single Mean for Small Sample (When Variance Known)		
	15	Test for Specified value of a single Mean for Small Sample (When Variance Known) Test for Equality of two Means Small Sample (Unknown Variance)		
6	16	Basic concept of Fourier Transform		
	17	Fourier sine transform and Inverse Fourier sine transform		
	18	Fourier cosine transform and Inverse Fourier cosine transform Properties of Fourier transform	ASG-01	
7	19	The Convolution theorem of Fourier transform Parseval's identity of Fourier transform and uses in solving boundary value problems		
	20	Fourier Integral		
	21	Uses of Fourier integral	M	
8	22	Evalute Fourier integral		
	23	Complex number system, General function of a complex variable		
	24	Limits and continuity of a function of complex		

		variable and related theorems		
9	25	Complex function , differentiation		
	26	The Cauchy- Riemann Equation		
	27	Cauchy's form of remainder(expansion of remainder)		
10	28	expansions of functions, differentiation		
	29	Integration ,Line integral of a complex function,		
	30	Cauchy's Integral formula, Liouvillie's Theorem		
11	31	Taylor's and Laurent's Theorem,		
	32	Singular Residues, Cauchy's Residue Theorem		
	33	Residue, Residue theorem	CT-02	Lectures 23-32
12	34	Evaluation of definite integrals		
	35	Definition of Laplace transform, Sufficient conditions for existence of Laplace transform		
	36	Laplace transforms of some elementary	ASG-02	
13	37	Evaluating function through Laplace transformation		
	38	Laplace transforms of some elementary functions.		

	39	Inverse Laplace transform, Laplace transforms of derivatives by using Partial fraction		
14	40	The Unit Step function, Periodic function , some special theorems on Laplace transforms		
	41	Partial fraction, Solutions of differential equations by Laplace transform		
	42	Convolution theorem of LT		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
2	CT	30	
4	CT	20	
	Exam		
1	F	80	
2	F	70	
3	F	100	
4	M,F	70	
5	M,F	100	

REFERENCE BOOKS

Theory and Problems of Complex variables-Marry R Sprigel

Theory and Problems of Complex variables-Shanti Narayan

Mathematical Physics – Raj Put

Fourier Analysis - Marry R Sprigel

Probability Theory –Monindra Kumar Roy

An Introduction to Statistics – Nurul Islam

HUM 1215: English

COURSE INFORMATION			
Course Code	HUM 1215	Lecture Contact Hours	3.00
Course Title	English	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
The course will develop students' writing skills necessary for their academic and professional success. It will also help the students to learn and follow the conventions of standard written English in sentence structure, punctuation, grammar usage and spelling. This course will also provide fundamental aspects of reading, writing, listening and speaking skills. The course will help students to develop their language and communication skills through interactive participation in the class. Students will practice brainstorming, freewriting, paragraph and argumentative essay writing. In addition, they will practice listening and speaking activities. By attending this course student can build up communicative skills which they can utilize in their academic as well as professional life.			
OBJECTIVE			
To help students learn rudiments of English, write grammatically correct sentences and use them in their real-life situations. To enable the students to develop their reading ability through practicing a substantial number of reading materials in the classroom. To enable the students to develop their writing ability through practicing a substantial number of writing tasks in the classroom.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Acquire their knowledge of fundamental grammatical structures and functions	1	C1	1,2	1		Q, ASG, F

CO2	Read and write grammatically correct sentences. Utilize the strategies of free hand writing in other courses	2.3,5	C3	3	2		Q, ASG, F
CO3	Use the language for their daily life communication with the native speakers and nonnative speakers more efficiently	10	C2	3,7	3,6	1	Q, ASG, F
CO4	Write paragraph, easy, report, summary, précis writing, cover letter and cv writing	5,12	C3	3,8	5,7		Q, ASG, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

Rules and types of tenses

WH question

Parts of speech

Phrase and clause

Structures and transformation of sentences

Write paragraph, easy, report, summary, précis writing, cover letter and cv writing

b. Detail Contents:

SECTION-A: General discussion: Introduction, various approaches to learning English, Grammatical Problem: Construction of sentences, grammatical errors, sentence variety and style, conditionals, vocabulary and diction; Reading Skill: Discussion readability, scan and skin reading, generating ideas through purposive reading, reading selective stories, Approaches to Communication: Communication today, business communication, and different types of business communication, Listening Skill: The phonetics and correct English pronunciation, Speaking Skill: Practicing dialogue, storytelling.

SECTION-B: Writing Skill: Principles of effective writing, organization, planning and development of writing, composition (Paragraph, Comprehension), précis writing, amplification, General Strategies for the Writing process: Generating ideas, identifying audiences, and purposes, construction arguments, stating problems, drafting and finalizing, Report Writing: Defining a report, classification of reports, structure of a report and writing of report.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Acquire their knowledge of fundamental grammatical structures and functions	3											

CO2	Read and write grammatically correct sentences. Utilize the strategies of free hand writing in other courses		3	3		3							
CO3	Use the language for their daily life communication with the native speakers and nonnative speakers more efficiently										3		
CO4	Write paragraph, easy, report, summary, précis writing, cover letter and cv writing					3							3

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to know about the fundamental grammatical structures and functions of English language. They will get clear theoretical knowledge about correct rules devices and by using these devices they can formulate grammatically correct sentences.
CO2-PO2	3	Students will develop the ability to identify different problems using their grammatical knowledge while reading and writing in English.
CO2-PO3	3	Students will be able to solve different grammatical problems with their theoretical knowledge.
CO2-PO5	3	Students will be able to use different tools and grammatical devices to write correct sentences and use them in their real life situations.
CO3-PO10	3	By attending this course student can build up communicative skills which they can utilize in their academic as well as professional life. At the same time, they will be able to improve their presentation skills for academic purposes.
CO4-PO5	3	Students will learn different techniques and structures to develop their writing skills necessary for their academic and professional success.
CO4-PO12	2	After the completion of the course, the students will be able to use the acquired theoretical and practical knowledge in other academic and professional fields in the long run too.

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, and problem solving.	

COURSE SCHEDULE				
Weeks	Lectures	Topics	CT	Remarks
1	1	Types of questions, ways of asking an answering questions		
	2	Different Uses of Tense		
	3	Difference between Past and present Perfect Difference between Simple future and present continuous		
2	4	Definition of Phrase, Types of Phrase Identify Phrases (Lec 1)		
	5	Definition of Phrase, Types of Phrase Identify Phrases (Lec 2)		

	6	Definition of Clause, types of Clause Identify Clause		
3	7	Noun clause, adjective clause,		
	8	Adverbial clause and conditional clause		
	9	Function and paraphrase of the Modals	CT-01	Lecture 1-6
4	10	Basic sentence structures (Lec-01)		
	11	Basic sentence structures (Lec-02)		
	12	Different Rules of Transformation		
5	13	Difference between phonetics and phonology, IPA symbols		
	14	Phonemic transcription and rules of pronunciation		
	15	Notions and Functions: formal and informal situations, asking for information, making request, greeting someone, congratulating etc. (Lec-01)		
6	16	Notions and Functions: formal and informal situations, asking for information, making request, greeting someone,		

		congratulating etc. (Lec-02)		
	17	Practicing dialogue: role play, guided conversation, questioning and answering.		
	18	Practicing dialogue: role play, guided conversation, questioning and answering.	ASG-01	
7	19	Reading: diferent reading strategies (Scanning and Skinning, guessing, contextualization)		
	20	Practice reading using authentic materials and giving feedback		
	21	Practice reading using authentic materials and giving feedback		
8	22	Practice reading using authentic materials and giving feedback		
	23	Writing: how to write an application		
	24	Different types of application (job application, cover letter etc.)		
9	25	CV writing (Lecture 1)		
	26	CV writing (Lecture 2)	M	
	27	Report writing (Lecture 1)		

10	28	Report writing (Lecture 2)		
	29	Summary and precise (Lecture 1)		
	30	Summary and precise (Lecture 1)		
11	31	Pragraph writing: Strategies of writing a paragraph, different parts of a paragraph		
	32	Types of paragraph		
	33	Listing paragraph	CT-02	Lectures 23-32
12	34	Example paragraph		
	35	Comparison paragraph		
	36	Contrast paragraph		
13	37	Essay writing: how to write an essay		
	38	Different parts of an essay	ASG-02	
	39	Descriptive essay		
14	40	Narrative essay		
	41	Argumentative essay		
	42	Review		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
3	CT	30	
4	CT	30	

	Exam		
1	M, F	80	
2	F	100	
3	M, F	70	
4	F	70	

REFERENCE BOOKS
High school English Grammar by Wren & Martin A Practical English Grammar by Thomson & Martinet English Phonetics and Phonology by Peter Roach Language & Communication by Miller, G.A.

HUM 2117 Economics

COURSE INFORMATION			
Course Code	HUM 2117	Lecture Contact Hours	2.00
Course Title	Economics	Credit Hours	2.00
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides procedures of analyzing economic principles and their applications. Students will be able to understand basic economic concepts – demand, supply, elasticity, market structures, time value of money and aggregate demand & supply and monetary, fiscal policies. Understand the basic of micro and macro-economics The knowledge accumulation for finding a balance between unlimited demands and scarce resources. Gaining knowledge about stages of economic upturns and downturns and how government tackles it.			
OBJECTIVE			

To solve basic problems regarding economics. To know how societies use scarce resources to meet unlimited needs. To learn how markets and other governance structures organize core economic activities, such as production, distribution, consumption and the growth of productive resources. To learn about the determinants of macroeconomic conditions (national output, employment, and inflation), causes of business cycles, and interactions of monetary and financial markets with the real economy, familiarizing themselves in the process with major economic theories of relevance.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify economic concepts and theories related to the behavior of economic agents, markets, industry and firm structures, legal institutions, social norms, and government policies.	2	C1	1			Q, ASG, M, CT, F
CO2	Demonstrate knowledge on the basic features of alternative representations of human behavior in economics and integrate theoretical knowledge with quantitative and qualitative evidence in order to explain past economic events and to formulate predictions on future ones	2	C2	1			Q, ASG, M, CT, F
CO3	Discuss the linkages between financial markets and the real economy, and how these linkages influence the impact of economic policies over differing time horizons and the consequences within a business cycle.	3	C5	5			Q, Pr, CT, F

CO4	Evaluate the consequences of economic activities and institutions for individual and social welfare.	1	C5	1			F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

The Economic Problem.

Demand and Supply.

Competitive Dynamics and Government.

Market Structure.

Theory of production and cost.

Time value of Money.

Aggregate Demand and Supply.

Fiscal Policy, Monitory Policy, Money.

b. Detail Contents:

The Economic Problem: micro economics and macro-economics, positive vs. normative economics, economic choice, production possibility frontier, economic goals.

Demand and Supply: concept of supply and demand and their determinants, market equilibrium and shifts of market equilibrium, the law of diminishing marginal utility, price elasticity of demand, price elasticity of supply, spillover effects.

Theory of production and cost: production cost and profit, total cost, average cost, marginal and variable cost, production in the short run, costs in the short run, production and costs in the long run.

Market Structure: market structures, mergers.

Time value of Money: time value for money depreciation.

Competitive Dynamics and Government: circular flow of income, various measurement methods of national income accounting.

Aggregate Demand and Supply: concept of aggregate demand and aggregate supply shift of AD & AS, factors behind the shift of AD & AS, interaction of AD & AS.

Fiscal Policy, Monitory Policy, Money: fiscal policy: concept, the spending multiplier, impact, monetary policy: concept, tools of monetary policy, balance of payment, exchange rates, money: use, money market, money creation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify economic concepts and theories related to the behavior of economic agents, markets, industry and firm structures, legal institutions, social norms, and government policies.		3										
CO2	Demonstrate knowledge on the basic features of alternative representations of human behavior in economics and integrate theoretical knowledge with quantitative and qualitative evidence in order to explain past economic events and to formulate predictions on future ones.		2										

CO3	Discuss the linkages between financial markets and the real economy, and how these linkages influence the impact of economic policies over differing time horizons and the consequences within a business cycle.			3								
CO4	Ability to evaluate the consequences of economic activities and institutions for individual and social welfare.	3										

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO2	3	Students will get clear theoretical knowledge about various economic agents, market, government policies and societal norms.
CO2-PO2	2	Students will be able to determine both their personal and professional revenue, spending habits and patterns, tax, subsidiaries etc.

CO3-PO3	3	Students will have an ability to calculate the change in different economic measures and government policies.
CO4-PO1	3	Students will be able to evaluate the consequences of economic activities and institutions for individual and social welfare.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	50
Formal Assessment	3.5
Total	81.5

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Assignment, Presentation

COURSE SCHEDULE

Weeks	Lectures	Topics	CT	Remarks
1	1	Definition, Micro Economics and Macro Economics,		
	2	Positive Vs. Normative Economics, Economic choice, Production Possibility Frontier		
2	3	Economic Goals		
	4	Concept of Demand and their determinants		
3	5	Concept of Supply and their determinants		
	6	Market equilibrium and shifts of market equilibrium, The law of diminishing marginal utility	CT-01	Lecture 1-6
4	7	Price elasticity of Demand		
	8	Price elasticity of Supply		
5	9	Calculating price elasticity of demand and supply		
	10	Spillover effects		

6	11	Introduction to Market Structures ,Perfect Competitions and Benefits of perfect competitions		
	12	Monopoly and Imperfect competitions, Traits of Imperfect competitions, Mergers.	ASG-01	Lectures 10-12
7	13	Break-even point analysis		
	14	Concept of Aggregate demand and supply		
8	15	shift of aggregate demand and supply		
	16	factors behind the shift of AD	M	
9	17	Production cost and profit, total cost, average cost		
	18	Production cost and profit, total cost, average cost, Marginal and variable cost, Production in the short run		
10	19	Costs in the short run, Production and Costs in the long run.		
	20	The Business Cycle		
11	21	Fiscal Policy: Concept	CT-02	Lectures 15-21
	22	The Spending Multiplier		
12	23	Tools of monetary policy, Balance of Payment, Exchange Rates.		
	24	Impact of Monetary Policy: Concept, Money: Use, Money Market		
13	25	Time Value of Money		
	26	The Money creation Process	ASG-02	
14	27	Review class		
	28	Review class for Final exam		

ASSESSMENT STRATEGY

	CO	Assessment Method	(100%)	Remarks	
		Class Assessment			
	1	Q, ASG, CT	20		
	2	Q, ASG, CT	30		
	3	Q, Pr, CT	30		
		Exam			
	1	MID, Final Exam	80		
	2	MID, Final Exam	70		
	3	Final Exam	70		
	4	Final Exam	100		

REFERENCE BOOKS
Mark Lovewell: Understanding Economics- A Contemporary Perspective. N. Gregory Mankiw: Principles of Macroeconomics. Johnson: Macroeconomics.

HUM 2219 Accounting

COURSE INFORMATION			
Course Code	HUM 2219	Lecture Contact Hours	2.00
Course Title	Accounting	Credit Hours	2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			

This course intends to develop students' understanding of basic concepts of accounting, accounting process, and the application of the conceptual framework in such process in order to develop their abilities to complete the accounting cycle ending with preparation and presentation of financial statements.
OBJECTIVE
To introduce the theoretical foundation of accounting (concepts, assumptions, and principles) and the financial statements of a profit seeking enterprise. To develop the skills required to identify and record accounting transactions, prepare basic financial statements including the statement of financial position, statement of comprehensive income, and statement of changes in equity. To familiarize the students with different principles of managerial accounting and cost accounting fundamentals .
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	To describe the concepts of accounting to be able to solve the financial and managerial problems.	11	C1	2	P6, P7		Q, ASG, F
CO2	To explain the rules of debit/credit as well as the apply the procedures of preparing journal entries, posting the journal into ledger, scheduling trial balance, and preparing financial statements for better economic decision making.	4, 11	C2, C3	2	P6, P7		Q, ASG, F
CO3	To analyze and solve a variety of financial and managerial accounting problems, business problems and utilize	6	C4, C5	7	P4, P6		Q, ASG, F

	opportunities in real life situations.						
CO4	To communicate accounting and financial information with stakeholders.	6	C6	7	P4, P6		Q, ASG F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Accounting in Action

The Recording Process

Adjusting the Accounts

Preparation of Financial Statements

Cost accounting fundamentals

Budgeting

b.Detail Contents:

Fundamentals: Definition of accounting, accounting concept and convention, definition of book keeping, objects and advantages of book keeping, principles of double entry book keeping.

The Nature of Transaction: Classification of accounts, rules for debit and credit, kinds of cheques and treatment of cheques in accounts.

Journal: Journal posting, balancing and closing,

Trial Balance: Introduction to trial balance, functions, preparation of trial balance, limitations of trial balance, financial statements, analysis of financial statement.

Cost Accounting: Introduction, reasons for cost accounts, recorded cost, estimated cost, standard cost, elements of cost, cost statement, sources of cost data, distribution of overhead charges, stores ledger, marginal costing, break-even point, margin of safety, p/v ratio.

Budgeting: Types of budgets, preparing budgets and budgetary controls.

CO-PO MAPPING

	No.	Course Outcome	PROGRAM OUTCOMES (PO)

			1	2	3	4	5	6	7	8	9	10	11	12
	CO1	To describe the concepts of accounting to be able to solve the financial and managerial problems.											3	
	CO2	To explain the rules of debit/credit as well as the apply the procedures of preparing journal entries, posting the journal into ledger, scheduling trial balance, and preparing financial statements for better economic decision making.				3							3	
	CO3	To analyze and solve a variety of financial and managerial accounting problems, business problems and utilize opportunities in real life situations.						3						
	CO4	To communicate accounting and financial information with stakeholders.						3						

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

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO11	3	Students will understand how to apply financial accounting concepts and principles to make better economic decisions.
CO2-PO4	3	Students will be able to investigate the accounting transactions and subsequently analyze and interpret the financial data by combining financial information.
CO2-PO11	3	Students will attain knowledge about how to take financial and managerial decisions after analyzing journal, ledger, trial balance, and financial statements.
CO3-PO6	3	The students will be able to understand about cost accounting fundamentals as well as they

		will learn to utilize cost accounting knowledge in their professional field.
CO4-PO6	3	Students will gather relevant knowledge budgeting.

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	Lecture	Topics	CT/AS G	Remarks
1	1	Definition of accounting, Users of accounting information, Importance of Accounting Information		
	2	Transaction and its Characteristics, Branches of Accounting, Difference between bookkeeping and Accounting, GAAP		
2	3	The Accounting concepts, Accounting conventions, Assumptions		
	4	Financial and Managerial Accounting, Basic Event & transaction, Classification of transaction, Accounting Equation		
3	5	Steps of recording process, Debit, credit & rules of debit credit		
	6	Journal and its advantages, Process of Journal Entries Journal Entry Practice	CT-01	Lectures 1-6
4	7	Ledger, Procedure of making Ledger, Ledger Practice		
	8	Trial Balance, Advantages, and Limitations of Trial Balance		

5	9	Adjusting the Accounts: Fiscal Year, Calendar Year, Adjusting Entries,		
	10	Types of Adjusting Entries, Cash basis, Accrual Basis, Depreciation Problem solving of adjusting entries		
6	11	Adjusted ledger, Adjusted trail balance, Worksheet		
	12	Purpose, importance, uses of worksheet, Steps in preparing worksheet	ASG-01	
7	13	Income Statement, Balance sheet		
	14	Income Statement, Balance sheet		
8	15	Cash flow Statement, Changes in Ownership Statement	M	
	16	Cost concept and classification. Segregation of mixed costs, overhead costs.		
9	17	Cost concept and classification. Segregation of mixed costs, overhead costs		
	18	Introduction to breakeven analysis, contribution margin approach, sensitivity analysi		
10	19	CVP analysis		
	20	CVP analysis		
11	21	Use of those tools and technique in calculating, anticipating and controlling cost, profit, breakeven in relation to the desir ed or actual volume of produced units.		
	22	Use of those tools and technique in calculating, anticipating and controlling cost, profit, breakeven in relation to the desir ed or actual volume of produced units.	CT-02	Lectur es 23-32
12	23	Variable costing		
	24	Budget, classification, importance and nature	ASG-02	
13	25	Preparation of different budgets		
	26	Preparation of different budgets		
14	27	Review class		
	28	Review class		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
2	CT	20	
3	CT	20	
4	CT	20	
	Exam		
1	F	80	
2	F	80	
3	M,F	80	
4	M,F	80	

REFERENCE BOOKS

Accounting Principles: Donald E. Kieso, 12th Edition

Managerial accounting: Ray H. Garrison, Eric W. Noreen, Peter C. Brewer

HUM 3111: Sociology

COURSE INFORMATION			
Course Code	HUM 3111	Lecture Contact Hours	2.00
Course Title	Sociology	Credit Hours	2.00

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course is designed to teach about fundamental concepts of Sociology and application of those knowledge in Engineering fields.

OBJECTIVE

The objective of this course is to provide the knowledge about the basic concepts and principles of industrial sociology pertaining to real-life situation.

Encourages creative thinking and development of a deeper understanding and intuitive feel for sociology.

Enhance their different problem-solving skills in different social situations.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom’s Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Knowing about the nature, scope, aim and rise of industrial sociology, history of industrialization-ancient and modern, the development of industry and industrial society in Bangladesh.	6	C2	7	7		T, MT, F, ASG
CO2	Learn about the industrial bureaucracy, Work and art, nature of industrial work, work ideology, work values.	12	C2	7	6		T, MT, F, ASG
CO3	Understand the social, moral and human values, ethics of a society, Industry and Community, social stratification and development.	8	C2	7	6		T, MT, F, ASG
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

Introduction: Fundamental concepts, viscosity, compressibility and elasticity, surface tension and capillarity, vapour pressure, manometer.

Fluid Statics: Pressure at a point, pressure gradient, pressure on flat and curved surfaces immersed in fluids, center of pressure. Buoyancy and flotation, meta-center and metacentric height, stability of submerged and floating bodies, fluid containers subjected to constant acceleration and rotation.

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. Euler's equation and Bernoulli's equation. Hydraulic grade line and energy grade line. Energy equation with or without losses, comparison of energy equation with Bernoulli's equation, kinetic energy correction factor. Transient flow in emptying of tank and flow between connected vessels. Flow measuring devices. Flow through sharp edged orifice, the pitot tube, the Venturi-meter, the flow nozzle and orifice meter, notches and sharp crested weirs. Momentum equation for inertial control volume, application of momentum principle for incompressible fluids in variable area duct. Impact of jet on fixed and moving vanes. Application of momentum principle for jet propulsion and propellers. Momentum correction factor: Force caused by a flow round a pipe-bend, force at nozzle and reaction of a jet, force on solid body in a flowing fluid.

Dimensional Analysis: Fundamental & derived units, Dimensional homogeneity, Buckingham theorem, significance of dimensionless numbers, Application of dimensional analysis in fluid flow problems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Knowing about the nature, scope, aim and rise of industrial sociology, history of industrialization- ancient and modern, the development of industry and industrial society in Bangladesh.						3						
CO2	Learn about the industrial bureaucracy, Work and art, nature of industrial work, work ideology, work values.												3
CO3	Understand the social, moral and human values, ethics of a society, Industry and Community, social stratification and development.								3				

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO6	3	Students will have basic knowledge of various core areas of sociology and society.
CO2-PO12	3	Students will be able to analyze the industrial bureaucracy, Work and art, nature of industrial work, work ideology, work values.
CO3-PO8	3	Students will understand the social, moral and human values, ethics of a society, Industry and Community, social stratification and development.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	56
Formal Assessment	5
Total	89

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE				
Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Nature, scope, aim and rise of industrial sociology.		
	2	History of industrialization- ancient and modern. The development of industry and industrial society in Bangladesh.		
2	3	Work and art, nature of industrial work, work ideology, work values.		
	4	Role of work in man's life: work and mental health, work attitudes, work involvement.		

3	5	The motivation to work, work satisfaction, commitment to industrial work		
	6	development and commitment of industrial labor force in Bangladesh.	CT-01	Lectures 1-4
4	7	The factory system, its characteristics		
	8	The formal relations of production in the factory system.		
5	9	The executive in the industrial bureaucracy		
	10	Industrial production and the worker's role		
6	11	social relations at work. Management as a social elite.	ASG-01	
	12	Industry and family,		
7	13	industry and social change		
	14	shifting values, influence of convictions		
8	15	religion and industrial development	M	
	16	Place of industrial worker in the society		
9	17	Nature and causes of industrial conflict		
	18	role and functions of trade unionism		
10	19	resolution of industrial conflict,		
	20	collective bargaining		
11	21	Patterns of industrial development in developing countries (1)	CT-02	
	22	Patterns of industrial development in developing countries (2)		
12	23	role of foreign capital and borrowed technology (1)		
	24	role of foreign capital and borrowed technology (2)		
13	25	Technology and social structure (1)	ASG-02	
	26	Technology and social structure (2)		
14	27	Review class		
	28	Review class		
ASSESSMENT STRATEGY				

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	20	
3	CT	30	
	Exam		
1	M, F	80	
2	M, F	100	
3	M, F	70	

REFERENCE BOOKS
Hirszowicz, M. (1981). Industrial Sociology. 6th Edition

HUM 3113: Engineering Ethics

COURSE INFORMATION			
Course Code	HUM 3113	Lecture Contact Hours	2.00
Course Title	Engineering Ethics	Credit Hours	2.00
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
The course aims at providing basic knowledge of ethics for engineers in different types of work roles and prepare the engineer for identifying, taking responsibility for, and find solutions to potential ethical dilemmas in their future profession. Special emphasis is placed on ethics in technology-intensive activities.			

OBJECTIVE
Understand the engineering code of ethics and be able to apply them as necessary. Understand moral complexities in many engineering activities and decision-making processes. Understand some of the contemporary issues in the engineering professions Effectively communicate their knowledge and understanding of engineering ethics.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Knowing about the introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering. Societal and environmental responsibilities of engineers, sustainable practices in engineering, safety, risk and liability in engineering practices.	7,8	C2	7	7		T, MT, F, ASG
CO2	Learn about the Ethical Philosophy, The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice; Ethics Issues in Mechanical Engineering	8	C2	7	6		T, MT, F, ASG

CO3	Understand the Ethical Codes and Standards and effectively communicate their knowledge and understanding of engineering ethics.	12	C2	7	6		T, MT, F, ASG

(ASG – Assignment, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Introduction: Introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering. Societal and environmental responsibilities of engineers, sustainable practices in engineering, safety, risk and liability in engineering practices.

Ethical Philosophy: Introduction to Philosophy of Engineering, The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice; Ethics Issues in Mechanical Engineering;

Ethical Codes and Standards: Professional Engineering Codes, Codes of Ethics (IEB); Code of Ethics (ASME).

Case Studies: Ethical problem-solving techniques; Case study methodology, different case studies

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Knowing about the introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering. Societal and environmental responsibilities of engineers, sustainable practices in engineering, safety, risk and liability in engineering practices.							2	3				
CO2	Learn about the Ethical Philosophy, The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice; Ethics Issues in Mechanical Engineering								3				

CO3	Understand the Ethical Codes and Standards and effectively communicate their knowledge and understanding of engineering ethics.												2

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO7, PO8	3	Students will have basic knowledge of various core areas of sociology and society.
CO2-PO8	3	Students will be able to analyze the industrial bureaucracy, Work and art, nature of industrial work, work ideology, work values.
CO3-PO12	3	Students will understand the social, moral and human values, ethics of a society, Industry and Community, social stratification and development.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	56
Formal Assessment	5
Total	89
TEACHING METHODOLOGY	
Class lecture, pop quiz, case study, and problem solving.	

COURSE SCHEDULE				
Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introduction to ethics, history, evolution		
	2	importance of ethics in Mechanical Engineering		

2	3	Societal and environmental responsibilities of engineers		
	4	sustainable practices in engineering,		
3	5	safety, risk and liability in engineering practices		
	6	Ethical Philosophy: Introduction to Philosophy of Engineering (1)		
4	7	Ethical Philosophy: Introduction to Philosophy of Engineering (2)		
	8	The Rights and Responsibilities of Engineers (1)		
5	9	The Rights and Responsibilities of Engineers (2)	CT-01	Lectures 1-6
	10	Ethical Issues in Engineering Practice (1)		
6	11	Ethical Issues in Engineering Practice (2)		
	12	Ethical Issues in Engineering Practice (3)		
7	13	Ethics Issues in Mechanical Engineering (1)	ASG-01	
	14	Ethics Issues in Mechanical Engineering (2)		
8	15	Professional Engineering Codes (1)	M	
	16	Professional Engineering Codes (2)		
9	17	Codes of Ethics (IEB) (1)		
	18	Codes of Ethics (IEB (2)		
10	19	Code of Ethics (ASME) (1)		
	20	Code of Ethics (ASME) (2)		
11	21	Ethical problem-solving techniques (1)		
	22	Ethical problem-solving techniques (2)	CT-02	Lectures 15-20
12	23	Case study methodology (1)		
	24	Case study methodology (2)		
13	25	different case studies (1)		

	26	different case studies (2)	ASG-02	
14	27	Review class		
	28	Review class		

ASSESSMENT STRATEGY

		Class Assessment		
	1	CT	20	
	3	CT	30	
		Exam		
	1	M, F	80	
	2	M, F	100	
	3	M, F	70	

REFERENCE BOOKS

Ethics in Engineering, Fourth Edition, Mike W. Martin and Roland Schinzinger (ISBN 0-07-283115-4), McGraw-Hill, New York 2005

PHY 1105: Physics -I

COURSE INFORMATION			
Course Code	PHY 1105	Lecture Contact Hours	3.00
Course Title	Physics-I	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course is the basic physics in the field of electricity and magnetism, modern physics, theory of relativity, and structure of matter. The course will be emphasized the fundamental concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.			
OBJECTIVE			
To familiarize students with electricity and magnetism, modern physics. Theory of relativity, and structure of matter. To explain the basic theories and laws of electricity and magnetism, modern physics, theory of relativity, and structure of matter. To solve (numerical and analytical) problems regarding electricity and magnetism, modern physics.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Knowing about different basic parameters in the field of electricity and magnetism, modern physics, theory of relativity, and structure of matter.	1	C1	1	1		CT, M, F

CO2	Explaining and analyzing different theories and formulas for electricity and magnetism, modern physics and mechanics such as Coulomb’s law, Gauss’s law, Ampere’s law, Faraday’s laws of electromagnetic induction, special theory of relativity, mass-energy relation, Compton theory, radioactivity, nuclear reaction, etc.	2	C4	1	1		CT, M, F
CO3	Solving quantitative problems in the field of electricity and magnetism, modern physics, theory of relativity, and structure of matter	1	C3	1	1		CT, M, F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							
COURSE CONTENT							

a. Main Contents:

Structure of Matter

Electricity and Magnetism

Modern Physics

Theory of Relativity

b. Detail Contents:

Structure of Matter: States of matter: solid, liquid, and gas. Classification of solids: amorphous, crystalline, ceramic and polymers; Plasticity and Elasticity, Atomic arrangement in solid; different types of bonds in solids: metallic and Vander Waal's, covalent and ionic bond. Packing in solids; Inter atomic distances and forces of equilibrium; X-ray diffraction; Bragg's law, distinction between metal, insulator and semiconductor.

Electricity and Magnetism: Electricity: electric charges and Coulomb's law. The electric field: calculation of the electric flux and Gauss' law; some application of Gauss' law, electric potential, relation between electric potential and electric-field; capacitors: Capacitance, dielectrics and atomic view, dielectric and Gauss' law; Current and resistances: current density, ohm's law, resistivity-an atomic view, Ampere's law, Faraday's law; Lenz's law, self-inductance and mutual inductance.

Magnetic properties of matter: magneto motive force, magnetic field intensity, permeability, susceptibility; classification of magnetic materials, magnetization curves.

Modern Physics: Photoelectric effect, Compton effect, de-Broglie wave, Bohr atomic model, radioactive decay, half-life, mean life, isotopes; nuclear binding energy, alpha, beta, gamma decay.

Theory of Relativity: Michelson Morley's experiment, Galilean transformation, Special theory of relativity, Lorentz transformation, relative velocity, Length contraction, Time dilation, mass energy relation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Knowing about different basic parameters in the field of electricity and magnetism, modern physics, theory of relativity, and structure of matter.	3											
CO2	Explaining and analyzing different theories and formulas for electricity and magnetism, modern physics		3										

	and mechanics such as Coulomb’s law, Gauss’s law, Ampere’s law, Faraday’s laws of electromagnetic induction, special theory of relativity, mass-energy relation, Compton theory, radioactivity, nuclear reaction, etc.												
CO3	Solving quantitative problems in the field of electricity and magnetism, modern physics, theory of relativity, and structure of matter	3											

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	**Level of Matching**	**Justification**
CO1-PO1	3	Students will gain necessary fundamental knowledge related to electricity and magnetism, modern physics, theory of relativity, and structure of matter which required for this subject.
CO2-PO2	3	Students will be able to analyze various formulas for electricity and magnetism, modern physics, theory of relativity, and structure of matter.
CO3-PO1	2	Students will apply their gathered theoretical knowledge for the solution of the quantitative problems.

TEACHING LEARNING STRATEGY

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

TEACHING METHODOLOGY

Lecture and Discussion, co-operative and collaborative method, problem based learning (PBL)

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introductory concepts about electricity and magnetism, modern physics, solid state physics		
	2	Basic of electricity		
	3	Coulomb's law		
2	4	Electric field		
	5	Electric potential		
	6	Gauss's law		
3	7	Dielectric and Gauss's law		
	8	Capacitor and capacitance		
	9	Current density, ohm's law	CT-01	Lectures 1-6
4	10	Drift velocity of electron		
	11	Magnetic effects on current, Magnetic field		
	12	Biot-Savart's law		
5	13	Applications of Biot-Savart's law		
	14	Ampere's law, calculation of magnetic field		
	15	Electromagnetic induction, Faraday's law		
6	16	Self and Mutual inductance		
	17	Photo-electric effect		
	18	Laws of photo-electric effect	ASG-01	
7	19	Einstein's photo-electric equation		
	20	Compton effect		
	21	Compton equation		
8	22	Mathematical problem of photo-electric effect and Compton effect	M	
	23	Nuclear Physics		
	24	Nuclear reaction		

9	25	Radioactivity		
	26	Special theory of relativity		
	27	Postulates of special theory, Michelson Morley's experiment		
10	28	Galilean transformation		
	29	Lorentz transformation		
	30	Length contraction		
11	31	Time dilation		
	32	Relativity of mass	CT-02	Lectures 23-27
	33	Einstein's mass-energy relation		
12	34	Solid and its classification, some definitions		
	35	Unit cell, lattice symbols, crystal system		
	36	Miller indices		
13	37	Atomic radius, packing factor		
	38	Interplaner spacing, energy band		
	39	Bragg's law, Bonds in solids		
14	40	Inter-atomic distances, crystal defect	ASG-02	
	41	Review and discussion class		
	42	Review and discussion class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	70	
2	CT	70	
3	CT	70	
4	CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	

	4	M, F	30		

REFERENCE BOOKS
Concepts of Modern Physics by Arthur Beiser Engineering Physics by Joshi Introduction to Solid State Physics, by Charles Kittel Introduction to Special Relativity-Resnick Modern Physics by B. L. Theraja Electricity and Magnetism, by K.K. Tewari

PHY 1205: Physics -II

COURSE INFORMATION			
Course Code	PHY 1205	Lecture Contact Hours	3.00
Course Title	Physics -II	Credit Hours	3.00
PRE-REQUISITE			
Course Code: PHY 1105 Course Title: Physics I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course is the basic physics in the field of Waves and Oscillations, geometrical optics and physical optics. The course will be emphasized the fundamental concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.			
OBJECTIVE			
To familiarize students with Waves, Oscillations, geometrical optics and physical optics. To explain the basic theories and laws those are to Waves, Oscillations, geometrical optics and physical optics. To solve (numerical and analytical) problems regarding Waves, Oscillations, geometrical optics and physical optics.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Knowing about different basic parameters in the field of Waves, Oscillations, geometrical optics and physical optics.	1,2	C1	1	1		T, MT, F
CO2	Explaining and analyzing different theories and formulas for Waves, Oscillations, geometrical optics and physical optics such as Simple harmonic motion, Lissajous figures, group velocity and phase velocity, Doppler's effect, Sabine's formula, Newton's rings, Fresnel & diffraction of light, Polarization of light etc.	2,3	C2	1	1		T, MT, F, ASG
CO3	Solving quantitative problems in the field of Waves, Oscillations, geometrical optics and physical optics.	1,2	C3	1	1		T, MT, F, ASG

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Geometrical Optics: Reflection and refraction by spherical surfaces, lenses, Combination of lenses, Equivalent lens and equivalent focal length. Defects of images formed by lenses, Monochromatic and chromatic aberrations, Spherical aberrations, Astigmatism, Coma, Distortion and curvature of image, achromatism and achromatic combination of lenses.

Oscillations: Differential equation of Simple harmonic motion, Combination of Simple harmonic motion, Lissajous figures, vibrating systems, Undamped and damped oscillations, determination of damping co-efficient, forced oscillation, resonance, two-body oscillations.

Waves: Transverse and longitudinal nature of waves, progressive and stationary waves, power and intensity of wave motion, Energy calculation of progressive and stationary waves, interference of sound waves, wave velocity, group velocity and phase velocity. Sound waves: audible, ultrasonic, infrasonic and supersonic waves, beat, Meld’s experiment, Doppler’s effect and its application.

Acoustics: Intensity of sound, Bel, acoustic intensity, architectural acoustics, noise insulation and reduction, sound distribution, Sabine’s formula, room acoustics, requisites of a good auditorium.

Physical Optics: Theories of light, Huygen’s principle and construction, superposition of light waves.

Interference: Introduction, condition of interference, Young’s double slit experiment, Interference by multiple reflection, Newton’s rings.

Diffraction: Introduction, Fresnel & Fraunhoffer diffraction, diffraction by single slit and double slit, Plane diffraction gratings.

Polarization: Introduction, Polarization by double refraction, Nicole Prism, Polarimeters, Production and analysis of polarized light, Optical activity, optics of crystals.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Knowing about different basic parameters in the field of Waves, Oscillations, geometrical optics and physical optics.	3											

CO2	Explaining and analyzing different theories and formulas for Waves, Oscillations, geometrical optics and physical optics such as Simple harmonic motion, Lissajous figures, group velocity and phase velocity, Doppler’s effect, Sabine’s formula, Newton’s rings, Fresnel & diffraction of light, Polarization of light etc.	3	3										
CO3	Solving quantitative problems in the field of Waves, Oscillations, geometrical optics and physical optics.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO1	3	Students will gain necessary fundamental knowledge related to Waves, Oscillations, geometrical optics and physical optics. which required for this subject.
CO2-PO1	3	Students will be able to explain different theories and formulas for Waves, Oscillations, geometrical optics and physical optics.
CO2-PO2	3	Students will be able to analyze various formulas for Waves, Oscillations, geometrical optics and physical optics.
CO3-PO1	2	Students will apply their gathered theoretical knowledge for the solution of the quantitative 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, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Introductory concepts about Waves, Oscillations, geometrical optics and physical optics.		
	2	Basic concept of Waves		
	3	Electromagnetic waves, standing Wave		
2	4	Progressive wave		
	5	Group		
	6	Differential equation of simple harmonic oscillator		
3	7	Two body oscillation, Reduced mass		
	8	Damped oscillation, Forced oscillation, resonance		
	9	Kinetic energy and potential energy of SHM	CT-01	Lectures 1-6
4	10	Lissajous figures, Composition of two SHM in a straight line		
	11	Composition of two SHM of equal time periods acting at right angles		
	12	Wave Motion		
5	13	Introduction to Optics		
	14	Interference of light		

	15	Newton's rings, Interferometers;			
6	16	Fresnel Bi-prism			
	17	Interference by multiple reflection			
	18	Diffraction of light	CT-02	Lectures 7-15	
7	19	Diffraction by single slit			
	20	Diffraction at double slit			
	21	Diffraction Grating			
8	22	Dispersive power of grating	M		
	23	Polarization of light			
	24	Brewster's Law			
9	25	Malus law			
	26	Nicol prism			
	27	Wave plates			
10	28	Quarter wave plates			
	29	Optical activity, specific rotation			
	30	Polarimeters			
11	31	Laser and optical fiber			
	32	Einstein's mass-energy relation			
	33	Lenses, Combination of lenses			
12	34	Reflection and refraction by spherical surfaces			
	35	Aberrations			
	36	ultrasonic, infrasonic and supersonic waves	CT - 02	Lecture 28-33	
13	37	Acoustics			
	38	Sabine's formula			

	39	Doppler’s effect and its application		
14	40	Review and discussion class		
	41	Review and discussion class	ASG-02	
	42	Review and discussion class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	30	
2	CT	30	
3	CT	30	
	Exam		
1	M, F	70	
2	M, F	70	

3	F	70	

REFERENCE BOOKS
Waves and Oscillations- Brijlal, N. Subrahmanyam
Engineering Physics by Joshi
A text book of optics by Brijlal and Subramannyam
Physics for Engineers by Dr. Gias Uddin Ahmed
Waves and Oscillations- R.N. Chaudhuri

PHY 1206 Physics Sessional

COURSE INFORMATION					
Course Code Course Title	: :	PHY 1206 Physics Sessional	Credit Hours Contact Hours	: :	1.50 3.00

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE).
RATIONALE
This course is a laboratory course for the basic physics in the field of optics, mechanics, thermal physics and electricity. This laboratory course will enable students to understand basic physics practically
OBJECTIVES
To understand different properties of light To understand different characteristics of some rigid materials To understand some properties of heat To understand different properties of electricity
COURSE CONTENT
This course consists of four parts. In the first part, students will perform experiments to verify different properties of light. In the second, third and four parts, students will perform experiments to verify different properties of heat, electricity and general properties of matter respectively.
COURSE OUTCOMES AND GENERAL SKILLS

No.	CO	PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO-1	Familiarize with different parameters regarding waves and oscillations, optics, mechanics, electricity and	1	Remember	8			R, Q, T

	thermal physics etc.						
CO-2	Be capable to describe the different phenomena regarding waves and oscillations, optics, mechanics, electricity and thermal physics etc.	1	Analyze	2, 3, 4	3, 4		R, Q, T
CO-3	Be skilled to construct experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity and thermal physics etc.	9	Evaluate	3	1		R, Q, T
CO-4	Be able to prepare a report for an experimental work.	10	Create	6, 8	5, 6, 7		R, Q, T

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

SKILL MAPPING

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
CO-1	3											
CO-2	3											

CO-3									2			
CO-4										1		

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	The conceptual knowledge of the natural sciences applicable to the engineering discipline
CO-2-PO1	3	The descriptive knowledge of the natural sciences applicable to the engineering discipline
CO3-PO9	2	Able to do work or complete a task as an individual and as a team
CO4-PO10	1	Capable to write a report on an experimental work

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (Hours)
Face to Face Learning	
Lectures	14
Experiments	28
Self-Directed Learning	
Preparation of Lab Reports	28
Preparation of Lab Quiz	7
Preparation of Lab Test	7
Formal Assessment	
Continuous Assessment	2
Lab Quiz	1
Lab Test	2
Total	89

TEACHING METHODOLOGY

Lecture followed by Experiments and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

LECTURE SCHEDULE

Weeks	Intended topics to be covered	Remarks

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	
2	Determination of the spring constant and the effective mass of a loaded spring and hence to calculate the rigidity modulus of the material of the spring	
3	Determination of acceleration due to gravity 'g' by means of a compound pendulum	
4	Determination of the wavelength of a monochromatic light by spectrometer using a plane diffraction grating. Hence to calculate the dispersive power of the grating	
5	Determination of the radius of curvature of a Plano-convex lens by Newton's rings method	
6	Practice class	
7	Lab Test – I	
8	Determination of the refractive index of a liquid by pin method using plane mirror and convex lens	
9	Determination of the Young's modulus of a bar by bending method	
10	Determination of the value of the mechanical equivalent of heat (J) by electrical method	
11	Determination of the resistance of a galvanometer by half-deflection method	
12	Practice class	
13	Lab Test – II	
14	Viva and Quiz	

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	25%

1-4	Report Writing/ Programming	15%
1-4	Mid-Term Evaluation (Exam/Project/assignment)	20%
1-4	Final Evaluation (Exam/Project/assignment)	30%
1-4	Viva Voce / Presentation	10%
	Total	100%

REFERENCE BOOKS
Practical Physics by Dr. Gias Uddin Ahmad and Md. Shahabuddin

HUM 2211 স্বাধীন বাাংলার অভযযদয়ের ইহত্িাস

COURSE INFORMATION			
Course Code	HUM 2211	Lecture Contact Hours	2.00
Course Title	History of Bangladesh	Credit Hours	2.00
PRE-REQUISITE			
None			
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			
To equip students with factual knowledge that will enable them to learn and critically appreciate the history, culture, and economy of Bangladesh. 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.			

To promote an understanding of the development of Bangladesh and its culture from ancient time. To create an awareness among the students about the History, Politics and Culture of Bangladesh.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom’s Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Identify specific stages of Bangladesh’s political history, through the ancient, medieval, colonial and post-colonial periods.	8	C1, C2	7			Q, ASG, F
CO2	Critically analyse plurality of cultural identities of Bangladesh.	7	C1, C2	7			Q, ASG, F
CO3	Clear understanding of the History of Bangladesh and its impact on reforming of a nation. This eloquent history will help the students to know the actual roots of their nation	12	C1, C2	7			Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, CT – Class Test, PR – Project, Q – Qu(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report). iz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, M – Mid-Term, F – Final Exam)
COURSE CONTENT
a. Main Contents: History Political Movement(1947-1971)

Libertion war and Sovereign Bangladesh

b. Detail Contents:

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.

Political Movement (1947-1971): Religious and social reform movements, Nationalist Movements, Division of the Indian sub-continent; Two Nations Theory; Language movement 1948-1952; 21st February 1952, Establishment of Bangla language, Emergence of Democratic Politics, Organization of United Front, Twenty first-points of united front, Election of 1954.

Stratocracy of Ayub Khan, Education movement of 1962; Election of 1965, Six-point movement of 1966, Conspiracy of Agartola, Mass uprising of 1969,Eleven-point movement, Empowerment of 'Bangabandhu' of Sheikh Mujibur Rahman, election of 1970.

Liberation War and Sovereign Bangladesh: Significant speech of 7th March, Massacre of 25th March, Declaration of independence, War of independence and emergence of Bangladesh in 1971, Organization of Mujibnagar Government, Establishment of Bangladesh Radio, Constitution of Bangladesh, Foreign affairs and their significant contribution, Conspiracy of Rajakar, Albador, Miserable condition of Refugees, Final achievement of Liberation War and Return of Bangabandhu.

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.								3				
CO2	Critically analyse plurality of cultural identities of Bangladesh.							3					
CO3	Clear understanding of the History of Bangladesh and its impact on reforming of a nation. This eloquent history will help the students to know the actual roots of their nation												3

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification

CO1-PO8	3	The students will have a good overall knowledge of historical, social, cultural aspects of Bangladesh.
CO2-PO7	3	Students will build attitude of ethical and the professional responsibility.
CO3-PO12	3	This history will help to the students for their life-long learning and enrichment.

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	Lecture	Topics	CT/ASG	Remarks
1	1	Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course		
	2	Demography of Bangladesh.		
2	3	Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal		
	4	Bengal under the East India Company		
3	5	Religious and Social reform movements		
	6	Nationalist movements, division of the Indian sub-continent	CT-01	Lectures 1-4
4	7	Language movement 1948-1952, 21st February 1952, establishment of Bangla language		
	8	Emergence of democratic politics		
5	9	Organization of united front, twenty first-points of united front		

	10	Election of 1954		
6	11	Stratocracy of Ayub Khan		
	12		ASG-01	
7	13	Education movement of 1962		
	14			
8	15	Election of 1965	M	
	16	Six-point movement of 1966		
9	17	Conspiracy of Agartola		
	18	Mass uprising of 1969		
10	19	Eleven-point movement, empowerment of 'Bangabandhu' of Sheikh Mujibur Rahman		
	20	Election of 1970, significant speech of 7th March		
11	21	Massacre of 25th March, declaration of independence		
	22	War of independence and emergence of Bangladesh in 1971	CT-02	Lectures 18-20
12	23	Constitution of Bangladesh		
	24	Foreign affairs and their significant contribution		
13	25	Conspiracy of Rajakar, Albador, miserable condition of refugees	ASG-02	
	26	Final achievement of liberation war and return of Bangabandhu		
14	27	Revision		
	28	Revision		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG,CT	30	
2	ASG,CT	30	
3	ASG,CT	30	
	Exam		

1	M,F	70	
2	M,F	70	
3	M,F	70	

REFERENCE BOOKS
Bangladesh Studies: Md. ShamsulKabir Khan and DaulatunnaharKhanam The Constitution of the People's Republic of Bangladesh Discovery of Bangladesh: Akbar Ali Khan History of Bangladesh, Vols, 1-3: Sirajul Islam History of Modern Bengal, Vol, 1: R C Majumdar Dynastic History of Bengal: Dr. Abdul Mumin Chowdhury A History of Bangladesh: William Van Schende

List of Core Courses: CSE

CSE 1271: Computer Programming

COURSE INFORMATION			
Course Code	CSE 1271	Lecture Contact Hours	3.00
Course Title	Computer Programming	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
The structured programming language course introduces the fundamental concepts and mechanisms of computer programming skills. It helps to develop baseline programming knowledge to design and develop algorithms to solve real world problems. This Course begins with introductory concepts of structured programming language and then covers other important topics such as Control Statements, Loop, Array, String, Function, Pointer, Structure, File, Storage Classes, Error Handling and Command Line Parameters.			
OBJECTIVE			

To know about flowcharts and algorithms with Implementation using Computers. To know about various syntax, semantics of structured programming languages. To develop problem solving skills.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Illustrate flow charts and describe algorithms to solve problems using computers.	1	C1-C3	1	1		MT, Pr /ASG
CO2	Analyze the fundamental principles, usual characteristics and appropriate mechanisms of a structured programming language.	2	C4	2	1,2		F,MT
CO3	Develop fundamental programming skills of program design and development.	2	C1-C5	5	1,3		F, Pr /ASG
CO4	Develop fundamental programming skills of program design and development.	10	A2				Pr /ASG

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).
COURSE CONTENT

Programming concepts; Program development stages; Flow charts; Structured programming language: data types, operators, expressions, control structures; Functions and program structure: Function basics, parameter passing conventions, scope rules and storage classes, recursion; Header files; Preprocessor; Pointers and arrays, Strings, Multidimensional array; User defined data types: structures, unions, enumerations; Input and Output: standard input and output, formatted input and output, file access; Variable length argument list; Pointer and it's uses; Command line parameters; Error Handling; Graphics; Linking; Library functions.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Illustrate flow charts and describe algorithms to solve problems using computers.	3											
CO2	Analyze the fundamental principles, usual characteristics and appropriate mechanisms of a structured programming language.		3										
CO3	Develop fundamental programming skills of program design and development.		3										
CO4	Develop fundamental programming skills of program design and development.										1		

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	In order to solve complex engineering problems, knowledge of algorithms and computer usage is very important.
CO2-PO2	3	Understand and implement the required fundamental principles, typical characteristics and mechanisms of a

		structured programming language with required modifications based on the scenario.
CO3-PO2	3	To design and develop solutions for complex engineering problems, one need to develop basic programming skills.
CO4-PO10	1	Develop communication skills through participating in presentation etc.

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

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Programming		
	2	Flow Charts, Algorithms, Structured Programming Language Concept		
	3	ASCII Value/code, Data types		
2	4	Basic Input/ Output		
	5	Operators, Expressions		
	6	Operators, Expressions(cont.), Type Casting		
3	7	Control Structure: if-else		

	8	Control Structure: nest if-else, else-if ladder			
	9	Switch	CT-01	Lectures 1-6	
4	10	Loop : for loop			
	11	Loop: while, do while			
	12	break, continue, Nested Loop			
5	13	Nested Loop(cont.)			
	14	Nested Loop(cont.)			
	15	Nested Loop(cont.), Array Introduction			
6	16	1-D array			
	17	Multidimensional array: 2-D, 3-D etc.	ASG-01		
	18	Memory Allocation of arrays			
7	19	Character array/ String			
	20	String: various input/ output methods, iterative approach			
	21	String handling functions			
8	22	Function: Introduction, function declaration, definition	M		
	23	Function: Parameter, argument, function call			
	24	Function: various types with example			
9	25	Recursion			
	26	Recursion (cont.)			
	27	Pointer: Introduction			

10	28	Pointer: Indirections , Pointer Arithmetic		
	29	Pointer: restrictions, Call by value, Call by reference		
	30	Dynamic Memory Allocation: malloc(), calloc(), realloc(), free()		
11	31	User defined data type: Structure	CT-02	Lectures 22-27
	32	Union, Enumeration		
	33	File: Basics, Input/output, Various modes of opening file		
12	34	Header files, preprocessor		
	35	Storage Classes: auto, register, static		
	36	Variable arguments, Command line arguments		
13	37	Error handling		
	38	Linking, Library Functions	ASG-02	
	39	Library function: Graphics		
14	40	Review Class		
	41	Review Class		
	42	Review Class		

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	ASG, CT, Pr	30	
2	ASG, CT	30	
3	ASG, CT, Pr	30	
4	ASG, CT, Pr, CP	100	

	Exam		
1	M, F	70	
2	M, F	70	
3	F	70	

REFERENCE BOOKS
Teach Yourself C (3rd Edition) by Herbert Schidlt C: The Complete Reference (4th Edition) by Herbert Schildt Let Us C(14th Edition) Yashavant Kanetkar Programming in Ansi C (6th Edition) by E Balagurusamy

CSE 1272 Computer Programming Sessional

	COURSE INFORMATION
Course Code: CSE 1272 Course Title: Computer Programming Sessional	Lecture Contact Hours: 3.00 Credit Hours: 1.50
	PRE-REQUISITE
	None
	CURRICULUM STRUCTURE
	Outcome Based Education (OBE).
	SYNOPSIS/RATIONALE
	The structured programming language Sessional course is designed to introduce the fundamental concepts and mechanisms of computer programming skills. It helps to develop baseline programming knowledge to design and develop algorithms to solve real world problems practically. This sessional course begins with practicing introductory concepts of structured programming and then covers other important topics such as Control Statements, Loop, Array, String, Function, Pointer, Structure, File, Storage Classes, Error Handling and Command Line Parameters.
	OBJECTIVE
	To know basic ideas of programming languages with Implementation using Computer. To learn how to program with C to solve real world problems. To develop problem solving skills.
	LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome (Upon completion of the course, the students will be able to)	Bloom's Taxonomy	CP	CA	KP	Delivery Methods and Activities		Assessment Methods
CO1	Design flow charts, describe	C1-C3	1	3	5	Lecture,		F,ASG

	algorithms and solve problems using computers.					Discussion		
CO2	Analyze the fundamental principles, usual characteristics and appropriate mechanisms of a structured programming language practically.	C4	3		7	Lecture, Discussion, Group Work		F,Q
CO3	Apply knowledge to think about the problems, their solutions and translating it to programming language practically.	C1-C5	1,3		1-3	Discussion, Group Work		PR/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
	Basic Programming concepts: Data types, standard input and output, operators, expressions, Control Structure: if else, switch, Flow Charts, Loop, Nested Loop; Arrays: One-dimensional array, Multi-dimensional array, Character array/ string; Function: Parameter Passing Convention; Various types Recursion: Practice problems on recursion; Pointer: Different types of pointers, Pass pointer as arguments, Call by value vs call by reference; Dynamic Memory Allocation: Dynamically allocate memory using malloc(), calloc(), free(), realloc(); User defined data types: Practice problems on Structures, Unions, Enumerations; File I/O: Read, write, append in file; Header Files and Preprocessors: Header files, Preprocessor; Error Handling: Exception handling
	CO-PO MAPPING

No.	Course Learning Outcome		Program Outcome										
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Design flow charts, describe algorithms and solve problems using computers.									3			
CO2	Analyze the fundamental principles, usual characteristics and appropriate mechanisms of a structured						3						

	programming language practically.												
CO3	Apply knowledge to think about the problems, their solutions and translating it to programming language practically.						3						

	(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).
	Justification for CO-PO Mapping

Mapping	Corresponding Level of matching		Justifications
CO1-PO9	3		In order to perform effectively as a member or leader of a team, one needs to discuss algorithms with team members in order to solve problems using computers.
CO2-PO6	3		In order to apply reasoning and take responsibilities relevant to the professional engineering practice, one needs to analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language with required modifications based on the scenario.
CO3-PO6	3		In order to apply reasoning and take responsibilities relevant to the professional engineering practice, Apply practical knowledge to develop basic

			programming skills with respect to program design and development.

	TEACHING LEARNING STRATEGY

Teaching and learning activities		Engagement (hours)
Face-to-face learning		
Lecture		-
Practical/Tutorial/Studio		42
Student-centered learning		-
Self-directed learning		
Non-face-to-face learning		-
Revision		-
Assessment preparations		-
Formal assessment		
Continuous assessment		4
Final examination		3
Total		49

	TEACHING METHODOLOGY
	Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method
	COURSE SCHEDULE

Week	Lab	Topics		Assessment Methods
1	Lab 1	Programming Concept, Basic Input/Output, Mathematical problems		Quiz Viva Lab Final
2	Lab 2	Operators(unary, binary, ternary), Expression, Type Conversion		
3	Lab 3	Control Structure: if-else, nested if-else		
4	Lab 4	Control Structure: else-if ladder, switch		
5	Lab 5	Loop: for ,while, do while		
6	Lab 6	Loop: nested loops		

7	Lab 7	Array: 1-D array,2-D Array		
8	Lab 8	2-D array(Cont.), Character array/ String		
9	Lab 9	Function: Introduction, function declaration, definition, various types of functions		
10	Lab 10	Recursion		
11	Lab 11	Pointer		
12	Lab 12	User defined data type: Structure, Union, enumeration		
13	Lab 13	File I/O		
14	Lab 14	Dynamic memory Allocation : malloc(), calloc(), free(), realloc()		

ASSESSMENT STRATEGY

Components		Grading	CO		Bloom Taxonomy
Continuous Assessment (40%)	Lab Test	20%	CO1, CO2		C1-C3, C4
	Class Participation	5%	CO1		A2
	Project / Assignment	15%	CO1,CO3		C1-C5
Final Lab Test		40%	CO1, CO2		C1-C3, C4
Quiz/ Viva		20%	CO2		C4
Total Marks		100%			

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

REFERENCE BOOKS

Teach Yourself C (3rd Edition) by Herbert Schidlt

C: The Complete Reference (4th Edition) by Herbert Schildt

Let Us C(14th Edition) Yashavant Kanetkar

List of Core Courses: EEE

EEE 1159: Basic Electrical Engineering

COURSE INFORMATION			
Course Code	EEE 1159	Lecture Contact Hours	3.00
Course Title	Basic Electrical Engineering	Credit Hours	3.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE).

SYNOPSIS/RATIONALE
This course is designed to teach about fundamental concepts, solution techniques and different practical applications of DC circuits, magnetic circuits and different types of energy storage elements.

OBJECTIVE
To understand the basic rules regarding current flow and voltage differences. To calculate current through different branches and voltages differences across different pairs of nodes using several methods. To know about the energy storage elements (e.g., inductors and capacitors) and their transient behavior.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Correlate the theoretical knowledge to proceed for the analysis of electrical systems.	2	C4	8	1		CT, M, F
CO2	Knowing about different circuit elements and learning different theorems to solve circuit problems.	1	C1	1, 3	1		CT, M, F

CO3	Analyze complex electrical circuits consisting of different circuit elements.	2	C4	2	1, 2		CT, M, F
CO4	Understand different circuit solving methods and use them in analysis.	1	C2	1	1, 2		F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Fundamental Concepts and Units

Electrical Networks

Electrical field concepts

Introduction to magnetic circuits

Alternating Current

Introduction to Measurement of Electrical Quantities

b. Detail Contents:

Fundamental concepts and units, electrical networks: network laws and theorems, methods of analysis, electrical field concepts: capacitance, transient and steady state analysis of electrical networks for different forcing functions, introduction to magnetic circuits, alternating current: effective and average values of alternating waveforms, phasor and complex-impedance, steady state analysis of AC networks, balanced poly-phase systems, introduction to measurement of electrical quantities: voltage, current and power.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Correlate the theoretical knowledge to proceed for the analysis of electrical systems.		3										

CO2	Knowing about different circuit elements and learning different theorems to solve circuit problems.	3											
CO3	Analyze complex electrical circuits consisting of different circuit elements.		3										
CO4	Understand different circuit solving methods and use them in analysis.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO2	3	Students will be able to correlate the theoretical engineering knowledge to proceed for the analysis of complex engineering problems pertaining to electrical systems.
CO2-PO1	3	Students will gain necessary fundamental knowledge related to electrical circuit which are required for each and every topic which will be covered in this subject as well as in the future courses.
CO3-PO3	3	Students will be able to analyze different types of circuits to solve various types of problems.
CO4-PO4	3	Students will understand different circuit solving methods and use them in 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, and problem solving.

COURSE SCHEDULE				
Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	DC Circuits: Fundamental electrical concepts and measuring units,		
	2	D.C. voltage, current, resistance and power.		
	3	Introduction to circuit theory and Ohm's law.		
2	4	Kirchhoff's current law and their application		
	5	Kirchhoff's current laws and related problem		
	6	Kirchhoff's voltage laws and their application		
3	7	Kirchhoff's voltage laws and related problem		
	8	Simple resistive circuits: Series and parallel circuits,		
	9	Voltage and current division,	CT-01	Lectures 1-6
4	10	Wye-Delta transformation.		
	11	Various techniques for solving circuit problems:		
	12	Mesh Analysis and application		
5	13	Mesh Analysis and related problem		
	14	Mesh Analysis including supermesh		
	15	Nodal Analysis.		
6	16	Nodal Analysis application		
	17	Nodal including super node		
	18	Network theorems:	ASG-01	
7	19	Superposition theorem and related problem		
	20	Source transformation and related problem		

	21	Thevenin's theorem and applications		
8	22	Thevenin's theorem and related problem	M	
	23	Thevenin's and related problem having dependent sources in circuits.		
	24	Norton's theorems		
9	25	Norton's theorems and applications.		
	26	Maximum power transfer condition		
	27	Reciprocity theorem with their applications in circuits		
10	28	Energy storage elements: Inductors and capacitors and their characteristics.		
	29	Series parallel combination of inductors and capacitors.		
	30	Responses of RL, RC to natural and step responses		
11	31	Responses of RLC circuits to natural and step responses		
	32	Introduction to magnetic circuit, Comparison between electrical and magnetic circuits.	CT-02	Lectures 25-30
	33	Magnetic quantities and variables: Flux, permeability and reluctance.		
12	34	Magnetic field strength, magnetic potential, flux density.		
	35	Magnetization curve.		
	36	Laws of magnetic circuits: Ohm's law and Ampere's circuital law.		
13	37	Len’s law and Faradays law of electromagnetic induction.		
	38	Magnetic circuits: series, parallel and series-parallel circuits.	ASG-02	
	39	Electrical safety.		

14	40	Contemporary developments in Electrical Technology Worldwide.		
	41	Review of the overall courses.		
	42	Review of the overall courses.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	70	
2	CT	70	
3	CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	
4	M, F	30	

REFERENCE BOOKS

Fundamentals of Electrical Circuits by Alexander and Sadiku

Introductory Circuit Analysis by Robert L. Boylestad

EEE 1160: Basic Electrical Engineering Sessional

COURSE INFORMATION

Course Code	EEE 1160	Lecture Contact Hours	1.50
Course Title	Basic Electrical Engineering Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS/RATIONALE

This course is designed to teach about practical experiments on fundamental concepts, theorems, and different circuit problems.

OBJECTIVE

Analyze resistive circuits by using different network theorems (e.g., Mesh analysis, Nodal analysis, Superposition theorem, Thevenin theorem, Norton theorem etc.).

Learn the self-learning mechanism to gather knowledge about different type of present developments in electrical technology worldwide.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Correlate the theoretical engineering knowledge to proceed for the analysis of electrical systems.	2	C4	8	1		R, Q, T
CO2	Familiarization with electrical circuits and apply the knowledge of basic electrical components and networks practically.	1	C1	1	1, 2, 3, 4		R, Q, T
CO3	Analyze the differences between theoretical knowledge with the practical observations.	2	C4	2	3, 4		R, Q, T
CO4	Understand basic electrical laws and circuit theorems and use them.	2	C2	1, 2	1		R, Q, T

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Laboratory experiments based on EEE 1159.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Correlate the theoretical engineering knowledge to proceed for the analysis of electrical systems.		3										
CO2	Familiarization with electrical circuits and apply the knowledge of basic electrical components and networks practically.	3											
CO3	Analyze the differences between theoretical knowledge with the practical observations.		3										
CO4	Understand basic electrical laws and circuit theorems and use them.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO2	3	Students will be able to correlate the theoretical engineering knowledge to proceed for the analysis of complex engineering problems pertaining to electrical systems.
CO2-PO1	3	Students will gain necessary fundamental knowledge related to electrical circuit which are required for each and every topic which will be covered in this subject along with practical experiments.
CO3-PO2	3	Students will be able to analyze practically different types of circuits to solve various types of problems.
CO4-PO2	3	Students will be able to understand basic electrical laws and circuit theorems and use them.

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	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
Total		79

TEACHING METHODOLOGY
Class lecture, pop quiz, case study, and problem solving.

COURSE SCHEDULE		
Weeks	Topics	Remarks
1	Construction and Operation of Simple Electrical Circuits.	
2	Study on equivalent Resistance of Series-Parallel Network & Δ-Y Circuit.	
3	Study on equivalent Resistance of Series-Parallel Network & Δ-Y Circuit.	
4	To verify the V-I characteristics of series circuit using ohms law.	
5	Verification of KVL & Voltage Divider Rule.	
6	Verification of KVL & Voltage Divider Rule.	
7	Lab Test – I	

8	Verification of KCL & Current Divider Rule.	
9	Verification of Superposition Principle Theorem.	
10	Verification of Superposition Principle Theorem.	
11	Measurement of power using Two-wattmeter method.	
12	Measurement of power using Two-wattmeter method.	
13	Lab Test – II	
14	Report Submission and Quiz	

ASSESSMENT STRATEGY

Assessment Method	(100%)
Class Assessment	
Conduct of Lab Test /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%

REFERENCE BOOKS

Fundamentals of Electrical Circuits by Alexander and Sadiku

Introductory Circuit Analysis by Robert L. Boylestad

EEE 2259 Electrical Machines and Electronics Technology

COURSE INFORMATION			
Course Code	EEE 2259	Lecture Contact Hours	4.00

Course Title	Electrical Machines and Electronics Technology	Credit Hours	4.00
PRE-REQUISITE			
EEE 1159: Basic Electrical Engineering			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides a prologue to the concepts and standards of electrical machines such as dc generator, dc motors, transformers, alternators, induction motors, and synchronous motor with their basic operation and characteristics. Moreover, introduces the students with the basic theories and application of electronic devices and circuits.			
OBJECTIVE			
To understand students with the basic operations of different types of electrical machines. To make students to analyze different characteristics of electrical machines To familiarize students with digital electronics circuits. To teach students the real world applications of the electronic devices.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Identify different types of electrical machines with their basic operations and characteristics.	1	C2	1, 4	1		M, F
CO2	Determine the operating parameters of different types of motors, generators and transformers	2	C4	2	1,2		M, F
CO3	Understand the operating principle and practical knowledge of various electronic	1	C2	3	1		M, F

	devices and transducers						
CO4	Solve and analyze different electronic circuits	2	C4	2	1,2		M, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Detail Contents:

Balanced three-phase circuit analysis and power measurement. Single phase transformer equivalent circuit and laboratory testing, introduction to three-phase transformer. DC generator: principle, types, performances and characteristics. DC 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 Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify different types of electrical machines with their basic operations and characteristics.	3											
CO2	Determine the operating parameters of different types of motors, generators and transformers		3										

CO3	Understand the operating principle and practical knowledge of various electronic devices and transducers	3											
CO4	Solve and analyze different electronic circuits		2										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO3	3	Students will be able to know about the basic operation of dc and ac machines. Students will get clear theoretical knowledge about their constructions and operations and characteristics.
CO2-PO1	3	Students will be able to determine different operating parameters of transformers, dc generators, dc motors, induction motor, alternator, synchronous motor etc
CO3-PO1	3	Students will be able to understand the operating principle and practical knowledge of various electronic devices and transducers
CO4-PO7	2	Solve and analyze different electronic circuits.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	56
Self-Directed Learning	112
Formal Assessment	5.5
Total	173.5

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Lecture	Topics	CT/ASG	Remarks

1	1	Introduction to dc machines		
	2	Construction and working principal of dc generator		
	3	Types and characteristics of dc generator		
	4	Mathematics of dc generator		
2	5	Construction and working principal of dc motor		
	6	Types and characteristics of dc motor		
	7	Speed control mechanism of dc motor		
	8	Mathematics of dc motor		
3	9	Application of dc machines in industry		
	10	Construction and operation of transformer		
	11	Induced EMF equation of a transformer	CT-01	Lectures 1-6
	12	Equivalent circuits and phasor diagram of a transformer		
4	13	Different types of losses in a transformer		
	14	Three phase transformer and their application		
	15	Construction and operation of a three phase induction motor		
	16	Advantages, disadvantages, & application of induction motor		
5	17	Single phase induction motor		

	18	Mathematical problems related to induction motor		
	19	Construction and operation of an alternator		
	20	Parallel operation of alternators		
6	21	Mathematical problems related to alternator		
	22	Synchronous Motors: Principles of operation		
	23	Method of starting a synchronous motor	ASG-01	
	24	Equivalent circuit, power development of synchronous motor etc.		
7	25	Stepper motor		
	26	Servo motor		
	27	Fractional HP machines		
	28	Universal motor		
8	29	Atomic structures, band theory	M	
	30	Intrinsic and extrinsic semiconductor		
	31	PN junction semiconductor (diode), operation of a diode		
	32	Characteristics and equivalent circuit of a diode		
9	33	Diode Circuits: Half wave and full wave rectifiers		
	34	Miscellaneous diode circuits		
	35	Clipper		
	36	Clampers		

10	37	Construction and operation of BJTs		
	38	Different configurations of BJT circuits and their characteristics		
	39	Mathematical analysis of BJT based circuits		
	40	Mathematical analysis of BJT based circuits (cont.)		
11	41	BJT Biasing: DC and AC		
	42	BJT Biasing: DC and AC (cont.)		
	43	BJT based amplifiers	CT-02	Lectures 23-32
	44	BJT based amplifiers (cont.)		
12	45	Introduction to FET: JFET and MOSFET		
	46	Introduction to FET: JFET and MOSFET (cont.)		
	47	CMOS, VMOS, HFET etc.	ASG-02	
	48	FET applications and problem solving		
13	49	FET amplifiers		
	50	Introduction to SCR		
	51	Applications of SCR		
	52	Introduction to instruments: Oscilloscope and other instruments, OpAmp		
14	53	Transducers: Definition, types, and characteristics		

	54	Strain, pressure, and temperature measurements		
	55	Speed, and torque measurements		
	56	Practical implementations of transducers: Display devices, audio I/O, sensors etc.		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1			
3			
4			
	Exam		
2			
3			
4			

REFERENCE BOOKS

Electric Machinery Fundamentals – Stephen J. Chapman

A Text Book of Electrical Technology, Vol- II - B.L Thereja, and A.K. Thereja

Electrical Machines – Charles I. Hubert

Direct and Alternating Current Machinery – Jack Rosenblatt, & M. Harold Friedman

Principles of Electronics by V.K-Mehta

Electronic Devices and Circuit Theory by Robert Boylestad

Microelectronic Systems by Sedra Smith

EEE 2260 Electrical Machines and Electronics Technology Sessional

COURSE INFORMATION			
Course Code	EEE 2260	Lecture Contact Hours	3.00

Course Title	Electrical Machines and Electronics Technology Sessional	Credit Hours	1.50
PRE-REQUISITE			
EEE 2259: Electrical Machines and Electronics Technology Sessional			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS /RATIONALE			
This course is designed to teach about practical experiments on different electrical machines as well as basic electronic devices and cicuits.			
OBJECTIVE			
To understand students with the basic operations of different types of electrical machines. To make students to analyze different characteristics of electrical machines. To familiarize students with different electronics devices. To familiarize students with widely used electronics circuit, controllers, transducers, and industrial applications in detail.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	Analysis of the differences between theoretical knowledge with the practical observations on different electrical machines	2	4	2	1, 2		R, Q, T
CO2	Verification of different parameters like different losses, efficiencies etc	1	5	3	1		R, Q, T
CO3	Familiarization with different electronic devices and transducers.	1	1	1	1		R, Q, T

CO4	Experimental verification of theorems and formulations.	2	3	3	1,2		R, Q, T
CO5	Conduct a real-world project using the knowledge of electronic circuits.	2	4	3, 4	3		R, Q, T, PR

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

In this course students will perform experiments to verify practically the theories and concepts learned in EEE 2259.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Analysis of the differences between theoretical knowledge with the practical observations on different electrical machines												
CO2	Verification of different parameters like different losses, efficiencies etc												
CO3	Familiarization with different electronic devices and transducers.												
CO4	Experimental verification of theorems and formulations.												
CO5	Conduct a real-world project using the												

	knowledge of electronic circuits.												

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of matching	Justifications
CO1-PO2	3	Students will gain necessary fundamental knowledge related to AC electrical circuit which are required for each and every topic which will be covered in this subject along with practical experiments.
CO2-PO1	3	Students will be able to analyze practically different types of circuits to solve various types of problems.
CO3-PO1	3	Students will learn about the way of using different types of devices, instruments and tools for various practical issues
CO4-PO2	3	Enables experimental verification of theorems and formulations.
CO5-PO2	3	Students will be able to conduct a real-world project using the knowledge of electronic circuits.

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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		

	Continuous Assessment	14
	Final Quiz	01
	Total	112

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

COURSE SCHEDULE	
Week	Topics
1	Experiment on DC generator
2	Experiment on DC motor
3	Observation of alternator characteristics
4	Experiment on induction motor
5	Experiment on synchronous motor
6	Observation of the construction of single and three phase transformers
7	Lab Test – I
8	Introduction to oscilloscope, function generator, trainer board and other instruments
9	Construction of the I-V characteristics curve for a P-N junction semiconductor
10	Experiment on rectifier circuits
11	Experiment on CE/CB BJT circuit and it's amplification characteristics
12	Experiment on a FET amplifier circuit
13	Observation of power flow control using SCR
14	Lab Test – II Project Submission and Quiz

ASSESSMENT STRATEGY		
Assessment Method		Grading
Continuous Assessment	Lab participation and Report	30%
	Lab Test	30%
Lab Quiz, viva		40%

Total	100%

REFERENCE BOOKS
A Textbook of Electrical Technology (volume-II)- B.L Theraja, A.K Theraja Electric Machinery Fundamentals- Stephen J. Chapman Direct and Alternating Current Machinery– Rosenblatt, Friedman Principles of Electronics by V.K-Mehta. Electronic Devices and Circuit Theory by Robert Boylestad. Microelectronic Systems by Sedra Smith.

List of Core Courses: IPE

IPE 3277 Production Process

COURSE INFORMATION			
Course Code	IPE 3277	Lecture Contact Hours	3.00
Course Title	Production Process	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides students a brief understanding of different manufacturing process and their application. The focus is to introduce students to theory and operation of manufacturing including manufacturing processes and equipment overview, manufacturing design, production process and flow, materials, machine operations and application. The learning approach is to have depth knowledge about different manufacturing process such as casting, forming, welding etc. and operating procedure of machine tools. The students will achieve the skill to apply this knowledge in industrial case and to make different project.			
OBJECTIVE			
To introduce the student to different types of manufacturing processes and machine used in the manufacturing. To compare and contrast to different types of processes and materials used. To design and development of different parts and machinery used in manufacturing.			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess- ment Methods
CO1	Demonstrate knowledge of different manufacturing terms related to products and materials used.	1	C1, C2	1,3	1		CT, F

CO2	Analyze various machines and machine related operations with environmental sustainability.	2,7	C4	4, 7	1		CT, F
CO3	Understanding part manufacturing processes with a set of functional requirements and product development constraints.	1,2	C2, C4	2,4	1		M,F
CO4	Design theoretical concepts of various parts manufacturing operations with product development.	3,12	C3, C6	1,3	1		F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP-Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Main Contents:

Casting

Chip-less metal forming process

Welding and allied Process

Special welding techniques

Metal cutting processes

Machining process

Modern manufacturing process

b. Detail Contents:

Casting: Methods of sand casting, design of patterns, properties of molding sand, core and core making, casting in metallic and non-metallic moulds, die casting, centrifugal casting, precision investment casting, continuous casting. Defects of casting, causes and prevention.

Chip-less Metal Forming Process: Hot and cold working processes, rolling, properties of rolled products, cold drawing, forging, coining, stretching, bending, squeezing, extrusion, machines and tools for metal forming processes. Metal shearing operations, stamping, press and press tools.

Welding and Allied Processes: Gas welding: principle, equipments used, gas storage and safety measures. Gas cutting. Arc welding: principle, equipments used; AC and DC arc welding, electrodes, shielded arc welding: TIG, MIG and plasma arc welding; electrical resistance welding.

Special Welding Techniques: Thermit welding, LASER beam welding, brazing, soldering and braze welding, continuous welding. Welding job preparation, weldability, welded joint inspection, welding defects and causes of defects.

Metal Cutting Processes: Chip formation, types of chips, chip breakers, cutting forces, cutting fluid, tool geometry, cost and life of tool.

Machining Process: Lathe machine and accessories, types of lathes, drilling and other hole making machines, shapers and planners, milling, Gears and threads: manufacturing and related machines. Finishing Operation: grinding, honing, lapping, super-finishing etc.

Modern Manufacturing Processes: ECM, EDM, USM etc., processing of synthetic materials.

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 manufacturing terms related to products and materials used.	3											
CO2	Analyze various machines and machine related operations with environmental sustainability.		3					2					
CO3	Understanding part manufacturing processes with a set of functional requirements and product development constraints.	3	3										
CO4	Design theoretical concepts of various parts manufacturing operations with product development.			3									3

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Knowledge about different manufacturing terms used in manufacturing process respect to different types of products and

		related materials can be achieved through understanding of this course.
CO2-PO2	3	Able to know about different manufacturing machine and machining operations through analyzing process.
CO2-PO7	2	Understanding and evaluating the sustainability and impact of manufacturing activities in societal and environmental contexts.
CO3-PO1	3	Able to gain knowledge about different manufacturing methods and their working procedure.
CO3-PO2	3	Students will be able to analyze about manufacturing procedure and exact field of application.
CO4-PO3	3	Students will be able to think about design and development about manufacturing concept from different points of view.
CO4-PO12	3	Students will be able to conduct the design activities of the product and prepare themselves to take challenges in upcoming future.

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

TEACHING METHODOLOGY

Class lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Lecture	Topics	CT/AS G/M	Remarks
1	1	Introduction to Manufacturing Process		
	2	Sand Casting: Advantage and limitations, Applications,		
	3	casting terms, sand mould making procedure		
2	4	Pattern allowances, Pattern materials, types of patterns		
	5	Types of Molding Sand, Properties of Molding Sand, Mold for a Sand Casting, core and core making		

	6	Design of molds, Riser, Gate, Sprue and core,			
3	7	Defects of Casting defects, causes and prevention			
	8	Die Casting: Hot Chamber Die Casting, Cold Chamber Die Casting, Molds for Die Casting,			
	9	Centrifugal Casting, Continuous casting, Precision Investment casting	CT-01	Lectures 1-6	
4	10	Chip-less Metal Forming Process: Hot and cold working processes, rolling, properties of rolled products,			
	11	Cold drawing, forging, coining, stretching, bending, squeezing, extrusion,			
	12	Machines and tools for metal forming processes. Metal shearing operations, stamping, press and press tools.			
5	13	Joining Methods: Five Basic Joints, welding position, Classification of Welding, Terminology used in various welded Joints			
	14	Gas welding and cutting Principle, Oxy-Acetylene Welding technique,			
	15	Oxy-Acetylene Welding Equipment, Types of flame, gas cutting			
6	16	Electric Arc welding, Principle of arc, Arc welding equipment, Types of electrodes			
	17	Coating system and function, TIG, MIG,			
	18	Plasma Arc Welding, Resistance arc welding principle, Heat Balance	ASG-01		
7	19	Resistance spot welding, Resistance seam welding,			
	20	Resistance projection welding, Flash welding,			
	21	Upset welding, Conventional Welding Processes: Thermit Welding, Laser beam welding	M		

8	22	Continuous welding. Welding job preparation, weldability, welded joint inspection,			
	23	Soldering, Brazing, Braze Welding, Welding defects and causes of defects			
	24	Chip formation, types of chips, chip breakers,			
9	25	Cutting forces, cutting fluid, tool geometry, cost and life of tool.			
	26	Milling operations, Types of milling machine, Millling cutters, main parts, work holding devices,			
	27	Dividing head, Indexing,			
10	28	Main parts of Lathe machine, Drive system, Work holding devices, Lathe accessories,			
	29	Lathe operations, Taper turning method, Thread cutting method			
	30	Drilling process, Main parts of drilling machine,			
11	31	Drill bit, Drill holding devices			
	32	Shaper parts, Shaper drive, Quick return mechanism			
	33	Planer principle, Main parts of planer	CT-02	Lectures 23-32	
12	34	Gears and threads: manufacturing and related machines.			
	35	Finishing operation: grinding, honing, lapping, super-finishing etc.			
	36	ECM- working principle, equipment, advantage and disadvantage with application	ASG-02		
13	37	EDM- working principle, equipment, advantage and disadvantage with application			
	38	USM- working principle, equipment, advantage and disadvantage with application			
	39	Processing of synthetic materials			

14	40	Review class and direction about final examination		
	41	Review class and direction about final examination		
	42	Review class and direction about final examination		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks	
	Class Assessment			
1	CT	30		
2	CT	30		
3	CT	20		
	Exam			
1	F	70		
2	F	70		
3	M, F	80		
4	F	100		

REFERENCE BOOKS

P N Rao, (2009), Manufacturing technology: foundry, forming and welding.3rd Edition, New Delhi, India, McGraw-Hill ISBN- 0070087989 9780070087989.

Production Technology- R K Jain

IPE 3278 Production Process Sessional

COURSE INFORMATION			
Course Code	IPE 3278	Lecture Contact Hours	1.50
Course Title	Production Process Sessional	Credit Hours	0.75
PRE-REQUISITE			
IPE 3277: Production Process			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS /RATIONALE			
This course is designed to provide students practical knowledge of manufacturing methods including modern manufacturing process such as EDM, ECM, USM etc. and limitation. The focus of this curriculum is the development of student's practical knowledge regarding manufacturing process and tools used in manufacturing. The learning approach is get the opportunity to work physically in different types of machine tools like lathe machine, milling machine, drill machine etc and be able to manufacture an industrial part by using lathe, shaper machine etc. Students will be able to apply different types of manufacturing process practically like casting, welding and forming process and get the opportunity to know about chip, determine chip reduction coefficient and get familiarized with modern manufacturing process such as EDM, ECM, USM etc. Thus allowing them to relate theoretical knowledge with practical.			
OBJECTIVE			
To apply practical understanding for use of moulding tools: green sand moulding, gating system, risering system, core making. To plan and create jobs using machining process. To understand and plan for machining of jobs. To relate the job manufactured from practical relevance point of view.			
LEARNING OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods

CO1	Design the gating and riser system needed for casting and analyze the thermal, metallurgical aspects during solidification in casting.	2	C4, C6	3, 5	1		R,Q,T,
CO2	Analyze the thermal, metallurgical aspects during welding, behavior for common and new welding techniques and their role on quality of cast or weld objects.	2,3	C4	1, 3	1		R,Q,T,
CO3	Design and develop appropriate part for machine and products with different machining process.	3	C3,C6	5	1		R,Q,T,
CO4	To gain the knowledge of different Forming process and application in industrial domain	1,6	C2, C3	2, 7	1		R,Q,T, Pr

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

Study of Different types of casting term and process.

Study of different welding process.

Study of different machine tools.

Manufacturing of an Industrial Part by using machine tools.

Study of chip and chip dimension.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Design the gating and riser system needed for casting and analyze the thermal, metallurgical aspects during solidification in casting.		3	3									
CO2	Analyze the thermal, metallurgical aspects during welding, behavior for common and new welding techniques and their role on quality of cast or weld objects.		3										
CO3	Design and develop appropriate part for machine and products with different machining process.			3									
CO4	To gain the knowledge of different Forming process and application in industrial domain	3					3						3

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of matching	Justifications
CO1-PO2	3	Knowledge about different manufacturing terms used in manufacturing process respect to different types of products and related materials can be achieved through understanding of this course.
CO2-PO3	3	Able to know about different manufacturing machine and machining operations through analyzing process.
CO2-PO2	3	Understanding and evaluating the sustainability and impact of manufacturing activities in societal and environmental contexts.

CO3-PO3	3	Able to gain knowledge about different manufacturing methods and their working procedure.
CO4-PO1	3	Students will be able to analyze about manufacturing procedure and exact field of application.
CO4-PO6	3	Students will be able to think about design and development about manufacturing concept from different points of view.

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	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
	Total	79

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

COURSE SCHEDULE	
Week	Topics
1	Introduction and short brief regarding lab proceedings and experiments.

3	Study of sand mould and making sand mould.
5	Study about arc welding.
7	Study about oxy-acetylene gas welding.
9	Study about lathe machine
11	Study about milling machine
12	Study about drilling machine and shaper machine.
13	Lab Test
14	Lab Quiz

ASSESSMENT STRATEGY		
Assessment Method		Grading
Continuous Assessment	Lab participation and Report	30%
	Lab Test	30%
Lab Quiz, viva		40%
Total		100%

REFERENCE BOOKS
Manufacturing Engineering and Technology (4thedition) SeropeKalpakjiannStevenR. Schmid, Principles of Modern Manufacturing, 5th Edition, SI Version 2013‖, Authors: Mikell P. Groover, Manufacturing Processes and Materials for Engineers –Doyle Morris

IPE 4115 Industrial Management

COURSE INFORMATION			
Course Code	IPE 4115	Lecture Contact Hours	3.00
Course Title	Industrial Management	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			

This course provides an understanding of the fundamentals of management and structure and basics of industrial organizations. Students will obtain theoretical insights and be able to use practical tools within the area of management and organizations. The learning approach is to familiarize students with different perspectives for planning and decision making and ethical responsibility. Students will achieve skills such as how a business runs as well as leadership, organizing, strategic planning, and management control functions in an industrial organization.
OBJECTIVE
To introduce different management and administrative structures, functions and approaches. To expose students to different management thoughts for planning and decision making. To understand how an organization functions collaboratively with managers and engineers. To understand various personality traits and its impact on leadership and importance of motivation on management. To solve real-world management problems as an engineer.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Familiarize with the concept of management fundamentals, sustainable development, principles and ethics of management and organization structures.	1	C1	1,2,3	1	-	CT, F
CO2	Understand the contribution of leadership traits, leadership styles, motivational concepts and management skills in planning and decision making in order to solve real life problems.	2	C2	2	2	-	CT, ASG, F

CO3	Demonstrating conceptual knowledge, effective understanding and analytical problem solving skills in functional areas of financial and marketing management of both local and global markets.	11	C2	4	3	-	CT, M , F
CO4	Recognizing and analyzing occupational safety and health hazards.	6	C4	7	5,6	-	ASG, F
CO5	To be aware of moral theories, ethical decision making, and professional codes of ethics to deal with engineering ethics	8	C5	7	5		F
CO6	Understand field guidance perspectives to deal with engineering sustainable development.	7	C2	7	5,6		F
(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).							

COURSE CONTENT
Main Contents Management Fundamentals Management Ethics Development of Management Thoughts Planning and Decision Making

Organization

Personnel and Human Resources Management

Marketing

Management Information System

Global Management

Financial Management

Safety Management and Emergency Planning

Detail Contents

Management Fundamentals: Scope, function and role of management, Management and administration, Role of manager.

Management Ethics: Social and ethical responsibility of managers, sustainable development.

Development of Management Thoughts: Taylor's scientific management theory, contribution of H. Fayol, E. Mayo, Gilbreths and other pioneers, Classical management theory, Principles of management, Sustainable development.

Planning and Decision Making: Strategic management, planning process and organization goal: MBO nature and purpose, MBO process and effectiveness, Managerial decision making: the nature of decision making and decision-making process, Portfolio analysis: SWOT, BCG, SPACE ete.

Personnel and Human Resources Management: Functions, Personnel policies, manpower planning, recruitment and development, leading and motivating: Types of leadership and styles, Theory of leadership, Morale and motivation, motivation theories and morale building plans, Individual and group behavior, Job enlargement and enrichment, Performance appraisal/merit rating, Job evaluation, Salary, Wages and wage incentives plans, Fringe benefits.

Marketing: Concepts of marketing mix, product life cycle, Marketing decision making, Industrial and consumer selling, Channel of distributions, Sales promotion, Patent and tra mark, Marketing research, Development of new product.

Management Information System: MIS application of computer in management and decision making (DSS).

Global Management: Comparison of management systems of USA, Japan and China.

Financial Management:

Financial analysis, ratio analysis, Different types of ratios and their uses, Limitation and trend analysis, Time value of money, decision making based on PW, EUAW, B/C ratio, Break even analysis, Value engineering.

Safety Management and Emergency Planning: Preventive and break down maintenance, Occupational safety, fire and explosion hazards, Industrial Safety, Electrical hazards.													
CO-PO MAPPING													
No.	CO	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Familiarize with the concept of management fundamentals, principles and ethics of management and organization structures.	3											
CO2	Understand the contribution of leadership traits, leadership styles, motivational concepts and management skills in planning and decision making in order to solve real life problems.		3										
CO3	Demonstrating conceptual knowledge, effective understandi											3	

	ng and analytical problem-solving skills in functional areas of financial and marketing management of both local and global market.												
CO4	Recognizing and analyzing occupational safety and health hazards.						3						
CO5	To be aware of moral theories, ethical decision making, and professional codes of ethics to deal with engineering ethics								3				
CO6	Understand field guidance perspectives to deal with engineering sustainable development.							3					

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).		
JUSTIFICATION FOR CO-PO MAPPING:		
CO-PO	Level	Justification
CO1-PO1	3	Concept of management fundamentals and principles of management and organization structures will require knowledge of natural science, engineering fundamentals and an engineering specialization.
CO2-PO2	3	Identification and analysis of complex engineering problems such as planning and decision making in order to solve real life problems.
CO3-PO11	3	Demonstrating conceptual knowledge, effective understanding and analytical problem-solving skills in functional areas of financial and marketing management.
CO4-PO6	3	Contextual knowledge to assess health and safety hazards relevant to professional engineering practice.
CO5-PO8	3	Students will be able to learn engineering ethics.
CO6-PO7	3	Students will be able to deal with engineering sustainable development.
(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).		

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (Hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	42 14 07
Formal Assessment Continuous Assessment Final Examination	04 03

Total	112
TEACHING METHODOLOGY	
Class lecture, Quiz, Case study, Problem solving	
COURSE SCHEDULE	

Week	Lecture	Topics	Assessment Methods
1	1	Management Fundamentals: Scope, function and role of management	
	2	Management and administration, Role of manager.	
	3	Strategic Management, Management by Objectives (MBO)	
2	4	Management Ethics: Social and ethical responsibility of managers, sustainable development	
	5	Taylor's scientific management theory	
	6	SWOT Analysis, BCG Matrix	
3	7	Contribution of H. Fayol, E. Mayo, Gilbreths and other pioneers	
	8	Classical management theory, Principles of management	
	9	Personnel and Human Resource Management: Recruitment, Interviewing	
4	10	Organization: Fundamentals, organization variables	CT 01
	11	Organization structure, Types, span of control, Authority, Manpower Development	
	12	Leadership; Leadership style based on use of Authority	
5	13	Responsibility and accountability centralization and decentralization	
	14	Organization culture, Fiedler's Contingency Model	

	15	Managerial Grid type Leadership Style	
6	16	Reorganizing, Organization development	
	17	Management Information System: MIS	
	18	Hersey-Blanchard Situational Model, Motivation: Maslow's Hierarchy of Needs Model	ASG 01
7	19	Management Information System: MIS	
	20	MIS application of computer in management and decision making (DSS).	
	21	Herzberg's Two Factor 7 Alderfer's E-R-G Models, Porter and Lawler Model	
8	22	MIS application of computer in management and decision making (DSS).	
	23	Global Management	
	24	Equity Theory of Motivation, Job Evaluation: Non-Quantitative Methods	M
9	25	Comparison of management systems of USA, Japan and China	
	26	Financial Management: Financial analysis, ratio analysis	
	27	Job Evaluation: Quantitative Methods, Wages and Incentive Plans	
10	28	Different types of ratios and their uses	
	29	Limitation and trend analysis, Time value of money	
	30	Fringe Benefits, Marketing and Marketing Mix	
11	31	Decision making based on PW, EUAW	

	32	Break even analysis	
	33	Product Life cycle (PLC), Industrial and Consumer Selling, Channels of Distribution	CT 02
12	34	B/C ratio, Value engineering	
	35	Safety Management and Emergency Planning	
	36	Sales Promotion, Advertising	
13	37	Preventive and break down maintenance	
	38	Occupational safety, fire and explosion hazards, Industrial Safety, Electrical hazards.	
	39	Patents & trademarks, Marketing research, Development of New Products	ASG 02
14	40	Review class and discussion about final examination	
	41		
	42		

ASSESSMENT STRATEGY			
COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	30	
2	CT, ASG	20	
3	CT	20	
4	ASG	20	
	Exam		
1	F	70	
2	F	80	
3	M, F	80	
4	F	80	
5	F	100	
6	F	100	

Total Marks		100%	

REFERENCE BOOKS
Heinz Weihrich, Koontz, H., & Cannice, M. (2020). Management: a global, innovative, and entrepreneurial perspective. New Delhi: Mcgraw Hill Education (India) Private Limited, Cop. Flippo, E. B. (1976). Personnel management. Tokyo: Mcgraw-Hill. Arthur, J., R Edward Freeman, & Gilbert, D. R. (2001). Management. Cape Town: Prentice-Hall International. Industrial Engineering and Management by O.P. Khanna Khanna, O. P. (1985). Industrial engineering and management. Jullundur, Delhi: Dhanpat Rai & Sons. Rameshwar Das Agarwal. (1982). Organization and management. New Delhi: Tata Mcgrawhill.

IPE 4207 Tool Engineering & Machine Tools

COURSE INFORMATION			
Course Code	IPE 4207	Lecture Contact Hours	3.00
Course Title	Tool Engineering and Machine Tools	Credit Hours	3.00
PRE-REQUISITE			
EEE 1159: Basic Electrical Engineering, ME 2103: Engineering Mechanics-I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This course provides a brief understanding about different jigs, fixtures and machine tools and their applications. The focus is to introduce the students to different bench tolls, hand tools and machine tools. The learning approach is to give different examples to familiar with machine tools and gear drive design. Students will achieve brief knowledge about gear drive design, development of kinematic chain of machine tools, kinematic structure and computer-controlled manufacturing like NC, CNC, DNC, CAM and Robotics.			

OBJECTIVE
To learn how to locate and clamp a workpiece properly and understand the mechanisms of various jigs and fixtures. To understand different types of bending, forming and drawing dies and their working principles. To develop kinematic chains of machine tools and gear drive design. To enhance knowledge about computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics.

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Correspon ding PO	Bloom's Taxonomy	KP	CP	CA	Assess-ment Methods
CO1	Define how to locate and clamp a work piece properly and understand the mechanisms of various jigs and fixtures.	1	C2	3	1		Q, ASG, F, M
CO2	Be capable to understand different types of bending, forming and drawing dies and their working principles.	2	C2	2	1	5	Q, ASG, F, M
CO3	Be able to solve problems relating to develop kinematic chains of machine tools and gear drive design.	4	C3	5	1		ASG, F, M, CS
CO4	Evaluate the computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics.	1	C5	4	3		Q, ASG, F, M

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT
a. Main Contents:

Work Holding Devices

Die Design

Kinematic Structure of Machine Tools

Drive Systems

Modern Machining Techniques

Robotics

Machine Installation and Testing

Detail Contents:

Tool Engineering:

Work Holding Devices: Degrees of freedom, principles of location, locating methods, Locators, clamping devices and forces, Types, Design and detailed study of jigs and fixtures used in various machining processes.

Die Design: Dies and punches, Introduction to die cutting operations, die clearance, Piercing and blanking die design, cutting by punches, Strip layout, Bending, Forming and drawing dies, Drawing forces, Blank size determination.

Machine Tools

Fundamentals: Classification, Specification of different machine tools, Description of turret and copying lathe, Universal milling machine, Jig boring machine, Honing machine, Hobbing machine.

Kinematic Structure of Machine Tools: Developing the kinematic chain of machine tools, Determination of transmission ratio, Drawing of ray diagrams, Analysis of kinematic structure, Analysis of G.P. series.

Drive Systems: Mechanical, hydraulic, Electrical and pneumatic drive systems, Speed and feed gear boxes, Optimum speed, Gearbox design, Basic principles of cluster gear design, Stepless drives, Control systems in machine tools.

Modern Machining Techniques: Transfer line, Numerical control of machine tools-fundamental concepts, Main components of NC machine tools, Types of NC machines-machining center, Introduction of part programming, Introduction of CNC and DNC, Fundamentals of CAM, Application of group technology and introduction to flexible manufacturing system.

Robotics: Introduction to robotics, Basic components of robot technology levels, Manipulator features arm geometry, Rotation, Drive system, Work envelopes, Mounting, Internal components of controllers, General features, Input power, Master control memory.

Machine Installation and Testing: Installation procedure, Foundation design, Trends in the development of modern machine tools, Testing after installation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Define how to locate and clamp a work piece properly and understand the mechanisms of various jigs and fixtures.	3											
CO2	Be capable to understand different types of bending, forming and drawing dies and their working principles.		3										
CO3	Be able to solve problems relating to develop kinematic chains of machine tools and gear drive design.				3								
CO4	Evaluate the computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of Matching	Justification
CO1-PO1	3	Depth of knowledge will be achieved about how to locate and clamp a workpiece properly and understand the mechanisms of various jigs and fixtures.
CO2-PO2	3	Students will learn different types of bending, forming and drawing dies and their working principles.
CO3-PO4	3	Being able to solve problems relating to develop kinematic chains of machine tools and gear drive design.
CO4-PO1	3	Students will gain knowledge about computer controlled manufacturing 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	Lecture	Topics	ASG/CT/ M	Remarks
1	1	Tool Engineering: Work Holding Devices: Degrees of freedom, principles of location		
	2	Work Holding Devices: Locating methods, Locators		
	3	Work Holding Devices: Clamping devices and forces		
2	4	Work Holding Devices: Types, Design and detailed study of jigs used in various machining processes. (Lec 01)		
	5	Work Holding Devices: Types, Design and detailed study of jigs used in various machining processes. (Lec 02)		
	6	Work Holding Devices: Types, Design and detailed study of fixtures used in various machining processes. (Lec 01)		
3	7	Work Holding Devices: Types, Design and detailed study of fixtures used in various machining processes. (Lec 02)		
	8	Die Design: Dies and punches		
	9	Die Design: Introduction to die cutting operations	CT-01	Lectures 1-6
4	10	Die Design: Piercing and blanking die design		
	11	Die Design: Die clearance		

	12	Die Design: Cutting by punches, Strip layout		
5	13	Die Design: Bending, Forming and drawing dies		
	14	Die Design: Drawing forces, Blank size determination.		
	15	Robotics: Introduction to robotics, Basic components of robot technology levels		
6	16	Robotics: Manipulator features arm geometry		
	17	Robotics: Rotation, Drive system, Work envelopes		
	18	Robotics: Mounting, Internal components of controllers	ASG-01	
7	19	Robotics: Drive Systems		
	20	Robotics: General features, Input power, Master control memory		
	21	Robotics: Manipulator features arm geometry	M	
8	22	Machine Tools Fundamentals: Classification, Specification of different machine tools		
	23	Fundamentals: Description of Turret Lathe, Main units of a Turret Lathe, Copying Lathe, Universal Milling Machine		
	24	Fundamentals: Jig boring machine, Honing machine, Hobbing machine		
9	25	Kinematic Structure of Machine Tools: Developing the kinematic chain of machine tools, Determination of transmission ratio, Speed Range Ratio		
	26	Kinematic Structure of Machine Tools: Drawing of		

		ray diagrams, Analysis of kinematic structure		
	27	Kinematic Structure of Machine Tools: Analysis of G.P. series, Designing the layout of Mechanical drive		
10	28	Drive Systems: Methods of changing speed		
	29	Drive Systems: Mechanical, hydraulic, Electrical and pneumatic drive systems.		
	30	Drive Systems: Speed and feed gear boxes, Optimum speed		
11	31	Drive Systems: Gearbox design, Basic principles of cluster gear design		
	32	Drive Systems: Stepless drives		
	33	Drive Systems: Control systems in machine tools.	CT-02	Lectures 23-30
12	34	Modern Machining Techniques: Transfer line, Numerical control of machine tools-fundamental concepts		
	35	Modern Machining Techniques: Main components of NC machine tools, Types of NC machines- machining center		
	36	Modern Machining Techniques: Introduction of part programming, Introduction of CNC and DNC (Lec 01)	ASG-02	
13	37	Modern Machining Techniques: Fundamentals of CAM (Lec 02)		
	38	Modern Machining Techniques: Application of group technology and		

		introduction to flexible manufacturing system (Lec 03)		
	39	Machine Installation and Testing: Installation procedure		
14	40	Machine Installation and Testing: Foundation design, Trends in the development of modern machine tools		
	41	Machine Installation and Testing: Testing after installation		
	42	Review Class		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CT	30	
2	ASG	30	
3	CT	20	
	Exam		
1	M, F	70	
2	F	70	
3	M, F	80	
4	M, F	100	

REFERENCE BOOKS

Tool Design (3rd Edition) – Cyril Donaldson, George H Le CAIN and VC Goold, Tata McGraw Hill

Fundamentals of Tool Design –ASTME

Machine Tools – N. Chernov

Elements of Machine Tools – M. Anwarul Azim

Machine Tool Engineering – G.R. Nagpal, Khanna Publishers

IPE 4208 Tool Engineering & Machine Tools Sessional

COURSE INFORMATION			
Course Code	IPE 4208	Lecture Contact Hours	1.50
Course Title	Tool Engineering & Machine Tools Sessional	Credit Hours	0.75

PRE-REQUISITE

EEE 1159: Basic Electrical Engineering, ME 2103: Engineering Mechanics-I, IPE 4207: Tool Engineering & Machine Tools

CURRICULUM STRUCTURE

Outcome Based Education (OBE).

SYNOPSIS /RATIONALE

In this sessional students will be able to apply the basic knowledge of tool engineering by designing different work holding devices (such as locators, clamping devices), jigs and fixtures used in various machining processes. Knowledge of machine tools fundamentals will help in analyzing kinematic structures, drive systems of different machine tools (such as lathe, milling etc.)

OBJECTIVE

To study different types of chips.

Determination of chip thickness ratio and metal removal rate in turning.

To study speed and feed gearboxes with SolidWorks design.

To analysis kinematic structure and G.P. series of lathe.

To study gear indexing and manufacturing of a spur gear on milling machine.

To study and design of locators and clamping devices used in various machining processes (prototype making with SolidWorks design).

To study and design of jigs and fixtures used in various machining processes (prototype making with SolidWorks design).

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corres-ponding PO	Bloom's Taxo-nomy	KP	CP	CA	Assess-ment Methods
CO1	Relate basic concepts/principles of tool engineering and machine tools fundamentals for designing and analyzing different material removal	1	C3	4,5	1		Q, R, LT

	conditions (such as chips, chips ratio), tool designs, analysis of machines etc.						
CO2	Analyzing kinematic structures, and drive systems of different machine tools (such as lathe, milling etc.) using machine tools fundamentals.	2	C4	2	3		Q, R, LT
CO3	Designing different work holding devices (such as locators, clamping devices), jigs and fixtures used in various machining processes	3	C6	4			Q, R, LT

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

Experiments:

Study of Chips, and Determination of Chip Thickness Ratio and Metal Removal Rate in Turning.

Study of Speed and Feed Gearboxes with SolidWorks Design.

Analysis of Kinematic Structure and G.P. Series of Lathe.

Study of Gear Indexing and Manufacturing of a Spur Gear on Milling Machine.

Study and Design of Locators and Clamping Devices Used in Various Machining Processes.

Study and Design of Jigs and Fixtures Used in Various Machining Processes.

CO-PO MAPPING

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

CO1	Relate basic concepts/principles of tool engineering and machine tools fundamentals for designing and analyzing different material removal conditions (such as chips, chips ratio), tool designs, analysis of machines etc.	3											
CO2	Analyzing kinematic structures, and drive systems of different machine tools (such as lathe, milling etc.) using machine tools fundamentals.		3										
CO3	Designing different work holding devices (such as locators, clamping devices), jigs and fixtures used in various machining processes.			3									

JUSTIFICATION FOR CO-PO MAPPING		
Mapping	Level of matching	Justifications
CO1-PO1	3	In order to relate basic concepts/principles of tool engineering and machine tools fundamentals engineering fundamentals and an engineering specialization knowledge is required.
CO2-PO2	3	Analyzing kinematic structures, and drive systems of different machine tools using machine tools fundamentals.
CO3-PO3	3	Designing different work holding devices used in various machining processes that meet specified needs with appropriate consideration.

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	10
	Preparation of Presentation	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	07
	Final Quiz	01
	Total	79

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week	Topics
1	Study of Chips, and Determination of Chip Thickness Ratio and Metal Removal Rate in Turning.
2	Study of Speed and Feed Gearboxes with SolidWorks Design.
3	Analysis of Kinematic Structure and G.P. Series of Lathe.
4	Study of Gear Indexing and Manufacturing of a Spur Gear on Milling Machine.
5	Study and Design of Locators and Clamping Devices Used in Various Machining Processes.
6	Study and Design of Jigs and Fixtures Used in Various Machining Processes.
7	Lab Test, Final Lab Report Submission
8	Viva, Quiz

ASSESSMENT STRATEGY

Assessment Method		Grading
Continuous Assessment	Lab participation and Report	30%
	Lab Test	30%
Lab Quiz, viva		40%
Total Marks		100%

REFERENCE BOOKS
Tool Design (3rd Edition) – Cyril Donaldson, George H Le CAIN and VC Goold Fundamentals of Tool Design –ASTME Machine Tools – N. Chernov Elements of Machine Tools – M. Anwarul Azim Machine Tool Engineering – G.R. Nagpal

List of Core Courses: English

HUM 1115: English

COURSE INFORMATION			
Course Code	HUM 1115	Lecture Contact Hours	3.00
Course Title	English	Credit Hours	3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
The course will develop students' writing skills necessary for their academic and professional success. It will also help the students to learn and follow the conventions of standard written English in sentence structure, punctuation, grammar usage and spelling. This course will also provide fundamental aspects of reading, writing, listening and speaking skills. The course will help students to develop their language and communication skills through interactive participation in the class. Students will practice brainstorming, freewriting, paragraph and argumentative essay writing. In addition, they will practice listening and speaking activities. By attending this course student can build up communicative skills which they can utilize in their academic as well as professional life.			
OBJECTIVE			

To help students learn rudiments of English, write grammatically correct sentences and use them in their real life situations To enable the students to develop their reading ability through practicing a substantial number of reading materials in the classroom. To enable the students to develop their writing ability through practicing a substantial number of writing tasks in the classroom.
LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods
CO1	Acquire their knowledge of fundamental grammatical structures and functions.	1	C1	1,2	1		CT, CS,M, F
CO2	Read and write grammatically correct sentences. Utilize the strategies of free hand writing in other courses.	2	C3	3	2		CT, CS,M, F
CO3	Use the language for their daily life communication with the native speakers and nonnative speakers more efficiently.	10	C4	3,7	3,6	1	CT, CS,M, F
CO4	Write paragraph, essay, report, summary, précis writing, cover letter and cv writing.	5	C6	3,8	5,7		CT, CS,M, F

(ASG – Assignment, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, PR – Project, Pr – Presentation, Q – Quiz, R – Report).
COURSE CONTENT

a. Main Contents:

Rules and types of tenses

WH question

Parts of speech

Phrase and clause

Structures and transformation of sentences

Write paragraph, easy, report, summary, précis writing, cover letter and cv writing

b. Detail Contents:

Section-A: General discussion: Introduction, various approaches to learning English, Grammatical Problem: Construction of sentences, grammatical errors, sentence variety and style, conditionals, vocabulary and diction; Reading Skill: Discussion readability, scan and skin reading, generating ideas through purposive reading, reading selective stories, Approaches to Communication: Communication today, business communication, and different types of business communication, Listening Skill: The phonetics and correct English pronunciation, Speaking Skill: Practicing dialogue, storytelling.

Section-B: Writing Skill: Principles of effective writing, organization, planning and development of writing, composition (Paragraph, Comprehension), précis writing, amplification, General Strategies for the Writing process: Generating ideas, identifying audiences, and purposes, construction arguments, stating problems, drafting and finalizing, Report Writing: Defining a report, classification of reports, structure of a report and writing of report.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Acquire their knowledge of fundamental grammatical structures and functions	3											
CO2	Read and write grammatically correct sentences. Utilize the strategies of free hand writing in other courses		3										
CO3	Use the language for their daily life communication with the native speakers and nonnative speakers more efficiently										3		

CO4	Write paragraph, easy, report, summary, précis writing, cover letter and cv writing					3							

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	Students will be able to know about the fundamental grammatical structures and functions of English language. They will get clear theoretical knowledge about correct rules devices and by using these devices they can formulate grammatically correct sentences.
CO2-PO2	3	Students will develop the ability to identify different problems using their grammatical knowledge while reading and writing in English.
CO3-PO10	3	By attending this course student can build up communicative skills which they can utilize in their academic as well as professional life. At the same time, they will be able to improve their presentation skills for academic purposes.
CO4-PO5	3	Students will learn different techniques and structures to develop their writing skills necessary for their academic and professional success.

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 and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL), Pop quiz, Case study.

COURSE SCHEDULE

Week	Lecture	Topics	ASG/CT/M	Remarks
1	1	Different Uses of Tense		
	2	Types of questions, ways of asking an answering questions		
	3	Definition of Phrase, Types of Phrase Identify Phrases		
2	4	Definition of Phrase, Types of Phrase Identify Phrases		
	5	Definition of Clause, types of Clauses		
	6	Identify Clause - Noun clause, adjective clause, Adverbial clause and conditional clause		
3	7	Identify Clause - Noun clause, adjective clause, Adverbial clause and conditional clause		
	8	Function and paraphrase of the Modals	CT-01	Lectures 1-6
	9	Basic sentence structures		
4	10	Different Rules of Transformation		
	11	Different Rules of Transformation		
	12	Different Rules of Transformation		
5	13	Difference between phonetics and phonology		
	14	IPA symbols, Phonemic transcription and rules of pronunciation		
	15	Phonemic transcription and rules of pronunciation		
6	16	Phonemic transcription and rules of pronunciation		

	17	Notions and Functions: formal and informal situations, asking for information, making request, greeting someone, congratulating	ASG-01	
	18	Notions and Functions: formal and informal situations, asking for information, making request, greeting someone, congratulating		
7	19	Practicing dialogue: role play, guided conversation, questioning and answering		
	20	Practicing dialogue: role play, guided conversation, questioning and answering		
	21	Practicing dialogue: role play, guided conversation, questioning and answering		
8	22	Reading: different reading strategies (Scanning and Skinning, guessing, contextualization)	M	
	23	Reading: different reading strategies (Scanning and Skinning, guessing, contextualization)		
	24	Reading: different reading strategies (Scanning and Skinning, guessing, contextualization)		
9	25	Practice reading using authentic materials and giving feedback		
	26	Practice reading using authentic materials and giving feedback		
	27	Practice reading using authentic materials and giving feedback		
10	28	Writing: how to write different types of application		
	29	Writing job application		
	30	Writing job application		

11	31	Writing cover letter		
	32	Writing cover letter	CT-02	Lectures 25-30
	33	Writing leave application		
12	34	Writing leave application		
	35	Resume writing		
	36	CV writing		
13	37	Summary and precise writing		
	38	Paragraph writing: Strategies of writing a paragraph, different parts of a paragraph; Types of paragraph - Listing paragraph		
	39	Example paragraph, Comparison paragraph, Contrast paragraph		
14	40	Essay writing: how to write an essay, different parts of an essay		
	41	Types of essay - Descriptive essay.	ASG-02	
	42	Narrative essay, Argumentative essay		

ASSESSMENT STRATEGY

CO	Assessment Method	(100%)	Remarks
	Class Assessment		
1	CS, CT	70	
2	CS, CT	70	
3	CS, CT	70	
4	CS, CT	70	
	Exam		
1	M, F	30	
2	M, F	30	
3	M, F	30	
4	M, F	30	

REFERENCE BOOKS
High school English Grammar by Wren & Martin A Practical English Grammar by Thomson & Martinet English Phonetics and Phonology by Peter Roach Language & Communication by Miller, G.A.

HUM 1116 Technical Report Writing & Presentation

COURSE INFORMATION			
Course Code	HUM 1116	Lecture Contact Hours	3.00
Course Title	Technical Report Writing & Presentation	Credit Hours	1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE).			
SYNOPSIS/RATIONALE			
This sessional provides students with the knowledge of English language and communication. Students will get the opportunity to engage in practical use of spoken English. The learning approach is studying, designing, analyzing and demonstrating different skills in English, both verbal and non-verbal. Students will achieve competency in speaking, listening, reading and writing.			
OBJECTIVE			
To familiarize students with different situational and communicative English. To study and be able to operate successful conversation with different individuals. To acquaintance with professional verbal and written language and its usage.			

LEARNING OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corres-ponding PO	Bloom's Taxono-my	KP	CP	CA	Assess-ment Methods

CO1	Studying and applying different ways of communication for professional purposes.	10	C2, C3	-	-		R, Pr, T, F
CO2	Demonstrating the use of verbal and written excellence in real life situations.	10	C3, C6	-	-		R, Pr, T, F
CO3	Be able to design and write technical reports, project, and research proposals in English.	3	C2, C3, C6	-	-		R, Q, T, ASG, F
CO4	Analyzing the problems and finding solutions in English to daily life conversation.	2	C4	-	-		Q, Pr, T, F

(A- Affective Domain, ASG – Assignment, C-Cognitive Domain, CA-Complex Activities, CP- Complex Problems, CS – Case Study, CT – Class Test, D – Demonstration, F – Final Exam, KP-Knowledge Profile, LT-Lab Test, M-Mid-Term, P-Psychomotor Domain, PR – Project, Pr – Presentation, Q – Quiz, R – Report).

COURSE CONTENT

a. Main Contents:

Communicative English

Grammar and Vocabulary

Acquaintance with technical report writing

b. Detail Contents:

Communicative English: Practical English Speaking, Writing, Listening, Reading, Presentation Skills, Viva etc.

Grammar and Vocabulary: Tense, Verb, Modals, Conjunctions, Synonyms and Antonyms etc.

Acquaintance with technical report writing: Different types of report writing, project proposal writing, freehand writing etc.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Studying and applying different ways of communication for professional purposes.										3		
CO2	Demonstrating the use of verbal and written excellence in real life situations.										3		
CO3	Be able to design and write technical reports, project, and research proposals in English.										3		
CO4	Analyzing the problems and finding solutions in English to daily life conversation.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as low and 1 as none or zero level of matching).

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO10	3	Studying and applying different ways of verbal and non-verbal communication for professional and educational purposes.
CO2-PO10	3	Demonstrating the use of verbal and written excellence in real life situations.
CO3-PO10	3	Be able to design and write technical reports, project, and research proposals in English.
CO4-PO2	2	Analyzing the problems and finding solutions to effective report writing strategies in English. Also having necessary conversations in daily life situations will be taught.

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	05
	Preparation of Quiz	10
	Engagement in Group Projects	20
Formal Assessment		
	Continuous Assessment	14
	Final Quiz	01
Total		112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, co-operative and collaborative method, project-based method

COURSE SCHEDULE

Week	Topics	Remarks
1	Communicative English	
2	Grammar; Tense	
3	Grammar; Verb	
4	Synonyms and Antonyms	
5	Speaking Practice	
6	Presentation	
7	Group Work	
8	Report Writing	
9	Project Proposal Writing	
10	Listening Practice	
11	Listening Test	
12	Presentation	
13	Viva	
14	Revision Class	

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (60%)	Technical Report Writing	30%
	Listening and Speaking Test	30%
Final Presentation and Viva		40%
Total Marks		100%

REFERENCE BOOKS
Business Correspondence and Report Writing; Authored by: R C Sharma, Krishna Mohan, Edition: 5th Effective Business Report Writing; Authored by: Brown, Leland

Annexure 2 Bloom's Taxonomy

Bloom's Taxonomy

Bloom was the head of a group in the 1950's and 1960's that created the classic definition of the levels of educational activity, from the very simple (like memorizing facts) to the more complex (such as analyzing or evaluating information). The three types, or domains, of knowledge they defined are cognitive (knowledge), affective (attitudes) and psychomotor (physical skills). Bloom's committee wrote classification schemes for the first two domains; researchers such as Simpson (1972), Harrow (1972) and Dave (1970) developed competing systems for the psychomotor domain.

The three domains, their complexity levels and examples of educational activities that represent each level:

Cognitive Domain

(Bloom)

Level	**Definition**	**Sample Verbs**
Knowledge	Recall and remember information.	defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states, memorizes, tells, repeats, reproduces
Comprehension	Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words. Establish relationships between dates, principles, generalizations or values	comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives examples, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates, shows relationship of, characterizes, associates, differentiates, classifies, compares distinguishes
Application	Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace. Facilitate transfer of knowledge to new or unique situations.	applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, solves, uses, systematizes, experiments, practices, exercises, utilizes, organizes
Analysis	Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates, investigates, discovers, determines, observes, examines

Synthesis	Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. Originality and creativity.	categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes, synthesizes, imagines, conceives, concludes, invents theorizes, constructs, creates
Evaluation	Make judgments about the value of ideas or materials.	appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports, calculates, estimates, consults, judges, criticizes, measures, decides, discusses, values, decides, accepts/rejects

Affective Domain
(Bloom)

Level	Definition	Sample Verbs
Receiving phenomena	Awareness, willingness to hear, selected attention.	asks, chooses, describes, follows, gives, holds, identifies, locates, names, points to, selects, sits, erects, replies, uses.
Responding to phenomena	Active participation on the part of the learners. Attends and reacts to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation).	answers, assists, aids, complies, conforms, discusses, greets, helps, labels, performs, practices, presents, reads, recites, reports, selects, tells, writes.
Valuing	The worth or value a person attaches to a particular object, phenomenon, or behavior. This ranges from simple acceptance to the more complex state of commitment.	completes, demonstrates, differentiates, explains, follows, forms, initiates, invites, joins, justifies, proposes, reads, reports, selects, shares, studies, works.
Organization	Organizes values into priorities by contrasting different values, resolving conflicts between them, and creating a unique value system. The emphasis is on	adheres, alters, arranges, combines, compares, completes, defends, explains, formulates, generalizes, identifies, integrates, modifies,

	comparing, relating, and synthesizing values.	orders, organizes, prepares, relates, synthesizes.
Internalizing values	Has a value system that controls their behavior. The behavior is pervasive, consistent, predictable, and most importantly, characteristic of the learner.	acts, discriminates, displays, influences, listens, modifies, performs, practices, proposes, qualifies, questions, revises, serves, solves, verifies.

Psychomotor Domain
(Dave)

Level	**Definition**	**Sample Verbs**
Imitation	Includes repeating an act that has been demonstrated or explained, and it includes trial and error until an appropriate response is achieved.	begin, assemble, attempt, carry out, copy, calibrate, construct, dissect, duplicate, follow, mimic, move, practice, proceed, repeat, reproduce, respond, organize, sketch, start
Manipulation	Includes repeating an act that has been demonstrated or explained, and it includes trial and error until an appropriate response is achieved.	(similar to imitation), acquire, assemble, complete, conduct, do, execute, improve, maintain, make, manipulate, operate, pace, perform, produce, progress, use
Precision	Response is complex and performed without hesitation.	achieve, accomplish, advance, exceed, excel, master, reach, refine, succeed, surpass, transcend
Articulation	Skills are so well developed that the individual can modify movement patterns to fit special requirements or to meet a problem situation.	adapt, alter, change, excel, rearrange, reorganize, revise, surpass
Naturalization	Response is automatic. One acts "without thinking."	arrange, combine, compose, construct, create, design, refine, originate, transcend

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Annexure 3 Knowledge Profile (KP)

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

Source:

Institution of Engineers Bangladesh (2019). *Board of Accreditation for Engineering and Technical Education: Accreditation Manual for Undergraduate Engineering Programs*. 2nd Edition.

Annexure 4 Range of Complex Engineering Problem Solving (CP)

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 involvement and conflicting requirements needs
Interdependence	P7: Are high level problems including many component parts or sub-problems

Source:

Institution of Engineers Bangladesh (2019). *Board of Accreditation for Engineering and Technical Education: Accreditation Manual for Undergraduate Engineering Programs*. 2nd Edition.

Annexure 5 Range of Complex Engineering Activities (CA)

Attribute	**Complex activities** mean (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches

Source:

Institution of Engineers Bangladesh (2019). *Board of Accreditation for Engineering and Technical Education: Accreditation Manual for Undergraduate Engineering Programs*. 2nd Edition.