Syllabus

Department of Mechanical Engineering

Undergraduate

Session: 2021-22

Shahjalal University of Science and Technology

Sylhet-3114, Bangladesh

OVERVIEW OF THE UNIVERSITY AND DEPARTMENT
(At a glance)

Name of the University
Shahjalal University of Science and Technology, Sylhet

Establishment of the University
25 August 1986

Founder Vice Chancellor of the University
Professor Dr. Sadruddin Ahmed Chawdhury

Current Vice Chancellor of the University
Professor Farid Uddin Ahmed

First Academic Session of the University
1990-1991

Website of the University
www.sust.edu

E-mail of the University
registrar@sust.edu

Name of the Department
Mechanical Engineering (MEE)

First Academic Session of the Department
2015-16

Website of the Department
www.sust.edu/d/mee

E-mail of the Department
mee@sust.edu

PABX Extension of the Department: **791**

Founder Head of the Department
Professor Dr. Md. Ariful Islam

Current Head of the Department
Md Mahmud-Or-Rashid

Programs Offering
B.Sc. (Engineering)

FACULTY LIST (Current)

SL. No.	Full Name	PABX	Cell Phone
	Assistant Professors		
01.	Mr. Md. Zahidul Islam (On Leave)		01724793100
02.	Mr. Md. Ferdous Alam (On Leave)		01718323266
03.	Mr. Nuruzzaman Sakib (On Leave)		01829685368
04.	Nafiza Anjum (On Leave)		01972225872
05.	Md. Shafiqul Islam (On Leave)		01743033430
06.	Md Mahmud Or Rashid*		01758639844
	Lecturers		
07.	A K M Ashikuzzaman		01878939415
08.	Md. Syamul Bashar		01307486552
09.	Saad Been Mosharof		01923201142
10.	Mostafa Rafid		01521301153
11.	HM Toufik Ahmed Zisan		01558153862

*Student adviser

Ordinance for Semester System for Bachelor's Degree

(This ordinance will replace other ordinances/resolutions etc. on the issues described here; however, it will not affect ordinances/resolutions on issues not mentioned here.)

1. Student Admission

1.1 Undergraduate Admission:
The admission committee of the university will conduct the admission process for Bachelor's degree as per the rules. The student will be admitted in the first semester of an academic year in the individual discipline of different schools. However the admission of foreign students will be subjected to the verification of academic records as per the university rule.

1.2 Student Status and Student Level:
Every student has to maintain his/her student status by getting admission paying necessary fees and register for required credits every semester. Unless a student graduate early by taking courses in advance, every student has to get admission in every semester successively. For bookkeeping purposes a student's level will be expressed by his/her year and semester. A student will be transferred to next level if he/she completes or appears in 80% of his designated courses at his/her present level. Once a student reaches 4th year 2nd (5th year 2nd for Architecture) semester he/she will be kept at this level until he/she graduates.

1.3 Re-Admission:
A student has to take re-admission if his/her student status is not maintained or one or more semesters were canceled because of disciplinary action against him/her. In case of semester cancellation the student has to get re-admission in the same semester. The level (Year and Semester) of re-admission will be determined by his completed/appeared credits. A student will be eligible for re-admission in the first year first semester of the subsequent session if s/he was present in at least 25% of the classes of his/her major courses, appeared at the semester final examination and his/her admission/semester fees was clear in the past semester/session. Re-admitted students will always be assigned the original Registration Number.

1.4 Student's Advisor:
After admission every batch of students will be assigned to a student's Advisor from the teacher of his/her discipline to guide him/her through the semester system. Advisors will always be accessible to the students and will be ready to mentor them in their academic activities, career planning and if necessary, personal issues. There will be a prescribed guideline for the Advisors to follow.

2. Academic Calendar

2.1 Number of Semesters:
There will be two semesters in an academic year. The first semester will start on 1st January and end on 30th June, the Second semester will start on 1st July and end on 31st December. The routine of the final examination dates along with other academic deadlines will be announced in the academic calendar at the beginning of each semester.

2.2 Duration of Semesters:
The duration of each semester will be as follows:

Classes and Preparatory weeks	15 weeks
Final Examination	04 weeks
Total	19 weeks

These 19 weeks may not be contiguous to accommodate various holidays and the Recess before the final examination may coincide with holidays. The final grading will be completed before the beginning of the next semester.

3. Course Pattern

The entire Bachelor's degree program is covered through a set of theoretical, practical, project, viva and seminar courses. At the beginning of every academic session a short description of every available course will be published by the syllabus committee of each discipline.

3.1 Course Development:

3.1.1 Major and Non-Major Courses:
Syllabus committee of every discipline will develop all the courses that will be offered by that particular discipline and has to be approved by the respective school and the Academic Council. These include major courses for the respective discipline as well as non-major courses that will be offered to other disciplines. Non-major courses will be developed with close cooperation of the disciplines concerned keeping into consideration of the need of that discipline.

3.1.2 Syllabus:
(a) Major and Non-Major Courses: Syllabus committee will select and approve the courses from major courses of the discipline as well as non-major courses offered by other disciplines to complete the syllabus. The syllabus committee will also select a group of courses as core-courses and without these courses a student will not be allowed to graduate even if he completes the credit requirement. The committee may assign prerequisite for any course if deemed necessary.
(b) Second Major Courses: The syllabus committee will select a set of courses of 28-36 credits from the major courses for a second major degree.

3.1.3 Course Instruction:
At the beginning of every semester the course instructor has to make a detailed plan of the course instruction in the prescribed form and supply it to the head of the discipline to make it available to the students. The course plan should have the information about the suggested text books, number of lectures per topic, number and type of assignments, number and approximate dates of mid-semester examinations and mandatory office hours reserved for the students of the course offered. If not otherwise mentioned, the medium of instruction is always English.

3.2 Course Identification System:
Each course is designated by a three-letter symbol for discipline abbreviation followed by a three-digit number to characterize the course. To avoid confusion new or modified courses should never be identified by reusing a discontinued course number

3.2.1 Discipline Identification:
The three-letter symbol will identify a discipline offering the course as follows. If the same course is offered to more than one discipline, if necessary, an extra letter shown in the list may be used after the three digits to specify the department receiving the non-major course.

		School of Applied Sciences and Technology:	
1.	ARC	Architecture	A
2.	CEP	Chemical Engineering and Polymer Science	B
3.	CEE	Civil and Environmental Engineering	C
4.	CSE	Computer Science and Engineering	D
5.	EEE	Electrical and Electronic Engineering	E
6.	FET	Food Engineering and Tea Technology	F
7.	IPE	Industrial and Production Engineering	G
8.	MEE	Mechanical Engineering	Q
9.	PME	Petroleum and Mining Engineering	H
		School of Life Sciences:	
10.	BMB	Biochemistry and Molecular Biology	I
11.	GEB	Genetic Engineering and Biotechnology	J
		School of Physical Sciences:	
12.	CHE	Chemistry	K
13.	GEE	GeograPHYand Environment	L
14.	MAT	Mathematics	M
15.	OCG	Oceanography	S

16.	PHY	Physics	N
17.	STA	Statistics	O
		School of Social Sciences:	
18.	ANP	Anthropology	a
19.	BNG	Bangla	b
20.	ECO	Economics	c
21.	ENG	English	d
22.	PSS	Political Studies	e
23.	PAD	Public Administration	f
24.	SCW	Social Work	g
25.	SOC	Sociology	h
		School of Agriculture and Mineral Sciences:	
26.	FES	Forestry and Environmental Science	P
		School of Management and Business Administration:	
27.	BUS	Business Administration	i
		Institute of Information and Coommunication Technology	
28.	SWE	Software Engineering	W

3.2.2 Course Number:
The three-digit number will be used as follows:
(a) First Digit: The first digit of the three digit number will correspond to the year intended for the course recipient.
(b) Second Digit: A discipline should use the number 0 and 1 for the second digit to identify non-major courses. The digits 2-9 are reserved for major courses to identify the different areas within a discipline.
(c) Third Digit: The third digit will be used to identify a course within a particular discipline. This digit can be used sequentially to indicate follow up courses. If possible even numbers will be used to identify laboratory courses.

3.2.3 Course Title and Credit:
Every course will have a short representative course title, declaration if it is core course, a number indicating the total credits as well as reference to prerequisite courses if any.

3.2.4 Theory and Lab Course:
If a single course has both Theory and Laboratory/Sessional part, then the course must be split into separate Theory and Lab courses and both should have separate course number. A student may not register for a lab course without registering or completing the corresponding theory course.

3.3 Assignment of Credits:

3.3.1 Theoretical:
One lecture per week (or 13 lectures in total) of 1 hour duration per semester will be considered as one credit. (There will be 10 minutes recess between theory classes). A theory course will have only integer number of credits.

3.3.2 Laboratory Classes:
Minimum two contact hours of a laboratory class per week (or 26 contact hours in total) per semester will be considered as one credit. A laboratory course may have half integer credits with a minimum of 1 credit.

3.3.3 Seminar, Thesis, Projects, Monographs, Fieldwork, Viva etc.:
Will be assigned by the respective discipline.

3.4 Classification of the Courses:
The Bachelor's degree courses will be classified into several groups and the syllabus committee will finalize the curricula selecting courses from the groups shown below.
3.4.2 Major Courses:
A student has to take at least 70% courses from his/her own discipline. Out of these courses a section will be identified as core courses and every student of a particular discipline will be required to take those courses.

3.4.3 Non-Major Courses:
Every student is required to take at least 20% (including mandatory) courses from related disciplines. If any Non-Major course is declared as a Core course a student is required to take that course to graduate. The Non-Major courses will be designed, offered and graded by the offering disciplines.

3.4.4 Other Courses:
After completion of the required mandatory, major and non-major courses a student may take a few other courses of his/her choice not directly related to his/her discipline to fulfill the total credit requirement.

3.4.5 Credit-Only Courses:
The credit of these Credit-Only courses will be added to the total credits if passed but will not affect the CGPA as there will be no grades for these courses.

4. Course Registration

4.1 Registration:
A student has to register for his/her courses and pay necessary dues within the first two weeks of every semester. Departmental student advisor will advise every student about his/her courses and monitor his/her performances. A student at any level is expected to register the courses at his level provided he/she does not have any incomplete courses from previous

levels. A student will not be allowed to appear in the examination if his/her semester and examination fee is not cleared.

4.2 Minimum and Maximum Credits:
A student, if s/he is not a clearing graduate, has to register for at least 12 credits minimum and 30 credits maximum every semester.

4.3 Incomplete Courses:
If a student has incomplete courses, he/she has to register his/her available incomplete courses from preceding levels before s/he can register courses from current or successive levels. If an incomplete course is not offered in a given semester the student has to take the courses when it is offered next time. A student with incomplete courses will not be eligible for Distinction.

4.4 Advance Courses:
A student may register courses of higher levels in advance to get his degree in shorter time if he/she does not have any incomplete or failed courses from present and previous levels.

4.5 Incomplete Courses:
A student can register his/her incomplete courses, if offered, from proceeding semesters before s/he can register courses from current or successive semesters, otherwise s/he takes the courses when the desired course is offered next time. A student will not be allowed to take 100 and 300 level and 200 and 400 level courses simultaneously. 100 level courses mean courses of 1st and 2nd semesters, 200 level courses mean courses of 3rd and 4th semesters and so on.

4.6 Course Withdrawal:
A student can withdraw a course by a written application to the Controller of Examinations through the Head of the discipline on or before the last day of instruction. The Controller of Examinations will send the revised registration list to the disciplines before the examination. There will be no record of the course in transcript if the course is withdrawn.

4.7 Course Repetition:
If a student has to repeat a failed or incomplete course and that course is not offered any more, the discipline may allow him/her to take an equivalent course from the current syllabus. For clearing graduates, if any incomplete course is not offered in the running semester, the discipline may suggest a suitable course to complete the credit requirement.

5. Graduation Criteria

5.1 Major Degree:

5.1.1 Total Credits:
School of Physical Sciences, School of Social Sciences and School of Management and Business Administration have a requirement of 140 credits to graduate from its disciplines. School of Applied Sciences and Technology, School of Life Sciences and School of Agriculture and Mineral Science have a requirement of 160 (200 for Architecture) credits for graduation.

5.1.2 Total Years:
A regular student is expected to graduate in 8 semesters (4 years) or in 10 semesters (5 years) for the discipline of Architecture. A student may graduate in a shorter time period if s/he is willing to take extra courses in a systematic way. A student will be given 4 (2 years) extra semesters in addition to 8/10 semesters to complete his/her degree. The regular examination year will be identified by the session and the end-month (June or December) of the semester the student graduates.

5.1.3 Early Graduation:
A student may graduate early by completing courses in advance, in that case he does not need to pay tuition or get admission in subsequent semesters. However a student will not be able to start master's degree one session earlier unless he graduates two semesters early.

5.1.4 Minimum Credit for a Clearing Graduate:
For a clearing graduate (8th and subsequent semesters) condition for maximum and minimum credit requirements is relaxed.

5.1.5 Break in study:
Those students who have not been able to achieve their degrees by participating in the ascertained 12th (for ARC department 14th) semester final exams will have the opportunity to do so by enrolling into 2 (two) running semesters back to back if after the publications of their results of the 12th (for ARC department 14th) semester final exam, it becomes evident that they have completed at least 80% of their total credits. In case of such students, on the tabulation sheet, result sheet, certificate, transcript,
grade sheet, etc., number of total semesters shall be stated instead of the word “Irregular.” As for irregular students, studentship shall be annulled after the aforesaid 2 (two) semesters have come to an end.

5.2 Second Major Degree:

5.2.1 Total Credits:
A student may apply for a second major degree if he/she completes an extra 28-36 credit requirement designated by the offering discipline.

5.2.2 Total Semesters:

A student has to complete the credit requirement of second major degree within 8 regular and 4 extra semesters.

5.2.3 Requirement of Major Degree:
A student will not be given a second major degree if he/she fails to complete his regular major degree. A student will not be allowed to enroll in Masters program before completion of his/her second major degree even if he/she complete his/her major degree requirement.

5.2.4 Registration Criteria:
An offering discipline will decide on the number of seats for second major, enrollment criteria and get it approved from the academic council. Students willing to get a second major have to apply to the offering discipline for enrollment and the discipline will enroll them as per the admission criteria. During registration enrolled students have to get their courses approved from the offering department completing a separate registration form.

5.2.5 Class Routine:
After enrollment a regular student may start taking the second major courses starting 3rd semester. The class routine may be arranged to accommodate the student need.

5.2.6 Certificate and Mark sheet:
A student completing the requirement will be given an additional certificate and grade sheet for his second major degree.

6. Examination System

A student will be evaluated continuously in the courses system, for theoretical classes s/he will be assessed by class participation, assignments, quizzes, mid-semester examinations and final examination. For laboratory work s/he will be assessed by observation of the student at work, viva-voce during laboratory works, from his/her written reports and grades of examinations designed by the respective course teacher and the examination committee.

6.1 Distribution of Marks:

The marks of a given course will be as follows:

Class Attendance	10%
Assignments and Mid-Semester Examinations	30%
Final Examination	60%

6.1.1 Class Participation:
The marks for class participation will be as follows:

Attendance (Percentage)	Marks	Attendance (Percentage)	Marks	Attendance (Percentage)	Marks
95 and above	10	80 to 84	7	65 to 69	4
90 to 94	9	75 to 79	6	60 to 64	3
85 to 89	8	70 to 74	5	Less than 60	0

A student will not be allowed to appear at the examination of a course if his/her class attendance in that course is less than 50%.

6.1.2 Assignments and Mid-Semester Examinations:
There should be at least two mid-semester examinations for every course. The course teacher may decide the relative marks distribution between the assignments, tutorial and mid-semester examinations, however at least 50% contribution should come from the mid-semester examinations. The answer script should be returned to the students as it is valuable to their learning process.

6.1.3 Final Examination:
The final examination will be conducted as per the Semester Examination Ordinance.

(a) Duration of the Final Examination: There will be a 3-hour final examination for every course of 3 credits or more after the 13th week from the beginning of the semester. Courses less than 3 credits will have final examination of duration 2 hours.

(b) Evaluation of Answer Script: The students of the School of Applied Science and Technology and the School of Agriculture and Mineral Sciences will have two answer scripts to answer separate questions during final examination. Two separate examiner will grade the two scripts separately and the marks will be added together to get the final mark. For the students of the other schools there will be a single answer script which will be evaluated by two examiners. The two marks will be averaged and if the marks by the two examiners differ by 20% or more the concerned answer scripts will be examined by a third examiner and the two closest marks among the three will be averaged to get the final mark.

7. Grading System

7.1 Letter Grade and Grade Point:
Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25

60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00

7.2 Calculation of Grades

7.2.1 GPA:
Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

7.2.2 CGPA:
Cumulative Grade Point Average (CGPA) of only major and both major and second major degree will be calculated by the weighted average of every course of previous semesters along with the present semester. For clearing graduates if the roundup value of the third digit after decimal is nonzero the second digit will be incremented by one. A student will also receive a separate CGPA for his second major courses.

7.2.3 F Grades:
A student is given an 'F' grade if he fails or is absent in the final examination of a course. If a student obtains an 'F' grade his grade will not be counted for GPA and s/he has to repeat the course. An 'F' grade will be in his/her record and s/he will not be eligible for Distinction.

8. Distinction

8.1 Distinction:
Candidates for four-year Bachelor degree will be awarded the degree with Distinction if his/her overall CGPA is 3.75 or above. However a student will not be considered for Distinction if (a) s/he is not a regular student (has semester drop, incomplete courses in any semester or break of study) (b) has 'F' grade in one or more courses.

Ref.: This Ordinance was approved in the 126th Academic Council (26 June 2013). Clause 3.4.1 was cancelled in 127th Academic Council (27 August 2013). 128th Academic Council (21 November 2013) decided to make it effective from 01 January 2014.

শাহজালাল বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়ের বিএনসিসি ক্যাডেটদের জন্য ঐচ্ছিক বিষয় হিসেবে নির্ধারিত

MSC004 (3.0 Credits)
MILITARY SCIENCE (সামরিক বিজ্ঞান)

পঠিত বিষয় (তত্ত্বীয় ও ব্যবহারিক): বি এন সি সি'র ইতিহাস-ঐতিহ্য, বি এন সি সি'র সাংগঠনিক কাঠামো, মহান স্বাধীনতা যুদ্ধের পঠভূমি ও কারণ, স্বাধীনতা যুদ্ধের সেক্টর সমূহ, ড্রিল, কুচকাওয়াজ, ম্যাপ রিডিং, যুদ্ধের নানা কৌশল, যুদ্ধে ব্যবহৃত অস্ত্রের পরিচয়, বাংলাদেশের সশস্ত্র বাহিনীর পরিচয়, নেতৃত্বের বৈশিষ্ট্য, শরীর চর্চা, প্রাথমিক চিকিৎসা, সমাজ সেবা, দুর্যোগ ব্যবস্থাপনা, ভুমিকম্প ব্যবস্থাপনা, ঘূর্ণিঝড় ব্যবস্থাপনা, অগ্নি নির্বাপনের কৌশল, সাংস্কৃতিক প্রশিক্ষণ ইত্যাদি।

সহায়ক গ্রন্থ :
বি এন সি সি: সামরিক বিজ্ঞান সদর দপ্তর কর্তৃক নির্ধারিত ও প্রকাশিত।

Vision Statement

The vision of the Department of Mechanical Engineering is to be nationally and internationally recognized in providing mechanical engineering education, leading to well qualified engineers who are innovative, immediate contributors to their profession and successful in advanced studies.

Missions

The Mechanical Engineering program makes available a high quality, relevant engineering education to all the students admitted in the Department. The Program dedicates itself to providing students with a set of skills, knowledge and attitudes that will permit its graduates to succeed and thrive as engineers and leaders. The Program strives to:

- Prepare its graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges
- Maintain a vital, state-of-the-art research enterprise to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.
- Prepare its graduates to become industrial and civic leaders and demonstrate entrepreneurial spirit

Objectives of the B.Sc. (Engg.) in Mechanical Engineering program (Program Educational Objectives, PEO)

PEO1. Help graduates excel in diverse career paths using their engineering knowledge and professional skills to address complex problems and make positive impacts on society.

PEO2. Train graduates to serve their profession and the public as ethical team members and leaders with awareness of modern issues, commitment to inclusive collaboration, and effective communication.

PEO3. Our graduates' practice adaptive learning, expanding and enhancing their knowledge, creativity, and skills through professional development, continuing education, research and/or earning advanced degrees.

PEO to Mission Statement Mapping

Mission/PEO	PEO1	PEO2	PEO3
M1	X	X	X
M2	X		X
M3		X	X

Program Learning Outcome (PO):

The PO for the degree *B.Sc. in Mechanical Engineering* at *Shahjalal University of Science and Technology are as follows.*

By the time students' graduate, they should demonstrate:

PO1 - Engineering knowledge: Graduates of Mechanical Engineering program should demonstrate a thorough knowledge of engineering principles, concepts, theories, and techniques, as well as knowledge of mathematics, science, and engineering fundamentals.

PO2 - Problem analysis: Graduates should be able to identify, formulate, and solve complex engineering problems, and analyze and make decisions based on data and knowledge.

PO3 - Design/development of solutions: Graduates should be able to design, develop, and implement systems, components, or processes that meet specified needs while considering public health and safety, and cultural, societal, and environmental factors.

PO4 - Investigation: Graduates should possess the ability to conduct investigations, analyze data and information, and draw conclusions, and have knowledge of modern engineering tools, techniques and methods.

PO5 - Modern tool usage: Graduates should be able to use current and emerging engineering tools, techniques and methods to analyze complex engineering problems and develop solutions.

PO6 - The engineer and society: Graduates should recognize the impact of engineering solutions on a global, economic, environmental, and societal context and the need for sustainable development.

PO7 - Environment and sustainability: Graduates should recognize the importance of developing and implementing sustainable engineering solutions that balance technical, economic, and environmental considerations.

PO8 - Ethics: Graduates should exhibit a sense of ethics and professional responsibility, recognize ethical considerations in engineering practices, and uphold ethical standards.

PO9 - Individual work and teamwork: Graduates should be able to work independently and in teams effectively, and acknowledge the importance of collaboration and communication in the engineering profession.

PO10 - Communication: Graduates should be able to communicate effectively and clearly, both orally and in writing, and acknowledge the need for effective communication in the engineering profession.

PO11 - Project management and finance: Graduates should be able to manage and plan engineering projects, including schedules, budgets, and resource allocation, and recognize the principles of engineering project finance.

PO12 - Life-long learning: Graduates should exhibit a commitment to life-long learning, acknowledge the importance of continuous professional development, and engage in self-directed study and continuing professional development activities

Program Objectives (PEO/PO) to Program Learning Outcome (PO) Mapping:

PO/PEO	PEO1	PEO2	PEO3
PO1	**X**		
PO2	**X**	**X**	**X**
PO3		**X**	
PO4	**X**	**X**	
PO5		**X**	
PO6	**X**		**X**
PO7		**X**	
PO8			**X**
PO9			**X**
PO10	**X**	**X**	**X**

Semester Wise Course List for Undergraduate Program

First Year: 1st Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
CHE 0531-1101	Fundamentals of Chemistry	3	3.00	
MAT 101Q	Differential Calculus and Geometry	3	3.00	
ENG 0231-1101	Effective Communication in English	2	2.00	
PHY 0533 1107Q	Physics I	3	3.00	
MEE 0715-1181	Introduction to Mechanical Engineering	3	3.00	

SSS 0222-1100S	History of the Emergence of Independent Bangladesh	3	3.00	
CHE 0531-1112Q	Chemistry Sessional	3	1.50	
ENG 0231-1102	English language lab	2	1.00	
MEE 0715-1172	Mechanical Engineering Drawing	3	1.50	
MEE 176	Foundry and Welding Shops	2	1.00	
Total			22	

PHY 0533 1212Q	Physics Sessional	3	1.50	
EEE 0713-1212Q	Fundamentals of Electrical & Electronics Engineering Sessional	2	1.00	
MEE 0715-1242	Programming Methodology for Mechanical Engineering Lab	2	1.00	
MEE 0715-1274	Computer-aided Mechanical Engineering Drawing	3	1.50	MEE172
MEE 178	Machine Shop Practice	2	1.00	
MEE 0715-1288	Comprehensive Viva-I		0.50	
Total			21.5	

First Year: 2nd Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
CHE 0531-1203	Chemistry of Engineering Materials	3	3.00	
MAT 103Q	Integral Calculus and Differential Equations	3	3:00	
PHY 0533 1209Q	Physics-II	3	3.00	
EEE 0713-1211Q	Fundamentals of Electrical & Electronics Engineering	3	3.00	
MEE 0715-1241	Programming Methodology for Mechanical Engineering	3	3.00	

Second Year: 1st Semester

Course No.	Course Title	Contact Hours/ Week	Credits	Prerequisite
MAT 203Q	Vector Analysis, Matrices and Laplace Transform	3	3.00	
ECO 205Q	Principles of Economics	3	3.00	
MEE 0715-2131	Basic Thermodynamics	3	3.00	
MEE 0715-2157	Engineering Mechanics-I	3	3.00	

EEE 0713-2113Q	Fundamentals of Electrical Machines	3	3.00	EEE 0713-1211Q
MEE 0715-2132	Basic Thermodynamics Sessional	3	1.50	
EEE 0713-2114Q	Electrical Machines Sessional	2	1.00	
Total			17.5	

Second Year: 2nd Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
MAT 205Q	Complex Variables, Harmonic Analysis and Partial Differential Equations	4	4.00	
MEE 0715-2259	Engineering Mechanics-II	3	3.00	MEE 0715-2157
MEE 0715-2245	Numerical Analysis	3	3.00	
MEE 0715-2253	Mechanics of Solids	3	3.00	MEE 0715-2157
MEE 255	Engineering Materials (Metallic and Composites)	3	3.00	
MEE 246	Numerical Analysis Sessional	2	1.00	
MEE 0715-2254	Mechanics of Solids Sessional	2	1.00	
MEE 256	Engineering Materials Sessional	2	1.00	
MEE 0715-2288	Comprehensive Viva-II		0.50	
Total			19.5	

Third Year: 1st Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
MEE 0715-3121	Fluid Mechanics –I	3	3.00	
MEE 0715-3131	Conduction and Radiation Heat Transfer	3	3.00	
MEE 0715-3151	Mechanics of Machinery	3	3.00	MEE 253
MEE 371	Production Processes	3	3.00	
SOC 0134 3107Q	Industrial Sociology	3	3.00	
MEE 0715-3122	Fluid Mechanics- I Sessional	3	1.50	
MEE 332	Heat Transfer Sessional	2	1.00	
MEE 0715-3152	Mechanics of Machinery Sessional	2	1.00	
MEE 372	Production Processes Sessional	2	1.00	
MEE 0715-3182	Industrial Tour (Selected by MEE Department)		0.50	
Total			20	

Third Year: 2nd Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite

		Theory and Lab		
MEE 0715-3223	Fluid Mechanics-II	3	3.00	MEE 321
MEE 333	Convection, Boiling, Condensation and Mass Transfer	3	3.00	
MEE 0715-3253	Machine Design	4	4.00	MEE 0715-2253
MEE 367	Instrumentation and Measurement	3	3.00	
MEE 375	Machine Tools	3	3.00	
MEE 0715-3224	Fluid Mechanics- II Sessional	3	1.50	
MEE 334	Heat and Mass Transfer Sessional	2	1.00	
MEE 0715-3254	Machine Design Sessional	3	1.50	
MEE 368	Electro-mechanical System Design	2	1.00	
MEE 0715-3288	Comprehensive Viva-III		0.50	
Total			21.5	

Fourth Year: 1st Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
MEE 0715-4221	Fluid Machinery	3	3.00	
MEE 0716-4131	Internal Combustion Engines	3	3.00	
MEE 0715-4177	Production Planning and Control	3	3.00	
Optional I	Selected from prescribed optional subject-I	3	3.00	
Optional II	Selected from prescribed optional subjects=II	3	3.00	
MEE 0715-4222	Fluid Machinery Sessional	2	1.00	
MEE 432	Heat Engine Sessional	2	1.00	
MEE 0715-4284	Industrial Training	4 Weeks	1.00	
MEE 0715-4180	Project/Thesis	6	3.00	
Total			21.00	

Fourth Year: 2nd Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
IPE 0413 4205Q	Industrial Management	3	3.00	
MEE 0713-4233	Power Plant Engineering	3	3.00	
Optional III	Selected from Prescribed Optional Subjects-III	3	3.00	
Optional IV	Selected from Prescribed Optional Subjects-IV	3	3.00	
Optional V	Selected from Prescribed Optional Subjects-V	3	3.00	
MEE 0713-4234	Power Plant Engineering Sessional	2	1.00	

MEE 0715-4180	Project/Thesis (Continuation)	6	3.00	
Total			19.0	

TOTAL CREDIT FOR GRADUATION: 162

**All courses offered by the Department of Mechanical Engineering are compulsory to obtain the degree.

Optional Courses

Optional-I				
MEE 0715-4123	Biomedical Fluid Mechanics	3	3.00	MEE323
MEE 435	Refrigeration, A.C. and Building Mechanical System	3	3.00	
MEE 0715-4175	CAD/CAM	3	3.00	
MEE 479	Engineering Economy & Cost Management	3	3.00	
MEE 495	Renewable Energy	3	3.00	
Optional II				
MEE 425	Aerodynamics	3	3.00	MEE323
MEE 0715-4137	Advanced Thermodynamics	3	3.00	MEE231
MEE 0715-4161	Control Engineering	3	3.00	
MEE 0713-4191	Energy Resources & Utilization	3	3.00	
Optional III				
MEE 0714-4263	Robot Mechanics and Control	3	3.00	
MEE 465	Basic Mechatronics	3	3.00	
MEE 471	Operations Research	3	3.00	
MEE 473	Quality Control and Management	3	3.00	
Optional IV				
MEE 451	Fatigue, Creep and Fracture	3	3.00	
MEE 0715-4253	Noise and Vibration	3	3.00	
MEE 0716-4281	Automobile Engineering	3	3.00	
MEE 0713-4293	Nuclear Engineering	3	3.00	
Optional V				
MEE 0715-4239	Combustion and Pollution	3	3.00	
MEE 441	Applied Engineering Mathematics	3	3.00	
MEE 0715-4243	Applied Statistics for Engineers	3	3.00	
MEE 0711-4283	Bio-Engineering	3	3.00	

Courses Offered by MEE Department to Students of Other Department				
Course No.	Course Title	Year-Semester (Dept.)	Contact Hours/ Week	Credits
MEE 213F	Engineering Mechanics	2-1 (FET)	3	3.00

MEE 313E	Fundamentals of Mechanical Engineering	3-1 (EEE)	3	3.00
MEE 0715-3115A	Building Service II – Mechanical	3-1 (ARC)	2	2.00

Course Profiles
First Year First Semester

Course No: CHE 0531-1101	Credit: 3.0	Year: First	Semester: First
CourseTitle: Chemistry-I MEE		Course Status: Theory	

Course Rationale:
This course is aim to provide a preliminary understanding of Chemistry and important concepts of chemistry that will be needed for the further study of **higher courses.**

Course Objectives:
The objectives of this course are to
- Familiarize the students with the basic concept of atomic structure
- Acquire the knowledge about the thermochemistry
- Introduce preliminary ideas of chemical equilibrium and kinetics
- Facilitate the necessary knowledge on common phenomena of Electrochemistry
- Make the students understand and relate the colloids and their applications
- Acquaint students with the fundamentals of organic chemistry

Course Content:
Concept of Atomic Structure: Quantum numbers, electronic configuration, and periodic table; Properties and uses of noble gases; hybridization and molecular structure of compounds; selective organic reactions.
Thermo-chemistry: Laws of thermo chemistry; heat of reaction, heat of solution, heat of combustion, heat of formation and heat of neutralization; experimental determination of thermal changes during chemical reactions.
Chemical kinetics: Definition, rate of reaction, order and molecularity of reaction, determination of order of reaction; collision theory and activated complex theory; effect of catalyst on kinetics.
Chemical Equilibrium (reaction control): Definition, classification, properties, law of mass action, relation between kp, kc and, kx; Effect of pressure, concentration, and temperature on equilibrium for various chemical reactions.
Colloids: Classification of colloids; methods of preparation and purification of colloidal solutions, properties of colloids, applications of colloids.
Electrochemistry: Electrolysis; theories of electrolytic dissociation, ionic equilibrium, Ostwald's dilution law, ionization of water and pH concept, and buffer solution.
Fundamentals of Organic Chemistry: Introduction, Classification, Nomenclatures, preparations, and Properties (Physical & Chemical) of (i) Aliphatic and aromatic hydrocarbons, (ii) Aldehydes and ketones, (iii) Carboxylic acids and (iv) Alcohol s and phenols

Course Learning Outcomes:
After the successful completion of the course, students will be able to
CO1. Classify elements, orbit & orbitals, electron distribution, energy level and hybridization, will also be able to apply different principles to determine the configuration for
any atom or ion.
CO2. Explain the development of the periodic table of elements, analyze and compare periodic trends in physical and chemical properties of elements in periodic table
CO3. Understand and explain basic concepts of thermochemistry and also be able to explain the phenomenon related with laws of thermochemistry
CO4. Interpret the relationship between chemical kinetics and equilibrium
CO5. Explain the properties and applications of colloids, basics of electrochemistry and also be able to explore little bit about organic compounds

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1										
CO2										
CO3										
CO4										
CO5										
CO6										
CO7										
CO8										
CO9										
CO10										
CO11										
CO12										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture, PPT Demonstration	Class test (Short Q and MCQ)
CO2	Lecture, PPT Demonstration, Discussion	Quiz, assignment
CO3	Lecture, animated VDO clips, Question-Answer session	Class test (Short Q and MCQ)
CO4	Lecture, Group discussion	Essay type test, problem solving
CO5	Lecture, PPT presentation, Group discussion for problem analysis	Essay type test, problem solving

Books Recommended:

1. S. Z. Haider, Introduction to Modern Inorganic Chemistry.
2. Haque and Nowab, Physical Chemistry
3. R. T. Morrison and R. N. Boyd, Organic Chemistry (6th edition)
4. Raymond Chang, General Chemistry

Course No: MAT101Q	**Credit: 3.0**	**Year: First**	**Semester: First**
Course Title: Differential Calculus and Geometry		**Course Status: Theory**	

Rationale of the Course:

This course is about the basic mathematics that is fundamental and essential component in all streams of undergraduate studies in sciences and engineering. In this course, the students will study principles of differential calculus and coordinate geometry, and applies rules to calculate the derivative of various types of functions. Coordinate geometry is a very powerful language of mathematics that will be used for understanding derivatives and its applications. By the end of this course, students will have the ability to apply basic principles and techniques of differential calculus to the solution of various practical problems.

Course Objectives:

The objectives of this course are:

- to make the students interest on differential calculus and coordinate geometry as needed for solving problems in mechanics;
- to develop students skills in understanding derivatives of real variable functions and their properties;
- to use coordinate geometry for understanding the problems and solutions;
- the emphasis is given on concepts, techniques of solving the problems and its applications to real problems.

Course Content:

Differential Calculus: Functions, limits and continuity. Derivative of trigonometric, exponential and logarithmic functions, inverse trigonometric functions and hyperbolic functions. Finding rate of change, velocity and acceleration. Differentiation of explicit and implicit functions and parametric equations, successive differentiation. Expansion of functions. Extreme values of functions, concavity and inflexions, asymptotes and curve tracing. Finding roots of equations, linear approximations, Taylor polynomials, indeterminate forms.

Geometry: Coordinate system; straight line, circle, parabola, ellipse, hyperbola, parametric curves, its lengths and areas; polar curves, its slopes, areas, arc lengths. Planes and straight lines in 3-space, distances, quadric surfaces.

Course Learning Outcomes (CO)

After successful completion of the course, students will be able to:

CO 01: Explain the concept of limit, continuity and derivative of real valued functions.

CO 02: Explain how the idea of limit applies to tangents, velocities, and other rates of change;

CO 03: Compute the derivatives of transcendental functions.

CO 04: Expansion of transcendental functions to polynomial functions.

CO 05: Find maximum and minimum values of functions and its application to real life.

CO 06: Trace the Cartesian, Polar, and Parametric Curves, and rectify the curves.

CO 07: Compute arc lengths and areas of parametric and polar curves.

CO 08: Identify and apply the cartesian, spherical, polar and cylindrical coordinate systems to solve engineering problems.

Mapping of COs with POs

CO PO	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8
PO 01	X	X	X	X	X	X	X	X
PO 02								
PO 03								
PO 04	X	X	X	X	X	X	X	X
PO 05								
PO 06								
PO 07								
PO 08	X	X	X	X	X	X	X	X
PO 09	X	X	X	X	X	X	X	X
PO 10	X	X	X	X	X	X	X	X

Books Recommended:

1. R.A. Adams, Calculus.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, Ninth Edition.

Course No: ENG 0231-1101	**Credit: 2.0**	**Year: First**	**Semester: First**
Course Title: Effective Communication in English		**Course Status: Theory**	

Course Rational:

This course is expected to develop two basic skills i.e. reading and writing. A variety of reading strategies and texts will be used to effectively develop first year students' academic reading skills thereby facilitating their future study. Also, the course focuses on developing the writing skills of students by familiarizing them with grammar rules, providing them with practice and enabling them to demonstrate the accurate use of grammar in their writing.

Course Objectives:

(i) To enable students to write with accuracy;
(ii) To facilitate effective and comprehensible writing;
(iii) To raise awareness of common errors that occur in writing;
(iv) To develop students' ability to understand write-ups on issues of general concern;
(v) To improve the vocabulary of learners for effective communication.

Course Content:

- **a) Reading**
- **Different Reading Strategies**
- **Guessing Meaning from the Context**
- **Critical Reading (Analyze)**
- **Critical Reading (Synthesize)**
- **Critical Reading (Evaluate)**

- **Annotation**
- **Summary Writing**
-
- **Materials**
- **A selection of 08-10 editorials and reports from newspapers/magazines/journals,etc.**
- **Reading texts in New Headway Upper Intermediate Student's Book (Current edition)**
- **Selected passages from recommended books**
- **A selection of other materials may be supplied as handouts by the instructor as necessary**
-
- **b) Writing**
- **Forms and functions of different word categories (noun, verb, adjective, etc.)**
- **Aspects and uses of tense**
- **Subject-verb agreement**
- **Use of infinitive, gerund, present participle, past participle, modals, causatives, conditionals, subjunctives, modals.**
- **Use of sentence connectors/ cohesion markers/ punctuation**
- **Effective combination of sentences (simple, complex, compound)**
- **Developing a paragraph**

Course Learning Outcomes:

At the end of the course, students will be able to

CLO 1 apply grammar rules

CLO 2 express oneself correctly by using appropriate words, phrases, sentences or ideas

CLO 3 critically reflect on a text (grasp abstract ideas and interpret them effectively, arrive at well-reasoned conclusions and solutions)

CLO 4 Create using earned knowledge both independently and in collaboration with peer groups

CLO 5 Demonstrate a comprehension of subject knowledge and its subsequent use

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

Note: If required add/delete rows

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	TL 01, TL 02 TL 05	CA 01/CA 02, CA 03/CA 04
CO 2	TL 01, TL 02 TL 05	CA 01/CA 02, CA 04/CA 05
CO 3	TL 01, TL 02 TL 05	CA 04/CA 05
CO 4	TL 02	CA 05
CO 5	TL 01, TL 02 TL 05,06	CA 01/CA 02

APPENDIX C: Examples of the Teaching-Learning & Assessment Strategy

Code	Teaching-learning (TL) strategy	Code	Assessment Strategy
TL 01	Lecture using board/LCD projectors/OHP projectors		Continuous assessment (CA)
TL 02	Assignment/project/seminar/workshop /tutorial	CA 01	Midterm Examination 1
TL 03	Laboratory/Other teaching aids (Audio-visual: film and documentaries, virtual classroom, etc.)	CA 02	Midterm Examination 2

TL 04	Guest lectures/industrial visit/field visit	CA 03	Quiz
TL 05	Self-learning using reference books/research articles/case study/other online materials	CA 04	Assignment
TL 06	Simulation/field demonstration	CA 05	Presentation (Individual/group) /Viva voce

6. Evaluation

- IELTS, TOEFL and other standardized testing formats for assessing the level of reading skill will be followed. Test items may be as follows: fill in blanks, true/false, multiple choice/ matching word meanings/ information transfer/matching titles with relevant paragraphs in the text, etc.
- Reading skill will be tested on two reading texts. One reading text will be taken from one of the selections students have already read during the semester. The other reading text will be similar in terms of contents and difficulty but will not have been previously discussed.

7. Books Recommended

Tibbits, E. E., editor. *Exercises in Reading Comprehension*. Longman, 2013.
Liz and John Soars. *New Headway Upper Intermediate Student's Book*. Oxford University Press, 2014.
Payle, Michael. *Cliff's TOEFL Preparation Guide.* 12th ed., Cliffs Notes Inc., 2019.
Otherresources recommended by course instructors

Course No: PHY 0533 1107Q	Credit: 3.0	Year: First	Semester: First
Course Title: Physics I		Course Status: Theory	

Rationale of the Course: to gain the fundamental knowledge of natural sciences.

Course Objectives

The objectives of this course are:

- to accumulate basic ideas about the internal composition and electrical nature of solids.
- to know the detailed description of oscillations, waves and sound, and apply the concepts to analysis the mechanical systems.
- to develop the theoretical knowledge of difficulties and to overcome the difficulties in real image formation.
- to provide a new mechanics for dealing with Physics of microscopic mechanical systems.

Course Content

Structure of Matter: Crystalline and non-crystalline solids, Single crystal and polycrystal solids, Unit cell, Crystal systems, Co-ordination number, Crystal planes & direction, NaCl & CsCl structure, Packing factor, Miller indices, Relation between inter planer spacing from diffraction patterns; Defects in solids: Point defects, Line defects, Bonds in solids, Inter-atomic distances, Calculation of cohesive & Bonding energy; introduction to band theory: Distinction between Metal, semiconductor and insulator.

Waves & Oscillation: Simple Harmonic Oscillator, Total energy and average energy, Combination of Simple Harmonic Oscillator, Spring-mass system, Calculation of time period of torsional pendulum. Damped oscillation, Determination of damped co-efficient, forced oscillation, Resonance, Two-body oscillations, Reduce mass, Progressive wave, Power & intensity of wave motion, Stationary wave, Group velocity and Phase velocity, Architectural Acoustics, Reverberation and Sabine's formula.

Geometrical Optics: Combination of lenses: Equivalent focal length, Cardinal points of a lens, Power of a lens, Defects of image: Spherical aberration, Astigmatism, Coma, Distortion, Curvature, Chromatic aberration; Optical

instruments: Compound microscope, polarizing microscope, Resolving power of a microscope, Camera and photographic techniques.

Wave Mechanics: Principles of statistical physics, probabilities, Classical statistical; Quantum statistics: Bose-Einstein statistics, Fermi-Dirac statistics and their applications, Fundamental postulates of wave mechanics, Time dependent Schrodinger equation, Schrodinger equation for one-electron atom and its solution.

Course Learning Outcomes

After the successful completion of the course, students will be able to:

CO1 differentiate the solid in terms of the periodic arrangement of the atoms, know the compactness in different crystals applying structural analysis and classify materials based on electrical property to choose best one in electrical usage

CO2 introduce and describe the free, damped and forced oscillation to manufacture the large mechanical system not to produce huge vibration and wave making any accidents.

CO3 gain the knowledge to make the sound non-hazardous for audience generating by mechanical system

CO4 know the factors affecting the image quality and apply the concept to design and manufacture the instrument to have best quality image in real life.

CO5 understand the concept of quantum mechanics and statistical mechanics to know behavior quantities involved in various physical system.

Mapping of the COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01	3											2
CO 02	3											2
CO 03	3											2
CO 04	3											2
CO 05	3											2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	TL 01, TL 02	CA 04
CO2	TL 01, TL 02	CA 03
CO3	TL 01	CA 01
CO4	TL 01, TL 02	CA 02
CO5	TL 01, TL 02	CA 04

Recommended Books

1. Kittel, C .: Introduction to Solid State Physics
2. Beiser, A.: Perspective of Modern Physics
3. Halliday, D. and Resnick, R.:Physics (Vol. I)
4. Sears, Zemansky and Young: University Physics
5. Puri, S.P.: Fundamentals of Vibrations and Waves
6.Chowdhury, S.: Quantum Mechanics
7. Ahmad, Gias Uddin: Physics for Engineers Part-1
8. Ahmad, Gias Uddin: Physics for Engineers Part-2

Course No: MEE 0715-1181	Credit: 3.0	Year: First	Semester: First
Course Title: Introduction to Mechanical Engineering		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- To introduce major fields of mechanical engineering.
- To know about mechanical engineering curriculum and the content of engineering courses
- To familiarize various forms and sources of energy.
- To clarify how mechanical advantage and efficiency are defined and determined
- To understand principles of scientific computation and engineering solution.
- To introduce students with various mechanical devices and their working principle.

Course Content:

Energy: Study of forms and sources of energy: conventional and renewable, energy conservation and management, environmental pollution.

Basic Mechanical Devices/Systems: introduction to steam, gas and water turbines with their accessories; internal combustion engines, automobiles; introduction to pumps, blowers and compressors; refrigeration and air conditioning systems.

Study of Steam Generating Unit: study of steam generation units with their accessories and mountings; performance study of steam generators.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Compare and contrast among different sources of energy.

CO2. Explain different turbines.

CO3: Identify different components of IC engine.

CO4: Introduced with different mechanical components including pumps, blowers and compressors; refrigeration and air conditioning systems.

CO5: Explain steam generation units with their accessories and mountings.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	2			2								
CO3	2				2							
CO4	1				1							1
CO5	1											

Books Recommended:

1. An Introduction to Mechanical Engineering - Jonathan Wickert, Kemper Lewis
2. A Textbook of Thermal Engineering - RS Khurmi, JK Gupta

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lectures using Projectors and Board, Discussion	Term Test 01, Final Exam
CO2	Lectures using Projectors and Board,Discussion	Term Test 02, Final Exam
CO3	Lectures using Projectors and Board, Discussion	Assignment, Final Exam

CO4	Lectures using Projectors and Board, Group Discussion.	Assignment, Final Exam
CO5	Lectures using Projectors and Board, Group Discussion.	Term Test, Assignment, Final Exam

Course No: SSS 0222-1100S	**Credit: 3.0**	**Year: First**	**Semester: First**
Course Title: History of the Emergence of Independent Bangladesh		**Course Status: Theory**	

Rationale

This course is necessary for students to develop insights into the historical changes, the long struggle for freedom, and above all the War of Independence led by the Father of the Nation Bangabandu Sheikh Mujibur Rahman that has shaped today's Bangladesh.

The objectives of the course are to:

1. **Provide students with an overview of the historical emergence of Bangladesh.**
2. **Help students develop insights into the historical changes towards the building of an independent nation.**
3. **Facilitate students' learning of the long struggle for freedom in the country.**
4. **Foster students' knowledge of the War of Independence led by the Father of the Nation Bangabandu Sheikh Mujibur Rahman has shaped today's Bangladesh.**

Course Contents:

1. **Description of the country and its people**
   a. Impact of Geographical features
   b. Ethnic composition of Bangladesh
   c. Development of Bengali Language and its impact
   d. Cultural syncretism and religious tolerance
   e. Distinctive identity of Bangladesh in the context of undivided Bangladesh

2. **Proposal for undivided sovereign Bengal, the partition of the Subcontinent, 1947 and Foreshadowing Bangladesh**
   a. Rise of communalism under the colonial rule, Lahore Resolution 1940
   b. The proposal of Suhrawardi and Sarat Bose for undivided Bengal : consequences
   c. The creation of Pakistan 1947
   d. Foundation of Awami Muslim League and Foreshadowing Bangladesh

3. **Pakistan: Structure of the state and disparity**
   a. Central and provincial structure
   b. Influence of Military and Civil bureaucracy
   c. Economic , social and cultural disparity

4. **Language Movement and quest for Bengali identity**
   a. Misrule by Muslim League and Struggle for democratic politics
   b. The Language Movement: context, phases and International Recognition of Bengali Language
   c. United front of Haque – Vasani – Suhrawardi: election of 1954, consequences

5. **Military rule: the regimes of Ayub Khan and Yahia Khan (1958-1971)**
   a. Definition of military rules and its characteristics
   b. Ayub Khan's rise to power and characteristics of his rule (Political repression, Basic democracy, Islamisation)
   c. Fall of Ayub Khan and Yahia Khan's rule

6. Rise of nationalism and the Movement for self-determination

a. Resistance against cultural aggression and resurgence of Bengali culture

b. Sheikh Mujibur Rahman and the 6 points movement

c. Reactions : Importance and significance

d . The Agortola Case 1968

7. The mass- upsurge of 1969 and 11 point movement

a. Background

b. Programme

c. Significance

8. Election of 1970 and its Inpact

a. Legal Framework Order (LFO)

b. Programe of different political parties

c. Election result and centres refusal to comply

9. Non-cooperation Movement and 7th March Speech, 1971

a. The non-cooperation movement

b. Speech of 7th March : Background of the speech, major characteristics of the speech,
impact of this speech

c. International recognition of 7th March Speech as part of world heritage

10. Declaration of Independence of Bangladesh

a. Operation Searchlight

b. Declaration of Independence of Bangladesh by Bangobondhu

c. Beginning of the Liberation War of Bangladesh

11. The war of Liberation 1971

a. Genocide, repression of women, refugees

b. Formation of Bangladesh government and proclamation of Independence

c. The spontaneous early resistance and subsequent organized resistance (Mukti Fouz, Mukti Bahini, guerillas and the frontal warfare)

d. Publicity Campaign in the war of Liberation (Shadhin Bangla Betar Kendra, the Campaigns abroad and formation of public opinion)

e. Contribution of students, women and the masses (Peoples war) and different political parties

f. The role of Great powers and the United Nations in the Liberation war

g. The contribution of India in the Liberation War

h. The Anti-liberation activities of the occupation army, the Peace Committee, Al-Badar, Al- Shams, Rajakars, pro Pakistan political parties and Pakistani Collaborators , killing of the intellectuals

i. Trial of Bangabandhu and reaction of the World Community

j. Formation of joint command and the Victory

k. The overall contribution of Bangabandhu in the Independence struggle

12. The Bangabandhu Regime 1972-1975

a. Homecoming; Speech of 10 January

b. Making of the constitution

c. Reconstruction of the war-ravaged country

d. Foreign Policy of Bangabandhu; Bangabandhu's First Speech in the United Nations

e. The murder of Bangabandhu and his family and the ideological turn-around

Course Learning Outcomes

Upon completion of the course, students will be able to:

CLO1 Demonstrate understanding of the historical emergence of Bangladesh as an independent country;

CLO2 Communicate the knowledge concerning the context of historical change toward the building of an independent nation;

CLO3 Explain the reasons behind the war of independence in Bangladesh; and

CLO4 Display the understating of the role of the Father of the Nation Bangabandu Sheikh Mujibur Rahman during the emergence of Bangladesh as an independent country.

Mapping of COS with POS:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1										
CO2										
CO3										
CO4										
CO5										

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Visual Presentation	Class Participation
CLO2	Lecture and Class Discussion	Class Participation & Midterm 1
CLO3	Lecture and Visual Presentation	Class Participation and Midterm 2
CLO4	Lecture and Class Discussion	Assignment, & Final exam

Recommended texts:

1. Ahmed, S., & Chowdhury, B.M. (Eds.) (2004). *Bangladesh: National Culture and Heritage: An Introductory Reader.* Dhaka: Independent University Bangladesh.
2. Harun-or-Roshid. (2012). *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-1947*. Dhaka: The University Press Limited.
3. Jahan, R. (1977). *Pakistan: Failure in National Integration.* Dhaka: The University Press Limited.
4. Maniruzzaman, T. (2003). *Radical Politics and the Emergence of Bangladesh.* Dhaka: Mowla Brothers.
5. Muhith, A.M. A. (2016). *History of Bangladesh: A Subcontinental Civilization.* Dhaka: UPL.
6. Samad, A. (2019). *History of Liberation War of Bangladesh.* Dhaka: Aparajeyo Bangla Prakashani.
7. Dev, M. K., & Samad, M. A. (2014). *History of Bangladesh 1905-2005.* Dhaka: Biswabidyalya Prokasoni.
8. Van Schendel, Wi. (2009). *A History of Bangladesh.* Cambridge: Cambridge University Press.
9. †kL gywReyi ingvb : *Amgvß AvZ¥Rxebx, (*XvKv : w` BDwbfvwm©wU †cÖmwjwg‡UW, 2012)
10. bxnviiÄbivq : *evOvjxi BwZnvm, (*KjKvZv : †`Õ R cvewjwks, 1402 mvj)
11. mvjvn& DwÏb Avn‡g` I Ab¨vb¨ (m¤úvw`Z), *evsjv‡`‡ki gyw³ msMÖv‡gi BwZnvm* 1947-1971, (XvKv : AvMvgx cÖKvkbx, 2002)
12. Aveyj gvj Ave`yj gywnZ : *evsjv‡`k: RvwZiv‡ó"i D™¢e, (XvKv :* mvwnZ¨ cÖKvk, 2000)
13. wmivRyj Bmjvg (m¤úvw`Z), *evsjv‡`‡ki BwZnvm 1704-1971,* 3 LÛ, (XvKv : GwkqvwUK †mvmvBwU Ae evsjv‡`k, 1992)
14. nviæb-Ai-iwk` : *e½xq gymwjg jxM cvwK¯Ívb Av‡›`vjb evOvwji ivó"fvebv I e½eÜz,* (XvKv : Ab¨ cÖKvkb, 2018)
15. হাসান হাফিজুর রহমান:evsjv‡`‡ki ¯^vaxbZvhy× `wjjcÎ, (m¤úvw`Z), (XvKv:MYcÖRvZš¿x evsjv‡`k miKvi, 1985)
16. mq Av‡bvqvi †nv‡mb : *evsjv‡`‡ki ¯^vaxbZvhy‡× civkw³i f~wgKv,* (XvKv : Wvbv cÖKvkbx, 1982)
17. gybZvmxi gvgyb I Ab¨vb¨, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv: myeY©, 2017)
18. Avey †gv †`‡jvqvi †nv‡mb, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv : wek¦we`¨vjq cÖKvkbx, 2014)
19. AvkdvK †nv‡mb, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv: cÖwZk~Y¨ cÖKvkb, 2019)
20. Avey †gv †`‡jvqvi †nv‡mb, *evsjv‡`‡ki BwZnvm, 1905-1971,*
21. AvkdvK †nv‡mb : *evsjv‡`‡ki gyw³hy× I RvwZmsN*, (XvKv: evsjv GKv‡Wwg, 2003)
22. Avey †gv. †`‡jvqvi †nv‡mb, W. †gvnv¤§` †mwjg (m¤úv`bv) : *evsjv‡`k I ewnwe©‡k¦, (*XvKv : evsjv‡`k BwZnvm mwgwZ, 2015)
    AvkdvK †nv‡mb, *evsjv‡`‡ki gyw³hy× I Bw›`"iv MvÜx* (XvKv : myeY© cÖKvkbx, 2017)

Course No: CHE 0531-1112Q	Credit: 1.5	Year: First	Semester: First
Course Title: CHEMISTRY PRACTICAL		Course Status: Practical	

Rationale of the Course:

This laboratory based course is aimed to provide students hands on experimental skill based on chemistry theory and principle.

Learning Objectives:

The objectives of this course are:

- **Familiarize students with the basic concept of qualitative and quantitative analysis**
- **Develop skill on different titrimetric techniques**
- **Develop student's practical skill for oil analysis, waste water analysis etc.**

Course Content:

Qualitative analysis and quantitative Analysis, Acidimetry-alkalimetry, Titrations involving redox reactions, determination of Fe, Cu and Ca volumetrically,

Complexometric titration for the determination of hardness of water, Estimation of I2 value of oil or fat, determination of some waste water quality parameters,

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Explain the lab safety and measurement units of chemical analysis.

CO2. Interpret the sample quality based on chemical analsysis

CO3. Prepare standard solution and standardization of a solution of unknown concentration

CO4. Interpret the sample quantity based on chemical analysis followed by calcaulation.

CO5. Perform complexometric titration technique for determining the hardness of water, back titration of I2 value calculation.

Mapping of Course Learning Outcomes (COs) with Pos

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										
CO6										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategies	Assessment Strate
CO1	Lecture, Lab Demonstration	Class test (Short Q and MC
CO2	Lab Demonstration on solution preparation and installation of equipment.	Spot test and experimenta performance evaluation
CO3	Lab Demonstration on instrumental analysis	Assessment of instrumen and data presentation
CO4	Problem solving on data analysis and tips for good graphical presentation (hand written and software based graphs).	Oral test and report evalua
CO5	Lab Exam on specific experiment	Assessment of Oral prese grading based on overalal

Books Recommended:

1. Vogel, Qualitative Inorganic Analysis
2. A.I. Vogel, A Text Book of Practical Organic Chemistry
3. A.I. Vogel, Elementary Practical Organic Chemistry (Part 1)

4. Vogel, Text book of Quantitative Analysis.

Course No: ENG 0231-1102	Credit: 1.00	Year: First	Semester: First
Course Title: English Language Lab		Course Status: Sessional	

1. Course Rationale

This course is designed to improve the speaking and listening skills of students in the English language. Emphasis is laid on proper pronunciation for accurate articulation and recognition of speech sounds as well as correct stress, intonation and language use in varied situations.

2. Course Objectives

(i) To enable students' understanding of the variations in pronunciation;
(ii) To teach proper pronunciation and accurate articulation;
(iii) To facilitate appropriate stress and intonation in speech;
(iv) To encourage use of English effectively in everyday situations;
(v) To ensure overall improvement of oral communication through listening and speaking.

3. Course Contents

(a) Speaking

- Articulators
- English Phonetic Alphabet (British and American) and International Phonetic Alphabet (IPA)
- Stress rules of English
- Intonation rules and functions of intonation
- Communication styles and cultural context
- Fluency, mistakes, misunderstandings, audience, taboos, self-esteem, confidence
- Activities: dialogue, debate, extempore speech, interview, role-play

(b) Listening

- Basics of listening
- Various types of pronunciation
- IPA, RP, transcription
- Different accents and intonation patterns
- Activities for meaning-focused listening
- Information transfer strategies

Listening practice through selection of audio clips

Course Learning Outcomes:

At the end of the course, students will be able to

CLO 1 read the symbols of the International Phonetic Alphabet used to represent the sounds of the English language

CLO 2 apply appropriate intonation and stress patterns in English words and sentences

CLO 3 interpret information accurately

CLO 4 collaborate and apply intonation and stress patterns.

CLO 5 produce continuous speech clearly and convincingly

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

Note: If required add/delete rows

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	TL 01, TL 02 TL 05	CA 01/CA 02, CA 03/CA 04
CO 2	TL 01, TL 02 TL 05	CA 01/CA 02, CA 04/CA 05
CO 3	TL 01, TL 02 TL 05	CA 04/CA 05
CO 4	TL 02	CA 05
CO 5	TL 01, TL 02 TL 05,06	CA 01/CA 02

APPENDIX C: Examples of the Teaching-Learning & Assessment Strategy

Code	Teaching-learning (TL) strategy	Code	Assessment Strategy
TL 01	Lecture using board/LCD projectors/OHP projectors		Continuous assessment (CA)
TL 02	Assignment/project/seminar/workshop /tutorial	CA 01	Midterm Examination 1
TL 03	Laboratory/Other teaching aids (Audio-visual: film and documentaries, virtual classroom, etc.)	CA 02	Midterm Examination 2
TL 04	Guest lectures/industrial visit/field visit	CA 03	Quiz
TL 05	Self-learning using reference books/research articles/case study/other online materials	CA 04	Assignment
TL 06	Simulation/field demonstration	CA 05	Presentation (Individual/group) /Viva voce

6. Evaluation

- IELTS, TOEFL and other standardized testing formats for assessing the level of listening skill will be followed. Test items may be as follows: fill in blanks, true/false, multiple choice/ matching word meanings/ information transfer/matching, etc.
- Speaking skill will be tested through dialogue, debate, extempore speech, presentation, role-play, etc.

7. Books Recommended

Anderson, Anne C., et al.*Listening*.Oxford University Press, 1988.

Anderson, Kenneth, et al. *Study Speaking*. Cambridge University Press, 2007.

Hancock, Mark. *English Pronunciation in Use*. Cambridge University Press, 2004.

Jones, Daniel. *Cambridge English Pronunciation Dictionary*. Cambridge University Press, 2011. Richards, Jack C., and David Bohlke. *Speak Now: 1*. Oxford University Press, 2013.

Richards, Jack C., et al. *Person to Person*. Oxford University Press, 2007.

Roach, Peter. *English Phonetics and Phonology*. Cambridge University Press, 2009.

Course No: MEE 0715-1172	Credit: 1.5	Year: First	Semester: First
Course Title: Mechanical Engineering Drawing		Course Status: Sessional	

Course Objectives:

The objectives of this course are:

- To give information about the important tools of engineering drawing
- To make students learn how to draw the shapes, angels and lines and others which is essential for an engineer
- To understand the principle of projection and sectioning
- To help students learn basic engineering drawing formats.
- To understand the main idea of using dimension for engineering drawing.
- To develop student's imagination and ability to represent the shape size and specifications of physical objects.

Course Content:

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.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. define different engineering design parameter like shapes, angels and lines

CO2. draw different views including auxiliary views, orthographic projections and sections

CO3. Develop the ability to read and interpret engineering drawings created by others.

CO4. Create complex engineering drawings

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2		3										
CO3				2						2		1
CO4			2						2			

Books Recommended:

1. Mechanical Engineering Drawing - Dr. Md. Quamrul Islam
2. Fundamentals of Engineering Drawing - French &Vierck
3. Metric Drafting - Paul Wallah
4. Drafting Technology and Practice - William P. Spence

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using board, Assignment	Class work, Assignment, Final Exam
CO2	Lecture using board, Discussion	Class work, Assignment, Final Exam
CO3	Lecture, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture, Group discussion	Class work, Assignment, Final Exam

Course No: MEE 176	**Credit: 1.0**	**Year: First**	**Semester: First**
Course Title: Foundry and Welding Shops		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To provide detailed information about the molding processes.
- To provide knowledge of various casting process in manufacturing.
- To impart knowledge of various joining process used in manufacturing.
- To provide adequate knowledge of quality test methods conducted on welded and casted components

Course Content:

Foundry: Introduction to foundry, tools and equipment. Patterns: function, pattern making. Molding: molding materials sand preparation, types of molds, procedure.

Cores: types, core making materials. Metal melting and casting. Inspection of casting and casting defects.
Welding: Metal joints: riveting, grooving, soldering, welding. Welding practice: electric arc steel, aluminum. types of electrodes. Welding defects: visual, destructive and nondestructive tests of welding. Gas welding and equipment, types of flame, welding of different types of materials. Gas welding defects. Test of gas welding.

Course Learning Outcomes:

CO1. By the end of the lab, students should be able to operate foundry tools and equipment safely and effectively, including pattern making, molding, and core making procedures, and produce high-quality castings with minimal defects.
CO2. By the end of the lab, students will be expected to apply welding techniques, such as electric arc welding and gas welding, to join different types of metal joints, and use appropriate electrodes and gases to optimize welding quality.
CO3. By the end of the lab, students should be able to identify and troubleshoot welding defects and apply visual, destructive, and nondestructive tests to assess welding quality, and propose solutions to improve welding performance.
CO4.By the end of the lab, students will be able to demonstrate proficiency in selecting and using welding equipment, tools, and materials, as well as following safety procedures and practices while working in the foundry and welding shops.
CO5. By the end of the lab, students should be able to analyze and evaluate the advantages and limitations of different welding techniques and materials, and propose solutions to welding problems based on their knowledge of welding principles and techniques.

Mapping of COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 1	3	2	1	2	2				1	4		
CO 2	2	1		1	1				1	4		
CO 3	1	2		1	1				1	4		
CO 4		1								3		
CO 5	2	2	1	1	1				1	4		

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory	Assignment
CO2	Laboratory	Quiz
CO3	Laboratory	Assignment
CO4	Laboratory	Quiz
CO5	Laboratory	Assignment

Books Recommended:

1. Manufacturing Technology—Foundry, Forming and Welding, 5e (Volume 1); by P. N. Rao

First Year Second Semester

Course No: CHE 0531-1203	Credit: 3.0	Year: First	Semester: Second

Course Title: Chemistry of Engineering Materials	Course Status: Theory

Course Rationale:

This course is aim to provide basic chemistry principles, chemicals and reactions long with applied materials involved in Industrial Manufacturing process of some industries that will be needed for professional life after graduation.

Learning Objectives:

The objectives of this course are:

- **Provide the knowledge on sources, classification, composition of glass, ceramic, cement, plastic, carbon, Lubricant and Paint**
- **Provide the knowledge on industrial manufacture and applications of glass, ceramic, cement, plastic, carbon, Lubricant and Paint**
- **Facilitate necessary knowledge about the process of metal corrosion and its prevention**

Course Content:

Glass: Raw materials for normal glass, classification, manufacturing processes, Manufacturing of optical fibers, raw materials and methods of manufacturing optical fiber and its application, glass transition temperature and its importance, Annealing and its importance, tempered glass and other special glass composition and related chemistry.

Ceramics and Refractories: Fundamentals of ceramic industry, raw materials and industrial manufacturing processing, comparison with metals, classification and special application of refractory materials.

Cement Industry: Raw materials, different process of cement manufacturing (dry and wet methods), clinker composition and formation reactions, importance of additives, fly ash and slag in cement industries. Setting theories and setting and hardening of cement, chemical reactions in the kilns.

Plastics: Polymers and polymerization reactions, Different polymerization reaction (free radical, condensation and step growth polymerization reactions and mechanism), Thermosetting and thermoplastics, additives and its impact on plastics and environment, degradability of plastics and biodegradable plastics.

Carbon: Up to date knowledge of Allotropes of carbon, diamond, graphite, amorphous carbon and porous carbon and their related chemistry, Advanced carbon nanomaterials (fullerene, graphene, and carbon nanotubes CNTs) fabrication and industrial application

Lubricant and crude oil: Principle of lubrication, viscosity and its relationship with lubrication, Fluidostatic lubrication and Fluid-fluid lubrication, mechanical properties of lubricants, synthetic route of lubricant manufacturing, classification of lubricants, crude oil distillation and application.

Paints and Varnishes: Difference between paints and pigments, composition and application of paints, acrylic and synthetic emulsions paints, enamel paints and coating into metals, varnishing materials and application.

Corrosion: Nature forms and types of corrosion, electrochemical mechanism and prevention of corrosion.

Water treatments and its importance: Importance of water treatment in industries, different chemical methods, primary and secondary water treatment processes, activated sludge and its proper handeling for water treatment.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Identify the raw materials and understand the composition, properties and uses of different types of glass, ceramic, cement, plastic, carbon, Lubricant and Paint, also able to Understand the chemical reactions take place during the manufacturing process.

CO2. Express the basic concept of cement manufacturing and on setting and hardening of cement that will help acquiring mechanism of structural reinforcement.

CO3. Explain the use, function and importance of additives and its impact on plastics and environment; and understand the degradability of plastics and biodegradable plastics

CO4. Explain the related chemistry of different allotropic forms of carbon elements and their applications

CO5. Describe the manufacture of paint and varnishes by using chemical substances and the future prospect of paint industry in Bangladesh. Also able to handle water pollutant treatment mechanism and implementation into the plant.

Mapping of Course Learning Outcomes (COs) with Pos

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										
CO6										
CO7										
CO8										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture, PPT Demonstration	Class test (Short Q and MCQ)
CO2	Lecture, PPT Demonstration, Discussion	Quiz, assignment
CO3	Lecture, animated VDO clips, Question-Answer session	Class test (Short Q and MCQ)
CO4	Lecture, Group discussion	Essay type test, prob
CO5	Lecture, PPT presentation, Group discussion for problem analysis	Essay type test, prob

Books Recommended:

1. Shreve, *Chemical Process Industries*
2. *Morrison and Boyd, Organic Chemistry.*
3. B. K Sharma, *Industrial Chemistry*
4. Roger's, *Manual for Industrial Chemistry*
5. J. A. Kent, *Regels' Hand Book of Industrial Chemistry*
6. Colin Frayne, Boiler Water Treatment Principles and Practice, Volume I, CHEMICAL PUBLISHING CO. INC. New York, N.Y
7. Igor L. Shabalin, Ultra-High Temperature Materials I (Carbon (Graphene/Graphite) and Refractory Metals), Springer Dordrecht Heidelberg New York London.
8. Malkiat S. Johal Lewis E. Johnson, Understanding Nanomaterials, 2nd edition, CRC press.

Course No: MAT 103Q	**Credit: 3.0**	**Year: First**	**Semester: Second**
Course Title: Integral Calculus and Differential Equations		**Course Status: Theory**	

Rationale of the Course:
This course provides the essential mathematical techniques of engineering. These are the methods of multivariable integral calculus and differential equations. The course consists of topics in ordinary differential equations and Applications, and multiple integral and techniques with applications to various engineering problems. How it provides the students with a solid foundation for further study in engineering.

Course Objectives:
The objectives of this course are:

- to engage students in sound mathematical thinking and reasoning;
- to facilitate the necessary knowledge about the fundamental aspects of integral calculus and differential equations;
- to develop students' skills in understanding techniques to solve the problems of integral calculus and differential equations;
- to help the students understand how to analyze the structure of real-world problems and solution strategies;

Course Content:

Integral calculus: Definition of integration, integration by method of substitution, integration by parts, standard integrals, method of successive reduction. Definite integral, its properties and use in summing series. Improper integral, Beta and Gamma function. Area under a plane curve in cartesian and polar coordinates, area of the region enclosed by two curves in cartesian and polar coordinates, Arc length of curves in cartesian and polar coordinates, volumes of solid of revolution; area of surface of revolution.

Differential Equations: Ordinary differential equation and formation of differential equations, Solution of first order differential equations with various methods. Solutions of second order and higher order linear equations with constant coefficients in general. Solutions of homogeneous linear differential equations and its applications. Solution of differential equations of the higher order when the dependent and independent variables are absent. solutions of differential equations by the method based on factorization of the operators.

Course Learning Outcomes, CO

After successful completion of the course, students will be able to:

CO 01: acquire the skills to calculate the indefinite integral, definite integrals and improper integrals;

CO 02: apply the ideas of accumulation to calculate areas and volumes;

CO 03: analyze and combine ideas of accumulation in new contexts not specifically covered in the text;

CO 04: formulate differential equation in different area of science and Engineering;

CO 06: give an account of basic concepts and definitions for ordinary differential equations;

CO 07: apply the fundamental concepts of ordinary differential equations for their resolution;

CO 08: solve the differential equations of science and Engineering problems by choosing the most suitable method;

CO 09: formulate and solve differential equation problems in the field of Engineering.

Mapping of COs with POs

PO CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO8	PO8
CO 01	X			X				X	X	X
CO 02	X			X				X	X	X
CO 03	X			X				X	X	X
CO 04	X			X				X	X	X
CO 05	X			X				X	X	X
CO 06	X			X				X	X	X
CO 07	X			X				X	X	X
CO 08	X			X				X	X	X
CO 09	X			X				X	X	X

Books Recommended:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition.
2. W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition.

.

Course No: PHY 0533 1209Q	Credit: 3.0	Year: First	Semester: Second
Course Title: Physics II: Electricity, Magnetism & Modern Physics		Course Status: Theory	

Rationale of the Course:

This course provides an introduction to electric field and magnetic field and a brief idea about electromagnetic field using Maxwell's equation. It also gives an idea of modern physics and quantum mechanics.

Course Objectives

The objectives of this course are:

- To facilitate necessary knowledge of electricity and magnetism.
- To develop a basic understanding of electric and magnetic fields using Maxwell's equations.
- To provide an outline of modern physics with emphasis on its empirical basis which paved the way for quantum mechanics.

Course Content

Electrostatics: different electrical units, Coulomb's law, electric field, Gauss's law and its applications, electric potential and potential energy, capacitance, dielectrics and Gauss's Law, three electric vectors, energy storage in an electric field.

Magnetostatics: magnetic field and field strength, magnetic forces on charge and current, torque on a current loop, Hall effect, Ampere's Law, Biot-Savart law and their applications.

Electrodynamics: Faraday's law of induction, Lenz's law, time-varying magnetic field, inductance, energy in magnetic field, Maxwell's equations, EM energy, Poynting vector, scalar and vector potentials, the wave equations. plane EM waves in non-conducting media, waves in conducting media, boundary conditions, reflection and refraction at boundaries of two non-conducting media, total internal reflections

Modern Physics: atomic models, Bohr's atom, atomic spectra, photoelectric effect, x-rays, Bragg's law. atomic nucleus, nuclear forces, radioactivity, de Broglie wave, uncertainty principle.

Course Learning Outcomes

After the successful completion of the course, students will be able

CO1. Explain the concepts of static electricity and calculate electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law, and electric potential.

CO2. Describe the magnetic field for moving charges and steady currents and apply Biot-Savart and Ampere's laws to simple current distributions.

CO3. Explain electromagnetic induction and apply Maxwell's equations to electromagnetic wave in conducting and non-conducting media..

CO4. Describe the concept of atomic models and atomic spectra and the non-classical concepts underlying atomic and nuclear structure.

CO5. Describe the concept of nuclear forces, radioactivity, wave particle duality and explain the uncertainty principle.

Mapping of the COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01	2						1	2	2	2		2
CO 02	2						1	2	2	2		2
CO 03	2						1	2	2	2		2
CO 04	2						1	2	2	2		2
CO 05	2		2				1	2	2	2		2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning and Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using whiteboard	Quiz, Midterm exam 1, Semester final exam
CO2	Lecture using whiteboard	Quiz, Midterm exam 1, Semester final exam

CO3	Lecture using whiteboard	Quiz, Midterm exam 1, Semester final exam
CO4	Lecture using whiteboard	Quiz, Semester final exam
CO5	Lecture using whiteboard	Quiz, Midterm exam 2, Semester final exam

Books Recommended:

1. 1. Halliday, D and Resnick, R: Physics (Part II)
2. Halliday, D, Resnick, R and Walker, J: Fundamentals of Physics
3. Young, H D and Freedman, R A: University Physics
4. Beiser, A: Perspectives of Modern Physics
5. Krane, K S: Modern Physics
6. Ahmed,G. : Physics for Engineers(Vol. I & II)

Course No: EEE 0713-1211Q	**Credit: 3.0**	**Year: First**	**Semester: Second**
Course Title: Fundamentals of Electrical & Electronic Engineering		**Course Status: Theory**	

Rationale

The aim of this course is to provide basic knowledge of the principles and practices of different types of circuit analysis techniques to analyze simple and complex circuits. It also provides ideas about AC networks, including phasor and impedance diagrams. This course endeavors to build on this knowledge and further expand student's skills in analyzing and designing circuits involving transistors, diodes and operational amplifiers. The course focuses on developing fundamental ideas and basic concepts on electrical equipment and electronic devices. Upon completion, students should be able to construct, analyze, verify, and troubleshoot electrical and digital circuits using appropriate techniques and test equipment.

Course Objectives are:

- To facilitate necessary knowledge about electrical charge, voltage, current and power.
- To help students develop basic knowledge of DC circuit behavior.
- Help the students to conceptualize with the use of circuit analysis theorems and methods.
- To familiarize the students with the basics of AC networks.
- Acquaint students with the modeling and analysis of single phase RLC circuits for impedances, voltages, currents, powers and phase shift.
- Accumulate the basic knowledge about operations, device and circuit characteristics of diodes, BJT, JFET, MOSFET and Op-Amp.

Course Contents:

Circuit variables and elements: Voltage, current, power, energy, independent and dependent sources, and resistance.
Basic laws: Ohm's law, Kirchhoff's current and voltage laws.
Simple resistive circuits: Series and parallel circuits, voltage and current division, wye-delta transformation.
Techniques of circuit analysis: Nodal and mesh analysis including super node and super mesh.
Network theorems: Source transformation, Thevenin's, Norton's and superposition theorems with applications in circuits having independent and dependent sources, maximum power transfer condition and reciprocity theorem.
Energy storage elements: Inductors and capacitors, series parallel combination of inductors and capacitors.
Responses of RL and RC circuits: Natural and step responses.
Sinusoidal functions: Instantaneous current, voltage, power, effective current and voltage, average power, phasors and complex quantities, impedance, real and reactive power, power factor.
Analysis of single-phase AC circuits: Series and parallel RL, RC and RLC circuits, nodal and mesh analysis, application of network theorems in AC circuits.
P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a Zener diode, clamping and clipping circuits.
Bipolar Junction Transistor (BJT) as a circuit element: current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET) as circuit element: structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET, and biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.
Operational amplifiers (Op-Amp): Properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits.
Introduction to photodiode, Laser, Solar cell, Photo detector, LED.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CLO1 Explain the Basic concepts of Electrical Circuits.
CLO2 Solve and analyze the electrical circuits using different analysis methods and theorems
CLO3 Understand and explain the idea of AC networks and phasor.
CLO4 Explain the basics of diode and its applications.
CLO5 Interpret the operation and aplications of BJT and MOSFET.
CLO6 Understand the application of Op-Amps.

Mapping of COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01												
CO 02												
CO 03												
CO 04												
CO 05												

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLO	Teaching Learning Strategy	Assessment Strategy
CLO 1	Lectures	Class Test, Final Exam
CLO 2	Lectures, Assignments	Class Test, Final Exam
CLO 3	Lectures, Demonstration	Class Test, Final Exam
CLO 4	Lectures	Assignment, Final Exam
CLO 5	Lectures	Class Test, Final Exam
CLO 6	Lectures	Class Test, Final Exam, Assignment

Recommended Books
1. Introductory Circuit Analysis by Robert L. Boylestad
2. Electronic Devices and Circuit Theory by Robert L. Boylestad
3. Alternating Current Circuits by Russel M. Kerchner, George F. Corcoran
4. Operational Amplifiers and Linear Integrated Circuits-Robert F. Coughlin (Author), Frederick F. Driscoll

Course No: MEE 0715-1241	**Credit: 3.0**	**Year: First**	**Semester: Second**
Course Title: Programming Methodology for Mechanical Engineering		**Course Status: Theory**	

Course Objectives:
The objectives of this course are:
- to introduce computer hardware and its working principle.
- to provide the fundamental programming concepts and methodologies which are essential to building good C/python programs.

- to help students to code, document, test, and implement a well-structured, robust computer program using the C/python programming language.
- to make students able to write reusable modules (collections of functions).

Course Content:

Introduction to computer hardware and its working principle; Programming logic, algorithms and flowcharts.
Introduction to standard programming; Overview of C and python programming languages; C and python fundamentals – Variables; Data structures/Data types; Inputs and outputs; Expressions and statements; Operators; Libraries/modules; Keywords; Functions; Control statements; Iterations; Pointers; Object oriented programming; Exception handling; File handling. Introduction to user interface, how to use programming languages to solve mechanical engineering problems.

Course Learning Outcomes:

CO1 By the end of the course, students should be able to identify the basic components of computer hardware and are expected to demonstrate a comprehensive understanding of its working principle.
CO2 By the end of the course, students should be able to develop algorithms and flowcharts to solve mechanical engineering problems.
CO3 By the end of the course, students should be proficient in using C and Python programming languages, including basic data structures, inputs and outputs, and control statements.
CO4 By the end of the course, students should be able to utilize the object-oriented programming approach, as well as implement exception handling and file handling techniques in their programming.
CO5 By the end of the course, students should be able to apply programming concepts to create user interfaces and solve real-world mechanical engineering problems.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2											
CO2	2	3		1								
CO3	2				2							
CO4	2				2							
CO5			3	2						2		

Books Recommended:

1. TEACH YOURSELF C - Herbert Schildt
2. SCHAUM's Outlines Programming With C - Byron Gotteried
3. The C Programming Language - Brian W. Kernighan, Dennis M. Ritchie
4. Learn Python the Hard Way – Zed A. Shaw

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz
CO3	Lecture using board/LCD projectors/ Programming practice	Assignment
CO4	Lecture using board/LCD projectors/ Programming practice	Quiz
CO5	Assignment/project	Assignment

Course Code: PHY 0533 1212Q	Credit: 1.5	Year: First	Semester: Second
Course Title: Physics Sessional		Course Status: Lab	

Rationale of the Course

This course makes the students adept in experimental works so that they can verify physical laws and principles, and can measure the various natural quantities.

Course Objectives

The objectives of the course are:

1. to facilitate students in applying the theoretical knowledge of basic physics in experimental cross checks.
2. to train students about the use of scientific apparatus, measurements, analysis and interpretation of experimental data.

to instruct students about scientific report writing, oral communication, making logical arguments in favor of experimental findings.

Course Content

Mechanics:

1. Determination of the moment of inertia of a flywheel.

2. Determination of g, the acceleration due to gravity, by means of a compound pendulum and the determination of its moment of inertia.

Properties of Matter:

3. Using a flat spiral spring: a) Verification of Hooke's law and determination of its stiffness constant,

b) Determination of 'g' and the effective mass of the spring, c) Determination of the modulus of rigidity of the material of the spring.

4. Determination of Young's modulus of the material of a given bar by the method of bending.

5. Determination of the modulus of rigidity of the material of a given rod by static method.

Electricity:

6. Determination of the resistance of a galvanometer by half deflection method.

Course Learning Outcomes

After the successful completion of the course, students will be able to:

CO1 learn how to collect, plot and analyze experimental data properly, perform error analysis and present the findings in a formal report.

CO2 apply the principle of conservation of mechanical energy to calculate the moment of inertia of a flywheel, find the value of the acceleration due to gravity using a special type of physical pendulum, namely, the compound pendulum and to calculate its rotational inertia by measuring its time period.

CO3 realize that oscillations involving a massive spring can be considered simple harmonic provided that one-third of its mass is added to the mass of the load.

CO4 Grasp the technique to study the properties of material like Young's modulus, rigidity modulus.

CO5 explain the concepts of resistance, potential difference, Ohm's law and Kirchhoff's rule, and to construct a simple circuit with a galvanometer for determining the resistance of the galvanometer.

Mapping of the COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01	2	3		3						3		
CO 02	3			2	2							
CO 03	2			2	2							
CO 04	3			3	2							
CO 05	3			2	2							

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using white board / OHP projectors	Quiz and viva

CO2	Lecture using white board and laboratory teaching aids, giving instruction at experimental site	Quiz, evaluation of experimental report and semester-end oral examination
CO3	Lecture using white board and laboratory teaching aids, giving instruction at experimental site	Quiz, evaluation of experimental report and semester-end oral examination
CO4	Lecture using white board and laboratory teaching aids, giving instruction at experimental site	Quiz, evaluation of experimental report and semester-end oral examination
CO5	Lecture using white board and laboratory teaching aids, giving instruction at experimental site	Quiz, evaluation of experimental report and semester-end oral examination

Recommended Books

1. Worsnop, B.L. and Flint, H. T.: *Advanced Practical Physics*
2. Chowdhury, S. A. and Basak, A. K.: *Byaboharik PadarthaBidya*
3. Ahmed, G. and Uddin, M.S.: *Practical Physics*
4. Topping, J: *Errors of Observation and Their Treatment*

Course Code: EEE 0713-1212Q	**Credits: 1.0**	**Year: First**	**Semester: Second**
Course Title: Fundamentals of Electrical & Electronic Engineering Sessional		**Course Status: Sessional**	

Rationale

In this course, students will perform experiments to verify practically the theories and concepts learned in EEE-111Q. Theoretical knowledge is incomplete without hands-on experiments using the basic components and measuring devices used in electrical circuit analysis. This course teaches the fundamentals of electrical circuits, the application of circuit laws, theorems and measuring techniques for DC circuits. It contains experiments investigating the performance characteristics of diodes and different types of diode circuits. It contains a broad idea of transistors, Op-Amp and their applications.

Course Objectives are

The objectives of the course are

- To facilitate the necessary knowledge to implement dc circuits application in real-time environment
- Enable students with network analysis techniques to solve different types of circuits.
- To understand the transient analysis and steady-state analysis of a capacitor and inductor in a network.
- Help students to develop the ability in building AC electrical circuits and perform experiments on them.
- To provide the knowledge to apply Op-Amp, BJT and MOSFET in circuits.

Course Contents:

To get familiar with the operation of different electrical instruments. To verify the following theorems: KCL and KVL theorem, Superposition theorem, Thevenin's theorem, Norton's theorem and Maximum power transfer theorem RL and RC response. Study the frequency response of an RLC circuit and find its resonant frequency. Basic electrical element like fan, bulb, calling bell etc. connection from 220v AC Single phase supply. To familiar with electronics devices and Laboratory Equipment. To study of V-l Characteristics curve of P-N junction diode. To study of Half-Wave Rectification circuit. To study of Full-Wave Rectification circuit (Bridge &Center- tap). To study of Clipping and clamping circuit. To study MosFET and BJT characteristics. Speech/ Audio amplification using NPN/PNP Transistor. MosFET as an amplifier and switch. Different operational amplifier circuits.

In this course, students will perform experiments to verify practically the theories and concepts learned in EEE 111Q.

Lab 1-2: To familiarize students with the operation of different electrical instruments including measuring Equipment: Multi-meter, Frequency meter and Oscilloscope.

Lab 3-7: To verify the following theorems:

KCL and KVL theorem,

Superposition theorem,

Thevenin's theorem,

Norton's theorem and

Maximum power transfer theorem.

Lab 8: Diode Circuit and Half-wave rectifier

Lab 9: AC circuit, frequency measurement and lead-lag measurement.

Lab 10: Basic BJT circuits

Lab 11: To construct circuits using MOSFET

Lab 12: To implement different circuits using Op-Amp.

Lab 13:Lab test.

Lab 13:Quiz

Course Learning Outcomes:
After the successful completion of the course, students will be able to-

CLO 1 Explain the basic operation of different types of electrical instruments and measuring devices.

CLO 2 Implement network theorems and laws for different types of circuit analysis.
CLO 3 Measure the AC quantities in single phase circuit
CLO 4 Construct rectifier circuits using diode.
CLO 5 Manipulate logic expressions using binary BJT,MOS, Op-Amp.
CLO 6 Demonstrate team-based personal, leadership and communication skills, and magnify their moral

Mapping of COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01												
CO 02												
CO 03												
CO 04												
CO 05												

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching Learning Strategy	Assessment Strategy
CLO 1	Lectures, Demonstration	Viva, Quiz, Laboratory Test
CLO 2	Demonstration	Laboratory Test
CLO 3	Lectures, Demonstration	Laboratory Test, viva, Quiz
CLO 4	Lectures, Demonstration	Viva, Quiz, Laboratory Test
CLO 5	Lectures, Demonstration	Laboratory Test, , Quiz, Viva
CLO 6	Lectures, Demonstration	Viva

Recommended Books

1. Fundamental of Electric Circuits – Charles K. Alexander and Matthew N.O. Sadiku
2. Introductory Circuit Analysis by Robert L.Boylestad
3. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashlesky
4. Microelectronic Circuits- Sedra/Smith

Course No: MEE 0715-1242	**Credit: 1.0**	**Year: First**	**Semester: Second**
Course Title: Programming Methodology for Mechanical Engineering Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To help students to develop programming skills to solve different problems
- To assist student to implement various concepts and structures of C/python programming language
- To help students develop their critical and creative thinking for lifelong learning

Course Content:

Based on MEE141

Course Learning Outcomes:

CO1 By the end of the course, students should be able to identify the basic components of computer hardware and are expected to demonstrate a comprehensive understanding of its working principle.

CO2 By the end of the course, students should be able to develop algorithms and flowcharts to solve mechanical engineering problems.

CO3 By the end of the course, students should be proficient in using C and Python programming languages, including basic data structures, inputs and outputs, and control statements.

CO4 By the end of the course, students should be able to utilize the object-oriented programming approach, as well as implement exception handling and file handling techniques in their programming.

CO5 By the end of the course, students should be able to apply programming concepts to create user interfaces and solve real-world mechanical engineering problems.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2											
CO2	2	3		1								
CO3	2				2							
CO4	2				2							
CO5			3	2						2		

Books Recommended:

1. TEACH YOURSELF C - Herbert Schildt
2. SCHAUM's Outlines Programming With C - Byron Gotteried
3. The C Programming Language - Brian W. Kernighan, Dennis M. Ritchie
4. Learn Python the Hard Way – Zed A. Shaw

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Computer Assemble and disassemble	Assignment
CO2	Lecture using board/LCD projectors	Quiz

CO3	Programming practice	Assignment
CO4	Programming practice	Quiz
CO5	Assignment/project	Assignment

Course No: MEE 174	**Credit: 1.5**	**Year: First**	**Semester: Second**
Course Title: Computer-aided Mechanical Engineering Drawing		**Course Status: Sessional**	

Course Objectives:
The objectives of this course are:

- To provide for the students an insight into computer aided design and modelling.
- To develop an ability to create 2-D sketches, create and edit dimensions.
- To develop an ability to create solid models of machine components.
- To develop an ability to create assembly models of simple machine.
- To develop the ability to apply limits, fits, and dimensional tolerances, as well as geometric tolerances to components and assemblies on engineering drawings.
- To develop an ability to create 2D drawings from 3Dmodels

Course Content:
Prereq.: MEE172
Review of orthographic projections; Fasteners, gears, keys and springs; Sectional views and conventional practices; Auxiliary views; Specifications for manufacture; Working drawings; Introduction to Computer Aided Design (CAD).

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. recall all the drawing tools of AutoCAD and SolidWorks software
CO2. justify the engineering design with dimensions
CO3. design engineering components using AutoCAD and SolidWorks software

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	3				1					
CO2	2	2		1						
CO3		2	3						1	

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT, Assignment	Class work, Assignment, Final Exam
CO2	Lecture using PPT, Discussion	Class work, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam

Course No: MEE 178	**Credit: 1.0**	**Year: First**	**Semester: Second**
Course Title: Machine Shop Practice		**Course Status: Sessional**	

Course Objectives:
The objectives of this course are:

- To give ME undergraduates the opportunity to engage in machine shop operation under the supervision of qualified machine shop personnel
- To be familiar with the common bench and hand tools
- To operate drilling machine, lathe machine, shaper machine, milling machine, grinding machine

Course Content:

Tools: common bench and hand tools, marking and layout tools, measuring tools, cutting tools, machine tools. Bench work on jobs. Practices on machine tools: drilling machine, lathe machine, shaper machine, milling machine, grinding machine.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. Integrate the concept of machine design with fabrication.
CO2. Analyze the feasibility of manufacturing specific pieces
CO3. Operate machines safely
CO4. Conduct themselves ethically and responsibly in a machine shop context
CO5. Develop the skill of working in a group

Mapping of COs with POs

Course No: MEE 0715-1288	**Credit: 0.5**	**Year: First**	**Semester: Second**
Course Title: Comprehensive Viva-I		**Course Status: Viva**	

Course Objectives:

The objectives of this course are:

- To help students to communicate effectively with others
- To facilitate necessary knowledge about different topics related to courses
- To develop skills on speak in English fluently
- To facilitate students to share different ideas & thoughts in practical life
- To help students to identify better choice among all alternatives
- To understand basic solution process
- To introduce students about practical service life

Course Content:

Topics covered by all theoretical and practical courses in both two semesters of the running year.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. communicate effectively with other employees and workers in service life.
CO2. explain the understanding about different practical problems relevant to the course.
CO3. develop the capability of leading a team.
CO4. explain the integrated engineering knowledge learned throughout the semester.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1						2				3		
CO2	2	2										
CO3						1			3	2		
CO4	3	2		2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Self-learning using interpersonal relationship	Viva voce
CO2	Self-learning using reference books/other online materials	Viva voce
CO3	Self-learning using interpersonal relationship	Viva voce
CO4	Self-learning using reference books/other online materials	Viva voce

Second Year Second Semester

Course No: MAT 203Q	Credit: 3.0	Year: Second	Semester: First
Course Title: Vector Analysis, Matrices and Laplace Transform		Course Status: Theory	

Rationale of the Course:
This course is designed for the students of Mechanical Engineering department. It is the standard complete introduction to the concepts and methods of vector analysis, matrix and Laplace transform. The emphasis is given to teach the understanding of using vector and matrix algebra, real valued vector functions and Laplace transform. The applications for the related discipline will be discussed.

Course Objectives
The objectives of this course are:

- Introduce students to the fundamental concepts of matrices and vectors.
- Teach techniques and methods to solve a system of linear equations using matrix properties and its applications.
- Acquire knowledge of behavior of vector functions by studying its derivatives and integrations.
- Expose students to mathematical applications of matrices and vector functions to handle diverse problems which occur in mechanics.
- Introduce Laplace transform and its application to solve mathematical problems.

Course Content:
Vector analysis: Vector products and its application to geometry and mechanism. Vector calculus: Differentiation together with elementary applications. Gradient of a scalar functions. Divergence and curl of a vector function. Physical significance of gradient, divergence and curl. Integration of vectors together with elementary applications. Line, surface and volume integrals. Stoke's theorem, Green's theorem, Gauss's theorem and their applications.
Matrices: Types of matrices and algebraic properties. Rank and elementary transformations of matrix. Solution of linear equation by matrix methods. Linear

dependence and independence of vectors. Determination of characteristic roots and vectors.

Laplace transforms: Definition of Laplace transforms. Elementary transformation and properties. Convolution. Solution of differential equation by Laplace transforms. Evaluation of integrals by Laplace transforms.

Course Learning Outcomes

After the successful completion of the course, students will be able to

CO1 Compute the area and volume formed by the position vectors.
CO2 Discuss the nature of vector functions using derivatives.
CO3 Find the length of a curve line, surface area and volume of some models.
CO4 Apply the mathematical knowledge of matrix and vectors to their related topics.
CO5 Compute matrix algebra.
CO6 Find the solution set of a system of equations.
CO7 Determine linearly dependent and independent vectors.
CO8 Determine characteristic roots and corresponding vectors.
CO9 Apply Laplace transform to solve mathematical problems.

Mapping of the COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1O
CO1	**X**			**X**				**X**	**X**	**X**
CO2	**X**			**X**				**X**	**X**	**X**
CO3	**X**			**X**				**X**	**X**	**X**
CO4	**X**			**X**				**X**	**X**	**X**
CO5	**X**			**X**				**X**	**X**	**X**
CO6	**X**			**X**				**X**	**X**	**X**
CO7	**X**			**X**				**X**	**X**	**X**
CO8	**X**			**X**				**X**	**X**	**X**
CO9	**X**			**X**				**X**	**X**	**X**

Recommended Books

1. Speigel, M R.: *Vector analysis*
2. Howard Anton and Chris Rorres: *Elementary linear algebra with applications*, 9th edition
3. Spiegel, M. R.: *Laplace Transform*

Course No: ECO 205 Q	**Credit: 3.0**	**Year: Second**	**Semester: First**
Course Title: Principles of Economics		**Course Status: Theory**	

1.1 Course Description and Objectives

This ECO 105 course provides an introduction to the main ideas and concepts involved in modern economics and attempts to provide students with an understanding of how the economy works, what type of problems economists attempt to solve, and how they set about trying to solve them. The course is primarily concerned with the analysis of individual decision-making agents, the behaviour of firms and industries in the economy (microeconomics), on the economy as a whole (macroeconomics) and the inherent problems facing underdeveloped and developing countries (economic development).

Microeconomics part provides a brief and simple introduction to the subject matter and scope of Economics. This section aims to provide an introduction to microeconomic analysis. It outlines the theory of markets with relevant applications to business, social and individual issues. The course covers the principles and consequences of "rational" choice by individual economic agents in markets. The course also provides an introductory analysis of the role of governments in seeking to ensure the efficient operation of markets.

Macroeconomics section provides a brief and simple introduction to the subject matter and scope of Macroeconomics. It also aims to provide an introduction to macroeconomic analysis outlining how the national income is measured and determined. It also provides a framework in which the interaction of money and goods and services markets can be developed, allowing students to understand the process by which the levels of economic activity, employment is determined.

Economic development section provides students with an understanding of economic theories and analysis in the field of development economics. The section is designed to deal with a selection of issues and problems facing the developing economies.

1.2 Prerequisites

Basic arithmetic and an ability to learn, to understand, and manipulate simple graphs are required, else it would be difficult to do any job in the private or public sector without these skills.

1.3 Course Learning Outcome (CO)

Successful completion of this course should enable students to:

CO 1. Understand the analysis of individual decision-making agents, the behavior of firms and industries in the economy

CO 2. Understand the concept of elasticity quantitatively and qualitatively in economic analysis and know differences between different types of markets;
CO 3.Explain macroeconomic concepts and use simple economic models to interpret the behaviour of key macroeconomic variables;
CO 4. Understand monetary and fiscal policy and Government budget;

CO 5. Understand the main issues confronting underdeveloped and developing countries.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1					X		X			
CO2					X		X			
CO3							X			
CO4					X		X			
CO5							X			X

Part B: Teaching and Assessment

2.1 Teaching Strategies

The course materials are delivered through certain teaching-learning activities such as lectures, reading, assignments, and exercise and workshop papers.

2.2 Assessment Strategies

No.	Description	Mark
1	Class attendance	10
2	Midterm test	20
3	Assignments	10
4	Final Exam	60

Note: The coursework consists of at least two tests (one can be substituted by assignment) with a combined weight of 20% of the final mark, 10% as a part of continuous assessment like a class test, quiz, problem-solving, short assignment and 10% of the final mark is reserved for class attendance as per rule of the university. Assignment submission date will be fixed by the course convener.

2.3Assessment of Course Learning Outcome

Outcome	Test	Assignment	Final Examination
1	X	X	X
2	X	X	X
3	X	X	X
4	X	X	X
5	X		X

2.2 Grading System

The grading system has been detailed in Section 7 "Grading System" in Semester Ordinance

Part C: Course Content

3.1 Course Outline

Course Content	Teaching Strategy
1. Introduction to Microeconomics: Definition and scope; basic concepts and tools—PPF and circular flow model; fundamental economic problems and solution systems; Concepts of demand, supply and equilibrium; Concepts of elasticity, different types of elasticities, their applications; Concepts of total and marginal utility; Concepts of production, cost and profit, characteristics of different types of markets.	Lecture, tutorial and exercise
2. Introduction to Macroeconomics: Key macroeconomic indicators and their performance measurement - GNP, GDP, inflation, unemployment; money, functions of money, function of commercial and central bank, monetary policy; fiscal policy and structure of govt. budget.	Lecture, tutorial and assignment
3. Development and related issues: Growth and development; concept of poverty and poverty measures; HDI; key human-socio-economic development indicators of Bangladesh, Sustainable Development Goals (SDG).	Lecture and discussion

3.2 Alignment of topics of the courses with COs

	CO 1	CO 2	CO 3	CO 4	CO 5
Content 1	X	X			
Content 2			X	X	
Content 3					X

Part D: Learning Resources

4.1 Required readings

1. Arnold, R. A. (2014): Economics, South Western Publishing Company, Eleventh Edition
2. Bangladesh Economic Review relevant issues.
3. Mankiw, N. G. (2012): Principles of Economics, Thomson South Western Publishing, Sixth Edition
4. Samuelson, P. A. and Nordhaus,W. D. (2009): Economics, McGraw-Hill USA, Nineteenth Edition.
5. Todaro, M. P. and Smith,S. C. (2012): Economics of Development in the Third World, Longman, Eleventh Edition

Course No: MEE 0715-2131	**Credit: 3.0**	**Year: Second**	**Semester: First**
Course Title: Basic Thermodynamics		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To introduce the concept of dynamics involved in thermal energy transformation.
- To prepare them to carry out experimental investigation and analysis related to thermal interaction with the environment.
- To illustrate applications of thermodynamics in the field of mechanical engineering.

Course Content:

Fundamental concepts; Basic concepts and definitions; thermodynamic systems, property and state, thermodynamic processes and cycles. Pure Substance: Properties of water and steam; P-V-T behavior of simple

compressible substances; phase rule; thermodynamic property tables and charts; ideal and real gases. Properties of gases and vapors.
Laws of thermodynamics and their corollaries. Applications of First law to Non-flow and flow processes and cycles. Ideal gas cycles. Power cycles, refrigeration cycles and reciprocating compressors. Second law of thermodynamics: direct and reversed heat engines. Reversibility, processes and cycles. Carnot cycle, Clausius inequality. Application of second law to processes and cycles: Entropy changes of pure substances in non-flow, flow processes and different cycles. PV and TS diagrams.
Thermodynamic relations and equations of state. Mixtures of gases and vapors; Psychrometric; Fuels and combustion.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. Interpret fundamental concepts relevant to thermodynamics.
CO2. Explain the concepts of work, power, and heat in a thermodynamic system
CO3. apply the laws of thermodynamics in various practical application.
CO4. Determine thermodynamic properties of pure substances.
CO5. Apply the concepts of thermodynamics for a control volume, including with turbines, compressors, nozzles, diffusers, heat exchangers, and throttling devices.
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Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2											1
CO2		2		2								
CO3			2	1								
CO4	2			1								
CO5	1	2										1

Books Recommended:

1. Y. A. Cengel, M. A. Boles; Thermodynamics – An Engineering Approach; Tata McGrawHill Education Pvt. Ltd. New Delhi.4th Ed; 2012.
2. P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; NewDelhi.4th Ed.; 2008.
3. P. W Gill, J. H. Smith., E. J. Ziurys; Fundamentals of Combustion Engines; Oxford &IBH Publishing Co. Pvt. Ltd.; 4th revised Ed.;1967

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE 0715-2157	Credit: 3.0	Year: Second	Semester: First
Course Title: Engineering Mechanics-I		Course Status: Theory	

Course Objectives:
The objectives of this course are:

- To develop the capacity to predict the effects of force and motion
- To develop a knowledge of the physical and mathematical principles of mechanics
- To develop the ability to visualize physical configurations in terms of real materials, actual constraints, and the practical limitations which govern the behavior of machines and structures.
- To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies.
- To help learn the effect of friction on equilibrium
- To implement the above know how to solve practical problems.

Course Content:

Basic concepts of mechanics; Statics of particles and rigid bodies; Centroids of lines, areas and volumes; Forces in truss, frames, and machines; Forces in Cables; Friction, Power transmission by belts and ropes; Moments of inertia of areas and masses; Method of virtual work.

Course Learning Outcomes:

By the end of the course, students will be able to:

CO1. Apply basic principles of mechanics to solve static problems of particles and rigid bodies, and analyze forces in trusses, frames, machines, and cables.

CO2. Evaluate and predict frictional forces and understand power transmission through belts and ropes.

CO3. Compute centroids of lines, areas, and volumes and use them to solve practical problems.

CO4. Determine moments of inertia of areas and masses using mathematical methods.

CO5. Apply the method of virtual work to analyze and solve mechanical problems.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1		1	2	3	2	2
CO2					1		1		2	3	1	
CO3	1		1	1	1		2		1	3	1	1
CO4	2	1	1	3	2		1		2	2	1	2
CO5	2	2	2	3	2		1		2	2	2	2

Mapping of COs with Learning Strategies and Assessment Strategies:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz
CO3	Lecture using board/LCD projectors	Assignment
CO4	Lecture using board/LCD projectors	Quiz
CO5	Lecture using board/LCD projectors	Assignment

Books Recommended:

1. Engineering Mechanics: Statics - Russell Hibbeler
2. Engineering Mechanics: Dynamics - Russell Hibbeler
3. Vector Mechanics for Engineers – Ferdinand P. Beer

Course Code: EEE 0713-2113Q	**Credit: 3.0**	**Year: Second**	**Semester: First**
Course Title: Fundamentals of Electrical Machines		**Course Status: Theory**	

Rationale:

The main aim of this course is to provide practical knowledge of the principles and practices of different types of Electrical Machines. Electrical engineering includes study of large number of electrical machines which are used every day. These machines are found in regular wrist watches as well as large industries. The wide usage of these machines compels every engineer to know and understand their basic functions. So, students should have insight knowledge of how electric machineries works and how to handle them. This course examines the basic theory, characteristics, construction, operation and application of rotating electrical machines. It includes the study of transformer, poly-phase induction motors, synchronous generator, synchronous motor and DC machines.

Course objectives are:

- To provide the basic concepts of the construction, characteristics, operation and application of both DC and AC machines including of transformer, poly-phase induction motors, synchronous generator, synchronous motor and DC machines.
- To help the students develop skills to solve problems relating to rotor speed, flux, torque, developed power, generated voltage, terminal voltage, currents, load power factors, input and output power, efficiency, and voltage /speed regulation etc. in transformers, DC generators and DC motors.
- Acquaint the students with the techniques of solving different types of problems relating to generated voltage, terminal voltage, current, frequency,

synchronous impedance, synchronous speed, slip, rotor frequency, rotor voltage, rotor current, torque, developed power, efficiency and power factor in poly-phase induction motors.

- Facilitate necessary knowledge to explain the results of laboratory tests on various rotating and static electrical machines under load conditions.

- Helping the students to develop ability to safely wire and operate electrical rotating machines and their associated metering and starting equipment..
- To introduce the basic idea about the design of major classes of electric machines.

Course Contents:
Transformer: Ideal transformer- transformation ratio, no-load and load vector diagrams; actual transformer- equivalent circuit, regulation, short circuit and open circuit tests.
Three phase induction motor: Rotating magnetic field, equivalent circuit, vector diagram, torque-speed characteristics, effect of changing rotor resistance and reactance on torque-speed curves, motor torque and developed rotor power, no-load test, blocked rotor test, starting and braking and speed control.
Single phase induction motor: Theory of operation, equivalent circuit and starting.
Synchronous Generator: excitation systems, equivalent circuit, vector diagrams at different loads, factors affecting voltage regulation, synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations.
Parallel operation: Necessary conditions, synchronizing, circulating current and vector diagram.
Synchronous motor: Operation, effect of loading under different excitation condition, effect of changing excitation, V-curves and starting.
DC generator: Types, no-load voltage characteristics, build-up of a self-excited shunt generator, critical field resistance, load-voltage characteristic, effect of speed on no-load and load characteristics and voltage regulation.
DC motor: Torque, counter emf, speed, torque-speed characteristics, starting and speed regulation. Introduction to wind turbine generators.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-
CLO 1 Explain Transformer operating principle, Calculate Transformer parameters theoretically and also Identify the inadequacies of Transformers and how to reduce them.

CLO 2 Evaluate induction motor parameters theoretically and also explain three-phase and single-phase induction motor design and working principle
CLO 3 Understand the three-phase synchronous generator operating principle, Find voltage regulation on different loads and also Design a system with parallel connected generators.

CLO 4 Interpret synchronous motors V-curves and effect of loading under different excitation conditions

CLO 5 Apply measures for efficient operation of DC electrical machines (dc generator & dc motor), Understand DC machine design and working principle and also Formulate proper procedure for speed control, starting and braking.

Mapping of COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01												
CO 02												
CO 03												
CO 04												
CO 05												

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLO	Teaching Learning Strategy	Assessment Strategy
CLO 1	Lectures, Home Work	Class Test, Final Exam
CLO 2	Lectures, Assignments, Demonstration	Class Test, Final Exam
CLO 3	Lectures, Demonstration	Class Test, Final Exam

CLO 4	Lectures, Video Tutorials	Assignment, Final Exam
CLO 5	Lectures, Assignments, Demonstration	Class Test, Final Exam

Recommended Books:

1. A Textbook of Electrical Technology (Volume II) by B.L. Theraja and A.K. Theraja
2. Electric Machines by Charles I. Hubert
3. Principles of Electrical Machines by V.K. Mehta and Rohit Mehta

Course No: MEE 0715-2132	**Credit: 1.5**	**Year: Second**	**Semester: First**
Course Title: Basic Thermodynamics Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To identify and use units and notations in Thermodynamics.
- To state and illustrate first and second laws of thermodynamics and apply those laws in various gas processes and cycles.
- To explain the concepts of thermodynamic systems, property, state, process and cycles like entropy, enthalpy, reversibility, irreversibility, Carnot cycle etc.
- To familiarize students with properties of steam, thermodynamic vapor cycles, psychrometric charts& processes, human comfort conditions.

Course Content:

Fundamental concepts; Basic concepts and definitions; thermodynamic systems, property and state, thermodynamic process and cycle. Pure Substance: Properties of water and steam; P-V-T behavior of simple compressible substances; phase rule; thermodynamic property tables and charts; ideal and real gases. Properties of gases and vapors.

Laws of thermodynamics and their corollaries. Applications of First law to Non-flow and flow processes and cycles. Ideal gas cycles. Power cycles, refrigeration cycles and reciprocating compressors. Second law of thermodynamics: direct and reversed heat engines. Reversibility, processes and cycles. Carnot cycle, Clausius inequality. Application of second law to processes and cycles: Entropy changes of pure substances in non-flow, flow processes and different cycles. PV and TS diagrams. Thermodynamic relations and equations of state. Mixtures of gases and vapors; Psychrometric; Fuels and combustion.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1.Apply energy balance to systems and control volumes

CO2.Evaluate changes in thermodynamic properties of substances.

CO3. Evaluate the performance of energy conversion devices.

CO4. Differentiate between high grade and low-grade energy.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		2										
CO2		2										
CO3	1	2										
CO4		1		2								

Books Recommended:

1. Y. A. Cengel, M. A. Boles; Thermodynamics – An Engineering Approach; Tata McGrawHill Education Pvt. Ltd. New Delhi.4th Ed; 2012.

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture, Laboratory, Assignment	Class work, Assignment, Quiz
CO2	Lecture, Laboratory, Discussion	Class work, Assignment, Quiz
CO3	Lecture, Laboratory, Question-Answer session	Class work, Assignment, Quiz

CO4	Lecture, Laboratory, Question-Answer session	Class work, Assignment, Quiz

Course Code: EEE 0713-2114Q	**Credit: 1.0**	**Year: Second**	**Semester: First**
Course Title: Electrical Machines Sessional		**Course Status: Sessional**	

Rationale:
Electrical engineering is a field of engineering that generally deals with the study and application of electricity. The generation of electricity includes electric machinery. So the student should know how electric machinery works and how to handle them. The theoretical knowledge is incomplete without hands-on experiments using the basic components and measuring devices used in Electrical Machines. In this course, students will perform experiments to verify practically the theories and concepts learned in EEE-213Q. This course teaches the fundamentals of electrical machines, the effect of resistive, inductive and capacitive loading on a single and three-phase transformer. It contains a broad and hand on experience on no load test and blocked rotor test of three phase induction motor. It also familiarizes the torque-speed characteristics of the DC motor, voltage regulation of the f DC shunt generator, loading characteristics of the synchronous generator, V-curve of synchronous motor which is derived from the experimental data.

Course objectives are:

- To facilitate necessary knowledge about different DC and AC machines and handle various lab apparatus.
- To determine the voltage transformation ratio and turn ratio of transformer and experience their importance.
- Helping the students to develop ability in examining the effect of resistive, inductive and capacitive loading of single phase transformer.
- To describe to determine different transformer parameters without actually loading the transformer.
- Enable students to determine different AC asynchronous motor parameters without actually loading the motor.
- To help students develop skills to control the speed of dc motor and observe the existence of back EMF.
- To describe the importance of residual magnetism on voltage build-up of dc generator.
- To teach the students about how to determine voltage regulation of dc generator from experimental data
- To provide basic knowledge to obtain O.C.C and loading curve of synchronous generator and also the V-curve of synchronous motor.

Course Contents:

In this course students will perform experiments to verify practically the theories and concepts learned in EEE-214Q.

Lab 1: To familiarize students with the lab, its equipment and laboratory regulation.

Lab 2-4: To determine the following parameters and performance test of a single phase and three phase transformer:

- Voltage transformation ratio and turn ratio
- Voltage regulation and efficiency with resistive, inductive and capacitive loading
- Short circuit and open circuit test

Lab 5-7: Experiment related to No load test and blocked rotor test, speed control and drawing torque-speed curve of a single phase/three phase induction motor

Lab 8: Study of the Single phase capacitor-run induction motor speed control

Lab 9-10: Determining torque-speed characteristics of DC motor and voltage regulation of DC shunt generator.

Lab 11: No load and loading characteristics of synchronous generator.

Lab 12: Determining V-curve of synchronous motor.

Lab 13-14: Relevant Experiment based on EEE 0713-2114Q.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CLO 1 Explain the safety procedures for high voltage electrical machines and also Identify and interpret different electrical machines.
CLO 2 Draw the equivalent circuit of transformers from experiments, Calculate transformer parameters practically also practically find the electrical system's efficiency and improve it.
CLO 3 Apply induction motor speed control techniques, Draw equivalent circuit of induction motors from experiments and also Calculate induction motor parameters practically.
CLO 4 Differentiate between synchronous motor and machine V-curve, Calculate synchronous generators voltage regulation on different loads.
CLO 5 Interpret torque-speed characteristics of different machines, Demonstrate the difference between AC and DC machines

Mapping of CO with PO

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 01												
CO 02												
CO 03												
CO 04												
CO 05												

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lectures	Viva
CO2	Demonstration, Lectures	Viva, Quiz, Laboratory Test
CO3	Lectures, Demonstration	Laboratory Test
CO4	Lectures, Demonstration	Laboratory Test
CO5	Demonstration, Lectures	Viva, Quiz, Performance Test

Recommended Books:
1. A Textbook of Electrical Technology (Volume II) by B.L. Theraja and A.K. Theraja
2. Electric Machines by Charles I. Hubert
3. Principles of Electrical Machines by V.K. Mehta and Rohit Mehta

Second Year Second Semester

Course No: MAT 205Q	**Credit: 4.0**	**Year: Second**	**Semester: Second**
Course Title: Complex Variables, Harmonic Analysis and Partial Differential Equations		**Course Status: Theory**	

Course Objectives:
- To introduce students with the basic concept of complex variables (complex number system, functions of a complex variable and its limits and continuity, differentiation and line integral of complex functions).
- To learn Cauchy-Riemann equations and analytical functions.

- To apply Cauchy's integral formula and related theorems to solve relevant problems of complex function.
- To identify singular points and apply Cauchy's residue theorem to evaluate residues.
- To introduce the techniques of contour integration and conformal mappings.
- To understand the real and complex form of Fourier series, Fourier transform and Fourier integral and solve engineering problem by using them.
- To solve problems by using Laplace's equation in Cartesian, polar, cylindrical and spherical coordinates.
- To equip students with the concepts of partial differential equations and how to solvePartial Differential Equations with different methods.
- To introduced some physical problems in Engineering models that results in partial differential equations.

Course Content:

Complex variable: Complex number system. Functions of a complex variable and its limits and continuity. Differentiation of complex functions, Cauchy-Riemann equations and analytical functions. Line integral of complex functions. Cauchy's integral formula and related theorems. Singular points. Residue. Cauchy's residue theorem. Evaluation of residues. Contour integration. Conformal mapping.

Fourier series: Real and complex form. Fourier integral, Fourier transforms and their uses in solving boundary value problems. Harmonic functions. Definition of harmonics. Laplace's equation in Cartesian, polar, cylindrical and spherical coordinates. Solutions of these equations together with applications. Properties of harmonic functions.

Partial differential equation: Introduction, Equations of linear and non-linear first order Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients.

Course Learning Outcomes (COs):

By the end of this course the students will be able to

CLO 1. Define the complex number system, complex functions and integrals of complex functions

CLO 2. Grasp the techniques from Cauchy-Riemann equations, power series expansion and Cauchyintegral formulas to study analytic functions from different perspectives

CLO 3. Apply the theorems and results in complex analysis to complex valued functions

CLO 4. Compute contour integrals by calculating residues

CLO 5. Construct conformal mappings between many kinds of domain

CLO 6. Know the real and complex form of Fourier series, Fourier transform and Fourier integral and apply them in solving different engineering problems

CLO 7. Learn Laplace's equation in Cartesian, polar, cylindrical and spherical coordinates and use them to solve various problems

CLO 8. Use partial differential equations to solve hyperbolic, parabolic and elliptic equations

CLO 9. Apply a range of techniques to find solutions of standard Partial Differential Equations

Mapping of the COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1O
CO1	X									
CO2	X									
CO3	X									
CO4	X									
CO5	X									
CO6	X									
CO7	X									
CO8	X									
CO9	X									

Books Recommended:

1. Spiegel, M.R.: Complex Variable
2. Churchill: Introduction to Complex Variable and Applications
3. Rajput, B.S.: Mathematical Physics
4. Stephenson: Mathematical Methods

5. Kreyszig, Erwin: Advanced Engineering Mathematics
6. Khanna, M. L.: Partial Differential Equations
7. Raisinghania, M.D.: Ordinary and Partial Differential Equations

Course No: MEE 0715-2259	**Credit: 3.0**	**Year: Second**	**Semester: First**
Course Title: Engineering Mechanics-II		**Course Status: Theory**	

Course Objectives:
The objectives of this course are:

- To develop a knowledge of the physical and mathematical principles of mechanics
- To develop the ability to visualize physical configurations in terms of real materials, actual constraints, and the practical limitations which govern the behavior of machines and structures.
- To make them learn the fundamentals dynamic equilibrium of particles and rigid bodies.
- To provide knowledge kinematics, kinetics of particle and rigid body, related principles.
- To implement the above know how to solve practical problems.

Course Content:
Kinematics of particles: Kinetics of particles: Newton's second law, energy and momentum method; System of particles; Kinematics of rigid bodies; Plane motion of rigid bodies: forces and acceleration, Energy and momentum methods; Velocity and acceleration in mechanism.

Course Learning Outcomes:
CO1. By the end of the course, students will be able to apply Newton's second law to analyze the motion of particles and solve problems related to the kinetics of particles.
CO2. By the end of the course, students should be able to evaluate the energy and momentum methods to analyze the motion of particles and rigid bodies, and to solve related problems.
CO3. By the end of the course, students will be expected to apply the principles of system of particles to solve engineering problems related to the motion of systems.
CO4. By the end of the course, students should be able to analyze the velocity and acceleration of mechanisms and to apply the concepts of forces and acceleration to solve problems related to plane motion of rigid bodies.
CO5. By the end of the course, students will be able to apply the principles of energy and momentum methods to analyze the motion of rigid bodies and solve related engineering problems.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	3	3							
CO2	2	2	1	3	3							
CO3	1	2	1	3	3							
CO4	1	3	1	3	3							
CO5	2	2	1	3	3							

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz
CO3	Lecture using board/LCD projectors	Assignment
CO4	Lecture using board/LCD projectors	Quiz

CO5	Lecture using board/LCD projectors	Assignment

Books Recommended:

4. Engineering Mechanics: Statics - Russell Hibbeler
5. Engineering Mechanics: Dynamics - Russell Hibbeler
6. Vector Mechanics for Engineers – Ferdinand P. Beer

Course No: MEE 0715-2245	**Credit: 3.0**	**Year: Second**	**Semester: Second**
Course Title: Numerical Analysis		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To develop the basic understanding of numerical algorithms and skills
- To illustrate application of different algorithms in solving engineering problems.

Course Contents:

Roots of polynomials and transcendental equations; Determinants and matrices; Eigen values and eigen vectors; Solution of linear and non-linear algebraic equations; Solution of first-order and second order differential equations. Solution of system of differential equations. Interpolation methods; Numerical differentiation and integration; Solving equations by finite differences, FEM for 1-D heat flow, FEM for 2-D & 3-D heat flow; Curve fitting.

Course Learning Outcomes:

CO1. By the end of the course, students will be expected to find the roots of polynomials and transcendental equations using numerical methods.
CO2. By the end of the course, students will be able to solve linear and non-linear algebraic equations using matrix and numerical techniques.
CO3. By the end of the course, students will be able to apply numerical methods to solve first-order and second-order differential equations, and systems of differential equations, and utilize interpolation techniques to estimate unknown values.
CO4. By the end of the course, students should be able to apply numerical methods to differentiate and integrate functions and use finite differences and finite element methods (FEM) to analyze 1-D, 2-D, and 3-D heat flow problems.
CO5. By the end of the course, students will be able to perform curve fitting.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	2	3	3					3		2
CO2	2	3	2	3	3					3	3	2
CO3	2	2	2	3	3					3		2
CO4	2	2	2	3	3					3	3	2
CO5	1									3		2

Books Recommended:

1. Numerical methods for engineers, by Stevens C Chapra
2. Numerical methods, by E Balagurusamy

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz
CO3	Lecture using board/LCD projectors	Assignment
CO4	Lecture using board/LCD projectors	Quiz

CO5	Lecture using board/LCD projectors/Project	Assignment

Course No: MEE 0715-2253	**Credit: 3.0**	**Year: Second**	**Semester: Second**
Course Title: Mechanics of Solids		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To familiarize the students with stress analysis
- To provide knowledge about different kinds of loads
- Getting idea about different kinds of stresses
- To make students able to analyze and calculate stress in beams, columns, springs, thin walled cylinder, etc.
- To acquire knowledge about different kinds of failure theories

Course Content:

Stress analysis: statically determinate stress system- stress-strain relationship, 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.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Understand how to calculate axial, thermal and centrifugal stresses and strain

CO2. analyze different kinds of applied load and stress in case of different structure like cylinder, beam and column

CO3. analyze beam deflection by integration and area moment method

CO4. predict the effect of combined stress on a mechanical structure by using formula and Mohr's Circle

CO5.. analyze the failure of mechanical components.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3		3									
CO2			3	2								1
CO3	1	2	3	2								
CO4	1		2	3								
CO5	1	2	1	1								

Books Recommended:

1. Ferdinand L. Singer & Andrew Pytel - Strength of Materials
2. R.K. Bansal - Mechanics of Solids
3. David K. Felbeck - Strength and Fracture of Engineering Solids
4. James Martin Prentis - Engineering Mechanics

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam

CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE 255	Credit: 3.0	Year: Second	Semester: Second
Course Title: Engineering Materials (Metallic and Composites)		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- To familiarize the students with metallic materials and their alloys.
- To demonstrate different material testing methods
- To explain phase diagram and phase rules
- To introduce with composite materials
- To make them differentiate among different composite materials and their specific applications.

Course Content:

Metallic Materials: Concept of malleability, ductility, toughness, fatigue resistance and other properties of metallic materials. Mechanical and non-destructive tests of metals. Pig iron: production and uses. Cast iron: production, types, uses and effects of impurities. Steels: Bessemer and open- hearth steels, production and uses. Plain carbon and different types of allow steels. Bearing metals, light alloys, common metals and their alloys. The Fe-FeC equilibrium diagram. Types of heat treatment. Surface Treatments and coatings; joining of metals and alloys.

Composite materials: Different types of composites materials; Polymers; Review of Polymer types, synthesis and structures; structure-property relationships; processing; commodity vs. engineering plastics; case studies.; Polymeric matrix composites: Types and properties of fiber reinforced composites; multiplied laminated composites; applications of fiber-reinforced polymeric matrix composites; case studies.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. make qualitative comparisons between materials and application areas for the most common technical materials in the various materials categories,

CO2. interpret binary phase diagrams and utilize the underlying concepts to explain Fe-FeC phase diagrams

CO3. explain the underlying mechanisms for hardening of metals and surface hardening

CO4. differentiate fundamental differences between iron and steel making procedures in industries and differences between plain carbon and various alloy steels

CO5. explain different fabrication procedures of polymer composites.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1			3		2						2
CO 2	2	3	1									
CO 3				2		3						
CO 4					3	2	3					2
CO 5	3			2	2		1					

Books Recommended:

1. William D. Callister, Jr., DAVID G. RETHWISCH, Materials Science and Engineering An Introduction, 10th Edition.
2. Krishan K Chawla, composite materials
3. Sydney H. Avner. Introduction to Physical Metallurgy, 2nd Edition.
4. MF Ashby & DRH Jones, Engineering Materials 1: An Introduction to their Properties and Applications, 4th Edition.
5. Arthur K. Kaw, Mechanics of composite materials

Course No: MEE 246	**Credit: 1.0**	**Year: Second**	**Semester: Second**
Course Title: Numerical Analysis Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To develop the basic understanding of numerical algorithms and skills.
- To familiarize basic structure & syntax of programming language of MATLAB.
- To introduce numerical steps in solving engineering problems using MATLAB.

Course Content:

- Roots of polynomials and transcendental equations
- Determinants and matrices
- Eigen values and eigen vectors
- Solution of linear and non-linear algebraic equations
- Solution of first order and second order differential equations, Solution of system of differential equations.
- Interpolation methods
- Numerical differentiation and integration
- Solving equations by finite differences, FEM for 1-D heat flow, FEM for 2-D & 3-D heat flow
- Curve fitting.

Course Learning Outcomes:

CO1. By the end of the course, students will be able to apply numerical methods to solve linear and non-linear algebraic equations with different approaches, such as bisection method, Newton-Raphson method, and secant method, and evaluate the accuracy and efficiency of each method.

CO2. By the end of the course, students will be able to analyze the properties of matrices and determinants, and use them to solve systems of linear equations, calculate eigenvalues and eigenvectors, and apply these concepts to solve practical problems.

CO3. By the end of the course, students will be able to use numerical methods to approximate derivatives and integrals of functions, and apply these methods to solve practical problems, such as evaluating areas and volumes of irregular shapes.

CO4. By the end of the course, students will be able to apply interpolation methods, such as Lagrange interpolation and spline interpolation, to approximate functions and data sets, and evaluate the accuracy and efficiency of each method.

CO5. By the end of the course, students will be able to apply finite difference and finite element methods to solve partial differential equations, such as heat flow equations, and analyze the numerical solutions in terms of stability, accuracy, and convergence.

Mapping of COs with POs

CO/ PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 1	2	3	1	3	3				1	3		
CO 2	3	3	1	2	2				1	3		
CO 3	2	1		2	2				1	3		
CO 4	1			1	1				1	2		

CO 5	3	3	1	2	3				1	2		

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory	Assignment
CO2	Laboratory	Quiz
CO3	Laboratory	Assignment
CO4	Laboratory	Quiz
CO5	Laboratory	Assignment

Books Recommended:

1. Numerical methods for engineers, by Stevens C Chapra
2. Numerical methods, by E Balagurusamy

Course No: MEE 0715-2254	**Credit: 1.0**	**Year: Second**	**Semester: Second**
Course Title: Mechanics of Solids Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To learn practically how to operate several instruments
- To understand the process of Hardness test of Metal Specimens
- To introduce students How to operate UTM and perform compression test
- To make the students understand how to perform impact test
- To make the students understand how to perform bending test

Course Content:

Hardness test of metal specimens; Compression test and Tension test of metal specimens; Impact test of metal specimens; Bending moment test of metal beam; Whirling speed of column

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. analyze the failure of mechanical components.

CO2. explain the performance of compression test of metal block on UTM

CO3. Observe the strength and deflection of different mechanical structure.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3							1			
CO2	1			2								
CO3		2	3									

Books Recommended:

1. Solid Mechanics Lab manual (SUST)
2. J. R. Barber - Intermediate Mechanics of Materials
3. Russell C. Hibbeler - Mechanics of Materials

Course No: MEE 256	**Credit: 1.0**	**Year: Second**	**Semester: Second**
Course Title: Engineering Materials Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To demonstrate different metal processing methods
- To introduce different heat treatment processes and resulting micro-structure of metallic alloys
- To introduce the working principle and application of metallurgical microscope and heat treatment oven

Course Content:

Concept of malleability, ductility, toughness, fatigue resistance and other properties of metallic materials. Mechanical and non-destructive tests of metals. Pig iron: production and uses. Cast iron: production, types, uses and effects of impurities. Steels: Bessemer and open- hearth steels, production and uses. Plain carbon and different types of allow steels. Bearing metals, light alloys, common metals and their alloys. The Fe-FeC equilibrium diagram. Types of heat treatment. Surface Treatments and coatings; joining of metals and alloys.
Composite materials: Different types of composites materials; Polymers; Review of Polymer types, synthesis and structures; structure-property relationships; processing; commodity vs. engineering plastics; case studies.; Polymeric matrix composites: Types and properties of fiber reinforced composites; multiplied laminated composites; applications of fiber-reinforced polymeric matrix composites; case studies.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. Identify crystal structures for various materials and understand the defects in such structures;
CO2. Hypothesize how to tailor material properties of ferrous and non-ferrous alloys;
CO3. Quantify mechanical integrity and failure in materials
CO4. Identify micro-structures of metals based on different heat treatment processes

Mapping of COs with POs

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2		2						2		2
CO 2	2		3			2			2			
CO 3	1	3	2	2					2			
CO 4				1	3					2		

Books Recommended:

1. Sidney H Avner, Intro to Physical Metallurgy

Course No: MEE 0715-2288	**Credit: 0.5**	**Year: Second**	**Semester: Second**
Course Title: Comprehensive Viva-II		**Course Status: Viva**	

Course Objectives:

The objectives of this course are:

- To help students to communicate effectively with others
- To facilitate necessary knowledge about different topics related to courses
- To develop skills on speak in English fluently
- To facilitate students to share different ideas & thoughts in practical life
- To help students to identify better choice among all alternatives
- To understand basic solution process
- To introduce students about practical service life

Course Content:

Topics covered by all theoretical and practical courses in both two semesters of the running year.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. communicate effectively with other employees and workers in service life.
CO2. explain the understanding about different practical problems relevant to the course.
CO3. develop the capability of leading a team.
CO4. explain the integrated engineering knowledge learned throughout the semester.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2				3		
CO2	2	2										
CO3						1			3	2		
CO4	3	2		2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Self-learning using interpersonal relationship	Viva voce
CO2	Self-learning using reference books/other online materials	Viva voce
CO3	Self-learning using interpersonal relationship	Viva voce
CO4	Self-learning using reference books/other online materials	Viva voce

Third Year First Semester

Course No: MEE 0715-3121	Credit: 3.0	Year: Third	Semester: First
Course Title: Fluid Mechanics- I		Course Status: Theory	

Course Objectives:

The objectives of this course are as follows:

- To familiarize the students with the basic concepts of fluids and their properties
- To make them find out pressure variation in incompressible and compressible static fluid
- Helping the students conceptualize buoyancy and stability of floating and submerged bodies

- Making them learn manometry and their application
- To make them capable of applying continuity, momentum and energy equation for solving engineering problems
- To introduce different types of pressure, velocity and flow measuring devices

Course Content:
Fundamental concept of fluid as a continuum; Fluid statics: basic hydrostatic equation, pressure variation in static incompressible and compressible fluids; Manometers; Forces on plane and curved surfaces; Buoyant force; Stability of floating and submerged bodies; Pressure distribution of a fluid in a rotating system. Relation between system approach and control volume approach; Continuity , momentum and energy equations; Special forms of energy and momentum equations and their applications; Pressure, velocity and flow measurement devices. Introduction to inviscid incompressible flow to include two dimensional basic flows.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:

CO1. Develop the basic foundation about various types of fluids.

CO2. Analyze practical problems based on Newton's law of viscosity.

CO3. Apply the fundamental equations of fluid mechanics in problem solving.

CO4. Identify and describe the use of various devices used for measuring different fluid and flow properties.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1							3
CO2	2	3	3	2	1	1	1					2
CO3	2	3	3	3	1							2
CO4	2	2	1	2	3				1			3

Books Recommended:

1. Mechanics of Fluids- Irving H. Shames
2. Fluid Mechanics- Frank M. White
3. Fundamentals of Fluid Mechanics- Munson

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture	Midterm Examination 1

CO2	Lecture	Midterm Examination 2
CO3	Lecture	Assignment
CO4	Lecture	Semester-end examination

Course No: MEE 0715-3131	Credit: 3.0	Year: Third	Semester: First
Course Title: Conduction & Radiation Heat Transfer		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- Acquaint students with the he basic laws and modes of heat transfer.
- Getting idea about problems involving steady state heat conduction in different geometries.
- To develop skills for solutions for transient heat conduction in simple geometries.
- To analysis of heat conduction of system with heat sources and heat transfer from finned surfaces
- To obtain numerical solutions for conduction and radiation heat transfer problems.
- To understand basic of Thermal radiation, Blackbody radiation and net radiation interchange for different geometries.
- To familiarize the students about solar radiation and its prospects in Bangladesh.

Course Content:

Basic modes of heat transfer; General conduction equation for one dimensional and three dimensional situation; Steady state conduction in different geometrics and composite structures for one dimensional situation; Effect of variable thermal conductivity; Analysis of heat conduction of system with heat sources and heat transfer from finned surfaces; Transient heat conduction in solids with negligible internal resistance and with internal and surface resistance; Use of Heisler charts; Analytical and numerical solutions of conduction heat transfer problems. Heat transfer by the mechanism of radiation; Laws of radiation heat transfer; Blackbody radiation and radioactive properties of surfaces; Angle factor; Net radiation interchange between two infinite parallel planes, concentric spheres and long cylinders; Simple enclosure problems; Radiation shield; Solar radiation and its prospects in Bangladesh.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. calculate various heat transfer properties by conduction in solids for steady-state and transient conditions.

CO2. analyze improvement in heat conduction after using different types of fins on the system surface.

CO3. implement fundamental concepts of radiation for blackbody and net radiation interchange to different geometries.

CO4. hypothesize the prospect of solar radiation in Bangladesh to solve the crisis of non-renewable energy sources.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1		2								2
CO 2		2	3	2	1							
CO 3	3		2	2								2

CO 4		2		3		3	3		1	1	3	

Books Recommended:

01. Heat and Mass Transfer; Yunus A. Cengel & Afshin J. Ghajar.
02. Fundamental of Heat and Mass Transfer; Incropera, Dewitt, Bergman, Lavine.
02. Heat Transfer; J.P. Holman.

Course No: MEE 0715-3151	**Credit: 3.0**	**Year: Third**	**Semester: First**
Course Title: Mechanics of Machinery		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To familiarize the students with mechanisms
- To facilitate necessary knowledge about turning moment
- To make the students understand the balancing
- To make students able to analyze different kinds of vibrations
- To provide the knowledge of transmission of force

Course Content:

Mechanisms; displacement, velocity and acceleration; Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Static and dynamic balancing: reciprocating and rotating parts, multi-cylinder in-line and V-engines, radial engines, and opposed-piston engines; Balancing machines. Undamped free vibrations with one and two degrees of freedom; Longitudinal, transverse and torsional vibrations; Damped free and forced vibrations with single degrees of freedom; Whirling of shafts and rotors; Vibration of geared systems; Vibration absorption, isolation and deisolation; Vibration measuring instruments. Study of cams and cam followers; Power transmission by belts, ropes and chains; Clutches and brakes; Dynamometers. Study of gears and gear trains; Study of governors; Gyroscopes: principles and applications.

Course Learning Outcomes:

After the successful completion of the course, students should be able to:

CO 01: Explain different mechanisms and be proficient in the use of mathematical methods to analyze the forces and motion (velocity and acceleration) of complex systems of linkages and mechanisms, and turning moment diagram.

CO 02: Estimate inertia force and kinetic energy of reciprocating and rotating parts and make balancing of machines.

CO 03: Design for cams and follower for different operation

CO 04: Explain different relationships and diversities of the mechanical elements of power transferring mechanism like brakes, clutches, belt, ropes, chains, and gear train and solve problems.

CO 05: Analyze different types of vibrations in the machine and its application.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	03											
CO2		03										
CO3			03									
CO4			03									
CO5				02								

Books Recommended:

1. R.S. Khurmi - Theory Of Machines
2. 2. Alex; B. W. Kennedy - The Mechanics of Machinery
3. C. W Ham - Mechanics of machinery
4. Mahmoud A. Mostafa - Mechanics of Machinery

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	**Teaching-Learning Strategy**	**Assessment Strategy**

CO1	Lecture	Midterm Examination 1
CO2	Lecture	Midterm Examination 2
CO3	Lecture	Assignment
CO4	Lecture	Semester-end examination
CO 5	Lecture	Semester-end examination

Course No: MEE371	**Credit: 3.0**	**Year: Third**	**Semester: First**
Course Title: Production Processes		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To familiarize the students with metal removing processes
- To know about chip formation processes
- To understand different types of casting
- To make students able to understand Bulk deformation processes
- To acquire knowledge about different types of weldings

Course Content:

Metal removing processes: turning, drilling, shaping, planing, milling, broaching, grinding, precision and non-precision finishing processes. Tool geometry and chip formation processes. Casting: sand, die, centrifugal and other types of casting, Casting design and casting defects. Bulk deformation processes: Forging; open, close, coining, Extrusion; Hot and cold extrusion process; Rolling; Welding: arc, gas, TIG, MIG, resistance, thermit, friction, EBW, LBW. Brazing and soldering. Plastic, ceramic and glass product manufacturing processes.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Distinguish different kinds of turning operations

CO2. Differentiate between shaping and milling operation

CO3. Understand tool geometry and know and about cutting tool angle

CO4. Identify what is Forging and it's types

CO5. Understand about Extrusion processes and their advantages and disadvantages

CO6. Understand the process of different types of weldings and know their advantages and disadvantages

CO7. Differentiate between Brazing and soldering

CO8. Understand the product manufacturing process using plastic, ceramic and glass

CL09. Outline the procedure for making gears using milling machine

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1						X			X	
CO2						X		X	X	
CO3								X		
CO4									X	
CO5									X	
CO6								X		X
CO7										X
CO8		X				X				X
CO9		X						X	X	

Books Recommended:

1. DeVries, Warren R - Analysis of Material Removal Processes
2. Dr. B J Ranganath – Metal Cutting and Tool Design
3. Larry Jeffus - Welding: Principles and Applications

Course No: SOC 0134 3107Q	**Credit: 3.0**	**Year: Third**	**Semester: First**
Course Title: Industrial Sociology		**Course Status: Theory**	

Course Rational:

The course this designed to teach students from the non-major department the basics of industrial sociology. It helps students learn different aspects related to work including the base of work as a human organization in the industry and how work is being organized in an industrial organization. In addition, it teaches students about labour in the context of the industry. Moreover, it provides students with an understanding of the sociology of industry, labour, human relations, and conflict management.

Course Objectives:

The objectives of the course are to:

1. Provide students with basic knowledge of the subject matter and the distinctiveness of industrial sociology.
2. Help students develop an understanding of key sociological concepts such as society, association, institution, work ideology, work attitude, work satisfaction, work commitment, formal relation in the factory system, and industrial bureaucracy.
3. Familiarize students with the nature and causes of industrial conflict and conflict management.
   Help students develop knowledge of the process of industrial development in development.

Course Contents

Introduction: Nature, scope and rise of Industrial Sociology, History of Industrialization, ancient and modern, early industrialization in India, arts and crafts, Renaissance, Industrial revolution in Europe, The development of industry and industrial society in Bangladesh. The concept of work: Society, Community, Association, & institution. Work and art, nature of industrial work, work ideology, work values, Role of work in human life, work and mental health, work attitudes, work involvement, the motivation of 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 characteristic, the formal relations of production in the factory system. The industrial Bureaucracy: The executive in the industrial bureaucracy, the role of worker, social relations at work, Management as social elite. Industry and the 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. Industrial Conflict: Nature and causes of industrial conflict, role and function 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, classification of industries, role of cottage industries, labor intensive vs. heavy industries, modernization.

Course Learning Outcomes:

Upon completion of the course, students will be able to:

CLO1 Demonstrate understanding of concepts such as society, association, institution, work ideology, work attitude, work satisfaction, work commitment, formal relation in the factory system, and industrial bureaucracy;

CLO2 Analyze the nature and causes of industrial conflict and the role of a trade union; and

CLO3 Explain the patterns of industrial development in developed countries and the other part of the world.

CLO4 Apply sociological concepts in analyzing real social and industrial phenomena.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1										
CO2										
CO3										
CO4										

Mapping CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Visual Presentation	Class Participation
CLO2	Lecture and Class Discussion	Class Participation & Midterm 1
CLO3	Lecture, Visual Presentation, and Class Discussion	Class Participation & Midterm 2
CLO4	Lecture, class participation	Assignment & Final exam

Books Recommended:

1. Berg I. E. (1979). *Industrial Sociology*. United States: Prentice-Hall.
2. Watson, T. J. (2008). Sociology, *work and industry* (5th Ed). United Kingdom: Routledge.

Course No: MEE 0715-3122	Credit: 1.5	Year: Third	Semester: First
Course Title: Fluid Mechanics- I Sessional		Course Status: Sessional	

Course Objectives:

The objectives of this course are as follows:

- To make the students understand the stability of a floating body
- Making the students verify Bernoulli's equation
- To make the students study impact of jet on a flat plate and a hemispherical vane
- Helping them to study the moment developed on a fully or partially submerged vertical plane surface due to the hydrostatic force
- To make them calibrate the orifice meter by observing the effect of flow rate on the accuracy of the flow meters and by finding out the loss through the flow meter.
- Helping the students to calibrate a rectangular and a V notch weir to predict the flow over them for different water head.

Course Content:

Stability of floating body; Verification of Bernoulli's equation, Impact of jet; Moment on fully and partially submerged plane surface; Flow measurement devices: Venturi meter, Orifice meter, Notch;

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Explain the importance of vertical center of gravity in the stability of a floating body.

CO2. Identify the application of Bernoulli's equation in practical world.

CO3. Explain and write up the operational procedures of different flow meters and gauges.

CO4. Develop teamwork skill through mutual collaboration in the experiment

CO5. Develop an ethical perspective about formal report writing.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2								
CO2	3	3	2	3	1	1						2

CO3	2	1	2	3	3							1
CO4			1	2	1	1			3	2		2
CO5								3				3

Books Recommended:

1. Fluid Mechanics - I lab sheet (SUST).

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory demonstration	Assignment and Quiz
CO2	Laboratory demonstration	Assignment and Quiz
CO3	Laboratory demonstration	Assignment and Quiz
CO4	Laboratory demonstration	Assignment and Quiz
CO5	Laboratory demonstration	Assignment and Quiz

Course No: MEE332	Credit: 1.0	Year: Third	Semester: First
Course Title: Heat Transfer Sessional		Course Status: Practical	

Course Objectives:

The objectives of this course are:

- To facilitate necessary knowledge on conduction through a rectangular and cylindrical body and analyze temperature profile and the rate of heat transfer.
- Make the students understand the experiment on conduction through fins with different shape and to find out fin parameters.
- Getting idea about radiation of a blackbody experimentally.
- Accumulate basic ideas about experiment on transient heat transfer.

Course Content:

Conduction heat transfer through a body with rectangular and cylindrical cross sectional body; Heat conduction through finned surfaces; Radiation heat transfer; transient Heat transfer.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. analyze conduction heat transfer through rectangular and cylindrical body.

CO2. calculate the improvement in performances due to the presence of extended surfaces (fin) on heat transfer.

CO3. conduct experiment on blackbody radiation and analyze radiation heat transfer.

Mapping of COs with POs

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1			3	2				1	2		
CO 2		2	3		1					2		1
CO 3	1	2		3	2				2			

Books Recommended:

01. Heat and Mass Transfer; Yunus A. Cengel & Afshin J. Ghajar.

Course No: MEE 0715-3152	**Credit: 1.0**	**Year: Third**	**Semester: First**
Course Title: Mechanics of Machinery Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To help the students differentiate between Static and Dynamic Balancing of a Shaft
- To make the students understand Free Vibration of a Single Degree of Freedom System
- To provide the knowledge of Mass Moment of Inertia of a Flywheel
- To facilitate necessary knowledge about Gyroscope
- Study of Cam
- To make the students understand Critical Speed of a Shaft

Course Content:

Laboratory procedures in balancing, analysis of cams and gears, vibration, moment of inertia of machine parts, and gyroscopes.

Course Learning Outcomes:

After the successful completion of the course, students will be expected to:
CO 01: Understand the mechanics of different mechanical systems, i.e. epicyclic gear train, gyroscope, vibration, helical spring etc.
CO 02: Investigate data obtained from experiment to determine performance parameters of machineries
CO 03: Demonstrate experimental results through technical reports individually.
CO 04. Develop the skill of group work and discussion

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	03											
CO2				03								
CO3										03		
CO4												03

Books Recommended:

1. Mechanics of Machinery Lab manual (SUST)
2. Textbooks on Theory of Machines Applied Kinematics

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory demonstration	Assignment and Quiz
CO2	Laboratory demonstration	Assignment and Quiz
CO3	Laboratory demonstration	Assignment and Quiz
CO4	Laboratory demonstration	Assignment and Quiz

Course No: MEE372	Credit: 1.0	Year: Third	Semester: First
Course Title: Production Processes Sessional		Course Status: Sessional	

Course Objectives:
The objectives of this course are:

- To make the students understand Sand Casting and Casting Defects
- To facilitate necessary knowledge about different types of Joints and Defects by Arc-Welding, TIG MIG Welding, Spot welding and Resistance welding
- To acquaint students with different Types of Turning Operations in Lathe Machine
- To provide the knowledge of different Extrusion processes and Rolling operations
- To develop skills for performing soldering operations

Course Content:
TIG, MIG, Spot welding, Resistance welding. Casting, Extrusion, Rolling, Brazing and Soldering.

Course Learning Outcomes:
CO1. By the end of the course, students should be able to compare and contrast different welding techniques (such as TIG, MIG, Spot, and Resistance) in terms of their strengths, limitations, and applications.
CO2. By the end of the course, students should be able to demonstrate proficiency in at least two types of welding (such as TIG and MIG), producing high-quality welds that meet specified requirements.
CO3. By the end of the course, students should be able to explain the basic principles of casting, extrusion, and rolling processes and describe how these processes are used in manufacturing products.
CO4. By the end of the course, students should be able to evaluate the advantages and disadvantages of different joining techniques (such as brazing and soldering) and select an appropriate method for a given application.
CO5. By the end of the course, students should be able to analyze and troubleshoot common issues that can arise in welding, casting, extrusion, rolling, brazing, and soldering processes, using appropriate methods (such as non-destructive testing).

Mapping of COs with POs

CO/PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO 1	1			2	1				1	3		
CO 2	2	2		1	2				2	3		
CO 3			3			1				1		

CO 4	1			2	1				1	3		
CO 5	1			1						2		

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory	Assignment
CO2	Laboratory	Quiz
CO3	Laboratory	Assignment
CO4	Laboratory	Quiz
CO5	Laboratory	Assignment

Books Recommended:

1. Production Process Lab manual (SUST)
2. Larry Jeffus - Welding: Principles and Applications

Course No: MEE 0715-3182	**Credit: 0.5**	**Year: Third**	**Semester: First**
Course Title: Industrial Tour		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To provide an exposure to students about practical working environment
- To let students to know things practically through interaction
- To bridge the gap between classroom theoretical training and practical learning in a real-life environment.

Course Content:

*Visit to prescribed industries selected by the Department.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Integrate theoretical knowledge with industrial perspective.

CO2. Identify the working scope in industries.

CO3. Develop critical insight about the application of academic knowledge in the industrial field.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	1			2							1
CO2						2			1		1	2
CO3					1	2			2			2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Self-learning	Viva voce / Presentation
CO2	Self-learning	Viva voce / Presentation
CO3	Self-learning	Viva voce / Presentation

Third Year Second Semester

Course No: MEE 0715-3223	Credit: 3.0	Year: Third	Semester: Second
Course Title: Fluid Mechanics- II		Course Status: Theory	

Course Objectives:

The objectives of this course are as follows:

- Familiarizing the students with dimensional analysis and different dimensionless numbers
- To provide the knowledge of similitude and different types of similarity
- Making the students understand model and prototype and use the concept in problem solving
- To make them introduced to major loss and minor loss in piping system
- Helping them conceptualize boundary layer theory and find out relative parameters
- Disseminating the ins and outs of laminar and turbulent flow in a pipe
- Providing knowledge about open channel flow and help them find out economic cross section of a channel
- To familiarize them with compressible flow, subsonic, sonic, supersonic flow, choking phenomena, normal shock using converging and C-D nozzle
- To make them understand the fluid properties at stagnation state

Course Content:

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

Course Learning Outcomes:

After the successful completion of the course, students should be able to:

CO 01: Evaluate the dimensional analysis similitude for the system involving fluid flow and parameters applying various theorem.

CO 02: Differentiate between the compressive and incompressible flow, and the real flow with ideal flow conditions.

CO 03: Predict boundary layer, momentum thickness, energy thickness, different types of drag and lift forces developed on various geometry, position of shock wave, and different parameters of real and ideal fluid flow.

CO 04: Design piping network, economic section of open channel, converging-diverging nozzle depending on design condition.

Mapping of COs with POs

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 01	3											
CO 02	3											
CO 03		3										
CO 04			3									

Books Recommended:

1. Mechanics of Fluids- Irving H. Shames
2. Fluid Mechanics- Frank M. White
3. Fundamentals of Fluid Mechanics- Munson

Course No: MEE-333	**Credit: 3.0**	**Year: Third**	**Semester: Second**
Course Title: Convection, Boiling, Condensation, and Mass Transfer		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- Getting idea about the fundamentals of convective heat transfer process.
- To facilitate necessary knowledge about laminar and turbulent flow including boundary layer development.
- To evaluate heat transfer coefficients for natural convection from exterior surfaces of common geometrics.
- Helping the students to develop ability in evaluating heat transfer coefficients for forced convection for different geometries.
- To provide the knowledge of heat transfer mechanism with phase change such as boiling and condensation and also analyze practical problems.
- To analyze heat exchanger performance by using the method of log means temperature difference (LMTD) and heat exchanger effectiveness (NTU).
- Getting idea about the mechanism of mass transfer by diffusion, convection and change of phase and the analogy between Heat and Mass Transfer.

Course Content:

Mechanism of convective heat transfer; General methods for estimation of convective heat transfer coefficient; Heat and momentum transfer associated with laminar and turbulent flow of fluids in forced convection; Fully developed flows and boundary layer developments in tubes/ducts over flat plates: empirical equations; Free convection from exterior surfaces of common geometrics, such as cylinder, plate, sphere etc. Heat transfer mechanism with change of phase: condensation, types and analysis of film wise condensation on a vertical plate and horizontal cylinders; Boiling: mechanism and heat transfer correlations; Heat pipe. Heat exchanger: basic types, LMTD, exchanger effectiveness-NTU relations, fouling and scaling of heat exchanger; Heat exchanger calculations; Techniques of heat transfer augmentation heat exchanger devices. Mass Transfer: mechanism of mass transfer by diffusion convection and change of phase, simultaneous heat and mass transfer phenomena; Analogy between heat and mass transfer; Empirical equations.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. explain basic heat transfer mechanisms through convection in closed conduits and over external surfaces.

CO2. calculate heat transfer co-efficient for both natural and forced convection for different geometry.

CO3. analyze heat exchanger performance by using log mean temperature difference (LMTD) and heat exchanger effectiveness-NTU method.

CO4. utilize fundamental concepts to mathematical problems involving boiling and condensation.

CO5. apply mass transfer by analogy to heat transfer surfaces.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2						1
CO2		2	2	3								

CO 3		3	3			2	3	1			1	
CO 4		1										
CO 5	2			1								

Books Recommended:

1. Heat and Mass Transfer; Yunus A. Cengel & Afshin J. Ghajar.
2. Fundamental of Heat and Mass Transfer; Incropera, Dewitt, Bergman, Lavine.
3. Heat Transfer; J.P. Holman.
4. Convective Heat and Mass Transfer, W.M. Kayes and M. E. Crawford, Crawford, Tata McGraw Hill
5. Convection Heat Transfer, Andrian Bejan, John Wiley and Sons. Inc.

Course No: MEE 0715-3253	**Credit: 4.0**	**Year: Third**	**Semester: Second**
Course Title: Machine Design		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To teach students how to apply the concepts of stress analysis.
- To understand different failure criteria to overcome those failure.
- To make them able to analyze fatigue failure.
- To make students known about the types of fit.
- Getting idea about the basic concept of screws, fasteners and connections.
- Apply the knowledge of stress analysis in case of structural joints.
- 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.
- To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.

Course Content:

Introduction to design; Stress analyses; Deflection and stiffness considerations; Shock and impact; Column design; Statistical considerations; Types of fits; Design for static strength; Design for fatigue strength; Fracture mechanics in design; Design of screws and welded joints;

Design of mechanical springs; rolling contact bearings, lubrication and journal bearings, spur, helical, worm and bevel gears, shafts, rope, belt and chain drives.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. understand the customers' need, formulate the problem and draw the design specifications.

CO2: formulate and analyze stresses and strains in machine elements and structures in 3-D subjected to various static and fatigue loads.

CO3. understand different design concepts like principal stresses, theories of failure, stress concentration.

CO4. design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.

CO5. analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	3			2		1			1	
CO2		2	2	3							1	
CO3		2	3									
CO4	1	3	2									
CO5		2	3				1					1

Books Recommended:

1. Shigley's Mechanical Engineering Design - J. Keith Nisbeth and Richard G. Budynas

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE367	Credit: 3.0	Year: Third	Semester: Second
Course Title: Instrumentation & Measurement		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- To provides an introduction to the field of Instrumentation.
- To introduce students about different types of sensing elements.
- Getting idea about the basic principles of measurement and the measuring system.
- To facilitate necessary knowledge about different physical parameter such as displacement, pressure, temperature, heat flux, flow, motion and vibrations, force, torque and strain.
- To enhancing the skill on data acquisition and processing.

Course Content:

Basic principles of measurements; Characterization and behavior of typical measuring systems; Different types of sensing elements; Measuring, transmission and recording methods; Measurements of displacement, pressure, temperature, heat flux, flow, motion and vibrations, force, torque and strain; Data acquisition and processing.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. analyze the behavior shown by different orders of measuring system and design their system dynamics accordingly.

CO2. calculate different types of errors and uncertainties involving in measurement systems.

CO3. measure various physical parameter with the proper selection of instrument.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3		3									
CO 2		3		2	1			2				
CO 3		2	1	1	3						2	2

Books Recommended:

1. Figliola, R.S. & Beasley, D.E., Theory & Design for Mechanical measurements, J. Wiley & Sons, Inc.
2. Halman, J.P., Experimental Methods for Engineers, McGraw-Hill, Inc.
3. Beckwith, T.G., Marangoni, R.D. &Lienhard, J.H., Mechanical Measurements, Addison Wesley, Inc.

Course No: MEE 375	Credit: 3.0	Year: Third	Semester: Second

Course Title: Machine Tools	Course Status: Theory

Course Objectives:

The objectives of this course are as follows:

- To familiarize the students with locators and locating principles
- To make them understand jigs and fixtures and differentiate them
- To acquaint the students with different types of slideways, their material, application, advantage, drawbacks
- To help them gather thorough knowledge of lathe machine, shaping machine, milling machine, drilling machine, boring machine
- Making them capable of finding out the sources of machine tools vibration and eliminating them
- To familiarize the students about how to install machine tools
- To introduce the acceptance tests of machine tools
- Providing knowledge of speed range and how to design gearbox

Course Content:

Locating and Clamping: Purpose of work-piece location; degree of freedom; fundamental locating arrangements; clamping devices and forces. Tooling: Types of tools; jigs and fixtures; general tool design principles and their applications. Dies: Progressive and compound dies; design of cutting, forming and drawing dies; punch design. Design of Power Transmission System: Mechanical, Electrical, Hydraulic and Pneumatic drive in machine tools. Basic considerations; speed range, gearbox design. Machine Tool Slides and Guides: Slide ways, Guide material, guide wear, effect of temperature and lubrication, error elimination. Detailed Study of Basic Machine Tools: Lathe machines; milling machines; shaping machines, planning machine; drilling machine; boring machine; hobbing machine; grinding machine; broaching, lapping and honing machine with their operations. Structure of Bed, Tables and Columns: Classification, design principles, sources of machine tools vibration and its elimination. Installation and acceptance tests of machine tools

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Identify the major components of machine tools and find out any problem if occurs

CO2. Analyze the vibration caused by machine tools and take proper steps

CO3. Apply knowledge for installation and the acceptance tests necessary for machine tools.

CO4. Design a gearbox

CO5. Apply their knowledge for properly running a machine shop

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3		2								
CO2		3		2								
CO3	3		1									
CO4			3				1		2	2		
CO5	1				2	1		1				2

Books Recommended:

1. Machine Tools - N. Chernov
2. Elements of Machine Tools - AnwarulAzim

Course No: MEE 0715-3224	Credit: 1.5	Year: Third	Semester: Second
Course Title: Fluid Mechanics - II Sessional		Course Status: Sessional	

Course Objectives:
The objectives of this course are as follows:

- Helping the students to find the velocity profile in a pipe flow
- To make the students capable of studying flow in a nozzle
- To help them find out the major loss in a pipe flow
- To make them capable of finding the minor loss in a pipe flow

Course Content:
Velocity profile, nozzle, Pipe flow, Major loss in pipe flow, Minor losses in pipe flow; Different types of pipe fittings, valves.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. Analyze data obtained from experiment to determine performance parameters of fluid flow measuring instruments
CO 02: Display individually the procedure of operating fluid flow measuring instruments and taking data
CO3. Develop writing skill through report writing based on each experiment
CO4. Develop communication and speaking skill through oral test

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		03										
CO2	02											
CO3										03		
CO4												03

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory demonstration	Report and Quiz
CO2	Laboratory demonstration	Report and Quiz
CO3	Laboratory demonstration	Report Writing
CO4	Laboratory demonstration	Oral Viva

Course No: MEE-334	Credit: 1.0	Year: Third	Semester: Second
Course Title: Heat and Mass Transfer Sessional		Course Status: Sessional	

Course Objectives:
The objectives of this course are:

- To facilitate necessary knowledge about heat transfer coefficients for a flow through inside a pipe/duct.
- Apply the knowledge about flow over a flat surface and to find out the heat transfer coefficient.
- Getting idea about boiling and condensation heat transfer.

- To enhance the skill on shell and tube heat exchanger and to find out its performance
- Getting idea about mass transfer.

Course Content:

Convective heat transfer: Flow through circular pipe/rectangular duct, Flow over a flat surface. Phase change heat transfer: Boiling, Condensation; Heat Exchanger; Mass Transfer.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1: analyze heat transfer coefficient for both external and internal flow

CO2: explain the rate of heat transfer in case of boiling and condensation.

CO3: analyze heat exchanger by using log mean temperature difference (LMTD) and heat exchanger effectiveness (NTU) method.

CO4: Calculate mass transfer by analogy to heat transfer surfaces.

Mapping of COs with POs

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3		1	1		2			1		
CO 2	3				1				2	3		
CO 3		2	3	1					3	1		
CO 4		1		3						2		

Books Recommended:

1. Heat and Mass Transfer; Yunus A. Cengel&Afshin J. Ghajar.

Course No: MEE 0715-3254	**Credit: 1.5**	**Year: Third**	**Semester: Second**
Course Title: Machine Design Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- To teach students how to apply the concepts of stress analysis.
- To enhance the skill on stress analysis mathematically at pressure vessels and curved members.
- To solve problem with different failure criteria.
- To be able to solve problem related to fatigue failure.
- To make students known about the types of fit.
- To understand the basic concept of screws, fasteners and connections.
- To solve structural joints by using stress analysis.
- To introduce fundamental principles of interaction between motion and force in machinery design
- To demonstrate practical design methodology with emphasis on applications (sizing and selection)
- To familiarize with the synthesis of linkages, cams, gears, gear trains, and related components.

Course Content:

Introduction to design; Stress analyses; Deflection and stiffness considerations; Shock and impact; Column design; Statistical considerations; Types of fits; Design for static strength; Design for fatigue strength; Fracture mechanics in design; Design of screws and welded joints;
Design of mechanical springs; rolling contact bearings, lubrication and journal bearings, spur, helical, worm and bevel gears, shafts, rope, belt and chain drives.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO2: formulate and analyze stresses and strains in machine elements and structures in 3-D subjected to various static and fatigue loads.

CO3. understand different design concepts like principal stresses, theories of failure, stress concentration in practical cases.

CO4. design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.

CO5. analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	3			2		1			1	
CO2		2	2	3							1	
CO3		2	3									
CO4	1	3	2									
CO5		2	3				1					1

Books Recommended:

1. Shigley's Mechanical Engineering Design - J. Keith Nisbeth and Richard G. Budynas

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE 368	Credit: 1.0	Year: Third	Semester: Second
Course Title: Electro Mechanical System Design		Course Status: Sessional	

Course Objectives:

The objectives of this course are:

- To provide an introduction to the field of Instrumentation.
- To introduce students about different types of sensing elements and their operations to measure various parameters.
- Getting idea about data acquisition.
- Apply the knowledge and develop a project practically based on instrumentation.

Course Content:

In this course students are required to undertake a design of a small electro-mechanical or instrumentation system involving sensors, actuations, signal conditioning, feed-back etc. The system design would involve the stages of concept, calculations, fabrication, presentation and demonstration of product. Use of locally available prospects materials will be emphasized.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. use various sensing element to sense different properties.

CO2. measure various physical parameter with the proper selection of instrument.

CO3. develop a project with automation by using their knowledge.

Mapping of COs with POs

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		3			2				2	1		
CO 2		2					2	2			2	
CO 3			3		2	1		3	3	3	3	2

Books Recommended:

1. Figliola, R.S. & Beasley, D.E., Theory & Design for Mechanical measurements, J. Wiley & Sons, Inc.
2. Beckwith, T.G., Marangoni, R.D. &Lienhard, J.H., Mechanical Measurements, Addison Wesley, Inc.

Course No: MEE 0715-3288	**Credit: 0.5**	**Year: Third**	**Semester: Second**
Course Title: Comprehensive Viva-III		**Course Status: Viva**	

Course Objectives:

The objectives of this course are:

- To help students to communicate effectively with others
- To facilitate necessary knowledge about different topics related to courses
- To develop skills on speak in english fluently
- To facilitate students to share different ideas & thoughts in practical life
- To help students to identify better choice among all alternatives
- To understand basic solution process
- To introduce students about practical service life

Course Content:

Topics covered by all theoretical and practical courses in both two semesters.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. communicate effectively with other employees and workers in service life.
CO2. explain the understanding about different practical problems relevant to the course.
CO3. develop the capability of leading a team.
CO4. explain the integrated engineering knowledge learned throughout the semester.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1						2				3		
CO2	2	2										
CO3						1			3	2		
CO4	3	2		2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Self-learning using interpersonal relationship	Viva voce
CO2	Self-learning using reference books/other online materials	Viva voce
CO3	Self-learning using interpersonal relationship	Viva voce
CO4	Self-learning using reference books/other online materials	Viva voce

Fourth Year First Semester

Course No: MEE 0715-4121	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Fluid Machinery		Course Status: Theory	

Course Objectives:
The objectives of this course are:

- Getting idea about different types of turbines.
- Acquaint students with different types of pumps.
- To provide the knowledge of dimensional analysis to compare relative advantage among all hydraulic machines.
- Accumulate basic ideas about performance and characteristics of turbines and pumps.
- Apply the knowledge of fan, blower and compressor.
- To develop skills on Hydraulic transmission.
- Apply the knowledge of hydraulic machine in practical life.

Course Content:
Types of fluid machinery; Rotodynamic and positive displacement machines; Velocity diagrams and Euler pump/turbine equation; Impulse and reaction turbines; Centrifugal and axial flow pumps; Deep well turbine pumps; Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge; Performance and characteristics of turbines and pumps; Design of pumps; Cavitation; Reciprocating pump, gear and screw pumps; Fans, blowers and compressors; Hydraulic transmission: fluid coupling and torque converter; System analysis and selection of fluid machine.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. Explain various types of fluid machinery.
CO2. Analyze different types of turbines theoretically and mathematically to select the best one.
CO3. Analyze different types of pumps theoretically and mathematically to select the best one.
CO4. Develop the practice of applying dimensional analysis to compare between different fluid machineries.
CO5. Describe the impact of cavitation in fluid machineries.

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3				2					2		**2**
CO2	3	3	2	3	2							**2**
CO3	3	3	2	3	2							**2**
CO4	3	3	3	2	2							
CO5	2			2	3					2		

Books Recommended:

1. Fluid Mechanics, Hydraulics and Hydraulic Machines - Dr. K. R. Arora
2. Hydraulics and Fluid Mechanics including Hydraulic Machines - P. N. Modi, S. M. Seth
3. Hydraulic Machine - Dr. Md. Quamrul Islam

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO1	Lectures	Assignment
CO2	Lectures	Midterm Examination 1
CO3	Lectures	Midterm Examination 2
CO4	Lectures	Quiz
CO5	Lectures	Quiz

Course No: MEE 0716-4131	**Credit: 3.0**	**Year: Fourth**	**Semester: First**
Course Title: Internal Combustion Engines		**Course Status: Theory**	

Course Objectives:

The objectives of this course are as follows:

- To introduce the students with the details of combustion, flame, stoichiometry
- Familiarizing them with basic engine types, their operation and testing
- To provide insights on IC engine fuels, their properties and tests, knocking

- To give the students complete idea about combustion in SI, CI engine and gas turbines
- To make them learn different fuel injection systems
- To make them capable of analyzing exhaust gas, air pollution and emission control
- Making them understand the performance and design of naturally aspirated and supercharged engines
- Providing knowledge about volumetric efficiency, multistage compression, intercooling
- Preparing the students to analyze air standard cycle as well as fuel air cycle

Course Content:

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; Performance and design: performance of unsupercharged engines and supercharged engines, design considerations, application of principle of similitude in engine design.

Compressors and turbines: compression processes, volumetric efficiency, multistage compression, intercooling; various types of compressors and gas turbines.

Course Learning Outcomes:

After the successful completion of course, students will be expected to:

CO 01: Identify the different types of engines, engine components, and its different subsystems.

CO 02: Analyze the factors controlling combustion phenomena of different internal combustion engines depending on different types of fuel, and engine performance.

CO 03: Compare different cycles and their efficiencies.

CO 04: Comprehend engine characteristics, engine performance, combustion system, engine knocking and remedy, engine air charging etc

CO 05: Comprehend the Air Pollution and Emission Control Systems of Engines and investigate the Engine Performance Parameters

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	3									
CO2			3							
CO3		3								
CO4		2		3						
CO5		3								

Books Recommended:

1. Internal Combustion Engine Fundamentals- John B. Heywood
2. Internal Combustion Engines, Edward F. Obert, 3rd Edition, International Textbook Company, 1970
3. Engineering Fundamentals of the Internal Combustion Engine, Willard W. Pulkrabek, Prentice Hall, Upper Saddle River, New Jersey

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 01	Lecture & Video Demonstration	Midterm Examination 1
CO 02	Lecture	Midterm Examination 2

CO 03	Lecture & Video Demonstration	Assignment
CO 04	Lecture	Semester-end examination
CO 05	Lecture	Assignment

Course No: MEE 0715-4177	**Credit: 3.0**	**Year: Fourth**	**Semester: First**
Course Title: Production Planning and Control		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To deliver goods in required quantities to customers in required delivery schedules.
- To ensure maximum utilization of all resources
- To ensure production quality products
- To minimize the product throughput time
- To maintain optimum level inventory
- To maintain flexibility in manufacturing operations
- To coordinate between labor and machines and various supporting departments

Course Content:

Elements of production planning and control, types of production system. Forecasting methods and their application, aggregate planning, master production scheduling, MRPI, MRPII, coding and standardization, capacity planning, inventory management, ABC analysis. Production scheduling techniques, CPM and PERT, line balancing, capacity planning. Plant location and layout, work study and method study, plant performance measurement. Computers in production planning and control and MRPII, JIT.

Course Learning Outcomes:

CO1. By the end of the course, students will be expected to demonstrate a comprehensive understanding of the elements of production planning and control and the types of production systems.

CO2. By the end of the course, students should be able to compare and evaluate the different forecasting methods and apply them in aggregate planning.

CO3. By the end of the course, students should be able to apply MRPII in inventory management and evaluate its effectiveness using ABC analysis.

CO4. By the end of the course, students should be able to analyze and compare CPM, PERT, and line-balancing techniques in production scheduling.

CO5. By the end of the course, students should be able to evaluate plant location and layout, and measure plant performance using work-study and method study.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	2							
CO2	2	3		2	2				2	2		2
CO3	2	3		3	3						2	2
CO4	2	2		3	3							2
CO5	2	2	2	2	2	2	2		2	2	2	2

Books Recommended:

1. **Elements of Production Planning and Control -** *Samuel Eilon*
2. **Modern Production / Operations Management -** *Baffa&RakeshSarin*

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz
CO3	Lecture using board/LCD projectors	Assignment
CO4	Lecture using board/LCD projectors	Quiz
CO5	Lecture using board/LCD projectors	Assignment

Course No: MEE 422	**Credit: 1.0**	**Year: Fourth**	**Semester: First**
Course Title: Fluid Machinery Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are:

- Getting ideas about the turbine and pump.
- To develop skills on Pelton wheel, Francis Turbine and Kaplan Turbine.
- To enhance the skill for centrifugal pumps.
- Accumulate basic ideas about experiment when two pumps are in series or parallel.

Course Content:

The concept of turbine and pump; Turbine: Pelton wheel, Francis Turbine, Kaplan Turbine; Centrifugal Pump; Reciprocating Pump Series and Parallel connection of two Pumps.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Distinguish between different types of fluid machineries.

CO2. Analyze impulse and reaction turbines and select the better one depending upon the given conditions.

CO3. Analyze experimentally and mathematically centrifugal pump to make proper applications

CO4. Apply theoretical knowledge to sort out the requirements of series or parallel connection of pumps

CO5. Develop an ethical perspective about formal report writing.

Mapping of COs with POs

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3			2	3							
CO2	2	3		3	3							
CO3	2	3		3	3							
CO4		3	1	2	2							
CO5								3				3

Books Recommended:

1. Hydraulic Machine; Dr. Md. Quamrul Islam

2. Fluid Machinery Sessional Lab Sheet (SUST)

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Laboratory demonstration	Assignment and quiz
CO2	Laboratory demonstration	Assignment and quiz
CO3	Laboratory demonstration	Assignment and quiz
CO4	Laboratory demonstration	Assignment and quiz
CO5	Laboratory demonstration	Assignment and quiz

Course No: MEE 432	Credit: 1.0	Year: Fourth	Semester: First
Course Title: Heat Engine Sessional		Course Status: Sessional	

Course Objectives:

The objectives of this course are as follows:

- To familiarize the students with different types of engines
- To make them conduct performance test of SI and CI engine
- To make them capable of assembling and dismantling SI and CI engine

Course Content:

SI and CI engine combustion, performance test of SI and CI engine, Dismantling and assembling of SI and CI engine

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Distinguish between SI and CI engines

CO2. Understand fuel injection system, air intake system, luboil system, ignition system, cooling system, exhaust system of an engine and represent them in block diagram

CO3. Identify different parts of SI and CI engine after dismantling

CO4. Understand clearly how the SI and CI engine works

CO5. Evaluate the performance of a particular engine based on the engine parameters

CO6. Demonstrate the skill of group work and discussion

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	X									
CO2	X					X				
CO3	X									
CO4	X									
CO5						X				
CO6			X		X					

Course No: MEE 0715-4184	Credit: 1.0	Year: Fourth	Semester: First
Course Title: Industrial Training		Course Status: Sessional	

Course Objectives:
The objectives of this course are:

- To provide a comprehensive learning platform to students where they can enhance their employability skills and become job ready along with real corporate exposure.
- To enhance students' knowledge in one particular technology.
- To increase self-confidence of students and help in finding their own proficiency.
- To cultivate a student's leadership ability and responsibility to perform or execute the given task.
- To provide learners hands-on practice within a real job situation.

Description:
Intensive training in a particular industry prescribed by the MEE Department.
**Note: Industrial Training will be considered a co-curricular activity. It may be conducted at any convenient time as can be arranged by the Department after the completion of the courses of third year second semester.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:

CO1. Identify the gap between academia and industry through a first-hand exposure

CO2. Become updated with the latest changes in technological world

CO3. Identify the application of academic knowledge in industries

CO4. Develop a sense of leadership alongside the attainment of teamwork experience

CO5. Identify, formulate and model problems and find engineering solution based on a systems approach

CO6. Develop the social, cultural, global and environmental responsibility as an engineer

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		2								
CO2	2		1		3							
CO3	3	2	2	1								
CO4						1			3	2	2	
CO5	2	3	3	2								
CO6						3	2					

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Self-learning	Viva voce / Presentation
CO2	Self-learning	Viva voce / Presentation
CO3	Field demonstration	Viva voce / Presentation
CO4	Self-learning	Viva voce / Presentation
CO5	Case study and field demonstration	Viva voce / Presentation
CO6	Self-learning	Viva voce / Presentation

Course Code: MEE 0715-4180	Credits: 3.0	Year: Fourth	Semester: First
Course Title: Project/Thesis		Course Status: Thesis	

Course Objectives are

- To help the students understand the basics of doing scientific research
- Be conversant on analysis of scientific data.
- To make the students understand how to present scientific work.
- To develop skills to conduct research along with understanding of the current research questions.
- To provide the knowledge about ethical issues in an adequate manner related to the scientific work.

Course Contents:

The undergraduate thesis /project within the field of Mechanical Engineering research is an individual study that must include hypothesis testing that will substantiate new data.

The undergraduate thesis/project includes search, studies and summary of scientific literature, practical work in close relation to ongoing Mechanical Engineering research, compilation and critical analysis of the results, and oral and written presentation.

The undergraduate thesis/project is mastered under individual supervision. The supervision includes how to perform a scientific study and how to orally and in writing present gathered data in good scientific manner. The supervisor must have documented scientific experience.

Course Learning Outcomes:

CO1. Identify the research gap through proper literature review with a practical approach towards the work

CO2. Explain basics of planning and performance of a scientific work

CO3. Obtain Theoretical and practical professional specialization within Mechanical Engineering including understanding of the current research questions

CO4. Present scientific data and conclusions in written and oral form addressed to different groups

CO5. Develop a sense of responsibility and ethical concern regarding research field

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2			2		2						
CO2	1	2							2	2		
CO3	3	2	3	2	2						2	2
CO4											3	2
CO5			1					3				2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Assignments using online materials	Viva voce / Presentation
CO2	Lecture	Viva voce / Presentation
CO3	Lectures and self-learning using reference books and research articles	Viva voce / Presentation

CO4	Assignment and self-learning	Viva voce / Presentation
CO5	Self-learning	Viva voce / Presentation

Fourth Year Second Semester

Course Code: IPE 0413 4205Q	Credit: 3	Year: Fourth	Semester: Second
Course Title: Industrial Management (for MEE)		Course Status: Theory	

Rationale of the Course:
This course aims to provide an understanding of the theories and principles of industrial management and encourage the course participants to appreciate these principles in relation to their own experiences and selected managerial case studies.

Course Objectives:
The objectives of this course are to:

- provide knowledge about the basic principles of management, the major functions of managers, e.g., planning, organizing, staffing, leading, and controlling, and the challenges managers face in each stage
- make students think critically and strategically about management theories and issues which will enable them to develop their decision-making and analytical skills
- familiarize students with the sound employment function as well as implementing a good wage and incentive scheme.
- let the students understand different marketing issues and the fundamental concepts of marketing management.

Course Content:

Organization and management: evolution, management functions, organization structure, development of organization theories, study of various types of organization and management information systems, concepts, and scope of application. *Personnel management:* importance, scope, need hierarchy, motivation theories, defense mechanism, productivity and satisfaction, leadership, group dynamics, job evaluation, merit rating, personnel development: hiring, training, and wage systems. *Marketing management:* marketing concept, marketing organization, industrial and consumer selling, channel decisions, advertising decisions, new product strategy. *Basics of Technology management;* Case studies.

Course Learning Outcomes (COs)
After successful completion of the course, students will be able to:

- **CO 1:** explain the theories, principles of management, contemporary theories of motivation, and apply these theories to tackle the managerial challenges;
- **CO 2:** apply leadership skills and implement its ideas in organizations/industries;
- **CO 3:** evaluate the different tasks of personnel management such as recruitment, selection, wages, and incentives
- **CO 4:** identify what marketing strategies organizations might practice to attract and retain customer
- **CO 5:** describe the concepts and techniques of strategic management of technology.

Mapping of CLOs with PLOs

According to the PLOs of MEE department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Assignment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/projectors /Assignment/tutorial	Assignment, Midterm Examination 1, Semester-end examination
CO 3	Lecture using board projectors	Assignment, Semester-end examination

CO 4	Lecture using board/projectors /Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 5	Lecture using board/projectors /Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination

Books Recommended:

1. Management-A Global Perspective, Heinz Weihrich and Harold Koontz, McGRAW HILL International Edition.
2. Industrial Engineering and Management -A New Perspective, Philip E. Hicks, McGRAW -HILL International Editions.
3. Industrial Engineering and Management, O.P. Khanna and A. Sarup, Dhanpat Rai Publication Ltd.
4. Andrew J. Dubrin, Essentials of Management, South-Western College Pub.

Course No: MEE 0713-4233	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Power Plant Engineering		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To familiarize the students with difference sources of energy
- To acquaint students with the working principle of different thermal power plants
- To make the students understand the advantages and disadvantages of different power plants
- To provide the knowledge of the efficiency of combined cycle power plant
- To acquire knowledge about governing of water turbine

Course Content:

Sources of energy, production of power, comparison of different types of power plants, survey of power plants in Bangladesh. The variable load problem, economic analysis of power plants, theory of rates, Diesel electric power plants: engine types and their performances, advantages, present trend. Gas turbine power plants: cycle analysis; intercooling, regeneration and reheating, governing. Thermal power plants: fuels, 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. Hydro-electric power plants: site selection, components of the plant. Governing of water turbine. Nuclear power plant: types of reactors, layout of nuclear power plant; waste disposal.

Course Learning Outcomes:

After the successful completion of the course, students should be able to:

CO 1: explain the types, factors related to economic power generation considering load zone, levelized cost of electricity, discount rate etc, the process of site selection of power plants

CO 2: evaluate the performance of the overall power system and the major components of available power plants

CO 3: design smaller-capacity power plants considering social, environmental and economic impacts and their relationships with different sustainable development goals (SDGs)

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 01	3											
CO 02		3										
CO 03			3		2		3					

Books Recommended:

1. P K Nag - Power Plant Engineering
2. 2. V. Ganapathy - Industrial Boilers and Heat Recovery Steam Generators: Design, Applications and Calculations
3. M.M. E-Wakil - Power Plant Engineering

4. A.K. Raja, Amit Prakash, Srivastava, Manish Dwivedi - Power Plant Engineering

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO 01	Lecture & Video Demonstration	Midterm Examination 1
CO 02	Lecture	Midterm Examination 2
CO 03	Lecture & Video Demonstration	Semester-end examination

Course No: MEE 0713-4234	Credit: 1.0	Year: Fourth	Semester: Second
Course Title: Power Plant Engineering Sessional		Course Status: Sessional	

Course Objectives:
The objectives of this course are:

- To help the students to know how to perform Performance Test of a Cooling Tower
- To provide the knowledge of boiler
- To help the students understand how to perform Performance Test of a Refrigeration Unit
- To help the students to understand Gas turbine system

Course Content:
Laboratory Experiments based on MEE 433.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:

CO1. Analyze the process data and obtained results and write a comprehensive discussion on construction and performance of cooling tower
CO2. Identify different mountings & accessories on a fire tube boiler and draw a line diagram of the water flow circuit which includes the water treatment plant
CO3. Perform Hydraulic test of a boiler and calculate the efficiency of the boiler
CO4. Understand assembled Rover gas turbine and identify different components
CO5. Become familiar with different components of the Turbo Jet Engine

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**1**	2	3		1							1
CO2		2	1									
CO3		2	3									
CO4	2											
CO5	2				1							

Books Recommended:

1. Power plant Lab manual (SUST)
2. P K Nag - Power Plant Engineering
3. V. Ganapathy - Industrial Boilers and Heat Recovery Steam Generators: Design, Applications and Calculations
4. M.M. E-Wakil - Power Plant Engineering
5. A.K. Raja, Amit Prakash, Srivastava, Manish Dwivedi - Power Plant Engineering

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Assignments using online materials	Viva voce / Presentation
CO2	Lecture	Viva voce / Presentation
CO3	Lectures and self-learning using reference books and research articles	Viva voce / Presentation
CO4	Assignment and self-learning	Viva voce / Presentation
CO5	Self-learning	Viva voce / Presentation

Course Code: MEE 480	Credits: 3.0	Year: Fourth	Semester: Second
Course Title: Project/Thesis		Course Status: Thesis	

Course Objectives are

- To help the students understand the basics of doing scientific research
- Be conversant on analysis of scientific data.
- To make the students understand how to present scientific work.
- To develop skills to conduct research along with understanding of the current research questions.
- To provide the knowledge about ethical issues in an adequate manner related to the scientific work.

Course Contents:

The undergraduate thesis /project within the field of Mechanical Engineering research is an individual study that must include hypothesis testing that will

substantiate new data.
The undergraduate thesis/project includes search, studies and summary of scientific literature, practical work in close relation to ongoing Mechanical Engineering research, compilation and critical analysis of the results, andoral and written presentation.
The undergraduate thesis/project is mastered under individual supervision. The supervision includes how to perform a scientific study and how to orally and in writing present gathered data in good scientific manner. The supervisor must have documented scientific experience.

CO1. Identify the research gap through proper literature review with a practical approach towards the work

CO2. Explain basics of planning and performance of a scientific work

CO3. Obtain Theoretical and practical professional specialization within Mechanical Engineering including understanding of the current research questions

CO4. Present scientific data and conclusions in written and oral form addressed to different groups

CO5. Develop a sense of responsibility and ethical concern regarding research field

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2			2		2						
CO2	1	2								2	2			
CO3	3	2	3	2	2						2	2
CO4										3		2
CO5			1					3				2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Assignments using online materials	Viva voce / Presentation
CO2	Lecture	Viva voce / Presentation

CO3	Lectures and self-learning using reference books and research articles	Viva voce / Presentation
CO4	Assignment and self-learning	Viva voce / Presentation
CO5	Self-learning	Viva voce / Presentation

Optional Course-I

Course No: MEE 0715-4123	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Biomedical Fluid Mechanics		Course Status: Theory	

Course Objectives:

The objectives of this course are as follows:

- To help the students differentiate between the various approaches and solutions applied to a wide variety of fluid mechanics problems related to physiological processes, medical devices, and laboratory setups as used for testing and measuring.
- To reinforce the student's prior knowledge in calculus, differential equations, and engineering as it applies to fluid mechanics.
- To make the students capable of reviewing relevant anatomy and physiology emphasizing qualitative considerations

Course Content:

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

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. Understand basic physical properties of bio fluids
CO2. Evaluate force and pressure balances acting on bio fluid
CO3.Analyze and solve biomedical fluid flow problems
CO4. Understand physiology of the human circulation system
CO5. Apply fluid mechanics to blood flow models

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1											1
CO2		2		1								
CO3			3	2								
CO4	2					1						
CO5				2								

Books Recommended:

1. Biofluid Mechanics: The Human Circulation -KB Chandran, AP Yoganathan, SE Rittgers
2. Applied Biofluid Mechanics- Lee Waite and Jerry Fine
3. A Brief Introduction to Fluid Mechanics- Young, Munson, and Okiishi

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE 435	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Refrigeration, A.C. and Building Mechanical Systems		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- Introduce the fundamental principles and different methods of refrigeration and air-conditioning.
- Illustrate various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
- Provide comparative study of different refrigerants with respect to properties, applications and environmental issues.
- Make students understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
- Familiarize with various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Course Content:

Refrigeration: Concept and application of refrigeration, different refrigeration methods, Refrigerants, Analysis of vapor-compression refrigeration system and its modifications, Absorption refrigeration, Air-cycle refrigeration, Low-temperature refrigeration, Multi-pressure systems of refrigeration. Refrigeration equipment: Defrost mechanism and automatic controls used in commercial refrigeration systems, Heat-flow problems in condensers and evaporators. Manufacture of water ice and dry ice.

Air Conditioning: Concept and classification of a/c and its use, Psychometric properties, comfort data, cooling and heating load calculation of various applications, Air distribution system and duct design, Air conditioning equipment, Air purification, Installation of units, Charging, Leak detection, wiring diagram and service, Trouble shooting.

Fire Hazards; Firefighting equipment; Vertical transportation, its system design; Escalators and moving ramps.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system,

CO2. Calculate cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration system.

CO3. Calculate cooling load for air conditioning systems used for various condition

CO4. Design a lift for vertical transportation in a building

CO5. Operate and analyze the refrigeration and air conditioning systems.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12

CO 1	3					1						1
CO 2	2	3										
CO 3		2	2	3					3	2		
CO 4			3	2					3	2		
CO 5		1			3							

Books Recommended:

1. Hundy, Trott & Welch (2008), Refrigeration & Air-conditioning, Butterworth-Heinemann.
2. Ameen (2006), Refrigeration & Air-conditioning, Prentice Hall
3. Stoecker & Jones (1983), Refrigeration & Air-conditioning, McGraw-Hill, Inc
4. Dossat (1996), Principles of Refrigeration, Prentice Hall

Course No: MEE 0715-4175	**Credit: 3.0**	**Year: Fourth**	**Semester: First**
Course Title: CAD/CAM		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To understand the concept of use of computers in design and manufacturing.
- To understand the basic design process and product life cycle management.
- To develop 3D modeling skills required for product design.
- To understand the nature & significance of CNC machine tools.
- To develop skills for programming skills required for CNC manufacturing.

Course Content:

CAD: fundamental concepts, application, benefits, hardware and software, types of CAD systems, common 2D CAD software features, basic 3D CAD features.
CAM: fundamental concepts, trend of development of numerical control (NC), principles of NC, types of NC systems, types of NC machines, CNC (manual) part programming, CNC part programming using CAM software, interfacing CAM software with CNC machines, computer aided machining.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO1. Understand & explain basic concepts and applications and tools of CAD and CAM.
CO2. Recognize part families and group technology.
CO3. Execute the steps required in CAD software for developing 2D and 3D models and perform transformations
CO4. Explain fundamental and advanced features of NC & CNC machines.

Mapping of COs with POs

CO/PO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
CO1	1	1										1
CO2		2		2								
CO3			2	3								
CO4	1					2	1					

Books Recommended:

1. CAD/CAM: Computer-Aided Design and Manufacturing - *Mikell P. Groover*

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam

CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE 479	**Credit: 3.0**	**Year: Fourth**	**Semester: First**
Course Title: Engineering Economy & Cost Management		**Course Status: Theory**	

Course Objectives:
The objectives of this course are:

- To familiarize the students with the basic concept of Engineering Economy.
- Getting idea about time value of money and the types of interest.
- To develop skills on different economic analysis and depreciation analysis.
- To be able to make proper economic decision through analysis.
- To facilitate necessary knowledge about various costing analysis and its management in manufacturing companies.
- To understand basic financial statements broadly and apply it.

Course Content:
Basic Concept of Engineering Economy: The role of engineers in business and corporation, time value of money, simple and compound interest, types of investment; Types of Economic Analysis: Present, future and annual worth analysis, Cost-Benefit Analysis, Internal Rate of Return Analysis, Incremental Analysis Depreciation: Straight Line Depreciation, Declining Balance Method, MACRS, Sum of years method etc.; After tax cash flow analysis; Inflation and its impact on economic decision; Capital budgeting and rationing; Sensitivity Analysis.

Cost Management: Scope and Application of cost and management accountancy, costing methods and techniques, marginal costing and standard costing, income measurements in manufacturing companies, Variable Costing Vs. absorption costing, *Cost allocation and categories:* material costing and labor costing, overheads and their allocations; *Financial statements analysis:* concept, test for profitability, liquidity, solvency, overall measures, Cost-volume-profit analysis, Budgeting, Variance Analysis.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. explain the basic concept of economic analysis.
CO2. conduct economic analysis on cost and budget.
CO3. make a depreciation fund by depreciation cost analysis.
CO4. analyze cost management to develop manufacturing companies.
CO5. make a financial statement of a company.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1							X			X
CO2	X					X				
CO3	X					X	X			X
CO4	X					X	X			X
CO5						X			X	

Books Recommended:

1. Engineering Economic & Cost Analysis; Courtland A. Collier, Charles R. Glagola.
2. Fundamentals of Engineering Economics and Decision Analysis; David L. whitman, Ronald E. Terry.
3. Fundamentals of economics analysis in engineering Projects; Osama khayal.
4. Engineering Economics and costing; Mishra Sasmita.

Course No: MEE495	Credit: 3.0	Year: Third	Semester: Second
Course Title: Renewable Energy		Course Status: Theory	

Course Objectives:
The objectives of this course are:

- To make the students understand various forms of conventional energy resources
- To introduce students to the economics of sustainable energy sources and the financing options available in the sector
- To help the students understand various forms of conventional energy resources
- To provide the knowledge of the present energy scenario and the need for energy conservation
- To develop skills to analyze the environmental aspects of renewable energy resources

Course Content:
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 renewables in small scale systems; Current technology: wind wave, tidal, passive and active solar, biological and examples of devices; Energy management, interaction of non-technical requirements (social, economic, political, environment) in engineering design and innovation; case-study.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. Describe the environmental aspects of non-conventional energy resources
CO2. Differentiate among various conventional energy systems, their prospects and limitations
CO3. Identify the need of renewable energy resources, historical and latest developments
CO4. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
CO5.Evaluate the need of Wind Energy and the various components used in energy generation and know the classifications
CO6. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications
CO7. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations
CO8. Evaluate the usefulness of fuel cells, wave power, tidal power and geothermal energy
CL09. Design a biogas power plant using regional resources

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1				X						
CO2				X						X
CO3				X						
CO4	X									
CO5	X							X		
CO6									X	
CO7				X					X	
CO8									X	
CO9	X	X	X	X		X				

Books Recommended:

1. John Twidell, Tony Weir- Renewable Energy Resources
2. Roland Wengenmayr, Thomas Bührke- Renewable Energy: Sustainable Energy Concepts for the Energy Change
3. David Buchla, Thomas Kissell, Thomas Floyd - Renewable Energy Systems

Optional Course-II

Course No: MEE 425	Credit: 3.0	Year: Fourth	Semester: First

Course Title: Aerodynamics	Course Status: Theory

Course Objectives:
The objectives of this course are:

- To learn the basics of aerodynamics.
- To differentiate types of flow in the context of fluid dynamics.
- To define inviscid incompressible flow with incorporation of flow circulation.
- To familiarize the use of potential function and stream function in case of designing a flow field.
- To understand Kutta-Joukowski theorem, the aero foil theory and wing theory.
- To understand Drag, aircraft propulsion and propeller.
- To introduce longitudinal stability and control of aerodynamic bodies.

Course Content:
Prereq.: MEE 323 (Fluid Mechanics-II)
Inviscid incompressible flow to include potential function, stream function, circulation and basic flows; Kutta-Joukowski theorem; Aero foil theory and wing theory. Drag, aircraft propulsion and propeller; Static performance problem; Special performance problem; Introduction to stability and control, Longitudinal stability and control; Lateral and directional stability and control.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. Understand & explain basic concepts of aerodynamics.
CO2. Distinguish between different types of fluid flows.
CO3. Choose appropriate fluid flow type when designing an experimental model.
CO4. Use the stream function to plot the stream lines of the flow and to find the velocities.
CO5. Calculate lift of an airfoil using Kutta-Joukowski theorem.
CO6. Calculate required angle of attack for a specified lift using aero foil theory for a real system.
CO7. Calculate aerodynamic forces acting on a body using wing theory for a real system.
CO8. Calculate drag and lift force.
CO9. Understand and apply the concept of stability and control in the context of aerodynamics.
CO10. Design a stable aerodynamic body.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1	X									X
CO2	X									X
CO3	X									
CO4						X				
CO5	X					X				X
CO6	X					X				
CO7	X			X		X				
CO8	X					X				X
CO9	X									X
CO10							X		X	X

Books Recommended:

1. Fundamentals of Aerodynamics - *John D. Anderson*
2. Aerodynamics for Engineers **-** *John J. Bertin, Russell M. Cummings*

Course No: MEE 0715-4137	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Advanced Thermodynamics		Course Status: Theory	

Course Objectives:
The objectives of this course are:

- To facilitate necessary knowledge about the laws of thermodynamics
- Make the students understand the concept of availability, reversibility and etc.

- Getting idea about entropy
- To facilitate necessary knowledge different energy functions.
- To provide broad knowledge about ideal gas and ideal gas mixtures.
- To develop skills on Statistical mechanics.
- Apply the knowledge of Thermodynamic probability.
- To enhancing the skill on optimization procedures for thermodynamic systems with applications.

Course Content:

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.

Course Learning Outcomes:

CO1. By the end of the course, students will be able to apply classical and statistical viewpoints in thermodynamics to analyze the concepts of equilibrium, stability, reversibility, irreversibility, and availability of thermodynamic systems.

CO2. By the end of the course, students should be able to calculate and interpret entropy changes in thermodynamic systems, and analyze the entropy of mixing, absolute entropy, entropy flow, and entropy production.

CO3. By the end of the course, students will be able to apply the principles of thermodynamic potentials, including Helmholtz and Gibbs free energy functions, to determine the stability and spontaneity of a thermodynamic system and its transformations.

CO4. By the end of the course, students should be able to apply statistical mechanics and thermodynamic probability, including Bose-Einstein and Fermi-Dirac statistics, to analyze the thermodynamic properties of a system.

CO5. By the end of the course, students will be able to analyze and evaluate the thermodynamic properties of special systems, including elastic systems, fuel cells, magnetic systems, and thermo-electric systems

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2		3	2			2	2			2
CO2				3	2			1	2			1
CO3		1	1	3	2			1	2			1
CO4				3	2				1			
CO5				3	1				1			

Books Recommended:

1. Heat and Mass Transfer; Yunus A. Cengel&Afshin J. Ghajar
2. Advanced Thermodynamics for engineers; Desmond E. Winterbone and Ali Turan.
3. Advanced Thermodynamic engineeering;Dr. KalyanAnnamalai, Dr. Ishwar K. Puri,Dr. Milind A. Jog.

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz

CO3	Lecture using board/LCD projectors	Assignment
CO4	Lecture using board/LCD projectors	Quiz
CO5	Lecture using board/LCD projectors	Assignment

Course No: MEE 0715-4161	**Credit: 3.0**	**Year: Fourth**	**Semester: First**
Course Title: Control Engineering		**Course Status: Theory**	

Course Objectives:

The objectives of this course are as follows:

- To make the students familiar with control system represented by differential equation
- Making them capable of expressing a physical system with mathematical modeling and finding out different types of responses
- To make them learn feedback and non-feedback system as well as transfer function of a system
- Making them capable of reducing block diagram
- To make them find out poles and zeros of a system
- Making them prepared to check the stability of a system by poles-zeros and Ruth Hurwitz criterion
- To familiarize them with hydraulic and pneumatic control systems
- Providing knowledge about the basic elements of electro-mechanical controls
- To facilitate necessary knowledge about logic gates, Boolean algebra and combinational circuits

Course Content:

Introduction to control systems and their representation by different equations and Laplace transforms; Block diagrams and transfer functions; Analog computer solution of system equations; System response, control action and system types; Frequency response; System analysis; System compensation; Analogues of control systems; Hydraulic and pneumatic control systems; Elements of electro-mechanical controls; Introduction to digital computer control.

Course Learning Outcomes:

By the end of the course, students should be able to:

CO1. Analyze and design control systems by applying different mathematical representations, such as equations and Laplace transforms, and understand the role of block diagrams and transfer functions in control systems.

CO2. Evaluate system response, control action, and system types, including frequency response, and explain the differences between various control systems, such as analog and digital computer control systems.

CO3. Apply system analysis and compensation techniques to design effective control systems, including hydraulic and pneumatic control systems, as well as electro-mechanical controls.

CO4. Compare and contrast analog and digital computer control systems and their advantages and disadvantages, including their use in industrial applications.

CO5. Synthesize the knowledge gained throughout the course to design and implement effective control systems that meet specific requirements and constraints.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	2	2	1			3		1	
CO2	1	2	2	2	2	1			2		1	
CO3	3	3	3	2	2	1			3		1	
CO4	1	2	2	2	2	1			2		1	
CO5	2	2	2						2		1	

Books Recommended:

1. Modern Control Engineering- Katsuhiko Ogata

Teaching-Learning & Assessment Strategy

COs	Lecture using board/LCD projectors	Assignment
CO1	Lecture using board/LCD projectors	Quiz
CO2	Lecture using board/LCD projectors	Assignment
CO3	Lecture using board/LCD projectors	Quiz
CO4	Lecture using board/LCD projectors	Assignment
CO5	Assignment/project	Assignment

Course No: MEE 0713-4191	**Credit: 3.0**	**Year: Fourth**	**Semester: First**
Course Title: Energy Resources & Utilization		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- to familiarize the students with world energy demand, available resources& their extraction system.
- to describe different types of conventional & renewable energy resources.
- To explain Solar energy&its various application to meet human needs
- To introduce the students with the energy storage& waste heat rejection system.
- to make them understand the environmental impact of energy conversion systems.

Course Content:

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

Conventional and Renewable energy Conversion Systems: Review of current conventional conversion systems, bioenergy, hydro- power, geo-thermal power, wind-power, tidal energy, solar energy.

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 and stored energy system, waste heat rejection and utilization.

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

Course Learning Outcomes:

After the successful completion of the course, students should be able to:

CO1. Define basic properties of different sources of energy and technologies for their utilization

CO2. Describe main elements of technical systems designed for utilization of resources of energy,

CO3. Interpret advantages and disadvantages of different resources of energy

CO4. Undertake simple analysis of energy potential of resources of energy

CO5. Select engineering approach to problem solving when implementing the projects on resources of energy

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12

CO1	03											
CO2					02							
CO3	03											
CO4					02							
CO5											03	

Books Recommended:

3. Energy Resources, Utilization & Technologies; by AnjaneyuluYerramilli and Francis Tuluri

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO1	Lecture	Midterm Examination 1
CO2	Lecture	Midterm Examination 2
CO3	Lecture	Assignment
CO4	Lecture	Assignment
CO 5	Lecture	Semester-end examination

Optional Course-III

Course No: MEE 0714-4263	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Robot Mechanics & Control		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To introduce various robot structures and their workspace.
- To develop student's skills in performing spatial transformations associated with rigid body motions.
- To demonstrate kinematics analysis of robot systems.
- To familiarize the student of the singularity issues associated with the operation of robotic systems.
- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control.

Course Content:

Robotics system components. Notations. Position definitions. Coordinate frames. Different orientation descriptions. Free vectors. Translations rotations and relative motion. Homogeneous transformations; Manipulator Forward and Inverse Kinematics: Link coordinate frames. Denavit-Hartenberg convention. Joint and end- effect r Cartesian space. Forward kinematics transformations of position. Inverse kinematics of position. Solvability. Trigonometric equations. Closed-Form Solutions. Workspace; Mechanics of Robot Motion: Translational and rotational velocities. Velocity Transformations. The Manipulator Jacobian. Forward and inverse kinematics of velocity. Singularities of robot motion; Static Forces and Compliance: Transformations of static forces and moments. Joint and End-Effect or force /torque transformations; Robot Dynamics and Trajectory

Planning: Lagrangian formulation. Model properties. Newton-Euler equations of motion. Simulations. Joint-based motion planning. Cartesian-based path planning; Robot Control: Independent joint control. Feed forward control. Inverse dynamics control, Robot controller architectures. Mobile Robots and Automated Guided Vehicles, Human Robot Interaction. Implementation problems.

Course Learning Outcomes:

After the successful completion of the course, students should be able to:

CO1. Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CO2. Apply spatial transformation to obtain forward kinematics equation of robot manipulators.

CO3. Solve inverse kinematics of simple robot manipulators.

CO4. Obtain the Jacobian matrix and use it to identify singularities.

CO5. Generate joint trajectory for motion Planning

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	02											
CO2			03									
CO3			03									
CO4		02										
CO5		03										

Books Recommended:

4. Introduction to Robotics: Mechanics and Control 4th Edition; by John Craig
5. Industrial Robotics Fundamentals: Theory and Applications Third Edition;by Larry T. Ross, Stephen W. Fardo, Michael F. Walach

Course No: MEE 465	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Basic Mechatronics		**Course Status: Theory**	

Course Objectives:

The objectives of this course are as follows:

- To facilitate necessary knowledge about closed loop controllers
- To provide the knowledge of different types of operational amplifier, filter and their implementation in controllers
- Making the students skilled in data acquisition system: ADC and DAC conversion and data transmission system
- To familiarize them with CAD, CAM, CIM
- Introducing different types of sensors and actuators to the students
- Providing the knowledge of machine vision and its key elements
- To help the students conceptualize basic robotics and learn about different types of robots
- To acquaint them with the fundamentals of industrial, home and office automation

Course Content:

Organization structure; System concept; mechanical, electrical, electronic and software components; process; software based tools: Virtual instrumentation; CAD; CAM; Computer integrated system; Computer interfacing; manipulator; actuator types; Sensors and vision system; Smart robots; Artificial Intelligence; Factory, Office and Home automation; MEMS and Nanotechnology; Future trends.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Understand different types of controllers and the effects of P, I and D controller on a system

CO2. Apply Zeigler-Nichols tuning rules to tune a PID controller

CO3. Convert an analogue signal to a digital signal and vice versa

CO4. Implement PID controller using Op-amps and solve design problems of a process control system

CO5. Identify key challenges of CAD, CAM, CIM systems and take necessary steps to overcome them

CO6. Apply machine vision and know the key elements of machine vision

CO7. Identify a proper sensor and actuator for a control system

CO8. Classify different types of robots and manipulator configuration

CO9. Explain automation in industry, office or home

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1	X									
CO2		X							X	
CO3	X									
CO4	X								X	
CO5	X								X	
CO6		X							X	
CO7	X									
CO8	X								X	
CO9	X									X

Books Recommended:

1. Mechatronics-W. Bolton
2. Introduction to Mechatronics and Measurement Systems-David Alciatore

Course No: MEE471	**Credit: 3**	**Year: Fourth**	**Semester: Second**
Course Title: Operations Research		**Course Status:**	

Course Objectives:

The objectives of this course are:

- To impart knowledge in concepts and tools of Operations Research
- To make the students understand mathematical models for analysis of real problems in Operations Research
- To develop skills about the applications of these techniques constructively to make effective business decisions
- To make the students capable for analyzing different situations in the industrial scenario involving limited resources and finding the optimal solution within constraints
- To help the students to develop ability in the use of Operations Research approaches and computer tools in solving real problems in industry

Course Content:

Introduction, linear programming (simplex and transportation model), Network analysis, dynamic programming, introduction to simple queuing models, introduction to probabilistic inventory models, game and decision theory, simulation integer programming, scheduling, and reliability.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Construct linear integer programming models and discuss the solution techniques

CO2. Set up decision models and use some solution methods for nonlinear optimization problems

CO3. Take best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models

CO4. Solve multi-level decision problems using dynamic programming method

CO5.Prepare a team-based project about heuristics /meta-heuristics algorithms used to solve integer or nonlinear programming problems

CO7. Understand the mathematical tools that are needed to solve optimization problems

CO8. Analyze any real-life system with limited constraints and depict it in a model form

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1	X									
CO2	X									
CO3						X				
CO4	X									
CO5			X		X		X			
CO6	X									X
CO7								X		
CO8						X				X
CO9	X									

Books Recommended:

1. C. West Churchman, Russell L. Ackoff& E. L. Arnoff - Introduction to Operations Research
2. Hillier, Frederick S. & Lieberman - Introduction to Operations Research Concepts and Cases
3. J.K. Sharma - Operations Research Theory and Applications

Course No: MEE473	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Quality Control & Management		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To facilitate necessary knowledge about quality and its measurement, characteristics, principle, cost etc.
- Getting idea about quality management and quality planning.
- To enhancing the skill on total quality management to manage quality of product.
- To understand basic of quality standards.

Course Content:

Concept of Quality: Modern concept of quality and its measurement, quality redefined, identification of quality characteristics: quality of design conformance and performance, Deming's principles on quality and productivity, Quality costs and their interpretation; **Statistical Quality Control:** Control and measurement of quality, Elementary SPC tools: Control charts, Process capability analysis, Design of experiments, Acceptance sampling plans: OC curves, single and double sampling plane, rectifying inspection, AOQ; **Quality Management:** Fundamentals of Quality Management, Quality planning, Total Quality Management: origin, concept and implementation, QCC, TQC, Quality Standards – ISO 9000 and 14000, 5S, TPM, SMED, Poka-Yoke etc.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1: measure quality and its cost.
CO2: use different Statistical procedure to control quality.
CO3: manage quality by using some quality management system.
CO4: select a high quality lot by analysis.
CO5: explain some quality standards so that they can improve manufacturing process.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO1	X									X
CO2	X					X				
CO3	X	X								X
CO4	X	X				X	X			
CO5							X			X

Books Recommended:

1. Fundamentals of Quality Control and improvement; AmitavaMitra.
2. Economic Control of Quality of Manufactured product; Walter A. Shewhart.
3. The Handbook for Quality Management; Thomas Pyzdek, paul Keller.

Optional Course-IV

Course No: MEE 451	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Fatigue, Creep and Fracture		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To define and understand basic concepts of fatigue, creep and fracture failure.

- To acquire fundamental insight into the underlying mechanisms controlling mechanical deformation.
- To gain basic understanding of the mechanical properties of different engineering materials.
- To develop detailed understanding of mechanical testing.
- To acquire basic understanding of complex stress states and principal states of stress.
- To learn about basic yielding and fracture criteria used to predict and control yield and fracture.
- To know how to apply basic concepts of fracture mechanics to predict fracture.
- To understand basic techniques used to predict and control fatigue.
- To learn about basic mechanisms behind creep and how to model and control creep.

Course Content:

Fatigue: Fatigue failure; types of fatigue with fixed and varying amplitude, Combined stress fatigue properties; Notch sensitivity, factors influencing fatigue strength; fatigue tests, Utilization of fatigue properties in design.

Creep: Creep-stress-time -temp. Relation for simple tension and combined stresses, Recovery creep and relaxation, Testing techniques, Creep in tension, bending, torsion and buckling.

Fracture: Basic modes of fracture, Theories of linear elastic fracture mechanics, Griffith theory of brittle fracture, Irwin's theory of fracture in elastic plastic materials, stress intensity factors; fracture toughness testing, Interpretation of test data.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Define failure by fatigue, creep and fracture.

CO2. Describe the key characteristics that distinguish fatigue, creep and fracture failure.

CO3. Distinguish among different types of fatigue with fixed and varying amplitude.

CO4. Utilize the fatigue properties in design purpose.

CO5. Understand how notch sensitivity affects a specific design.

CO6. Understand how different factors affect fatigue strength.

CO7. Choose and perform the more appropriate fatigue testing method among different fatigue tests.

CO8. Analyze relationships among creep stress, time and temperature for simple tension and combined stress.

CO9. Distinguish among creep failures based on tension, bending, torsion and buckling.

CO10. Choose and perform the more appropriate creep testing among different creep testing methods.

CO11. Distinguish between a brittle fracture and ductile fracture.

CO12. Investigate a brittle fracture using Griffith theory.

CO13. Investigate fractures in plastic material using Irwin's theory.

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1	X									
CO2	X									X
CO3	X									
CO4	X									X
CO5	X									
CO6	X									
CO7	X									X
CO8		X				X				
CO9	X									X
CO10	X									
CO11	X									
CO12	X					X				
CO13						X				

Books Recommended:

1. Fracture Mechanics: fundamentals and applications - *T.L. Anderson*
2. Fracture Mechanics: an introduction - *E.E. Gdoutos*
3. Metal Fatigue in Engineering - *R.I. Stephens, A. Fatemi, R.R. Stephens, and H.O Fuchs*

4. Multiaxial Fatigue - *D.F. Socie and G.B. Marquis*

Course No: MEE 0715-4253	Credit: 3.0	Year: Fourth	Semester: Second
Course Title: Noise and Vibration		Course Status: Theory	

Course Objectives:
The objectives of this course are as follows:

- To acquaint students with the fundamentals of vibrations and noise
- To make them analyze the fundamental relationships of noise and vibrations
- Teaching students the skills required to be proficient in the assessment of the oscillations and acoustics of the machinery and engineering facilities
- Preparing the students to mathematically model real-world mechanical vibration problems

Course Content:
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.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. Identify, formulate, and solve engineering problems
CO2. Analyze sound propagation and reflections in space.
CO3. Distinguish between different sounds and noise levels in the environment.
CO4. create model for undamped and damped mechanical systems and structures
CO5. analyze free and harmonically forced vibrations

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	3								1	1
CO2		3	2									
CO3	1											1
CO4			3	2								
CO5	1	2	3									

Books Recommended:
1. Engineering Vibration-D. J. Inman
2. Engineering Acoustics: An Introduction to Noise Control-Michael Möser

Mapping of COs with **Learning Strategies andAssessment Strategies:**

COs	Teaching-Learning Strategies	Assessment Strategies
CO1	Lecture using PPT and board	Midterm Exam-I, Assignment, Final Exam
CO2	Lecture using PPT and board	Midterm Exam-II, Assignment, Final Exam
CO3	Lecture using PPT, Question-Answer session	Class work, Assignment, Final Exam
CO4	Lecture using PPT and board	Assignment, Final Exam
CO5	Lecture using PPT, Question-Answer session	Assignment, Final Exam

Course No: MEE 0716-4281	Credit: 3.0	Year: Fourth	Semester: Second
Course Title: Automobile Engineering		Course Status: Theory	

Course Objectives:
The objectives of this course are:

- To familiarize the students with the anatomy of the automobile in general
- To understand the location and importance of each part.

- To know the functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
- To know how suspension, frame, springs and other connections work.
- To know about emissions, ignition, controls, electrical systems and ventilation.

Course Content:

Introduction to road vehicles; Components of automobiles; Automotive engines: types and construction; Valve events; Knock, pre-ignition and post-ignition. Friction in engines and automobile components; Lubrication systems; Automotive fuel systems for SI and CI engines; Ignition system; Alternative fuels and alternative types of engines; Engine cooling and exhaust systems.

Vehicle performance: linear and angular inertia, braking effects, gyroscopic effects and reactions, tractive effort and vehicle vibration; Resistance to vehicle motion: gradient resistance, aerodynamic resistance, rolling and frictional resistance; Development strategies for minimum resistance.

Automotive transmission systems and powertrain: clutch, gear, differential and final drives. Automotive safety: brakes; Reduction of injuries; Automotive body: materials and vehicle shape; Springs and suspension: Steering system.

Electrical systems: cranking motor, alternator and lighting; Electronic control systems and indicators. Environmental considerations: vehicle emissions and control strategies; Noise pollution and control; Vehicle fuel economy. Testing of vehicles; Motor vehicle regulations

Course Learning Outcomes:

After the successful completion of the course, students will be expected to:

CO1. Identify the different components of automobile and automobile engines.

CO2. Develop strategies to minimize the resistance to motion experienced by the vehicle and increase performance of the vehicle changing various parameters of body and engine.

CO3. Describe how the safety system, automotive drive-train, transmission, clutch, brakes, steering, tire and the suspension systems operate.

CO4: Comprehend the environmental implications of automobile emissions and motor vehicle regulations.

CO5: Explain the working of various parts like engine, cooling system, lubricating system, electronic and electrical system, fuel and ignition system, exhaust and emission system.

Mapping of COs with POs

CO/ PO	PO 1	PO 2	PO 3	P O4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2			3		3							
CO3				3								3
CO4						3	3					
CO5	2											

Books Recommended:

1. Automotive Engineering Fundamentals - *Richard Stone*
2. Automotive Technology: A Systems Approach - *Jack Erjavec*
3. Automotive Mechanics-*William H. Crouse, Donal L. Anglin*.
4. Advanced Vehicle Technology-*H. Heisler*
5. Automobile Engineering (Volume–1 & 2)-*Dr. Kirpal Singh*

Course No: MEE 0713-4293	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Nuclear Engineering		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To teach students fundamental physics that applies to a broad range of nuclear technologies
- To develop skills to differentiate different nuclear reactions
- To introduce students to environmental impacts of nuclear technology, and the physical and biological effects of ionizing radiation
- To provide the knowledge of reactor coolants
- To make the students understand how to dispose nuclear waste

Course Content:

World energy resources; Importance of fission energy; Atomic structure; Nuclear energy and nuclear forces; Nuclear fission and fusion processes; Nuclear fission

reactors; Reactor controls; Reactor coolants; Process waste disposal; Nuclear power reactor systems.

Course Learning Outcomes:

CO1. Explain the basic nuclear terminologies and describe the breadth of current and potential nuclear applications

CO2. Describe the fundamentals of sustained neutron chain reactions, fission reactor design, and fission products

CO3. Define and describe various reactor types and enumerate the basic systems of each reactor type

CO4. Identify the threats posed by nuclear wastes and describe their safe disposal process

CO5. Explain the importance of nuclear energy in the context Bangladesh power sector

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2								
CO2	3	2	1	1								
CO3	3	2	3	2	1							
CO4	2	1		1			3					2
CO5	2			2		2						3

Books Recommended:

1. J. Kenneth Shultis& Richard E. Faw - Fundamentals of Nuclear Science and Engineering
2. John R. Lamarsh and Anthony J. Baratta - Introduction to Nuclear Engineering
3. James E. Turner - Atoms, Radiation, and Radiation Protection

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lectures	Assignment
CO2	Lectures	Midterm Examination 1
CO3	Lectures	Midterm Examination 2

CO4	Lectures	Quiz
CO5	Lectures	Quiz

Optional Course-V

Course No: MEE 0715-4239	Credit: 3.0	Year: Fourth	Semester: Second
Course Title: Combustion and Pollution		Course Status: Theory	

Course Objectives:

The objectives of this course are as follows:

- To introduce the students with combustion, heat of reaction, flame temperature, heating value etc.
- Familiarizing them with the chemistry and kinetics of reaction
- To make them learn flame propagation and structure of laminar premixed flame
- Making them understand combustion process for internal and external combustion engines
- To make them analyze the emission from combustion and control pollution
- To make them understand the process of exhaust gas recirculation

Course Content:

Introduction to combustion; Heat of reaction, adiabatic flame temperature, heating values, chemical composition of products of combustion; Chemistry and kinetics of reactions; Reaction rate and flame propagation; Structure of laminar premixed flames; Explosions and fuel oxidation; Detonation; Combustion in internal and external combustion engines.

Production of pollutants in combustion systems; Emissions of greenhouse gas, carbon monoxide, oxides of nitrogen and sulfur, and other pollutants. Pollution control: post-engine exhaust treatment for emission control - thermal reactors, exhaust gas recirculation, catalysis; Pollution control by modification of combustion parameters; other pollution control strategies

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Analyze combustion process in internal and external combustion engines

CO2. Identify the impacts of emission on the environment and search for new modifications that can be incorporated for the further reduction of emission pollution

CO3.Explain the details of flame propagation and structure of laminar premixed flame

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2								
CO2	3	3	2	3	3		3					2
CO3	3	2										

Books Recommended:

1. Internal Combustion Engine Fundamentals- John B. Heywood
2. Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control-Eran Sher

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lectures	Assignment
CO2	Lectures	Midterm Examination 1
CO3	Lectures	Midterm Examination 2

Course No: MEE441	Credit: 3.0	Year: Fourth	Semester: Second
Course Title: Applied Engineering Mathematics		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- To give broad coverage of mathematics useful to senior year Mechanical Engineering students
- To provide the students with sufficient exposure to advance mathematical methods and tools that are relevant to theoretical and mathematical aspects of mechanical engineering research.
- To make students able to solve non-linear differential equations utilizing different numerical methods
- To help students learn the basics of Finite Difference Method and Finite Element Method to solve physical problems
- To facilitate students with understanding of boundary element method and calculus of variations
- To provide an introductory knowledge about Chaos Theory

Course Content:

Non-linear differential equations: asymptotic method, perturbation method, Rayleigh- Ritz method, collocation method; Finite difference method; Finite element method; Boundary element method; Calculus of variations; Chaos theory.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Apply a range of mathematical theorems and methods to solve routine and complex analytic and applied problems
CO2. Analyze data necessary for the solution of engineering problems
CO3. Identify and examine the effectiveness of proposed solutions to identified engineering problems
CO4. Derive mathematical models of physical systems
CO5. Solve differential equations using appropriate methods
CO6. Present mathematical solutions in a concise and informative manner
CO7. Utilize their knowledge to conduct advanced numerical studies related to Finite Element Analysis, Finite Difference Method and Computational Fluid Dynamics

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0
CO1	X									X
CO2	X					X				
CO3	X									X
CO4	X									
CO5	X					X				X
CO6	X									
CO7	X								X	X

Books Recommended:

1. Fourier Series and Numerical Methods for Partial Differential Equations- *Richard Bernatz*
2. Numerical Methods for Solving Partial Differential Equations- *Byron Gotteried*
3. Fundamentals of Finite Element Analysis - *David V. Hutton*

Course No: MEE 0715-4243	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Applied Statistics for Engineers		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To develop the student's knowledge in engineering data collection, interpretation &problem-solving process
- To develop student's skills in various sampling methods& decision-making problems.
- To develop student's skills in analyzing data from engineering experiments and apply CRD, RBD and CSD.

Course Content:

Simple regression and correlations, multiple regression. Tests of significance. Analysis of variance. Experimental design. Factor analysis. Statistical packages.

Course Learning Outcomes:

CO1. By the end of the course, students will be able to apply simple regression and correlation techniques to analyze the relationship between two variables and interpret their findings effectively.
CO2. By the end of the course, students will be able to use multiple regression analysis to identify and explain the impact of multiple independent variables on a dependent variable.
CO3. By the end of the course, students will be able to conduct hypothesis testing and use statistical tests of significance to evaluate whether observed differences in means or proportions are statistically significant or not.
CO4. By the end of the course, students will be able to design and analyze experiments using techniques like analysis of variance (ANOVA) and factor analysis, and interpret the results to draw meaningful conclusions.
CO5. By the end of the course, students will be able to use statistical packages effectively to conduct data analysis and produce meaningful statistical output that informs decision-making processes.

Books Recommended:

1. The Elements of Statistical Learning; by Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie
2. Statistical Models: Theory and Practice; by David A. Freedman

Mapping of COs with POs

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2		2	2				2	3		2
CO2	1	2		1	2				1	2		2
CO3		1			1					2		1
CO4			2	1	1	1	2			1		
CO5	1	2		2	2				1	3		2

Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy

CO1	Lecture using board/LCD projectors/Projects	Assignment
CO2	Lecture using board/LCD projectors/Projects	Quiz
CO3	Lecture using board/LCD projectors/Projects	Assignment
CO4	Lecture using board/LCD projectors/Projects	Quiz
CO5	Assignment/Projects	Assignment

Course No: MEE 0711-4283	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Bio-Engineering		**Course Status: Theory**	

Course Objectives:
The objectives of this course are:

- To introduce students to the human musculoskeletal system
- To introduce students to the Biomechanics of human movement
- To make the students understand the material characterization of bones, ligaments, muscle and joints
- To integrate the knowledge core of traditional engineering disciplines and modern biology to solve problems encountered in living systems
- To facilitate necessary knowledge about imaging and sensing, therapeutics, biomechanics, cell and tissue engineering, and computational and systems biology

Course Content:
Introduction to human musculoskeletal system; Biomechanics of human movement: applications of engineering mechanics to the movements of muscles, bones and skeletal joints; Material and structural characteristics of bones, ligaments, muscle/tendons and joints - alternative materials.
Introduction to biomechanical fluid mechanics; Engineering approach to the function of circulatory and respiratory systems involving fluid dynamics.
Introduction to biomedical instrumentation; Ultrasound, x-ray, laser, microwave and ultraviolet rays - physics and technology of generation - their use in diagnostic, therapeutic, and processing applications in medicine and industry.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CO1. Formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
CO2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare
CO3. Utilize major medical imaging modalities in radiology, including X-ray, CT, nuclear medicine, ultrasound, and MRI
CO4. Evaluate the engineering mechanics including stress, strain, deformation, and analysis of structures with application to biomechanical phenomena over a range of biological length scales
CO5. Utilize computational fluid dynamics tools to investigate momentum transport (viscous flow) and mass transport (diffusion and convection) in living systems

Mapping of COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	3	3	3	1							

CO2	1	2	3	3	2	2	2					
CO3	1	1	2	3	3							
CO4	3	3	2	3								
CO5	2	3		2	2							

Books Recommended:

1. Y C Fung - Introduction to Bioengineering
2. S. A. Berger, W. Goldsmith, and E. R. Lewis - Introduction to Bioengineering
3. Satya Prakash and Dominique Shum-Tim - Stem Cell Bioengineering and Tissue Engineering Microenvironment
4. M Cerrolaza - Computational Bioengineering

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy:

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO1	Lectures	Assignment
CO2	Lectures	Midterm Examination 1
CO3	Lectures	Midterm Examination 2
CO4	Lectures	Quiz
CO5	Lectures	Assignment

Courses Offered by MEE Department to Students of Other Department

Course No: MEE 213F	Credit: 3.0	Year: Second	Semester: First
Course Title: Engineering Mechanics		Course Status: Theory	

Course Objectives:

The objectives of this course are:

- To develop skills on the capacity to predict the effects of force and motion
- To provide the knowledge of a knowledge of the physical and mathematical principles of mechanics

- Getting idea about the ability to visualize physical configurations in terms of real materials, actual constraints, and the practical limitations which govern the behavior of machines and structures.
- To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies.
- To provide the knowledge of the effect of friction on equilibrium.
- To understand the basic of kinematics, kinetics of particle and rigid body, related principles.
- Apply the knowledge to solve practical problems.

Course Content:

Basic concepts of mechanics; Statics of particles and rigid bodies; Centroids of lines, areas and volumes; Forces in truss, frames, and cables; Friction; Moments of inertia of areas and masses; Relative motion.
Kinetics of particles: Newton's second law of motion; Principles of work, energy, impulse and momentum; System of particles; Kinematics of rigid bodies; Kinetics of plane motion of rigid bodies: forces and acceleration; Principles of work and energy.

Course Learning Outcomes:

CO1. By the end of the course, students will be able to apply the principles of statics to analyze and solve problems involving forces in truss, frames, and cables.
CO2. By the end of the course, students will be able to use the principles of kinetics to analyze the motion and forces of particles and rigid bodies, including work, energy, impulse, and momentum.
CO3. By the end of the course, students will be able to calculate centroids of lines, areas, and volumes, as well as moments of inertia of areas and masses, and apply these concepts to practical engineering problems.
CO4. By the end of the course, students will be able to analyze and solve problems related to friction and relative motion, and apply these concepts to real-world situations.
CO5. By the end of the course, students will be able to apply the principles of work and energy to analyze the motion and forces of rigid bodies in plane motion, including forces and acceleration, and apply these concepts to practical engineering problems.

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3							
CO2	3	3	3	3	3							
CO3	3	2	3	3	3							
CO4	2	2	2	2	2							
CO5	3	2	3	3	3							

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/LCD projectors	Assignment
CO2	Lecture using board/LCD projectors	Quiz
CO3	Lecture using board/LCD projectors	Assignment
CO4	Lecture using board/LCD projectors	Quiz
CO5	Lecture using board/LCD projectors	Assignment

Books Recommended:

1. Engineering Mechanics: Statics - *Russell Hibbeler*
2. Engineering Mechanics: Dynamics - *Russell Hibbeler*
3. Vector Mechanics for Engineers – *Ferdinand P. Beer*

Course No: MEE 0715-3113E	**Credit: 3.0**	**Year: Third**	**Semester: First**
Course Title: Fundamentals of Mechanical Engineering		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- Make the students understand the various forms of conventional energy resources
- To provide the knowledge of the Thermodynamics
- To develop skill on Thermodynamics Law's
- To apply the knowledge of different Fluid Machineries
- To understand the basic working principle of different Thermal Engines

Course Content:

Sources of Energy: Classification, Applications, Advantages and Disadvantages; Thermodynamics: Basic concepts and definitions of cycle, Properties, Process, 1st and 2nd law's of Thermodynamics and their application; Thermal Engines: IC Engine, Gas Turbine, Boiler, Steam Turbine: Classification, Operating Principle, Performance, and Applications; Fluid Machineries: Turbine, Pump, Compressor, Blower, Fan: Classification, Operating Principle, Performance, Applications.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CO 01. Compare and contrast among different sources of energy.
CO 02: Explain different turbines
CO 03: Introduced with different mechanical components including pumps, blowers and compressors; refrigeration and air conditioning systems.
CO 04: Explain steam generation units with their accessories and mountings.

Mapping of COs with POs:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2									
CO2	3	2		3								
CO3	3	2	2									
CO4	3	2			2							2
CO5	3	2		3								

Books Recommended:

1. DevendraVashist - Mechanical Engineering: Fundamentals
2. R.L. Timings - Fundamentals of Mechanical Engineering
3. Claus Borgnakke, Richard E. Sonntag - Fundamentals of Thermodynamics
4. Munson - Fundamentals of Fluid Mechanics

Course No: MEE 0715-3115A	**Credit: 2.0**	**Year: Third**	**Semester: First**
Course Title: Building Service II – Mechanical		**Course Status: Theory**	

Course Objectives:

The objectives of this course are:

- To understand the basic concept of thermodynamics so that students are able to understand psychrometry and air conditioning systems.
- To introduce the fundamental principles and different methods of air conditioning.
- To make students able to apply psychrometric charts in calculating psychrometric properties.
- To make students understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
- To introduce various equipment-operating principles, operating and safety controls employed in air conditioning systems
- Getting idea about fire fighting methods in application of building service
- To familiarize different vertical transportation systems employed in building structures.

Course Content:

Thermodynamics: Introduction: Definition and applications of thermodynamics, Basic concept and definition: Systems and control volume, state and equilibrium, process and cycles, thermodynamic properties, forms of energies, Laws of thermodynamics,

Psychrometry: Definition, psychrometric properties, psychrometric chart, and its application.

Air-conditioning: importance application of air-conditioning, air-conditioning systems, basic refrigeration cycle: Basic concept, vapor compression cycle for air-conditioning, air-conditioning equipment, cooling load calculation;

Duct system design: Concept, importance and objectives of duct system design, air handling and distribution, different types of supply and return duct systems, duct design methods;

Fire hazards, fire-fighting methods.

Vertical Transportation: Types of elevators, Determination of size and quality of elevators, Incoming and outgoing traffic handling, Escalators and moving ramps.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1. Explain fundamental laws and concepts of thermodynamics,
CO2. Illustrate the fundamental principles and applications of air conditioning system,
CO3. Design duct systems for the application of air handling in building systems.
CO4. Calculate cooling load for air conditioning systems used for various conditions.
CO5. Explain different vertical transport systems for the application in building service.

Books Recommended:

1. Hundy, Trott& Welch (2008), *Refrigeration & Air-conditioning*,Butterworth- Heinemann.
2. Ameen (2006), *Refrigeration & Air-conditioning*, Prentice Hall

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lectures using Projectors and Board, Discussion	Term Test 01, Final Exam
CO2	Lectures using Projectors and Board,Discussion	Term Test 02, Final Exam
CO3	Lectures using Projectors and Board, Discussion	Assignment, Final Exam

CO4	Lectures using Projectors and Board, Group Discussion.	Assignment, Final Exam
CO5	Lectures using Projectors and Board, Group Discussion.	Term Test, Assignment, Final Exam