Syllabus

Department of Mechanical Engineering

Undergraduate

Session: 2020-21

Shahjalal University of Science and Technology

Sylhet-3114, Bangladesh

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 (PLO):

The PLO 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:

PLO1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

PLO2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

PLO3. an ability to communicate effectively with a range of audiences

PLO4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

PLO5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

PLO6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

PLO7. an ability to be aware of management and entrepreneurship

PLO8. an ability to engage in applications-oriented design, manufacturing, and management of mechanical systems, including computer-aided design and manufacturing, and all the technical and economic variables affecting production

PLO9. an ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations

PLO10. an ability to pursue lifelong learning and continuous improvement of their knowledge and skills in the design development, and application of mechanical systems in diverse industries with the highest professional and ethical standards

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

PLO/PEO	PEO1	PEO2	PEO3
PLO1	X		
PLO2	X	X	X
PLO3		X	
PLO4	X	X	
PLO5		X	
PLO6	X		X
PLO7		X	
PLO8			X
PLO9			X
PLO10	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 101Q	Fundamentals of Chemistry	3	3.00	
MAT 101Q	Differential Calculus and Geometry	3	3.00	
ENG 101Q	Effective Communication in English	2	2.00	
PHY 107Q	Physics I	3	3.00	
MEE 181	Introduction to Mechanical Engineering	3	3.00	
SSS 100	History of the Emergence of Independent Bangladesh	3	3.00	
CHE 112Q	Chemistry Sessional	3	1.50	
ENG 102Q	English language lab	2	1.00	
MEE 172	Mechanical Engineering Drawing	3	1.50	
MEE 176	Foundry and Welding Shops	2	1.00	
Total			22	

First Year: 2nd Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
CHE 103Q	Chemistry of Engineering Materials	3	3.00	
MAT 103Q	Integral Calculus and Differential Equations	3	3:00	
PHY 109Q	Physics-II	3	3.00	
EEE 111Q	Fundamentals of Electrical & Electronics Engineering	3	3.00	
MEE 141	Programming Methodology for Mechanical Engineering	3	3.00	
PHY 112Q	Physics Sessional	3	1.50	
EEE 112Q	Fundamentals of Electrical & Electronics Engineering Sessional	2	1.00	
MEE 142	Programming Methodology for Mechanical Engineering Lab	2	1.00	
MEE 174	Computer-aided Mechanical Engineering Drawing	3	1.50	MEE172
MEE 178	Machine Shop Practice	2	1.00	
MEE 188	Comprehensive Viva-I		0.50	
Total			21.5	

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 231	Basic Thermodynamics	3	3.00	
MEE 257	Engineering Mechanics-I	3	3.00	
EEE 213Q	Fundamentals of Electrical Machines	3	3.00	EEE 111Q
MEE 232	Basic Thermodynamics Sessional	3	1.50	
EEE 214Q	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 259	Engineering Mechanics-II	3	3.00	MEE 257
MEE 245	Numerical Analysis	3	3.00	
MEE 253	Mechanics of Solids	3	3.00	MEE 257
MEE 255	Engineering Materials (Metallic and Composites)	3	3.00	
MEE 246	Numerical Analysis Sessional	2	1.00	
MEE 254	Mechanics of Solids Sessional	2	1.00	
MEE 256	Engineering Materials Sessional	2	1.00	
MEE 288	Comprehensive Viva-II		0.50	
Total			19.5	

Third Year: 1st Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
MEE 321	Fluid Mechanics –I	3	3.00	
MEE 331	Conduction and Radiation Heat Transfer	3	3.00	
MEE 351	Mechanics of Machinery	3	3.00	MEE 253
MEE 371	Production Processes	3	3.00	
SOC 307Q	Industrial Sociology	3	3.00	
MEE 322	Fluid Mechanics- I Sessional	3	1.50	
MEE 332	Heat Transfer Sessional	2	1.00	
MEE 352	Mechanics of Machinery Sessional	2	1.00	
MEE 372	Production Processes Sessional	2	1.00	

MEE 382	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 323	Fluid Mechanics-II	3	3.00	MEE 321
MEE 333	Convection, Boiling, Condensation and Mass Transfer	3	3.00	
MEE 353	Machine Design	4	4.00	MEE 253
MEE 367	Instrumentation and Measurement	3	3.00	
MEE 375	Machine Tools	3	3.00	
MEE 324	Fluid Mechanics- II Sessional	3	1.50	
MEE 334	Heat and Mass Transfer Sessional	2	1.00	
MEE 354	Machine Design Sessional	3	1.50	
MEE 368	Electro-mechanical System Design	2	1.00	
MEE 388	Comprehensive Viva-III		0.50	
Total			21.5	

Fourth Year: 1st Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
MEE 421	Fluid Machinery	3	3.00	
MEE 431	Internal Combustion Engines	3	3.00	
MEE 477	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 422	Fluid Machinery Sessional	2	1.00	
MEE 432	Heat Engine Sessional	2	1.00	
MEE 484	Industrial Training	4 Weeks	1.00	
MEE 480	Project/Thesis	6	3.00	
Total			21.00	

Fourth Year: 2nd Semester

Course No.	Course Title	Hours/ Week	Credits	Prerequisite
		Theory and Lab		
IPE 405Q	Industrial Management	3	3.00	
MEE 433	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 434	Power Plant Engineering Sessional	2	1.00	
MEE 480	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 423	Biomedical Fluid Mechanics	3	3.00	MEE323
MEE 435	Refrigeration, A.C. and Building Mechanical System	3	3.00	
MEE 475	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 437	Advanced Thermodynamics	3	3.00	MEE231
MEE 461	Control Engineering	3	3.00	
MEE 491	Energy Resources& Utilization	3	3.00	
Optional III				
MEE 463	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 453	Noise and Vibration	3	3.00	
MEE 481	Automobile Engineering	3	3.00	
MEE 493	Nuclear Engineering	3	3.00	
Optional V				
MEE 439	Combustion and Pollution	3	3.00	
MEE 441	Applied Engineering Mathematics	3	3.00	
MEE 443	Applied Statistics for Engineers	3	3.00	
MEE 483	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 315A	Building Service II – Mechanical	3-1 (ARC)	2	2.00

Course Profiles
First Year First Semester

Course No: CHE 101Q	**Credit: 3.0**	**Year: First**	**Semester: First**
Course Title: Fundamentals of Chemistry		**Course Status: Theory**	

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 k_p, $k_c$and, k_x; 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
CLO1. Classify elements, orbit & orbitals, electron distribution, energy level and hybridization
CLO2. Apply different principles to determine the configuration for any atom or ion
CLO3. Explain the development of the periodic table of elements, analyze and compare periodic trends in physical and chemical properties of elements in periodic table
CLO4. Understand and explain basic concepts of thermochemistry
CLO5. Explain the phenomenon related with laws of thermochemistry
CLO6. Understand the reaction enthalpies and their roles in chemical reactions
CLO7. Determine the relationship between chemical kinetics and equilibrium
CLO8. Perceive and explain the properties and applications of colloids
CLO9. Understand the electrochemical phenomenon
CLO11. Name and understand the proper structure of different organic compounds
CLO12. Predict physical and chemical properties of different organic compounds

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	X									X
CLO2						X				
CLO3						X				X
CLO4		X								
CLO5		X								
CLO6		X								
CLO7	X					X				
CLO8										X
CLO9		X								
CLO10	X									
CLO11						X				
CLO12										X

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 (CLO)

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

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

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

CLO 03: Compute the derivatives of transcendental functions.

CLO 04: Expansion of transcendental functions to polynomial functions.

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

CLO 06: Trace the Cartesian, Polar, and Parametric Curves, and rectify the curves.
CLO 07: Compute arc lengths and areas of parametric and polar curves.
CLO 08: Identify and apply the cartesian, spherical, polar and cylindrical coordinate systems to solve engineering problems.

Mapping of CLOs with PLOs

CLO / PLO	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7	CLO8
PLO 01	X	X	X	X	X	X	X	X
PLO 02								
PLO 03								
PLO 04	X	X	X	X	X	X	X	X
PLO 05								
PLO 06								
PLO 07								
PLO 08	X	X	X	X	X	X	X	X
PLO 09	X	X	X	X	X	X	X	X
PLO 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: ENG101Q	**Credit: 2.0**	**Year: First**	**Semester: First**
Course Title: Effective Communication in English		**Course Status: Theory**	

Course Rational:
This course will 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 thereby enabling them to demonstrate the accurate use of grammar in their writing.

Course Objectives:

- To enable students to write with accuracy
- To facilitate effective and comprehensible writing
- To raise awareness of common errors that occur in writing
- To develop student's ability to understand write-ups on issues of general concern.
- To improve the vocabulary of learners for effective communication.

Course Content:

Reading

- Different Reading Strategies
- Guessing Meaning from the Context
  Critical Reading (Analyze)
- Critical Reading (Synthesize)
- Critical Reading (Evaluate)
- Annotation
- Summary Writing

Material

- 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 material may be supplied as handouts as deemed necessary by the instructor.

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 able to
CLO1: apply grammar rules.
CLO2: produce grammatically correct meaningful sentences.
CLO3: express oneself correctly by using appropriate words, phrases, sentences or ideas
CLO4: critically reflect on a text (grasp abstract ideas and interpret them effectively, arrive at well reasoned conclusions and solutions).
CLO5: extract information from passages accurately

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1			X		X					
CLO2			X		X					X
CLO3			X							
CLO4			X		X					
CLO5					X					

Evaluation

- IELTS, TOEFL and other standardized testing formats for assessing the level of reading skill are to 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.

Books Recommended
Tibbits, E. E. ed. Exercises in Reading Comprehension. Longman
Liz and John Soars. (Current edition). New Headway Upper Intermediate Student's Book.
Oxford : Oxford University Press Cliff's TOEFL
Other Resources recommended by course instructors

Course No: PHY 107Q	**Credit: 3.0**	**Year: First**	**Semester: First**
Course Title: Physics I		**Course Status: Theory**	

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:

CLO1 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

CLO2 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.

CLO3 gain the knowledge to make the sound non-hazardous for audience generating by mechanical system

CLO4 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.

CLO5 understand the statistical concept to deal with a large number of particles and apply this to find the different quantities involved in various physical system.

CLO6 apply quantum mechanics to explain the phenomena of the microscopic physical world.

Mapping of the CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	X			X						X
CLO2	X	X		X				X	X	X
CLO3	X			X				X	X	X
CLO4	X	X								X
CLO5	X	X		X				X	X	X
CLO6	X	X		X						X

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 181	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 source 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 generator.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CLO1. evaluate the sources of energy.
CLO2. understand pros and cons of various sources of energy.
CLO3. understand the degree of pollution caused by the conversion of energy.
CLO4. identify Steam, Gas and Water turbine and classify them.
CLO5. understand how engine works and describe various components of an engine.
CLO6. demonstrate how refrigeration and air conditioning system works.
CLO7. distinguish among pumps, blowers and compressors.
CLO8. understand the basics of steam generation.
CLO8. distinguish between mountings and accessories.
CLO9. determine the efficiency and power output of a steam generator.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2										X
CLO3				X						
CLO4	X									
CLO5										X
CLO6										X
CLO7										X
CLO8										X
CLO9	X									

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

Course No: SSS 100	Credit: 3.0	Year: First	Semester: First
Course Title: History of the Emergence of Independent Bangladesh		Course Status: Theory	

Course Description

This is a special compulsory course for all students of Bachelor program of Shahjalal University of Science and Technology, Sylhet. This course deals with the

interrelated themes and topics that are essential to understand the emergence of Bangladesh.

Course Objective

The of this course is make students understand about the causes of liberation war, rising of Bengali nationalism and identity, feelings of victory of Bangladesh. The specific course objectives are:

1) Give an outline about the concept of liberation war and freedom fighter.
2) Clarify the role of different people in liberation war.
3) Explain the role of Bangabandhu in liberation war.
4) Develop an insight about the value of the sacrifice of martyrs for motherland.

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

By studying this course the students will be able to:

CLO1. Know liberation war of Bangladesh and role of freedom fighters
CLO2. Know the causes of developing movement and nationalism
CLO3. Know different disparities and deprivation of Bangladesh by Pakistan
CLO4. Know the declaration and continuing breathtaking moments of liberation war.
CLO5. Know the lifelong contributions of of Bangabandhu Shekh Mujibor Rahman in the creation of independent Bangladesh.

Mapping of CLOS with PLOS:

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1					X					
CLO2					X					
CLO3										
CLO4					X					
CLO5			X		X		X			

Recommended texts:

1. Ahmed, Salahuddin and Bazlul Mobin Chowdhury (eds.), *Bangladesh: National Culture and Heritage: An Introductory Reader* (Dhaka: Independent University Bangladesh, 2004)
2. Harun-or-Roshid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-1947* (Dhaka : The University Press Limited, 2012)
3. Jahan Rounaq,*Pakistan: Failure in National Integration,(Dhaka :* The University Press Limited, 1977)
4. Maniruzzaman Talukder, *Radical Politics and the Emergence of Bangladesh, (Dhaka :* Mowla,Brothers, 2003)
5. Muhith, A M A,*History of Bangladesh: A Subcontinental Civilization*, (Dhaka: UPL, 2016)
6. Samad Abdus, *History of Liberation War of Bangladesh*, (Dhaka : Aparajeyo Bangla Prakashani, 2019)
7. Milton Kumar Dev, Md. Abdus Samad, *History of Bangladesh* (Dhaka : Biswabidyalya Prokasoni, 2014)
8. Schendel, Willem van : *A History of Bangladesh* (Cambridge: Cambridge University Press, 2009)
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‡ói 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 ivó³fvebv I e½eÜz,* (XvKv : Ab¨ cÖKvkb, 2018)

15. হাসান হাফজুর রহমান : □□□□□□□□□□ □□□□□□□□□□□□□□ □□□□□□□□, (m¤úvw`Z), (□□□□: MY□□□□□□□□□□□□ □□□□□□□□ □□□□□, ১৯৮৫)

16. ˆmq` 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‡`‡kigyw³hy× 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)

23. AvkdvK †nv‡mb, *evsjv‡`‡ki gyw³hy× I Bw›`³iv MvÜx* (XvKv : myeY© cÖKvkbx, 2017)

Course No: CHE 112Q	**Credit: 1.5**	**Year: First**	**Semester: First**
Course Title: Chemistry Sessional		**Course Status: Sessional**	

Course Objectives:

The objectives of this course are to

- Familiarize students with the basic concept of different titration techniques
- Develop student's necessary practical skill to perform an experiment for quantitative estimation

Course Content:

Volumetric analysis; Acidimetry-alkalimetry, Titrations involving redox reactions, determination of Fe, Cu and Ca volumetrically, Complexometric titration, determination of Ca and Mg ions in water.

Course Learning Outcomes:

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

CLO1. Calculate mole quantities, reaction ratio, molar concentration etc.

CLO2. Choose a suitable indicator for a particular titration technique

CLO3. Prepare standard solution and standardization of a solution of unknown concentration

CLO4. Differentiate between an end-point and equivalence-point in acid-base titration

CLO5. Design an oxidation-reduction reaction to determination the amount of specific metal in a sample solution

CLO6. Perform complexometric titration technique for determining the hardness of water

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	X									
CLO2						X				
CLO3		X								
CLO4	X									
CLO5								X		
CLO6		X								X

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 102 Q	Credit: 1.00	Year: First	Semester: First
Course Title: English Language Lab		Course Status: Sessional	

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.

Course Objectives

- To enable students' understanding of the variations in pronunciation
- To teach proper pronunciation and accurate articulation.
- To facilitate appropriate stress and intonation in speech.
- To encourage use of English effectively in everyday situations.
- To ensure overall improvement of oral communication through listening and speaking.

Course Content

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

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:

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

CLO1**:** read the symbols of the International Phonetic Alphabet used to represent the sounds of the English language.

CLO2: understand all that is being said in English in varied accents

CLO3: interpret information accurately

CLO4: apply appropriate intonation and stress patterns in English words and sentences.

CLO5: produce continuous speech clearly and convincingly.

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1			X							X
CLO2			X							X
CLO3					X					
CLO4			X							X
CLO5			X							

Evaluation

- IELTS, TOEFL and other standardized testing formats for assessing the level of listening skill are to 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.

Books Recommended:

Anderson, A. & Lynch, T. Listening. Oxford: Oxford University Press. 1988
Hancock, Mark. English Pronunciation in Use. New York: Cambridge University Press.
2004
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 J, et al. Person to Person. Oxford University Press, 2007
Richards, Jack C, and David Bohlke. Speak Now: 1. Oxford University Press, 2013
Roach, Peter. English Phonetics and Phonology. Cambridge University Press, 2009

Course No: MEE 172	**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:
CLO1. Perform basic sketching techniques
CLO2. Draw auxiliary views, orthographic projections and sections.
CLO3. Produce engineered drawings.
CLO4. Develop the ability to read and interpret engineering drawings created by others.
CLO5. Convert sketches to engineered drawings.
CLO6. Apply the four key principles which are accuracy, speed, neatness, and time management

CLO7. Communicate ideas graphically.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1						X				
CLO2								X		
CLO3						X				
CLO4								X		
CLO5						X				
CLO6			X					X		

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

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

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1						X				
CLO2								X		
CLO3						X				
CLO4								X		
CLO5						X				
CLO6			X					X		

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:

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

CLO1.Build thorough knowledge of various tools, machines, devices used in engineering practice

CLO2.carry out various operations in mechanical engineering workshop

CLO3. Utilize measuring skills gained in workshop practice

CLO4. Acquire “Hands on” training and practice to students for use of various tools, devices and machines

CLO5. Acquire skills in basic engineering practice for creating objects from raw materials

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1		X						X		
CLO2	X									X
CLO3		X				X		X		
CLO4		X			X			X	X	
CLO5		X			X			X	X	

Books Recommended:

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

First Year Second Semester

Course No: CHE 103Q	**Credit: 3.0**	**Year: First**	**Semester: Second**
Course Title: Chemistry of Engineering Materials		**Course Status: Theory**	

Course Objectives:

The objectives of this course are to

- 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, classification, manufacturing processes, 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, grapheme and its related application, carbon nano tube and its chemistry, fullerene and its application.

Lubricant and crude oil: Principle of lubrication, viscosity and its relationship with 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.

Course Learning Outcomes:

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

CLO1. Identify the raw materials and understand the composition, properties and uses of different types of glass, ceramic, cement, plastic, carbon, Lubricant and Paint

CLO2. Understand the chemical reactions take place during the manufacturing of glass, ceramic, cement, plastic, carbon, Lubricant and Paint

CLO3. Illustrate the physical & chemical properties of glass; demonstrate industrial manufacturing process of glass; describe the composition and use of special glasses

CLO4. Understand the basic concept on setting and hardening of cement

CLO5. Understand the use, function and importance of additives and its impact on plastics and environment; and understand the degradability of plastics and biodegradable plastics

CLO6. Understand the related chemistry on different form of carbon elements and their applications

CLO7. Describe the manufacture of paint and varnishes by using chemical substances and the future prospect of paint industry in Bangladesh

CLO8. Understand the energy generation and protection of metallic substances from corrosion

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	X									
CLO2						X				
CLO3		X								
CLO4	X									
CLO5		X								
CLO6										X
CLO7	X									
CLO8		X				X				

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

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. It will provide 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, CLO
After successful completion of the course, students will be able to:
CLO 01: acquire the skills to calculate the indefinite integral, definite integrals and improper integrals;
CLO 02: apply the ideas of accumulation to calculate areas and volumes;
CLO 03: analyze and combine ideas of accumulation in new contexts not specifically covered in the text;
CLO 04: formulate differential equation in different area of science and Engineering;
CLO 06: give an account of basic concepts and definitions for ordinary differential equations;
CLO 07: apply the fundamental concepts of ordinary differential equations for their resolution;
CLO 08: solve the differential equations of science and Engineering problems by choosing the most suitable method;
CLO 09: formulate and solve differential equation problems in the field of Engineering.

Mapping of CLOs with PLOs

PLO / CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO8	PLO8
CLO 01	X			X				X	X	X
CLO 02	X			X				X	X	X
CLO 03	X			X				X	X	X
CLO 04	X			X				X	X	X
CLO 05	X			X				X	X	X
CLO 06	X			X				X	X	X
CLO 07	X			X				X	X	X
CLO 08	X			X				X	X	X
CLO 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 109Q	Credit: 3.0	Year: First	Semester: Second
Course Title: Physics II		Course Status: Theory	

Course Objectives
The objectives of this course are:
- to facilitate necessary knowledge of Electricity and Magnetism.
- to develop skills for calculating electric field intensity and magnetic field intensity and understand their important application.
- to understand the fundamental knowledge of Modern Physics.

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
CLO1: gain the basic idea of electrostatic and solve the related problem.
CLO2: interpret magnetic force on a moving charge, torque on a current loop, Hall effect, Ampere's Law, Biot-Savart law and their applications.
CLO3: understand the idea of unification (electromagnetism) and derive electromagnetic wave equation; explain some phenomena using this theory.
CLO4: explain various phenomena related to Modern Physics and know the approach of quantum theory. to:

Mapping of the CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	X	X						X	X	X
CLO2	X	X						X	X	X
CLO3	X	X						X	X	X
CLO4	X	X						X	X	X

Books Recommended:

1. Halliday, D. and Resnick, R.: Physics (Vol. I & II)
2. Saha, M. N. and Srivastava, ATreatise on Heat.
3. Zemansky, Heat and Thermodynamics
4. Kip, A.: Fundamentals of Electricity and Magnetism
5. Beiser, A.: Concepts of Modern Physics

Course No: EEE 111Q	**Credit: 3.0**	**Year: First**	**Semester: Second**
Course Title: Fundamentals of Electrical & Electronic Engineering		**Course Status: Theory**	

Rationale

This is an introductory course which gives a thorough idea on different types of circuit analysis techniques to analyze simple and complex circuits. It also provides ideas about AC networks including the use of phasor and impedance diagrams. This course endeavors to build on this knowledge and further expand student's skill in analyzing and designing circuits involving transistors, diodes, operational amplifiers and basic logic gates. The course focuses on developing fundamental ideas and basic concepts on electrical equipment and electronic devices.

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-

CLO 1 Explain the Basic concepts of Electrical Circuits
CLO 2 Explain the basis operation of diode, and diode circuits
CLO 3 Interpret of AC networks and phasor
CLO 4 Apply network techniques to AC circuits and networks
CLO 5 Analyze the electrical circuits using different analysis methods and theorems
CLO 6 Distinguish between different MOSFET circuits
CLO 7 Design and analysis BJT amplifier circuits
CLO 8 Design and analysis JFET amplifier circuits
CLO 9 Analyze RLC circuit performance by hand.

Mapping of CLOs with PLOs

PLO/ CLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	X									
CLO 2	X									
CLO 3	X									
CLO 4	X									
CLO 5	X	X				X				
CLO 6		X								
CLO 7		X						X	X	
CLO 8		X						X		
CLO 9		X						X		

Recommended Books

1. Fundamental of Electric Circuits – Charles K. Alexander and Matthew N.O. Sadiku

Introductory Circuit Analysis by Robert L.Boylestad

2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashlesky
3. Microelectronic Circuits- Sedra/Smith

Course No: MEE 141	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/C++ programs.
- to help students to code, document, test, and implement a well-structured, robust computer program using the C/C++ 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 C++ programming languages; C and C++ fundamentals – data types and expressions; operators; Libraries and keywords; Statements; Arrays and strings; Functions; Control statements; Pointers; Input and output systems, Object oriented programming; Introduction to user interface, how to use programming languages to solve mechanical engineering problems.

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CLO1. Understand the advantages of a high-level language (C/C++), the programming process, and the compilation process.
CLO2. Describe and use software tools in the programming process.
CLO3. apply good programming principles to the design and implementation of C/C++ programs.
CLO4. Create and analyze algorithms for solving simple problems.
CLO5. Create and call functions that use parameter passing and return values.
CLO6. Develop code that includes the reuse of both existing code and calling functions in the C/C++ libraries
CLO7. Select appropriate data types for solving a variety of problems (e.g. integer, double, character and string data)
CLO8. Understand automatic type conversion rules, type casting, and determine the value and type of an expression involving mixed types
CLO8. Demonstrate the use of numeric arrays and c-style strings.
CLO9. Trace the execution of source code containing pointers

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2									X	
CLO3										X
CLO4	X								X	
CLO5									X	
CLO6										X
CLO7	X								X	
CLO8										X
CLO9									X	

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

Course Code: PHY 112Q	Credit: 1.5	Year: First	Semester: Second
Course Title: Physics Sessional		Course Status: Lab	

Course Objectives

The objective of this course is to enable the student to perform experiments to find out the numerical values of some physical observables based on various fundamental laws, principle and theorem of physics.

Course Content

Mechanics:

1. Determination of moment of inertia of a flywheel.
2. Determination of "g" by and moment of inertia of a compound pendulum.

Properties of matter:

3. Determination of Young's Modulus by the method of bending.
4. Determination of Rigidity Modulus by Static method.
5. Using a flat spiral spring: a) Verification of Hooke's Law and determination of stiffness constant; b) Determination of "g" and the effective mass of the spring; c) Determination of modulus of rigidity of the material of the spring.

Electricity:

6. Determination of galvanometer resistance by half deflection method.

Course Learning Outcomes

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

CLO1 calculate the moment of inertia of uniformly shaped rigid body exploiting the conservation of mechanical energy for both rotation and translation.

CLO2 observe the simple harmonic oscillation to determine the acceleration due to gravity at any place using any types of physical pendulum and compare the result with the standard value.

CLO3 realize Hooke's law involved in the elasticity interpreting load vs strain graph of the matter and able to determine the elastic moduli to choose the best material in mechanical usage

CLO4 construct a circuit to get current flowing and able to measuring the resistance.

CLO5 absorb the processes of data collection, data analysis, error calculation and able to do experiment precisely in a group

Mapping of the CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	X					X				
CLO2	X					X				
CLO3	X	X				X				
CLO4	X					X				
CLO5	X					X				

Recommended Books

1. Worsnop, B.L. and Flint, H.T.: Advanced Practical Physics
2. Chowdhury, S. A. and Basak, A. K.: ByaboharikPadarthaBidya
3. Ahmed, G. and Uddin, M.S.: Practical Physics

Course Code: EEE 112Q	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. This course teaches the fundamentals of electrical circuits, application of circuit laws, theorems and measuring techniques for DC circuits by experimentation. This course also explores the design, construction, and debugging of analog electronic circuits. It contains experiments investigating the performance characteristics of diodes, transistors, including the construction of AC circuits.

Course Objectives are

- To facilitate students with necessary knowledge of real-life dc circuits.
- Acquaint the students with the techniques of solving of different types of circuits by network theorem.
- To provide basic knowledge about voltage, current and load relationship in a network.
- To help students develop basic skills for transient analysis and steady state analysis of a capacitor and inductor network.
- To help students conceptualize about basic AC circuit and perform experiments on them.
- Accumulate basic ideas about diode, transistors, op-amps and their applications

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.

Course Learning Outcomes:

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

CLO 1 Explain the operation of BJT, JFET and MOSFET.
CLO 2 Identify BJT, JFET and MOSFET amplifier circuits
CLO 3 Impart the idea about complex circuit network.
CLO 4 Interpret transient response about capacitor and inductor circuits.
CLO 5 Calculate of operating point and perform DC analysis on circuits.
CLO 6 Differentiate between different types of diode circuits
CLO 7 Differentiate different types of electrical instruments and measuring devices.
CLO 8 Distinguish BJT and MOSFET switching circuits
CLO 9 Design AC electrical circuits on breadboard and perform measurements with electroni equipment
CLO 10 Design experiments to interpret different types of circuit analysis theorem and laws
CLO 11 Demonstrate team-based communication skills, magnify their moral standards and app in practical life

Mapping of CLOs with PLOs

PLO/ CLO	PL O 1	PL O 2	PL O 3	PL O 4	PL O 5	PL O 6	PL O 7	PL O 8	PL O 9	PL O 10
CLO 1						X				
CLO 2						X				
CLO 3						X				
CLO 4						X				
CLO 5						X				
CLO 6						X				
CLO 7						X				
CLO 8						X				
CLO 9								X	X	
CLO 10								X	X	
CLO 11					X					X

Recommended Books

1. Fundamental of Electric Circuits – Charles K. Alexander and Matthew N.O. Sadiku

Introductory Circuit Analysis by Robert L.Boylestad

2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashlesky
3. Microelectronic Circuits- Sedra/Smith

Course No: MEE 142	Credit: 1.0	Year: First	Semester: Second
Course Title: Programming Methodology for Mechanical Engineering Lab		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/C++ programming language
- To help students develop their critical and creative thinking for lifelong learning

Course Content:
Based on MEE141

Course Learning Outcomes:
After the successful completion of the course, students will be able to:
CLO1. Construct algorithms and flow charts as the part of problem analysis.
CLO2. Write, compile and debug programs in C/C++ language.
CLO3. Use different data types, operators and expressions in a computer program.
CLO4. Design and implement programs involving decision structures, loops, arrays, structures and unions.
CLO5. Design and implement programs using recursion, pointers and functions.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X								X
CLO2								X		
CLO3								X		
CLO4		X								
CLO5	X							X		X

Books Recommended:

4. TEACH YOURSELF C - Herbert Schildt
5. SCHAUM's Outlines Programming With C - Byron Gotteried
6. The C Programming Language - Brian W. Kernighan, Dennis M. Ritchie

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:
CLO1. Communicate with other mechanical engineering professionals, manufacturers of mechanical systems regardless their spoken language.
CLO2. Demonstrate basic concepts of the AutoCAD software
CLO3. Apply basic concepts to develop construction (drawing) techniques
CLO4. manipulate drawings through editing and plotting techniques
CLO5. Produce 2D Orthographic Projections, Section and Auxiliary Views
CLO6. Understand and demonstrate dimensioning concepts and techniques
CLO7. Demonstrate competency with multiple drawing and modification commands in SolidWorks.
CLO8. Create three-dimensional solid models.
CLO9. Create three-dimensional assemblies incorporating multiple solid models.
CLO10. Apply industry standards in the preparation of technical mechanical drawings

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2								X		X
CLO3	X							X		
CLO4	X							X		
CLO5								X		X
CLO6	X							X		
CLO7	X							X		
CLO8								X		X
CLO9	X							X		
CLO10.	X							X		X

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:
CLO1. Integrate the concept of machine design with fabrication.
CLO2. Analyze the feasibility of manufacturing specific pieces
CLO3. Operate machines safely
CLO4. Conduct themselves ethically and responsibly in a machine shop context
CLO5. Develop the skill of working in a group

Mapping of CLOs with PLOs

CLO /PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1	X									
CLO 2						X				
CLO 3						X		X		
CLO 4				X						
CLO 5					X		X			

Course No: MEE-188	**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:

CLO1. communicate effectively with other employees and workers in service life
CLO2. conduct solution for different practical problems
CLO3. be a good leader
CLO4. getting huge knowledge at a time
CLO5. understand about job viva to get a good job
CLO6. be introduced about practical service life

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1			X		X					
CLO2	X	X								
CLO3			X							
CLO4	X									X
CLO5							X			X
CLO6										X

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

CLO1 Compute the area and volume formed by the position vectors.
CLO2 Discuss the nature of vector functions using derivatives.
CLO3 Find the length of a curve line, surface area and volume of some models.
CLO4 Apply the mathematical knowledge of matrix and vectors to their related topics.
CLO5 Compute matrix algebra.
CLO6 Find the solution set of a system of equations.
CLO7 Determine linearly dependent and independent vectors.
CLO8 Determine characteristic roots and corresponding vectors.
CLO9 Apply Laplace transform to solve mathematical problems.

Mapping of the CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO1O
CLO1	X			X				X	X	X
CLO2	X			X				X	X	X
CLO3	X			X				X	X	X
CLO4	X			X				X	X	X
CLO5	X			X				X	X	X
CLO6	X			X				X	X	X
CLO7	X			X				X	X	X
CLO8	X			X				X	X	X
CLO9	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 (CLO)

Successful completion of this course should enable students to:

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

CLO 2. Understand the concept of elasticity quantitatively and qualitatively in economic analysis and know differences between different types of markets;

CLO 3.Explain macroeconomic concepts and use simple economic models to interpret the behaviour of key macroeconomic variables;

CLO 4. Understand monetary and fiscal policy and Government budget;

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

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1					X		X			
CLO2					X		X			
CLO3							X			
CLO4					X		X			
CLO5							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 CLOs

	CLO 1	CLO 2	CLO 3	CLO 4	CLO 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 231	**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 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:

CLO1. Explain fundamental concepts relevant to thermodynamics.

CLO2. Explain the concepts of work, power, and heat in thermodynamics; determine work and heat sign conventions.

CLO3. Explain the first and second law of thermodynamics.

CLO4. Perform energy analysis of refrigeration and heat pump thermodynamic cycles.

CLO5. Determine thermodynamic properties of pure substances.

CLO6. Apply the first law of thermodynamics for a control volume, including with turbines, compressors, nozzles, diffusers, heat exchangers, and throttling devices.

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Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1										X
CLO2										X
CLO3										X
CLO4		X				X				
CLO5						X				
CLO6	X	X				X				X

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

Course No: MEE 257	**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:

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

CLO1. Analysis and solve the practical problems of statics and dynamics

CLO2. Identify the moment of a force and calculate its value about a specified axis. Define the moment of a couple.

CLO3. Describe the concept of dry friction and analyze the equilibrium of rigid bodies subjected to this force.

CLO4. Construct "Free Body Diagrams" of real-world problems and apply Newton's Laws of motion and vector operations to evaluate equilibrium of particles and bodies.

CLO5. Apply the principles of equilibrium of particles and bodies to analyze the forces in planar truss members.

CLO6. Discuss the concepts of “center of gravity” and “centroids” and compute their location for bodies of arbitrary shape.

CLO7. Apply the concepts used for determining center of gravity and centroids to find the resultant of a generally distributed loading.

CLO8. Explain basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts)

CLO9. Explain basic dynamics concepts – force, momentum, work and energy;

CLO10. Explain and be able to apply Newton’s laws of motion;

CLO11. Explain and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution;

CLO12. Apply all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces)
CLO13. Demonstrate how to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X								X	
CLO3	X									X
CLO4	X								X	X
CLO5	X									X
CLO6	X									X
CLO7	X									X
CLO8	X									X
CLO9	X									X
CLO10	X									
CLO11	X									X
CLO12									X	
CLO13	X									X
CLO14	X									X
CLO15						X			X	

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 213Q	**Credit: 3.0**	**Year: Second**	**Semester: First**
Course Title: Fundamentals of Electrical Machines		**Course Status: Theory**	

Rationale:

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 teach 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 generated voltage, terminal voltage, currents, load power factors, input and output power, efficiency, and voltage regulation in transformers.
- To help the students develop skills to solve problems relating to 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 teach the construction, characteristics, operation and application of both DC and AC machines including dc motor, dc generator, alternator and synchronous motor.

- To help the students develop skills to solve problems relating to generated voltage, terminal voltage, currents, torque, speed, input and output power, efficiency, and voltage/speed regulation in DC generators.
- To help the students develop skills to solve problems relating to rotor speed, flux, torque, developed power, efficiency in DC motors.
- To help the students develop skills to solve problems relating to generated voltage, terminal voltage, current, frequency, load power factors, and synchronous impedance in poly-phase alternators.
- Helping the students to develop ability to safely wire and operate electrical rotating machines and their associated metering and starting equipment.
- To describe 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.
CLO 2 Identify the inadequacies of Transformers and how to reduce them.
CLO 3 Understand three phase power generation and distribution system.
CLO 4 Explain induction motor design and working principle.
CLO 5 Understand the three-phase synchronous generator operating principle.
CLO 6 Understand DC machine design and working principle.
CLO 7 Apply measures for efficient operation of electrical machines
CLO 8 Calculate Transformer, induction motor parameters and DC machine parameters theore practically.
CLO 9 Interpret synchronous generators voltage regulation on different loads
CLO 10 Differentiate between AC and DC machines.
CLO 11 Design systems with parallelly connected generators.
CLO 12 Evaluate which machine is effective in different conditions.
CLO 13 Formulate proper procedure for speed control, starting and braking.

Mapping of CLOs with PLOs

PLO/ CLO	PLO 1	PLO2	PLO3	PLO4	PLO 5	PLO6	PLO 7	PLO 8	PLO 9	PLO 10
CLO 1									X	
CLO 2	X									
CLO 3	X									
CLO 4	X									
CLO 5	X									
CLO 6	X									
CLO 7	X									
CLO 8								X		
CLO 9	X									
CLO 10										
CLO 11									X	
CLO 12								X	X	
CLO 13								X		

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 232	**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:

CLO1.Apply energy balance to systems and control volumes, in situations involving heat and work interactions.

CLO2.Evaluate changes in thermodynamic properties of substances.

CLO3. Evaluate the performance of energy conversion devices.

CLO4. Differentiate between high grade and low-grade energy.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X								
CLO2						X				
CLO3						X		X		
CLO4		X							X	
CLO5										
CLO6										
CLO7										
CLO8										
CLO9										

Books Recommended:

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

Course Code: EEE 214Q	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, electronics, and electromagnetism. Generation of electricity includes electric machineries. So, student should have insight knowledge of how electric machineries works and how to handle them. The theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices used in Energy Conversion. This course is designed to complement the theoretical course EEE 213Q.
Pre-requisite: EEE 112Q Fundamentals of Electrical and Electronic Engineering Lab.

Course objectives are:

- To facilitate necessary knowledge about different DC and AC machines and handle various lab apparatus.
- To determine 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.
- To describe 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 help students determine voltage regulation of dc generator.
- To provide basic knowledge to obtain O.C.C and loading curve of synchronous generator.
- To provide basic knowledge to obtain V-curve of synchronous motor.

Course Contents:

Lab 1: Familiarization with the lab, its equipment and laboratory regulation.
Lab 2: Determination of voltage transformation ratio and turn ratio of a single phase transformer.
Lab 3: Determination of regulation and efficiency with resistive, inductive and capacitive loading of a single phase and three phase transformer.
Lab 4: Short circuit and open circuit of single phase transformer.
Lab 5: No load test and blocked rotor test of three phase induction motor.
Lab 6: Three phase induction motor speed control and drawing torque-speed curve.
Lab 7: Single phase capacitor-run induction motor speed control.
Lab 8: Determining torque-speed characteristics of DC motor.
Lab 9: Determining voltage regulation of DC shunt generator.
Lab 10: No load and loading characteristics of synchronous generator.
Lab 11: Determining V-curve of synchronous motor.

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.
CLO 2	Identify and interpret different electrical machines.
CLO 3	Calculate transformer and induction motor parameters practically.
CLO 4	Draw equivalent circuit of transformers and induction motors from experiments.
CLO 5	Apply induction motor speed control techniques.
CLO 6	Calculate synchronous generators voltage regulation on different loads.
CLO 7	Calculate DC machine parameters theoretically and practically.
CLO 8	Calculate electrical system's efficiency and improve it.
CLO 9	Interpret torque-speed characteristics of different machines.
CLO 10	Differentiate between synchronous motor and machine V-curve.
CLO 11	Differentiate between AC and DC machines

Mapping of CLO with PLO

PLO/ CLO	PL O1	PL O2	PL O 3	PL O 4	PL O 5	PL O 6	PL O 7	PL O 8	PL O 9	PL O 10

CLO 1					X					
CLO 2					X					
CLO 3					X					
CLO 4					X					
CLO 5								X		
CLO 6					X					
CLO 7					X					
CLO 8					X				X	
CLO 9								X		
CLO 10					X					
CLO 11					X					

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 (CLOs):

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 CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO1O
CLO1	X									
CLO2	X									
CLO3	X									
CLO4	X									
CLO5	X									
CLO6	X									
CLO7	X									
CLO8	X									
CLO9	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 259	**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:

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

CLO1. Analysis and solve the practical problems of statics and dynamics

CLO2. Identify the moment of a force and calculate its value about a specified axis. Define the moment of a couple.

CLO3. Describe the concept of dry friction and analyze the equilibrium of rigid bodies subjected to this force.
CLO4. Construct "Free Body Diagrams" of real-world problems and apply Newton's Laws of motion and vector operations to evaluate equilibrium of particles and bodies.
CLO5. Apply the principles of equilibrium of particles and bodies to analyze the forces in planar truss members.
CLO6. Discuss the concepts of "center of gravity" and "centroids" and compute their location for bodies of arbitrary shape.
CLO7. Apply the concepts used for determining center of gravity and centroids to find the resultant of a generally distributed loading.
CLO8. Explain basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts)
CLO9. Explain basic dynamics concepts – force, momentum, work and energy;
CLO10. Explain and be able to apply Newton's laws of motion;
CLO11. Explain and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution;
CLO12. Apply all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces)
CLO13. Demonstrate how to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X								X	
CLO3	X									X
CLO4	X								X	X
CLO5	X									X
CLO6	X									X
CLO7	X									X
CLO8	X									X
CLO9	X									X
CLO10	X									
CLO11	X									X
CLO12									X	
CLO13	X									X
CLO14	X									X
CLO15						X			X	

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 245	**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:
After the successful completion of the course, students will be able to:
CLO1. formulate and apply numerical techniques for root finding, curve fitting, differentiation, and integration.
CLO2. employ the Taylor Series for approximation and error analysis.
CLO3. model engineering systems using first and second order differential equations and solve the equations both analytically and numerically.
CLO4. Apply different numerical methods to solve real life engineering problems.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X								
CLO2	X	X								
CLO3	X	X				X				
CLO4		X								X

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

Course No: MEE253	**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:
CLO1. Understand how to calculate axial, thermal and centrifugal stresses
CLO2. Distinguish between different kinds of applied load
CLO3. Understand different types of stress in thin-walled cylinder and predict the fracture profile
CLO4. Understand different methods to draw share force and bending moment diagram
CLO5. Calculate beam deflection by integration and area moment method
CLO6. Calculate angle of twist due to torsion
CLO7. Understand how to determine principle stress, and share stress by using formula and Mohr's Circle
CLO8. Calculate critical load of columns
CL09. Understand different types of failure theories

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X					X				
CLO3	X	X						X		
CLO4	X							X		
CLO5	X									
CLO6	X					X				
CLO7	X							X	X	
CLO8	X					X				
CLO9						X		X		

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

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:

CLO1. explain basic relationships between structure and properties of metallic, ceramic and polymeric materials as well as composites,

CLO2. make qualitative comparisons between materials and application areas for the most common technical materials in the various materials categories,

CLO3. interpret and use binary phase diagrams

CLO4. explain the underlying mechanisms for hardening of metals,

CLO5. describe various methods for testing material properties.

CLO6. know different fabrication procedures of polymer composites.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X

CLO2		X				X				
CLO3		X				X				
CLO4	X									X
CLO5		X				X		X		
CLO6		X						X		

Books Recommended:

1. Krishan K Chawla, composite materials
2. Sidney H Avner, Intro to Physical Metallurgy
3. 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:

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

CLO1. formulate a MATLAB code to solve engineering programs.

CLO2. formulate and apply numerical techniques for root finding, curve fitting, differentiation, and integration with MATLAB

CLO3. employ the Taylor Series for approximation and error analysis by help of MATLAB

CLO4. Using MATLAB, model engineering systems using first and second order differential equations and solve the equations both analytically and numerically

CLO5. apply different numerical methods to solve real life engineering problems by using MATLAB.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X				X		X		X
CLO2	X	X				X		X		X
CLO3	X					X		X		X
CLO4		X						X		X
CLO5								X		X

Books Recommended:

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

Course No: MEE 254	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:
CLO1. Calculate hardness by using the Rockwell Hardness testing machine
CLO2. Determine the Hardness of the given specimens using Rockwell Hardness Testing Machine
CLO3. Observe the failure pattern of different metals tested in different scale
CLO4. Perform compression test of metal block on UTM
CLO5. Observe the effect of slenderness ratio
CLO6. Operate Impact testing machine and evaluate the energy absorbing characteristics of metal materials at room temperature using the Charpy, Izod, and tension impact methods
CLO7. Observe the failure patterns and failure surface
CLO8. Observe the tensile strength of different steel grades
CL09. Determine Bending stress of metal beam and whirling speed of column

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1						X				
CLO2	X									
CLO3						X				
CLO4	X					X		X		
CLO5									X	
CLO6	X									
CLO7									X	
CLO8									X	
CLO9	X									

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:
CLO1.Identify crystal structures for various materials and understand the defects in such structures;
CLO2.Understand how to tailor material properties of ferrous and non-ferrous alloys;
CLO3. Quantify mechanical integrity and failure in materials
CLO4. Identify micro-structures of metals based on different heat treatment processes

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X					X				
CLO2		X						X		
CLO3						X			X	
CLO4		X				X				

Books Recommended:

1. Sidney H Avner, Intro to Physical Metallurgy

Course No: MEE-288	**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:
CLO1. communicate effectively with other employees and workers in service life
CLO2. conduct solution for different practical problems
CLO3. be a good leader
CLO4. getting huge knowledge at a time
CLO5. understand about job viva to get a good job
CLO6. be introduced about practical service life

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10

CLO1			X		X					
CLO2	X	X								
CLO3			X							
CLO4	X									X
CLO5							X			X
CLO6										X

Third Year First Semester

Course No: MEE 321	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:
CLO1. Understand fluid and their various properties
CLO2. Distinguish between liquids and gases
CLO3. Understand different types of fluid flow, system and control volume concept
CLO4. Analyze practical problems based on Newton's law of viscosity
CLO5. Calculate stress and pressure variation in fluid
CLO6. Identify different types of manometer and solve practical problems based on manometry
CLO7. Apply the fundamental equations of fluid mechanics in problem solving
CLO8. Calculate buoyancy, metacenter, and metacentric height
CLO9. Calculate pressure, velocity and flow rate from various devices using corresponding formula

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3	X					X				
CLO4	X					X				
CLO5								X		
CLO6	X							X		
CLO7						X		X		
CLO8								X	X	
CLO9	X					X		X		

Books Recommended:

1. Mechanics of Fluids- Irving H. Shames

2. Fluid Mechanics- Frank M. White
3. Fundamentals of Fluid Mechanics- Munson

Course No: MEE331	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:

CLO1. identifying basic heat transfer mechanisms (conduction and radiation).

CLO2. analyze Heat transfer by conduction in solids for steady-state and transient conditions.

CLO3. calculate heat transfer by conduction and thermal radiation for practical situations.

CLO4. investigate about for transient heat conduction.

CLO5. calculate heat conduction from different types of finned surfaces.

CLO6. develop numerical solution for conduction and radiation heat transfer.

CLO7. understand radiation for blackbody and net radiation interchange for different geometries.

CLO8. apply solar radiation in Bangladesh.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X	X				X				
CLO3	X	X				X				X
CLO4	X	X				X				X
CLO5	X	X				X				X
CLO6	X	X				X				X
CLO7	X	X				X				X
CLO8							X			

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: MEE351	**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 will be able to:

CLO1. Understand how to calculate velocity and acceleration by drawing velocity diagram and acceleration diagram
CLO2. Understand how to draw turning moment diagram for different conditioned engines
CLO3. Understand static and dynamic balancing for reciprocating and rotating parts of different types of engines
CLO4. Explain about balancing machines
CLO5. Interpret different degree of freedoms
CLO6. Calculate whirling frequency
CLO7. Understand how to determine frequency for Damped free and forced vibrations with single degree of freedom
CLO8. Outline how to draw displacement, velocity and acceleration diagrams for different moves of follower
CLO9. Understand about power transmission devices and their merits and demerits
CL10. Determine the effect of Gyroscopic couple on Aeroplane, Naval Ship and Four-Wheeler Vehicle

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X								
CLO2	X									
CLO3	X	X								
CLO4	X									
CLO5	X							X	X	
CLO6	X	X						X		
CLO7		X				X				
CLO8								X		
CLO9	X							X		

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

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:
CLO1. Distinguish different kinds of turning operations
CLO2. Differentiate between shaping and milling operation
CLO3. Understand tool geometry and know and about cutting tool angle
CLO4. Identify what is Forging and it's types
CLO5. Understand about Extrusion processes and their advantages and disadvantages
CLO6. Understand the process of different types of weldings and know their advantages and disadvantages
CLO7. Differentiate between Brazing and soldering
CLO8. Understand the product manufacturing process using plastic, ceramic and glass
CL09. Outline the procedure for making gears using milling machine

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1						X			X	
CLO2						X		X	X	
CLO3								X		
CLO4									X	
CLO5									X	
CLO6								X		X
CLO7										X
CLO8		X				X				X
CLO9		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 307Q	**Credit: 3.0**	**Year: Third**	**Semester: First**
Course Title: Industrial Sociology		**Course Status: Theory**	

Course Rational:
The base of work as a human organisation in the industry, how the work is being organised in an industrial organisation, how the labour is abstracted in the industrial

work process, how the issue between labour and management is constructed and how the labour welfare measures are implemented will be the rationale for the students of Mechanical Engineering. Hence, this course is designed to provide an understanding of sociology of industry, labour, human relations and conflict management.

Course Objectives:

- To provide knowledge on the subject matter and the distinctiveness of industrial sociology.
- To develop an understanding of key sociological concepts such as society, association, institution, work ideology, work attitude, work satisfaction, work commitment, formal relation in factory system, industrial bureaucracy;
- To familiarize students with nature and causes of industrial conflict, conflict management, and the role of trade union.
- To develop knowledge on 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 the completion of this course, students will be able to:

CLO1: Explain the scope and the development of industrial sociology.

CLO2: Describe and explain the appropriate concepts including society, association, institution, work ideology, work attitude, work satisfaction, work commitment, formal relation in factory system, industrial bureaucracy.

CLO3: Can explain nature and causes of industrial conflict and the role of trade union.

CLO4: Describe and explain the patterns of industrial development, and how industrialization shaped our societies and everyday lives.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1				X						
CLO2					X		X			X
CLO3				X						
CLO4										X

Books Recommended:

1. Ivar Berg, Industrial Sociology
2. Watson: Sociology, work and industry

Course No: MEE 322	**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:

CLO1. Understand the effects of changing the position of the vertical center of gravity to the stability of a rectangular pontoon.

CLO2. Calculate the metacentric height of a pontoon

CLO3. Calculate the Co-efficient of Discharge at the venture and plot the Hydraulic and the Total Energy gradient lines in a scaled diagram of the apparatus (Bernoulli's equation verification)

CLO4. Calculate theoretical impact force and actual impact force at different jet velocity

CLO5.Estimate moment of forces acting on both partially and fully submerged body and compare with the theoretical moments

CLO6. Identify the location of the Centre of pressure

CLO7. Calculate theoretical flow rate from the orifice meter and hence the co-efficient of discharge

CLO8. Calculate theoretical discharge and actual Discharge over the weirs

CLO9. Develop communication skill through report writing and oral test

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X					X				
CLO2	X					X				
CLO3	X					X				
CLO4	X					X				
CLO5	X					X				
CLO6	X					X				
CLO7	X					X				
CLO8	X					X				
CLO9			X		X					

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:
CLO1: explain basic heat transfer mechanisms (conduction andradiation).
CLO2: analyze conduction heat transfer through rectangular and cylindrical body.
CLO3: calculate the effect of extended surfaces (fin) on heat transfer.
CLO4: conduct experiment on blackbody radiation and analyze radiation heat transfer.
CLO5: evaluate transient heat transfer.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1						X				X
CLO2	X								X	X
CLO3	X								X	X
CLO4	X								X	X
CLO5						X				X

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

Course No: MEE352	**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 able to:
CLO1. Calculate angular and longitudinal positions of counter balancing weights for static and dynamic balancing of an unbalanced rotating mass system and check experimentally that the positions of counter balancing weights calculated are correct
CLO2. Determine the frequency of small vibration of a pendulum by theoretical and experimental means
CLO3. Determine the mass moment of inertia of a flywheel by falling weight method and determine the frictional torque
CLO4. Determine the relation between the reaction torque and the processional speed

CLO5. Determine experimentally the critical speed of a transversely loaded rotating shaft and compare it with the theoretically calculated value
CLO6. Measure the displacement of the follower at different cam angles
CLO7. plot the displacement versus cam angle curves and compare the actual curves with the theoretical curves
CL08. Develop the skill of group work and discussion

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3	X									
CLO4								X		
CLO5	X					X	X	X		
CLO6	X									
CLO7						X	X	X		
CLO8			X		X					

Books Recommended:

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

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:
After the successful completion of the course, students will be able to:
CLO1. Understand the process of sand casting
CLO2. Differentiate different casting defects
CLO3. Perform different wielding operations practically
CLO4. Differentiate advantages and disadvantages of Arc-Welding, TIG MIG Welding, Spot welding and Resistance welding
CLO5. Understand different types of Turning operations
CLO6. Perform Direct Extrusion and Indirect Extrusion process and differentiate between them
CLO7. Perform different types of Rolling operation and learn about their limitations

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1						X				
CLO2						X				
CLO3								X		
CLO4								X		
CLO5	X					X		X		

CLO6								X		
CLO7								X		

Books Recommended:

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

Course No: MEE 382	**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:

CLO1. Combine theoretical knowledge with industrial knowledge.

CLO2. Identify their prospective area of work.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1				X	X		X			X
CLO2							X			X

Third Year Second Semester

Course No: MEE 323	**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 will be able to:

CLO1. Apply Rayleigh method and Buckinghum Pi theorem for dimensional analysis.

CLO2. Analyze different model-prototype related problems using different dimensionless numbers

CLO3. Calculate frictional loss in a pipe using Dercy-Weisbach equation and also calculate minor losses in pipe fittings, valves etc.

CLO4. Differentiate between laminar and turbulent flow and use Moody chart

CLO5. Calculate displacement thickness, energy thickness, momentum thickness from the velocity profile of the fluid flow

CLO6. Analyze practical problems related to open channel flow

CLO7. Design the economic cross section for a particular shaped channel

CLO8. Calculate the fluid flow properties at stagnation states of a compressible flow

CLO9. Understand the complexities of compressible flow e.g. shock which will trigger the students for further research on shock control and so on.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X	X				X				
CLO3		X						X		X
CLO4	X	X								
CLO5	X					X				
CLO6	X					X				
CLO7		X						X		
CLO8	X					X				
CLO9	X		X							X

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:

CLO1. explain Basic heat transfer mechanisms through convection in closed conduits and on external surfaces.

CLO2. analyze heat transfer through phase change (boiling and condensation).

CLO3. differentiate between laminar and turbulent flow.

CLO4. calculate heat transfer co-efficient for both natural and forced convection for different geometry.

CLO5. analyze heat exchanger by using log mean temperature difference (LMTD) and heat exchanger effectiveness (NTU) method.

CLO6: calculate mass transfer by analogy to heat transfer surfaces.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1										X
CLO2	X	X				X				
CLO3	X									X
CLO4	X	X				X				
CLO5	X	X				X				X
CLO6	X	X				X				X

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, AndrianBejan, John Wiley and Sons. Inc.

Course No: MEE353	**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:
CLO1. understand the customers' need, formulate the problem and draw the design specifications.
CLO2: formulate and analyze stresses and strains in machine elements and structures in 3-D subjected to various loads.
CLO3. perform tolerance analysis and specify appropriate tolerances for machine design applications.
CLO4. understand the concepts of principal stresses, theories of failure, stress concentration.
CLO5. apply multidimensional fatigue failure criteria in the analysis and design of mechanical components.
CLO6. analyze and design welded joints.
CLO7. approach a design problem successfully, taking decisions when there is no unique answer.
CLO8. demonstrate knowledge on basic machine elements used in machine design,
CLO9. design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
CLO10. analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X						X			
CLO2	X	X				X				X
CLO3	X	X				X	X			X
CLO4	X	X				X				X
CLO5	X	X				X				
CLO6	X	X				X				X
CLO7	X					X				
CLO8	X							X		X
CLO9								X	X	
CLO10	X					X			X	

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

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:

CLO1. understand instrumentation and define terms associated with instrumentation.

CLO2. use various sensing element to sense different properties.

CLO3. measure various physical parameter with the proper selection of instrument.

CLO4. conduct automation in different process industry.

CLO5. conduct data acquisition and processing.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1									X	X
CLO2		X		X		X			X	X
CLO3	X	X		X		X			X	X
CLO4	X	X			X	X	X	X	X	X
CLO5	X					X				X

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:
CLO1. Identify a proper clamping device for work piece holding
CLO2. Understand different types of slideways and their material
CLO3. Identify the major components of machine tools and find out any problem if occurs
CLO4. Analyze the vibration caused by machine tools and take proper steps
CLO5. Apply knowledge for a machine tool installation
CLO6. Apply the acceptance tests necessary for machine tools
CLO7. Design a gearbox
CLO8. Apply their knowledge for properly running a machine shop

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3	X			X		X				
CLO4				X		X				
CLO5	X				X					
CLO6	X					X				
CLO7		X						X		
CLO8			X	X			X			

Books Recommended:

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

Course No: MEE 324	**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:
CLO1. Calculate the velocity profile in a pipe flow
CLO2. Calculate the flow rate and co-efficient of discharge of a nozzle
CLO3. Distinguish between major loss and minor loss of a pipe flow
CLO4. Calculate the frictional loss in a pipe flow using Darcy-Weisbach equation
CLO5. Identify different types of pipe fittings and valves
CLO6. Calculate the minor loss in a pipe flow
CLO7. Develop writing skill through report writing based on each experiment
CLO8. Develop communication and speaking skill through oral test

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X					X				
CLO2	X					X				
CLO3	X									
CLO4	X					X				

CLO5	X								X	
CLO6	X					X				
CLO7			X		X					
CLO8			X							

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:
CLO1: analyze heat transfer coefficient for both external and internal flow
CLO2: explain the rate of heat transfer in case of boiling and condensation.
CLO3: analyze heat exchanger by using log mean temperature difference (LMTD) and heat exchanger effectiveness (NTU) method.
CLO4: Calculate mass transfer by analogy to heat transfer surfaces.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X				X				X
CLO2	X					X			X	X
CLO3	X	X								X
CLO4	X	X				X				X

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

Course No: MEE354	**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:
CLO1. understand the customers' need, formulate the problem and draw the design specifications.
CLO2. solve for the value of stresses and strains in machine elements and structures in 3-D subjected to various loads.
CLO3. do tolerance analysis and specify appropriate tolerances for machine design applications.
CLO4. solve problem for the value of minimum dimension by using the theories of failures.
CLO5. solve problems related to fatigue failure.
CLO6. solve structural joints related problem including riveted, bolted and welded joints.
CLO7. Design structural joints and mechanical springs.
CLO8. Analyze and design power transmission shafts carrying various elements with geometrical features.
CLO9. Analyze and design different types of gears
CLO10. Understand standards, safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X					X				X
CLO2	X	X							X	X
CLO3	X	X				X				X
CLO4	X	X							X	X
CLO5	X	X				X			X	X
CLO6	X	X				X				X
CLO1	X	X						X		
CLO2	X	X						X		
CLO3	X	X						X		
CLO4		X						X		X

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

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:
CLO1. use various sensing element to sense different properties.
CLO2. measure various physical parameter with the proper selection of instrument.
CLO3. develop a project with automation by using their knowledge.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1		X		X		X	X		X	X
CLO2		X		X		X			X	X
CLO3	X	X	X	X	X	X	X	X	X	X

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-388	**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:
CLO1. communicate effectively with other employees and workers in service life
CLO2. conduct solution for different practical problems
CLO3. be a good leader
CLO4. getting huge knowledge at a time
CLO5. understand about job viva to get a good job
CLO6. be introduced about practical service life

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1			X		X					
CLO2	X	X								
CLO3			X							
CLO4	X									X
CLO5							X			X
CLO6										X

Fourth Year First Semester

Course No: MEE 421	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:
CLO1. explain the types of fluid machinery.
CLO2. analyzedifferent types of turbines theoretically and mathematically to select the best one.
CLO3. analyzedifferent types of pumps theoretically and mathematically to select the best one.
CLO4. apply dimensional analysis to compare similar types of hydraulic machine.
CLO5. explain about fan, blower and compressor to use practically.
CLO6. calculate hydraulic Transmission.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X	X				X				
CLO3	X					X				X
CLO4	X					X			X	
CLO5		X					X			X
CLO6	X						X			

Books Recommended:
1. A textbook of Fluid Mechanics and Hydraulic machine - Dr. R.K. Bansal
2. Hydraulic Machine - Dr. Md. Quamrul Islam

Course No: MEE 431	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 the course, students will be able to:
CLO1. Identify a particular engine type and operate them
CLO2. Evaluate the performance of an engine by conducting different tests
CLO3. Distinguish between SI and CI engine combustion including their fuel injection system
CLO4. Apply necessary steps to reduce knocking in any type of engines
CLO5. Understand the fuel properties and choose a proper fuel for a specific engine
CLO6. Understand the problems associated with emission and take necessary measures to control the emission from IC engines
CLO7. Calculate MEP, BMEP, volumetric efficiency, mechanical efficiency, stoichiometric ratio of an engine
CLO8. Identify a proper fuel injection system for an engine
CLO9. Analyze air standard cycle and fuel air cycle and use the equilibrium chart

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X					X				
CLO2	X					X			X	
CLO3	X									
CLO4		X								
CLO5	X									
CLO6	X	X							X	
CLO7		X								
CLO8	X									
CLO9	X					X				

Books Recommended:
1. Internal Combustion Engine Fundamentals- John B. Heywood

Course No: MEE 477	**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 schedule.
- 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:
After the successful completion of the course, students will be able to:
CLO1. Develop various operating cost components and business strategies for operations management.
CLO2. Develop and analyze operations performance measurements and analysis for continuous improvement.
CLO3. Describe and determine the effect of product, process, inventory costs, product forecasting, operations strategies, and schedule design parameters on design of materials requirements planning, inventory planning, capacity planning, and production planning/control systems.
CLO4. Apply and analyze forecasting models to develop business enterprise forecasts for product demand, profits, sales, material requirements, capacity requirements, etc.
CLO5. Identify the impact of production/inventory cost decisions and operations strategies on the break-even, return on investment and profit analysis of a business enterprise.
CLO6. Develop and analyze production and inventory planning/control systems, and scheduling techniques by using engineering techniques for a complete production facility.
CLO7. Perform and analyze methods of evaluating operations location alternatives.
CLO8. Develop and analyze the capacity planning process. Identify characteristics and relationship to business operations in regard to managing product demand versus product capacity.
CLO9. Design, develop, and analyze a Master Production Schedule and a resultant Materials Requirement Plan (MRP) for a complete production facility.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3						X				
CLO4	X									
CLO5					X					X
CLO6	X									
CLO7	X									
CLO8	X									X
CLO9						X				X

Books Recommended:
1. **Elements of Production Planning and Control -** *Samuel Eilon*
2. **Modern Production / Operations Management -** *Baffa&RakeshSarin*

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 idea about the turbine and pump.
- To develop skills on Pelton wheel, Francis Turbine and Kaplan Turbine.
- To enhancing the skill on for centrifugal pump.
- 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:
CLO1. understand the types of fluid machinery and its concept.
CLO2. analyze impulse and reaction turbine and select the better one depending upon the given conditions.
CLO3. analyze experimentally and mathematically centrifugal pump to make proper applications
CLO4. conduct analysis when two pumps are in series or parallel.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1		X					X			X
CLO2		X		X		X	X			X
CLO3		X		X		X	X			X
CLO4	X	X							X	X

Books Recommended:
1. Hydraulic Machine; Dr. Md. Quamrul Islam

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:
CLO1. Distinguish between SI and CI engines
CLO2. Understand fuel injection system, air intake system, luboil system, ignition system, cooling system, exhaust system of an engine and represent them in block diagram
CLO3. Identify different parts of SI and CI engine after dismantling
CLO4. Understand clearly how the SI and CI engine works
CLO5. Evaluate the performance of a particular engine based on the engine parameters
CLO6. Demonstrate the skill of group work and discussion

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X					X				
CLO3	X									
CLO4	X									
CLO5						X				
CLO6			X		X					

Course No: MEE 484	**Credit: 1.0**	**Year: Fourth**	**Semester: First**
Course Title: Industrial Training		**Course Status: Sessional**	

Course Objectives:
The objectives of this course are:

- To provide comprehensive learning platform to students where they can enhance their employ ability 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 helps in finding their own proficiency.
- To cultivate 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:
CLO1. apply fundamental principles of engineering.
CLO2. Become master in one's specialized technology
CLO3. Become updated with all the latest changes in technological world
CLO4. communicate efficiently
CLO5. Become a multi-skilled engineer with good technical knowledge, management and leadership.
CLO6. Identify, formulate and model problems and find engineering solution based on a systems approach.
CLO7. Show the capability and enthusiasm for self-improvement through continuous professional development and life-long learning
CLO8. Understand the social, cultural, global and environmental responsibility as an engineer.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2							X			X
CLO3							X		X	
CLO4			X							
CLO5				X	X		X			
CLO6	X					X				X
CLO7				X			X			X
CLO8		X		X						

Course Code: MEE 480	**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:
After the successful completion of the course, the student will be able to

CLO 1 Explain basic knowledge on how to pursue scientific fact.

CLO 2 Explain basics of planning and performance of a scientific work.

CLO 3 Explain basics of analysis of scientific data.

CLO 4 Illustrate basic knowledge on how to present scientific work.

CLO 5 Obtain Theoretical and practical professional specialization within Mechanical Engineering including understanding of the current research questions.

CLO 6 Search scientific literature.

CLO 7 Summarize scientific literature.

CLO 8 Discuss scientific data related to the question at hand.

CLO 9 Present scientific data and conclusions in written and oral form addressed to different groups.

CLO 10 Understand and analyze ethical issues in an adequate manner related to the scientific work.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1									X	
CLO2	X					X				
CLO3						X				
CLO4	X					X			X	
CLO5										X
CLO6						X				
CLO7						X				
CLO8	X	X				X		X	X	X
CLO9			X		X		X			
CLO10				X						X

Fourth Year Second Semester

Course No.: IPE 405Q	Credit: 3.0	Year: Fourth	Semester: Second
Course Title: Industrial Management		Course Status: Theory	

Rationale of the Course:
The purpose of this course is to provide an understanding of the theories and principles of industrial management and encourage the course participants to make an appreciation of 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 basic principles of management, and the five major functions of managers e.g. planning, organizing, staffing, leading and controlling and 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 employment function as well as wage and incentive scheme
- let the students understand about different marketing issues and fundamental of technology management.

Course Content:

Organization and management: evolution, management functions, organization structure, development of organization theory, study of various types of

organization and management information systems, concepts and scope of application. Personnel management: importance, scope, need hierarchy, motivation, defense mechanism, productivity and satisfaction, leadership, group dynamics, job evaluation and merit rating personnel development-hiring, training, 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, CLO

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

CLO 1: understand the theories and principles of management and able to design an organogram
CLO 2: describe contemporary theories of motivation and discuss the challenges managers face in motivating distinctive group of people
CLO 3: know about leadership and implement its ideas in organizations/industries
CLO 4: know about different task of personnel management such as recruitment, selection, wages and incentives
CLO 5: identify what marketing strategies organizations might practice to attract and retain customer
CLO 6: understand the concepts and techniques of strategic management of technology.

Mapping of CLOs with PLOs

PLO / CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO 1							X			
CLO 2		X	X		X					
CLO 3					X		X			
CLO 4										X
CLO 5			X							
CLO 6									X	X

Books Recommended:

1. Management-A Global Perspective, Heinz Weihrich and Harold Koontz, McHILL International Edition, Tenth 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, DhanpatRai Publication Ltd.

Course No: MEE433	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 will be able to:
CLO1. Write a report on different power plants in Bangladesh
CLO2. Solve variable load problems
CLO3. Learn economic viability analysis of power plants
CLO4. Illustrate theory of rates
CLO5. Analyze diesel engine power plant and calculate it's load calculation
CLO6. Distinguish between steam turbine power plants and gas turbine power plants and their advantages and disadvantages
CLO7. Discriminate the cycle analysis of steam turbine, gas turbine and combined cycle power plant
CLO8. Understand the working principles of Condensers, evaporators and cooling towers
CLO9. Interpret the functions of different components of hydroelectric power plants
CL10. Distinguish among different types of nuclear power plants

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1			X		X					
CLO2	X									
CLO3				X						
CLO4						X				
CLO5	X									
CLO6	X					X				X
CLO7						X				
CLO8	X									
CLO9	X	X								
CLO10	X	X								

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

Course No: MEE434	**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:
CLO1. Plot Cooling Efficiency and % Make-Up water against water –air ratio in plain graph
CLO2. Analyze the process data and obtained results and write a comprehensive discussion on construction and performance of cooling tower
CLO3.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
CLO4. Perform Hydraulic test of a boiler and calculate the efficiency of the boiler
CLO5. Draw p-h diagram of a Refrigeration system and calculate the Refrigeration Effect and Coefficient of Performance
CLO6. Understand assembled Rover gas turbine and identify different components
CLO7. Become familiar with different components of the Turbo Jet Engine

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X	X				X				
CLO3						X			X	
CLO4	X					X				
CLO5	X	X				X				
CLO6						X				
CLO7						X				

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

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.

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

CLO 1 Explain basic knowledge on how to pursue scientific fact.

CLO 2 Explain basics of planning and performance of a scientific work.

CLO 3 Explain basics of analysis of scientific data.

CLO 4 Illustrate basic knowledge on how to present scientific work.

CLO 5 Obtain Theoretical and practical professional specialization within Mechanical Engineering including understanding of the current research questions.

CLO 6 Search scientific literature.

CLO 7 Summarize scientific literature.

CLO 8 Discuss scientific data related to the question at hand.

CLO 9 Present scientific data and conclusions in written and oral form addressed to different groups.

CLO 10 Understand and analyze ethical issues in an adequate manner related to the scientific work.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1									X	
CLO2	X					X				
CLO3						X				
CLO4	X					X			X	
CLO5										X
CLO6						X				
CLO7						X				
CLO8	X	X				X		X	X	X
CLO9			X		X		X			
CLO10				X						X

Optional Course-I

Course No: MEE 423	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:
CLO1. Understand basic physical properties of bio fluids
CLO2. Evaluate force and pressure balances acting on bio fluid
CLO3.Analyze and solve biomedical fluid flow problems
CLO4. Understand physiology of the human circulation system
CLO5. Understand vascular disease mechanisms (atherosclerosis)
CLO6. Apply fluid mechanics to blood flow models
CLO7. Evaluate and design biomedical fluid mechanics problems

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3	X					X				
CLO4	X									
CLO5	X									
CLO6		X							X	
CLO7		X						X		

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

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:

CLO1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system,

CLO2. Calculate cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration system.

CLO3. Present the properties, applications and environmental issues of different refrigerants

CLO4. Calculate cooling load for air conditioning systems used for various condition

CLO5. Operate and analyze the refrigeration and air conditioning systems.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X								
CLO2		X						X	X	
CLO3			X	X						X
CLO4	X	X				X				
CLO5	X	X				X				

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 475	**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 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's, interfacing CAM software with CNC machines, computer aided machining.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:
CLO1. Understand & explain basic concepts of CAD.
CLO2. Understand various applications of CAD such as computer aided part programming.
CLO3. Recognize part families and group technology.
CLO4. Execute the steps required in CAD software for developing 2D and 3D models and perform transformations
CLO5. Explain fundamental and advanced features of CNC machines.
CLO6. Understand the fundamentals used to create and manipulate geometric models.
CLO7. Understand principles of NC machines.
CLO8. Understand & explain basic concepts of CAM.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1								X		
CLO2								X		
CLO3	X									
CLO4								X		
CLO5	X						X			X
CLO6	X							X		
CLO7								X		
CLO8	X							X		

Books Recommended:

1. CAD/CAM: Computer-Aided Design and Manufacturing - *Mikell P. Groover*

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:

CLO1. explain the basic concept of economic analysis.
CLO2. conduct economic analysis on cost and budget.
CLO3. make a depreciation fund by depreciation cost analysis.
CLO4. analyze cost management to develop manufacturing companies.
CLO5. make a financial statement of a company.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1							X			X
CLO2	X					X				
CLO3	X					X	X			X
CLO4	X					X	X			X
CLO5						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:
CLO1. Describe the environmental aspects of non-conventional energy resources
CLO2. Differentiate among various conventional energy systems, their prospects and limitations
CLO3. Identify the need of renewable energy resources, historical and latest developments
CLO4. 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.
CLO5.Evaluate the need of Wind Energy and the various components used in energy generation and know the classifications
CLO6. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications
CLO7. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations
CLO8. Evaluate the usefulness of fuel cells, wave power, tidal power and geothermal energy
CL09. Design a biogas power plant using regional resources

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1				X						
CLO2				X						X
CLO3				X						
CLO4	X									
CLO5	X							X		
CLO6									X	
CLO7				X					X	
CLO8									X	
CLO9	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:
CLO1. Understand & explain basic concepts of aerodynamics.
CLO2. Distinguish between different types of fluid flows.
CLO3. Choose appropriate fluid flow type when designing an experimental model.
CLO4. Use the stream function to plot the stream lines of the flow and to find the velocities.
CLO5. Calculate lift of an airfoil using Kutta-Joukowski theorem.
CLO6. Calculate required angle of attack for a specified lift using aero foil theory for a real system.
CLO7. Calculate aerodynamic forces acting on a body using wing theory for a real system.
CLO8. Calculate drag and lift force.
CLO9. Understand and apply the concept of stability and control in the context of aerodynamics.
CLO10. Design a stable aerodynamic body.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X									X
CLO3	X									
CLO4						X				
CLO5	X					X				X
CLO6	X					X				
CLO7	X			X		X				
CLO8	X					X				X
CLO9	X									X
CLO10							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 437	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:

After the successful completion of the course, students will be able to:
CLO1: explain about different concepts of thermodynamics.
ClO2: calculate entropy and analyze entropy change and mixing.
CLO3: apply different energy functions.
CLO4: use different statistics of thermodynamic probability.
CLO5: develop an advanced thermodynamic system.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1										X
CLO2	X									X
CLO3	X					X				
CLO4		X				X				X
CLO5	X	X				X	X	X	X	X

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.
4.

Course No: MEE 461	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 findingout 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:

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

CLO1. Calculate different types of responses from the mathematical model of a system

CLO2. Calculate system parameters e.g. time constant, rise time, peak time, settling time, %overshoot, damping condition etc.

CLO3. Find out open loop and closed loop transfer function of a system

CLO4. Analyze block diagram and find out the equivalent transfer function of a complex system

CLO5. Identify the stability of a system using poles as well as Ruth Hurwitz stability criterion

CLO6. Analyze and solve the practical problems of hydraulic and pneumatic control systems

CLO7. Analyze and solve combinational circuits using the concept of logic gates and Boolean algebra

CLO8. Identify different types of sequential logic circuits and find out their output

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3	X									
CLO4	X					X				
CLO5	X									
CLO6	X					X		X		
CLO7	X					X		X	X	
CLO8	X								X	

Books Recommended:

3. Modern Control Engineering- Katsuhiko Ogata

Course No: MEE 491	**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 will be able to:

CLO1.define basic properties of different sources of energy and technologies for their utilization

CLO2.describe main elements of technical systems designed for utilization of resources of energy,

CLO3. interpret advantages and disadvantages of different resources of energy

CLO4. undertake simple analysis of energy potential of resources of energy

CLO5. select engineering approach to problem solving when implementing the projects on resources of energy

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X								X
CLO2						X		X		
CLO3						X			X	X
CLO4						X			X	X
CLO5	X	X				X				

Books Recommended:

3. Energy Resources, Utilization & Technologies; by AnjaneyuluYerramilli and Francis Tuluri

Optional Course-III

Course No: MEE 463	**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 will be able to:

CLO1.demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CLO2.apply spatial transformation to obtain forward kinematics equation of robot manipulators.

CLO3. solve inverse kinematics of simple robot manipulators.

CLO4. obtain the Jacobian matrix and use it to identify singularities.

CLO5. generate joint trajectory for motion Planning

CLO6. Understand fundamentals of robot controllers.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X	X							X	
CLO2		X						X	X	
CLO3		X							X	X	
CLO4		X							X	X	
CLO5		X					X			X	
CLO6	X								X	X	

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:
CLO1. Understand different types of controllers and the effects of P, I and D controller on a system
CLO2. Apply Zeigler-Nichols tuning rules to tune a PID controller
CLO3. Convert an analogue signal to a digital signal and vice versa
CLO4. Implement PID controller using Op-amps and solve design problems of a process control system
CLO5. Identify key challenges of CAD, CAM, CIM systems and take necessary steps to overcome them
CLO6. Apply machine vision and know the key elements of machine vision
CLO7. Identify a proper sensor and actuator for a control system
CLO8. Classify different types of robots and manipulator configuration
CLO9. Explain automation in industry, office or home

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2		X							X	
CLO3	X									
CLO4	X								X	
CLO5	X								X	
CLO6		X							X	
CLO7	X									
CLO8	X								X	
CLO9	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:
CLO1. Construct linear integer programming models and discuss the solution techniques
CLO2. Set up decision models and use some solution methods for nonlinear optimization problems
CLO3. Take best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models
CLO4. Solve multi-level decision problems using dynamic programming method

CLO5.Prepare a team-based project about heuristics /meta-heuristics algorithms used to solve integer or nonlinear programming problems
CLO6. Solve Linear Programming Problems, Transportation and Assignment Problems
CLO7. Understand the mathematical tools that are needed to solve optimization problems
CLO8. Analyze any real-life system with limited constraints and depict it in a model form
CLO9. Understand the application of OR and frame a LP Problem with solution – graphical and through solver add in excel (software)

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									
CLO3						X				
CLO4	X									
CLO5			X		X		X			
CLO6	X									X
CLO7								X		
CLO8						X				X
CLO9	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:
CLO1: measure quality and its cost.
CLO2: use different Statistical procedure to control quality.
CLO3: manage quality by using some quality management system.
CLO4: select a high quality lot by analysis.
CLO5: explain some quality standards so that they can improve manufacturing process.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X					X				
CLO3	X	X								X
CLO4	X	X				X	X			
CLO5							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:

CLO1. Define failure by fatigue, creep and fracture.

CLO2. Describe the key characteristics that distinguish fatigue, creep and fracture failure.

CLO3. Distinguish among different types of fatigue with fixed and varying amplitude.

CLO4. Utilize the fatigue properties in design purpose.

CLO5. Understand how notch sensitivity affects a specific design.

CLO6. Understand how different factors affect the fatigue strength.

CLO7. Choose and perform the more appropriate fatigue testing method among different fatigue tests.

CLO8. Analyze relationships among creep stress, time and temperature for simple tension and combined stress.

CLO9. Distinguish among creep failures based on tension, bending, torsion and buckling.
CLO10. Choose and perform the more appropriate creep testing among different creep testing methods.
CLO11. Distinguish between a brittle fracture and ductile fracture.
CLO12. Investigate a brittle fracture using Griffith theory.
CLO13. Investigate fractures in plastic material using Irwin's theory.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X									X
CLO3	X									
CLO4	X									X
CLO5	X									
CLO6	X									
CLO7	X									X
CLO8		X				X				
CLO9	X									X
CLO10	X									
CLO11	X									
CLO12	X					X				
CLO13						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 453	**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:
CLO1. Identify, formulate, and solve engineering problems
CLO2. Analyze sound propagation and reflections in space.
CLO3. Distinguish between different sounds and noise levels in the environment.
CLO4. Analyze the mechanism and the machinery noise levels
CLO5. Model reciprocating and oscillatory motions of mechanical systems
CLO6. Model undamped and damped mechanical systems and structures
CLO7. Model free and harmonically forced vibrations
CLO8. Model single- and multi-degree of freedom systems

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2						X				
CLO3	X	X								
CLO4						X				
CLO5									X	
CLO6									X	
CLO7									X	
CLO8									X	

Books Recommended:

1. Engineering Vibration-D. J. Inman
2. Engineering Acoustics: An Introduction to Noise Control-Michael Möser

Course No: MEE481	**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 he 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 automobile; 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 power train: 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 able to:

CLO1. Identify and describe different automobile components and their functions.

CLO2. Differentiate among different automobile engine types.

CLO3. Evaluate vehicle performance using proper testing approach(es).

CLO4. Apply development strategies to minimize the 'resistance to motion' experienced by the vehicle.

CLO5. Explain the working principle of clutch, gear, differential and final drives.

CLO6. Choose and implement proper safety systems for specific use of vehicle.

CLO7. Design and/or choose proper shape of automobile body for specific purpose.

CLO8. Explain the working principle braking system as a part of the safety system.

CLO9. Explain how the various parts of electrical and electronic system aid in proper functioning of automobile.

CLO10. Understand different terms, concepts and/or theories related to vehicle performance.

CLO11. Understand the detrimental effects of automobile emissions on environment.

CLO12. Control emissions and noise pollution from an automobile.

CLO13. Understand the motor vehicle regulations

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X									X
CLO3	X									X
CLO4	X									X
CLO5	X									X
CLO6	X								X	
CLO7	X									X
CLO8		X							X	
CLO9	X									X
CLO10	X								X	
CLO11	X									
CLO12				X	X					X
CLO13	X									X

Books Recommended:

1. Automotive Engineering Fundamentals - *Richard Stone*
2. Automotive Technology: A Systems Approach - *Jack Erjavec*

Course No: MEE493	**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:

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

CLO1. Write a report on Nuclear power plant in Bangladesh

CLO2. Apply $E= mc^2$ to calculate the energy released in nuclear reactions

CLO3. Understand basic nomenclature of nuclear physics, including how to find information on the Chart of the Nuclides, X(a,b)Y reaction notation, and radioactive decay types

CLO4. Compute decay constants from half-life and vice versa. Write decay equations, including decay with production, and solve the Bateman equations for simple decay chains

CLO5. Understand basic nuclear terminology and describe the breadth of current and potential nuclear applications, including fission power, medical diagnostic systems and cancer treatment, and fusion systems

CLO6. Understand the concept of cross-section, and define the concept of probability of interaction per unit path length (macroscopic cross section). Compute macroscopic cross-section of mixtures

CLO7. Describe the fundamentals of sustained neutron chain reactions, fission reactor design, and fission products

CLO8. Define and describe BWR and PWR and enumerate the basic systems of each reactor type

CLO9. Describe international reactor types, including GCR and PBMR, CANDU, LMFBR, and RBMK

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1			X		X					
CLO2	X								X	
CLO3									X	
CLO4	X									
CLO5	X	X						X		
CLO6	X									
CLO7		X		X						
CLO8								X		
CLO9								X		X

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

Optional Course-V

Course No: MEE 439	**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 gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants. Pollution control: post-engine exhaust treatment for emission control - thermal reactors, exhaust gas recirculation, catalysis; Pollution control by modification of combustion parameters; other pollution control strategies

Course Learning Outcomes:

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

CLO1. Understand combustion process in internal and external combustion engines

CLO2. Identify the impacts of emission on the environment and search for new modifications that can be incorporated for the further reduction of emission pollution

CLO3.Explain the details of flame propagation and structure of laminar premixed flame

CLO4. Apply necessary steps to control the pollution caused by the exhaust gas from combustion

CLO5. Understand the adverse effects of greenhouse gases on environment

CLO6. Apply modification to combustion parameters to control pollution

CLO7. Apply various methods to recirculate exhaust gas

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									
CLO2	X	X								
CLO3	X					X				
CLO4		X							X	X
CLO5		X								
CLO6		X							X	
CLO7		X							X	

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

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:
CLO1. Apply a range of mathematical theorems and methods to solve routine and complex analytic and applied problems
CLO2. Analyze data necessary for the solution of engineering problems
CLO3. Identify and examine the effectiveness of proposed solutions to identified engineering problems
CLO4. Derive mathematical models of physical systems
CLO5. Solve differential equations using appropriate methods
CLO6. Present mathematical solutions in a concise and informative manner
CLO7. Utilize their knowledge to conduct advanced numerical studies related to Finite Element Analysis, Finite Difference Method and Computational Fluid Dynamics

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X									X
CLO2	X					X				
CLO3	X									X
CLO4	X									
CLO5	X					X				X
CLO6	X									

CLO7	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 443	**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:

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

CLO1.Identify the role that statistics can play in the engineering problem-solving process, discuss the different methods that engineers use to collect data and, construct and interpret visual data displays

CLO2.Compute and interpret the descriptive statistics, correlation coefficient and rank correlation coefficient, use simple linear regression model to engineering data.

CLO3. Explain various sampling methods, compute and explain point estimators and interval estimators for mean, variance and proportion.

CLO4. Structure engineering decision-making problems as hypothesis tests, use z-test, t-test, chi-square and Ftest to test the statistical hypotheses, p-value approach for making decisions in hypothesis tests, explain and use the relationship between confidence interval and hypothesis tests.

CLO5. Understand how the analysis of variance (one-way and two-way) is used to analyze the data from engineering experiments and apply CRD, RBD and CSD in Engineering problems.

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X							X	X	
CLO2		X				X		X		
CLO3						X		X		
CLO4				X		X			X	
CLO5						X			X	
CLO6										
CLO7										
CLO8										
CLO9										

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

Course No: MEE483	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 ultra-violet 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:
CLO1. Formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
CLO2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare
CLO3. Differentiate the mechanical, chemical and thermal properties of replacement materials and tissues
CLO4. Utilize major medical imaging modalities in radiology, including X-ray, CT, nuclear medicine, ultrasound, and MRI
CLO5. Evaluate the engineering mechanics including stress, strain, deformation, and analysis of structures with application to biomechanical phenomena over a range of biological length scales
CLO6. Understand how to apply Engineering mechanics concepts to evaluate forces and moments acting on human joints, forces in musculoskeletal tissue
CLO7. Understand material properties of biological tissues
CLO8. Differentiate the disease state condition and understand the interaction between infected cells and their surrounding environment
CLO9. Understand momentum transport (viscous flow) and mass transport (diffusion and convection) in living systems
CL10. use computational fluid dynamics simulation tools

Mapping of CLOs with PLOs

CLO/PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
CLO1	X					x				
CLO2		X		X						
CLO3						X				
CLO4		X				X		X	X	
CLO5	X	X								X
CLO6	X	X				X				
CLO7	X									
CLO8	X	X								
CLO9	X	X								
CLO10	X								X	

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

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:

After the successful completion of the course, students will be able to:
CLO1. Analysis and solve the practical problems of statics and dynamics
CLO2. Define Newton's laws of motion.
CLO3. Recall trigonometric laws and apply to the addition and decomposition of vectors quantities.
CLO4. Identify the moment of a force and calculate its value about a specified axis. Define the moment of a couple.
CLO5. Describe the concept of dry friction and analyze the equilibrium of rigid bodies subjected to this force.
CLO6. Construct "Free Body Diagrams" of real-world problems and apply Newton's Laws of motion and vector operations to evaluate equilibrium of particles and bodies.
CLO7. Apply the principles of equilibrium of particles and bodies to analyze the forces in planar truss members.
CLO8. Discuss the concepts of “center of gravity” and “centroids” and compute their location for bodies of arbitrary shape.
CLO9. Apply the concepts used for determining center of gravity and centroids to find the resultant of a generally distributed loading.
CLO10. Discuss the basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts)
CLO11. Explain basic dynamics concepts – force, momentum, work and energy;
CLO12. Explain and be able to apply Newton’s laws of motion;
CLO13. Apply all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces)
CLO14. Demonstrate how to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy.

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 313E	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:
CLO1. Describe the environmental aspects of non-conventional energy resources
CLO2. Differentiate among various conventional energy systems, their prospects and limitations
CLO3. Understand the need of renewable energy resources, historical and latest developments
CLO4. Understand the law's of Thermodynamics
CLO5. Calculate brake power and mechanical efficiency of IC engines
CLO6. Understand working principle of gas turbine and steam turbine and their advantages and disadvantages
CLO7. Calculate COP of Refrigeration system
CLO8. Differentiate Turbine, Pump, Compressor, Blower and Fan
CL9. Learn Boiler mountings and accessories

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 315A	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 student 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 system 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:

CLO1. Explain fundamental laws and concepts of thermodynamics,

CLO2. Illustrate the fundamental principles and applications of air conditioning system,

CLO3. Design duct systems for the application of air handling in building systems.

CLO4. Calculate cooling load for air conditioning systems used for various condition.

CLO5. 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