COMSATS University Islamabad

Registrar Office, Academic Unit (PS)

No: CUI-Reg/Notif- 434 /24/ 448 February 22, 2024

NOTIFICATION

Academic Council in its 38th meeting held on January 09, 2024, on the recommendation of the 33rd meeting of Board of Faculty of Engineering, approved the revised Scheme of Studies of Bachelor of Science in Mechanical Engineering (BSME) effective from Fall 2023 as per Pakistan Engineering Council and Higher Education Commission Undergraduate Education Policy 2023.

1. Name of Degree: Bachelor of Science in Mechanical Engineering (BSME)

Minimum Duration:	04 Years		Minimum Semesters:	08	Minimum Credit Hours required:	134

2. Framework of Courses and Credit Hours for Degree Program

	Course Work	No. of Courses	No. of Credit Hours
a)	**Non-Engineering (Theory + Labs)**	**16**	**41**
b)	Engineering Courses (Theory + Labs)		
	• Computer and Information Sciences	2	7
	• Foundation Engineering Courses	10	24
	• Core Breadth of Engineering Discipline	11	24
	• Core Depth of Engineering Discipline (Including Major Electives)	13	24
	• Multidisciplinary Engineering Courses	3	8
	• Capstone Project	2	6
	Sub Total (Engineering Courses)	**41**	**93**
c)	Field Experience / Internship	1	0
d)	Community Services	1	0
e)	**Sub Total**	02	
	Total (Single Major)	**59**	**134**

Bachelor of Science in Mechanical Engineering is a degree program under the accreditation of Pakistan Engineering Council (PEC). Hence, the regulations of PEC regarding the program approved by COMSATS University Islamabad (CUI) shall be applicable.

Note: Common policies and procedures notified vide No. CUI-Reg/Notif-1794/23/1884, dated August 25, 2023 relating to Undergraduate Degree Programs approved by the Competent Authority and amended from time to time shall be applicable.

Dr. Muhammad Hanif
Deputy Registrar

Distribution:
1. All Directors, CUI
2. All Deans, CUI
3. Incharge Islamabad Campus, CUI
4. Controller of Examinations, CUI
5. All Chairpersons, CUI
6. Incharge QEC/ CUonline, CUI
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CC:
1. PS to Rector CUI
2. PS to Registrar CUI

3. Non-Engineering Domain/General Education:

3.1. Mathematics

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MTH231	Linear Algebra	3(3, 0)	-
2.	MTH114	Calculus and Analytical Geometry	3(3, 0)	-
3.	MTH242	Differential Equations	3(3, 0)	-
4.	MTH262	Statistics and Probability Theory	3(3, 0)	-

3.2. Physics

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	PHY131	Applied Physics for Mechanical Engineers	3(2, 1)	-

3.3. Mathematics Elective

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MTH375	Numerical Computations	3(2, 1)	-

3.4. English

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	HUM104	Functional English	3(3, 0)	-
2.	HUM120	Expository Writing	3(3, 0)	-

3.5. Culture

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	HUM112	Islamic Studies*	2(2, 0)	-
2.	HUM113	Ideology and Constitution of Pakistan	2(2, 0)	-
3.	HUM123	Fundamentals of Philosophy	2(2, 0)	-

*Non-Muslim students can opt for HUM116 Ethics 2(2, 0) course in lieu of HUM112 Islamic Studies if they intend to.

3.6. Social Science

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	HUM122	Fundamentals of Psychology	2(2, 0)	-
2.	CSC101	Applications of Information and Communication Technologies	3(2, 1)	-
3.	HUM208	Civics and Community Engagement	2(2, 0)	-

3.7. Professional Practice

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MEE311	Engineering Management and Economics	2(2, 0)	-
2.	MGT250	Introduction to Entrepreneurship	2(2, 0)	-

4. Engineering Domain:

4.1. Computer and Information Sciences

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	CSC103	Programming Fundamentals	4(3, 1)	-
2.	CSC354	Machine Learning	3(3, 0)	-
		Total	**7(6, 1)**	

4.2. Foundation Engineering Courses

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MEE111	Workshop Practice	2(0, 2)	-
2.	MEE100	Engineering Drawing and Graphics	2(1, 1)	-
3.	MEE101	Engineering Statics	3(3, 0)	-
4.	MEE112	Engineering Materials	2(2, 0)	-
5.	MEE201	Engineering Dynamics	3(3, 0)	MEE101
6.	MEE203	Mechanics of Materials – I	3(3, 0)	-
7.	MEE220	Thermodynamics – I	3(3, 0)	-
8.	MEE202	Engineering Mechanics Lab	1(0, 1)	MEE101
9.	MEE225	Engineering Fluid Mechanics – I	3(3, 0)	-
10.	MEE329	Instrumentation and Measurement	2(2, 0)	-
		Total	**24(20, 4)**	

4.3. Core Breadth of Engineering Discipline

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MEE204	Mechanics of Materials – II	3(3, 0)	MEE203
2.	MEE223	Thermodynamics – II	3(3, 0)	MEE220
3.	MEE205	Mechanics of Materials Lab	1(0, 1)	MEE203
4.	MEE222	Thermodynamics Lab	1(0, 1)	MEE220
5.	MEE302	Machine Design – I	2(2, 0)	-
6.	MEE304	Theory of Machines	3(3, 0)	MEE201
7.	MEE312	Manufacturing Processes	3(2, 1)	-
8.	MEE326	Engineering Fluid Mechanics – II	3(3, 0)	MEE225
9.	MEE303	Machine Design – II	2(2, 0)	MEE302
10.	MEE324	Heat Transfer	2(2, 0)	-
11.	MEE328	Engineering Fluid Mechanics Lab	1(0, 1)	MEE225
		Total	**24(20, 4)**	

4.4. Core Depth of Engineering Discipline

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MEE315	Computer Aided Design and Manufacturing	3(2, 1)	-
2.	MEE401	Mechanical Vibrations	3(3, 0)	-
3.	MEE432	Finite Element Analysis	2(2, 0)	-
4.	MEE433	Finite Element Analysis Lab	1(0, 1)	-
5.	MEE405	Air Conditioning and Refrigeration	2(2, 0)	MEE223
6.	MEE402	Mechanisms and Mechanical Vibrations Lab	1(0, 1)	MEE201
7.	MEE422	Heat Transfer Lab	1(0, 1)	MEE324
8.	MEE412	Air Conditioning and Refrigeration Lab	1(0, 1)	-
9.	MEE437	Instrumentation and Control Lab	1(0, 1)	-
10.	MEE428	IC Engines	2(2, 0)	-
11.	MEE430	IC Engines Lab	1(0, 1)	-
12.	MEExxx	Major Elective – I	3(3, 0)	-
13.	MEExxx	Major Elective – II	3(3, 0)	-
		Total	**24(17, 7)**	

4.5. Multidisciplinary Engineering Courses

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)

1.	MEE423	Control Systems	3(3, 0)	-
2.	EEE119	Circuits and Electronics	4(3, 1)	-
3.	MEE406	Health, Safety and Environment	1(1, 0)	-
Total			**8(7, 1)**	

4.6. Capstone Project (Final Year Design Project)

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	EGG498	Final Year Project (Part I)	3(0, 3)	-
2.	EGG499	Final Year Project (Part II)	3(0, 3)	-
Total			**6(0, 6)**	

4.7. Industrial Training

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	EGG497	Internship**	0(0, 0)	-

** The Internship Policy of the department is included at the end of this document.

4.8. Community Service

This is a non-credited/non-graded activity which is mandatory for the degree program. The community services policy of the Mechanical Engineering Department must be followed for qualification of this course.

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MEE496	Community Services	0(0, 0)	-

*** The Community Services Policy of the department is included at the end of this document.

5. List of Major Elective Courses

Major Elective – I and Major Elective – II must be chosen from this list. The major electives will be offered in the final year.

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	MEE403	Deformation and Failure	3(3, 0)	-
2.	MEE404	Mechanical Engineering Design and Analysis	3(3, 0)	-
3.	MEE409	Robotics and Automation	3(3, 0)	-
4.	MEE411	Advanced Material Processing	3(3, 0)	-
5.	MEE413	Gas Dynamics	3(3, 0)	-
6.	MEE415	Maintenance Engineering	3(3, 0)	-
7.	MEE421	Computational Fluid Dynamics	3(3, 0)	-
8.	MEE424	Renewable Energy Technology	3(3, 0)	-
9.	MEE425	Power Plants	3(3, 0)	-
10.	MEE426	HVAC	3(3, 0)	-
11.	MEE434	Smart Manufacturing	3(3, 0)	-
12.	MEE435	Composite Materials	3(3, 0)	-

6. Remedial Course

The following remedial course will be offered as a non-credited course to the students who have passed FSc/Equivalent with Physics, Mathematics and Computer Science (ICS) combination, i.e., FSc/Equivalent with non-Pre-Engineering background. These students may preferably pass this remedial course in the 1st semester of their degree program. This course will not contribute to the student's CGPA.

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite(s)
1.	CHM102	Introduction to Chemistry	3(2, 1)	-

Tentative Plan of Studies

The course offering in each semester as given below is not fixed; it may vary depending on the availability of faculty and needs of the students.

Sem	S.No.	Course Code	Course Title	Course Code	Prerequisite(s)
1st	1.	HUM104	Functional English	3(3, 0)	-
	2.	MTH114	Calculus and Analytical Geometry	3(3, 0)	-
	3.	PHY131	Applied Physics for Mechanical Engineers	3(2, 1)	-
	4.	HUM112	Islamic Studies	2(2, 0)	-
	5.	MEE111	Workshop Practice	2(0, 2)	-
	6.	CSC101	Applications of Information and Communication Technologies	3(2, 1)	-
	Total:			**18(14, 4)**	
2nd	1.	MTH231	Linear Algebra	3(3, 0)	-
	2.	CSC103	Programming Fundamentals	4(3, 1)	-
	3.	HUM113	Ideology and Constitution of Pakistan	2(2, 0)	-
	4.	HUM122	Fundamentals of Psychology	2(2, 0)	-
	5.	MEE100	Engineering Drawing and Graphics	2(1, 1)	-
	6.	MEE101	Engineering Statics	3(3, 0)	-
	7.	MEE112	Engineering Materials	2(2, 0)	-
	Total:			**18(16, 2)**	
3rd	1.	HUM123	Fundamentals of Philosophy	2(2, 0)	-
	2.	HUM208	Civics and Community Engagement	2(2, 0)	-
	3.	MTH262	Statistics and Probability Theory	3(3, 0)	-
	4.	MEE201	Engineering Dynamics	3(3, 0)	MEE101
	5.	MEE203	Mechanics of Materials – I	3(3, 0)	-
	6.	MEE220	Thermodynamics – I	3(3, 0)	-
	7.	MEE202	Engineering Mechanics Lab	1(0, 1)	MEE101
	Total:			**17(16, 1)**	
4th	1.	HUM120	Exository Writing	3(3, 0)	-
	2.	MTH242	Differential Equations	3(3, 0)	-
	3.	MEE204	Mechanics of Materials – II	3(3, 0)	MEE203
	4.	MEE225	Engineering Fluid Mechanics – I	3(3, 0)	-
	5.	MEE223	Thermodynamics – II	3(3, 0)	MEE220
	6.	MEE205	Mechanics of Materials Lab	1(0, 1)	MEE203
	7.	MEE222	Thermodynamics Lab	1(0, 1)	MEE220
	Total:			**17(15, 2)**	
5th	1.	EEE119	Circuits and Electronics	4(3, 1)	-
	2.	MTH375	Numerical Computations	3(2, 1)	-
	3.	MEE302	Machine Design – I	2(2, 0)	-
	4.	MEE304	Theory of Machines	3(3, 0)	MEE201
	5.	MEE312	Manufacturing Processes	3(2, 1)	-
	6.	MEE326	Engineering Fluid Mechanics II	3(3, 0)	MEE225
	Total:			**18(15, 3)**	
6th	1.	MGT250	Introduction to Entrepreneurship	2(2, 0)	-
	2.	CSC354	Machine Learning	3(3, 0)	-
	3.	MEE311	Engineering Management and Economics	2(2, 0)	-
	4.	MEE303	Machine Design – II	2(2, 0)	MEE302
	5.	MEE324	Heat Transfer	2(2, 0)	-
	6.	MEE329	Instrumentation and Measurement	2(2, 0)	-
	7.	MEE315	Computer Aided Design and Manufacturing	3(2, 1)	-
	8.	MEE328	Engineering Fluid Mechanics Lab	1(0, 1)	MEE225
	Total:			**17(15, 2)**	
7th	1.	MEE401	Mechanical Vibrations	3(3, 0)	-
	2.	MEE432	Finite Element Analysis	2(2, 0)	-
	3.	MEE433	Finite Element Analysis Lab	1(0, 1)	-
	4.	MEE405	Air Conditioning and Refrigeration	2(2, 0)	MEE223
	5.	MEE402	Mechanisms and Mechanical Vibrations Lab	1(0, 1)	MEE201

	6.	MEE422	Heat Transfer Lab	1(0, 1)	MEE324
	7.	MEE412	Air Conditioning and Refrigeration Lab	1(0, 1)	-
	8.	MEE4xx	Major Elective – I	3(3, 0)	-
	9.	EGG498	Final Year Project (Part I)	3(0, 3)	-
			Total:	**17(10, 7)**	
8th	1.	MEE496	Community Services	0(0, 0)	
	2.	EGG497	Internship	0(0, 0)	
	3.	MEE423	Control Systems	3(3, 0)	
	4.	MEE437	Instrumentation and Control Lab	1(0, 1)	
	5.	MEE428	IC Engines	2(2, 0)	
	6.	MEE430	IC Engines Lab	1(0, 1)	
	7.	MEE406	Health, Safety and Environment	1(1, 0)	
	8.	MEE4xx	Major Elective – II	3(3, 0)	
	9.	EGG499	Final Year Project (Part II)	3(0, 3)	
			Total:	**14(9, 5)**	

Course Code: MEE111

Course Title: Workshop Practice

Credit Hours: 2(0, 2)

Course Objectives: This lab provides an engineering foundation in the field of manufacturing engineering / technology, designed for the hand-on practice of first year students. The objective of this course to learn about manual work in machine shop, fitting, carpentry, welding, and foundry shop. To provide hands on practice to students in various basic skills required to fabricate mechanical components. To familiarize the students with various tools and machines used in manufacturing operations using different materials.

List of Experiments:

1. Introduction to workshop Technology
2. Fitting Shop: To get familiar with fitting, types of fitting, joints and fitting tools by performing different hands-on tasks.
3. Carpentry Shop: To get familiar with carpentry, types of wood joints and carpentry tools by performing different carpentry experiments.
4. Welding Shop: To get familiar with welding types and welding tools, types of welding joints by performing different welding experiments.
5. Forging Shop: To get familiar with forging and forging tools, application of forging process by performing different forging experiments.
6. Casting Shop: To get familiar with casting and casting tools, application of casting process by performing different casting experiments.
7. Sheet Metal Work: To get familiar with sheet metal working and its tools by manufacturing different sheet metal components.
8. Introduction to machine shop and different machines placed in it.
9. Introduction to lathe machine, its working and different operations of it.
10. Introduction CNC lathe machine, its working and different operations of it.
11. Introduction to milling machine, its working and different operations of it.

Books and Reading List

- Lab manual

Course Code: MEE100

Course Title: Engineering Drawing and Graphics

Credit Hours: 2 (1, 1)

Course Objectives: Engineering Drawing and Graphics theory focuses on the drawing techniques used in a manufacturing industry. This course enables the students to identify drawing as a part of the design process. Modern tool i.e., AutoCAD will give students the basic understanding of computer aided drafting (CAD). Students will use AutoCAD to draft 2D/3D models. After completing this course/lab, students will be able to execute and deal with various aspects the detailed engineering drawings.

Course Outline

Introduction, drawing standards, drawing equipment, scale of drawing, Line types and geometric construction, Theory of projection, Dimensioning, Development of object, Unified and metric thread standards, Tolerances, Interchangeability, Types of Fits, Clearance & Allowance, Shaft and Hole assembly nomenclature, Basic shaft and hole system, Geometric Dimensioning and Tolerancing, Production drawing and sectioning techniques.

List of Experiments

1. Lettering, Free hand sketching, Dimensioning
2. Basics, Geometric Constructions
3. Views Practicing (Front, Top and Side)
4. Draw views on A4 sheet
5. Sheet division and views on drawing sheet
6. Draw views on drawing sheet
7. AutoCAD basics and Installation
8. 2D basics and commands
9. 2D models practice
10. 2D model and Title box
11. Title box and 3D basics

Books and Reading List

- Technical Graphics Communication 3rd edition by Eric N. Wiebe and Garry R. Bertoline
- Engineering Graphics Essentials by Kirstie Plantenberg
- Dimensioning and Tolerancing ASME Y14.5 – 2018 by American Society of Mechanical Engineers

Course Code: MEE101

Course Title: Engineering Statics

Credit Hours: 3 (3, 0)

Course Objectives: This course provides the basic concept of Mechanics(Statics) to the 1st year Engineering Students. It is a part of the Engineering Foundation. It develops the knowledge regarding how to transform physical phenomena into mathematical terms. This course improves the student's ability to problems solving regarding forces acting on stationary objects as well as an understanding of various engineering structures in equilibrium.

Course Outline

Introduction to the Subject, Force Vectors; Cartesian Vectors, Position Vectors, Equilibrium of a particle; Conditions of equilibrium, Three-dimensional force system, Force System Resultants; Moment of a Force (Scalar and Vector formulation), Principle of Moments, Equilibrium of a Rigid Body; Conditions of a Rigid body equilibrium, equation of equilibrium, Structural Analysis; Simple Trusses, The method of joints, Friction; Dry friction, Center of Gravity and Centroid

Books and Reading List

- Engineering Mechanics (Statics), R. C. Hibbeler, 14th Edition, 2015.
- Vector Mechanics for Engineers: Statics & Dynamics Ferdinand P. Beer, E. Russell Johnston, 11th Edition, 2015.

Course Code: MEE112

Course Title: Engineering Materials

Credit Hours: 2 (2, 0)

Course Objectives: Engineering Materials is the first course to develop the basic concepts of materials. After studying this course, students will be able to demonstrate basic understanding of materials, their structures, properties, and applications. Students will also demonstrate understanding of heat treatment and material testing.

Course Outline

Crystalline structure of metals, Allotropy, crystallographic planes, Slip and Slip systems, Dislocations, Yield Phenomenon and Strain ageing, Production of Iron and steel and their classifications, Iron carbide phase diagram, Alloying elements and their effect on properties of alloy steel, Metals and alloys for special applications, Corrosion of metals, Heat treatment techniques, Polymers properties and classifications, Ceramic materials and their properties.

Books and Reading List

- Fundamentals of Materials Science and Engineering, William D. Callister, David G. Rethwisch, 5th Edition, 2018.

Course Code: MEE201

Course Title: Engineering Dynamics

Credit Hours: 3 (3, 0)

Prerequisite: MEE101

Course Objectives: This course provides the basic concept of Engineering Mechanics (Dynamics) to the 2nd year engineering students. It is a part of Engineering Foundation. The objective is to develop the knowledge regarding kinetics and Kinematics of both particle and rigid bodies in different coordinate systems.

Course Outline

Introduction to subject and Basic Concepts, Kinematics of a Particle, Kinetics of a Particle: Force and Acceleration, Kinetics of a Particle: Work and Energy, Kinetics of a Particle: Impulse and Momentum, Planar Kinematics of Rigid Bodies, Planar Kinetics of a Rigid body: Force and Acceleration, Planar Kinetics of a Rigid body: Work and Energy, Planar Kinetics of a Rigid Body: Impulse and Momentum.

Books and Reading List

- R.C Hibbeler Engineering Mechanics (Dynamics) 14th Edition, 2015.
- J L Meriam, L G Kraig. Engineering Mechanics (Dynamics): John Wiley & Sons Inc. 9th Edition, 2018.

Course Code: MEE203

Course Title: Mechanics of Materials - I

Credit Hours: 3 (3, 0)

Course Objectives: Mechanics of Materials-I is the first course to develop basic concepts of deformable body mechanics. The students should be able to understand and determine the stress/strain behavior of structural members based upon their mechanical and geometrical properties, under a variety of loading conditions. This course is essential to advance courses like Mechanics of Materials-II, Machine Design, Final Year Design Projects, and any further study in deformable mechanics.

Course Contents

Concept of Stress, Types of Stress and Strain, Axial loading, stress strain diagram, Elastic vs Plastic Behavior, Deformation under axial loading, Thermal Stresses, Statically Indeterminate problems, Shearing strain, Residual stress, Stress concentration, Torsion of circular bars, Shear stress, Angle of twist, Pure Bending of Beams. Shear force and bending moment in beams using various methods, Design of Prismatic Beams for Bending, Shearing Stresses in Beams and Thin-Walled Members.

Books and Reading List

- Mechanics of Materials 7th edition (SI Units) by F.P. Beer & E. R. Johnston, 2022.
- Mechanics of Materials by J. M. Gere & B. J. Goodno, 2012.

Course Code: MEE220

Course Title: Thermodynamics - I

Credit Hours: 3 (3, 0)

Course Objectives: The students will be able to understand the nature and role of the thermodynamics properties of matter and processes on appropriate diagrams. They will apply energy and entropy balances to the closed and open systems. Moreover, they will analyze implications and limitations of the Second Law of Thermodynamics.

Course Outline

Introduction and basic concepts about thermodynamics, concept of control mass, control volume, pressure, temperature and continuum. Heating and cooling of an ideal gas change in internal energy. Expansion and compression of an ideal gas, process work. Forms of energy, Energy transfer by heat and work, First Law of Thermodynamics, and its applications. Properties of a pure substance, steam tables, Thermodynamic cycles, P-V and T-S diagrams. Energy analysis of closed systems, Energy analysis of control volumes, Second Law of Thermodynamics, Heat Engines, Clausius statement. Reversibility, and irreversibility, Second Law Analysis for a Control Volume. Entropy, Entropy changes for pure Substance, Isentropic Process expansion of steam. Gas compressors, P-V and T-S diagrams, compressor efficiencies.

Books and Reading List

- Yunus A. Cengel, Michael A. Boles, Thermodynamics: An Engineering Approach, 9th edition, McGraw-Hill. ISBN: 1260048667, 9781260048667, 2018.
- M. J. Moran and H. O. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons.
- Claus Borgnakke and Richard Sonntag, Fundamentals of Thermodynamics, Wiley, ISBN: 111938284X, 9781119382843, 2017.
- T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, Pearson.

Course Code: MEE202

Course Title: Engineering Mechanics Lab

Credit Hours: 1(0, 1)

Prerequisite: MEE101

Course Objectives: This lab focuses on the foundations of the fundamental concepts of mechanics including types of forces, their components, and moments. It also demonstrates the experimental understanding on determination of various physical and mechanical parameters and their correlations such as moment of inertia, work done and friction for various mechanical systems.

List of Experiments:

1. Demonstration of the Triangle of forces theory using Force's kit apparatus.
2. Comparison of the effort, load, and angle relationships for a simple toggle using the Toggle kit apparatus.
3. Determine the moment of inertia of the flywheel & prove the theory of energy in the flywheel.
4. Demonstration of the law of falling bodies on an inclined plane and determine the moment of inertia of rolling disc down on an inclined plane.
5. Determination of the mass moment of inertia of different discs on an inclined plane.
6. Determine the work done by the variable force (vertical effort and tangential effort) using the work done apparatus.
7. Verification of the centrifugal force theory & demonstrate the relationship between centrifugal force and speed using Centrifugal Force Apparatus.
8. Demonstration of the relationship between centrifugal force, mass & radius of gyration using Centrifugal Force Apparatus.
9. Effect on the precession axis when the spin axis speed is changed using the gyroscope apparatus.
10. Analyze the variation of displacement of a constant velocity joint apparatus.
11. Determine the belt friction using the belt friction apparatus.
12. Determine the coefficient of friction of the clutch plate friction apparatus.
13. Determine the mechanical advantage, velocity ratio, and efficiency of the wheel and differential axle apparatus.
14. Investigate the relationship between the measured forces in a loaded frame experimentally and theoretically using truss apparatus.
15. Investigate the forces in a statically determinate and indeterminate cantilever truss experimentally and theoretically using redundant truss apparatus.
16. Investigate the forces in a roof truss with central and angled loads experimentally and theoretically using Pin Jointed Frameworks apparatus.

Books and Reading List

- Lab manual

Course Code: MEE204

Course Title: Mechanics of Materials - II

Credit Hours: 3 (3, 0)

Prerequisite: MEE 203

Course Objectives: Mechanics of Materials-II is a continuation of the first course to further study deflection of beams using various methods. Stress-strain transformation, Mohr's 2D/3D circles, Columns buckling and Strain energy. At the end of this course, students must be able to analyze and design structures like beams, columns, and pressure vessels. The students will also learn to apply appropriate failure theories while designing any structure.

Course Outline

Transformation of Stress and Strain in two and three dimensions, Principal Stresses and Strains, Mohr's Circle for stress, Failure Theories, Thin walled pressure vessels, Slope and deflection of beams using various methods, Columns buckling, Elastic Strain Energy.

Books and Reading List

- Mechanics of Materials 7th edition (SI Units) by F.P. Beer & E. R. Johnston, 2022.
- Mechanics of Materials by J. M. Gere & B. J. Goodno, 2012.

Course Code: MEE225

Course Title: Engineering Fluid Mechanics - I

Credit Hours: 3 (3, 0)

Course Objectives: The students will learn to apply the basic concepts to hydrostatic fluid problems. They will analyze the fluid kinematics and dynamics parameters using basic laws of mechanics. They will be able to solve the pipe flow problems using Bernoulli and energy equation. Upon successful completion of the course, they will be able to understand the concept of dimensional analysis.

Course Outline

Definition of fluid and its classification, Concept of continuum, Properties of the fluid, Concept of Pressure and basic equations for compressible and incompressible, Pressure measurements and devices, Hydrostatics forces on plane and curved surfaces, Buoyancy and Stability, Pressure variation in fluid with rigid body motion, Flow characteristics, Descriptions of Velocity and acceleration field (Streamlines, streak lines and path lines), Control volume and representation of system, Reynolds transport theorem (RTT), Application of Newton's 2nd law in fluids, Total stagnation and dynamic pressure, Deriving Bernoulli equation and its applications, Continuity equation using RTT, Linear momentum equation using RTT, Moment of momentum equation using RTT, Dimensional analysis, Buckingham Pi theorem and determination of Pi terms, Characteristics of pipe flow laminar and turbulent, Calculating friction factor and wall shear stresses, Solving pipe flow network problems.

Books and Reading List

- Munson, Young And Okiishi HT John, Fundamentals Of Fluid Mechanics, J. Wiley & Sons.
- Philip J. Pritchard and John C. Leylegian, Fox and McDonald's Introduction to Fluid Mechanics, J. Wiley & Sons.
- Frank M White, Fluid Mechanics. McGraw-Hill.

Course Code: MEE223

Course Title: Thermodynamics - II

Credit Hours: 3 (3, 0)

Prerequisite: MEE220

Course Objectives: The students will be able to analyze thermodynamics cycles of power, refrigeration, and air-conditioning using energy and exergy principles. They will apply the laws of thermodynamics to the chemical and phase equilibrium problems. Upon successful completion, they will be able to understand the implications of thermodynamics power, refrigeration, and air-conditioning systems on the environmental and future sustainability.

Course Outline

Review of Thermodynamics-I, gas power cycles (otto cycle, diesel cycle, Stirling and Ericsson cycles, Brayton cycles). Vapor and combined power cycles, superheat and reheat vapor power cycles, regenerative vapor power cycles, vapor compression refrigeration systems, gas mixtures without chemical reaction, their properties, gas mixtures with chemical reaction, P-V-T relations for gas mixtures, internal energy (u), enthalpy(h) and entropy(s) and specific heats for gas mixtures. Gas and steam nozzles and their efficiencies, single and multistage impulse/reaction steam turbines, thermodynamic property relations.

Books and Reading List

- Yunus A. Cengel, Michael A. Boles, Thermodynamics: An Engineering Approach, 9th edition, McGraw-Hill. ISBN: 1260048667, 9781260048667, 2018.
- Claus Borgnakke and Richard Sonntag, Fundamentals of Thermodynamics, Wiley, ISBN: 111938284X, 9781119382843, 2017.
- M. J. Moran and H. O. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons.
- T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, Pearson.

Course Code: MEE205

Course Title: Mechanics of Materials Lab

Credit Hours: 1(0, 1)

Prerequisite: MEE203

Course Objectives: Properties and behavior of engineering materials including stress-strain relations, strength, deformation mechanisms, strength, deformation, fracture, creep, and cyclic fatigue. Introduces experimental techniques common to structural engineering, interpretation of experimental data, comparison of measurements to numerical/analytical predictions, and formal engineering report writing.

List of Experiments:

1. Layout of the Mechanics of Material Lab.
2. Relationship between length of bar and angle of twist and the modulus of elasticity of different materials.
3. The hardness number of a given material using the Rockwell test machine and the hardness number of a given material using the Brinell test
4. The impact strength of notched bar of different materials by Charpy Test.
5. The stress strain diagram by software on universal testing machine (UTM) by tensile loading.
6. Bending moment variation in beam with increasing point load and that from point of loading variation.
7. Shear force variation in beam with increasing point load and that from point of loading variation.
8. Reactions forces and moments in a beam.
9. Modulus of Elasticity of a given specimen and stress-strain diagram using UTM.
10. Characteristics analysis of a sample by compression loading using UTM.
11. Study of fatigue and drawing of the SN curve.
12. Creep rate and failure phenomena and establishment of the time (t) vs extension (x) curves.

Books and Reading List

- Lab manual

Course Code: MEE222

Course Title: Thermodynamics Lab

Credit Hours: 1(0, 1)

Prerequisite: MEE220

Course Objectives: The orientation of this lab is to enhance the understanding of concepts of students which are pre-covered in their class lectures via performing experiments on it. The scope of these experiments is to demonstrate knowledge, working and thermodynamics of Compressors, Turbines, Boilers, Temperature measuring techniques, pressure measuring techniques, behavior of ideal gases by experimental verification of gas laws, heat processes and heat cycles and different boiling phases.

List of Experiments:

1. To measure pressure using pressure gauge (both pressure and vacuum) and compare values with ordinary manometers. Also examine the sensitivity of inclined manometer.
2. To familiarize with the basic working principle of non-electrical temperature sensors with physical change and examine calibration of sensors to calibrate sensors using water phase change
3. Understanding of the basic working principle of electronic temperature sensors and examine calibration of sensors.
4. Testing the calibration and sensitivity of electronic temperature sensor with fixed resistance and plot temperature characteristic curve.
5. Experimental determination of the adiabatic exponent of air using the Expansion of ideal gases apparatus by three different pressure conditions (ambient air, vacuum and pressurize tank) using Clément-Desormes process.
6. Understanding the working of boilers and analyzing the relationship between pressure and temperature for saturated steam in closed vessel and determine the behavioral change of pressure-temperature slope.
7. Understanding the working of multi-stage centrifugal compressor (centrifugal compressor).
8. Determination of the efficiency of multi-stage compressor and examine effect of variation in efficiency w.r.t speed.
9. Analyzing the pressure curve in convergent nozzles and variation between inlet pressure and mass flow rate or exit pressure and mass flow rate.
10. Analyzing how changes in pressure difference change the behavior of nozzles and determine effect of diameter and length of nozzles.

Books and Reading List

- **Lab manual**

Course Code: MEE302

Course Title: Machine Design – I

Credit Hours: 2 (2, 0)

Course Objectives: Subject deals with calculation of stresses, Identification of the parameters for selection of standard machine elements, Analyzing and Designing the machine elements for desired outputs including Keys, Couplings, Rivets, welded and bolted joints etc. Explaining the application of design standards and the importance of dimensional parameters in manufacturing aspects of mechanical design and presenting design aspects effectively through oral presentations covering effects of fatigue and creep also includes into this course.

Course Outline

Introduction and Design Philosophy, Mechanical Behavior of Deformable Materials under Loading, Factor of Safety, Design of Keys and Couplings, Design of Riveted Joints, Welded Joints and Bolted Joints, Design of Springs, Shafts, Design under fatigue loading, Design under Creep Loading, Metal Fits, Tolerances, Design Standards.

Books and Reading List

- Robert L. Mott ,*Machine Elements in Mechanical Design*
- Robert L. Norton, *Design of Machinery*
- R. S. Khurmi & J. K. Gupta, *A Textbook of Machine Design*
- Joseph E. Shigley, *Theory of Machines & Mechanisms*
- E. Doeblin, *Measurement Systems Applications and Design*, McGraw Hill
- D. G. Alciatore, M. B. Histand, *Introduction to Mechatronics and Measurement Systems*

Course Code: MEE304

Course Title: Theory of Machines

Credit Hours: 3 (3, 0)

Prerequisite: MEE201

Course Objectives: The overall objective of this course is to learn how to analyze the motions of mechanisms, determine mobility of different mechanisms and to solve kinematic parameters for developing working models of planar mechanisms. This includes relative motion analysis and design of gears, cams, linkages. It also includes graphical and analytical analysis of position, velocity, and acceleration.

Course Outline

Introduction to Mechanisms Machine & Mechanisms, Vector, Position and Displacement Analysis, Velocity Analysis of Mechanisms, Acceleration Analysis of Mechanisms, Force Analysis, Design & Development Mechanism Design, Cams, Gears, Governors.

Books and Reading List

- Machines & Mechanisms: Applied Kinematic Analysis, 4th Edition By David H. Myszka, Published By Pearson, 2012.
- Theory of Machines, SI units, R.S. Khurmi, J.K. Gupta, Eurasian Publishing House, New Delhi, 2010.
- Theory of Machines and Mechanisms, 5th Edition by John Joseph Uicker, G. R. Pennock, Joseph Edward Shigley, Published by Oxford University Press, 2017

Course Code: MEE312

Course Title: Manufacturing Processes

Credit Hours: 3 (2, 1)

Course Objectives: This is a fundamental course in the field of manufacturing engineering and deals with manufacturing methods of metals and plastic components. The objective is to understand various manufacturing processes and to apply effectively various manufacturing techniques/operations used in broad spectrum of engineering and manufacturing companies

Course Outline

Introduction and overview of Manufacturing, Material Properties and Product attributes, Solidification Processes; Fundamentals of Metal Casting, Metal Forming and Sheet Metalworking, Material Removal Processes; Theory of Metal Machining, Processing Operations; Heat Treatment of Metals, Surface Processing Operations, Fundamentals of Welding, Rapid Prototyping

List of Experiments:

1. To prepare mould and core assembly and to put metal in mould and fettle casting,
2. To understand the manufacturing of hollow and solid plastic parts using blow moulding machine and injection moulding machine (Simulation)
3. To make multiple v slots on a rectangular block using shaper machine and grinder machine.
4. To make a spur gear using milling machine.
5. To understand the basic knowledge of CNC machines
6. To perform step turning on CNC Lathe (Simulation).
7. To simulate and manufacture a rectangular plate with holes through CNC milling (Simulation).
8. To simulate and manufacture a rectangular plate with holes through CNC milling (Simulation).
9. To join plates of aluminum box using different types of welding.

Books and Reading List

- Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, by Mikell P. Groover, Published by Wiley, 7th Edition, 2019.
- Manufacturing Processes for Engineering Materials, Serope Kalpakjian, Steven R. Schmid Published by Pearson, 6th Edition, 2018.
- Lab Manual

Course Code: MEE326

Course Title: Engineering Fluid Mechanics - II

Credit Hours: 3 (3, 0)

Prerequisite: MEE225

Course Objectives: The students will be able to apply appropriate equations and principles to problems related to viscous flow through pipes. They will apply the fundamental characteristics of boundary layer to calculate drag and lift forces under different flow and geometry conditions and compressible flow problems. Moreover, they will analyze the selection of turbomachinery for an application.

Course Outline

Revision of basic concepts related to Fluid Mechanics-1, Derivation of the energy equation, Application of the energy equation, Comparison of the energy equation with the Bernoulli equation, Viscous flow in pipes and fully developed laminar flow, Laminar flow velocity profile, Turbulent flow velocity profile, Major losses in pipes, Minor losses and single pipe system, Multiple pipe systems, Flow over immersed bodies, Flow over streamlined and blunt bodies, Drag force on immersed bodies, Lift forces, Mach number and speed of sound, Isentropic flow of an ideal gas, Convergent divergent Nozzle, Turbomachinery.

Books and Reading List

- Munson, Young And Okiishi HT John, Fundamentals Of Fluid Mechanics, J. Wiley & Sons.
- Philip J. Pritchard and John C. Leylegian, Fox and McDonald's Introduction to Fluid Mechanics, J. Wiley & Sons.
- Frank M White, Fluid Mechanics. McGraw-Hill.
- Fluid Mechanics: Fundamentals and Applications, Yunus A. Cengel, John M. Cimbala 3rd edition.
- Fluid Mechanics for Engineers in SI Unite, Global Edition, David A. Chin

Course Code: MEE311

Course Title: Engineering Management and Economics

Credit Hours: 2 (2, 0)

Course Objectives: This course provides the basic concepts and enables the students to apply engineering management and economics knowledge in field of mechanical engineering. This course will also enable students to discover knowledge on their own for upcoming future trends in the field.

Course Outline

Plant Management: Productivity, Basic Concepts, Classification, Measurement, and Improvement. Role of Work Study, Measurement, and Work Sampling. Plant Location Criteria, Equipment and Utilities Layout, Types of Layout. Material Handling Systems, Material Requirement Planning. Inventory Models and Just in Time (JIT) Technique, Production Planning, Scheduling Problems & Models, Project Management PERT-CPM, Network Scheduling, Activity Crashing and Resource Leaving. Engineering Economics; Types of Costs: Direct, Indirect, Overheads, Fixed, Variable, Opportunity, Sunk, Cash Flow Diagrams, Time Value of Money, Discounted Cash Flows. Equivalence: Present Worth, Annual Equivalent Costs, Internal Rate of Return, Payback Period, Project Feasibility Analysis. Depreciation Accounting: Straight Line, Declining Balance, and Sum of Year Digits. Plant Replacement Analysis. Inflation and Economic Considerations: Cost Estimating Methods. Project Cost Control.

Books and Reading List

- M.H. Zuberi, "Industrial Management", 3rd Edition, Lahore Rabbani Printing Press, 2011

Everett E Adam, "Production and Operations Management: Concepts, Models, and Behavior", 10th Edition, Prentice Hall, 2005, ISBN-13: 978-0137179435

Course Code: MEE303

Course Title: Machine Design – II

Credit Hours: 2 (2, 0)

Prerequisite: MEE302

Course Objectives: Deals with various machine design fundamentals and the use of design software. Design for fatigue and consideration of fracture mechanics is emphasized. Calculation of stresses, Identification of the parameters for selection of standard machine elements, Analyzing and Designing the machine elements for desired outputs including gear teeth, flywheels, power screws, bearings, chains, belts, clutches, brakes, different types of structural joints, power transmitting shafts and mechanical springs is also carried out in the course.

Course Outline

Spur, Helical, Bevel and Worm Gears, Design of Flywheels, Selection Procedures of Different Contact Bearings, Design of Brake, Design of Clutches, Design of Power Screws / Translation Screws, Selection Criteria for Standard Machine Elements (Belts, Chains, Ropes), Design under Failure Theories.

Books and Reading List

- Robert L. Mott ,*Machine Elements in Mechanical Design*
- Robert L. Norton, *Design of Machinery*
- R. S. Khurmi & J. K. Gupta, *A Textbook of Machine Design*
- Joseph E. Shigley, *Theory of Machines & Mechanisms*
- E. Doeblin, *Measurement Systems Applications and Design*, McGraw Hill
- D. G. Alciatore, M. B. Histand, *Introduction to Mechatronics and Measurement Systems*

Course Code: MEE324

Course Title: Heat Transfer

Credit Hours: 2(2, 0)

Course Objectives: Heat and mass transfer is a 3rd year Course which helps students to understand and apply governing equations of heat transfer mechanism including conduction, convection, and radiation. In addition, this course provides deep insight of the thermal analysis of Heat exchanger along with basic understanding of governing laws of mass transfer and associated engineering problems.

Course Outline

Introduction to Heat Transfer, Three modes of heat transfer, steady and transient heat transfer, Fourier's law, 1-D heat conduction through composite walls. Heat conduction through extended surfaces, transient heat conduction, lumped system analysis, multi-dimensional heat conduction. Convection heat transfer, Newton's law of cooling, Heat transfer during laminar, transient, and turbulent flows, non-dimensional parameters, Internal flows: Convection correlations for laminar and turbulent flows. External flow: Flow over flat plates, cylinders, spheres, Boiling and condensation heat transfer, Heat exchangers, analytical design methods, numerical solutions, Radiation heat transfer, shape factors, radiation exchange for black and gray bodies.

Books and Reading List

- Heat and Mass Transfer, A practical Approach, *Third Edition*, Yunus A. Çengel, ISBN-13: 978-0071257398
- Fundamental of Heat and Mass Transfer, *Sixth Edition*, Incropera, Dewitt, Bergmann, Lavine, ISBN-13: 978-0470501979.

Course Code: MEE329

Course Title: Instrumentation and Measurement

Credit Hours: 2 (2, 0)

Course Objectives: During this course, students will learn about the significance of measurement, instrument types, and their performance characteristics that include static and dynamic characteristics of instruments, various types of errors that occur during the measurement, calibration of measuring sensors and instruments, measurement noise, and signal processing. Different types of sensor technologies like capacitive and resistive sensors, Temperature and pressure measurement sensors, magnetic sensors, hall effect sensors, piezoelectric sensor, optical sensors, and different types of environmental and rotary transducers. Understanding the integration of sensors in smart and autonomous systems.

Course Outline

Introduction to measurement and instrumentation. Significance of measurement, planning of experiments, general measurement system, choosing appropriate measuring instruments, calibration, Instrument types and performance characteristics (static and dynamics characteristics), Errors during the measurement process, Calibration of measuring sensors and instruments, Measurement noise and signal processing, Electrical indicating and test instruments, Sensor Technologies, Temperature measurement, Pressure Measurement, Measurement of length, displacement, force, torque, strain, frequency, pressure, flow, and temperature. Introduction to data acquisition systems, signal conditioning, display elements. Smart and non-smart sensors, integration of sensors in smart and autonomous systems.

Books and Reading List

- Measurement and Instrumentation Principles, by Alan S. Morris, Butterworth-Heinemann
- Measurement Systems Applications and Design, E. O. Doeblin, McGraw Hill
- Introduction to Instrumentation and Measurements, Robert B. Northrop CRC Press
- Introduction to Mechatronics and Measurement Systems, D. G. Alciatore, M. B. Histand, McGraw-Hill

Course Code: MEE315

Course Title: Computer Aided Design and Manufacturing

Credit Hours: 3(2, 1)

Course Objectives: Computer aided design and manufacturing (CAD/CAM) develops a thorough understanding of the effective computer usage in engineering applications for the design, development, and manufacturing of mechanical systems. Also, it focuses the students to have hands-on experience in the use of commercial Solid Modeling and CAM packages for industrial applications.

Course Contents

Introduction and overview of CAD hardware and software, Solid modelling & Respective techniques (2D sketching and 3D modelling), Lines, Curves, and surfaces, Assembly Modelling and mechanism, Engineering Drawing and CAD, Computer aided Analysis (CAE), Reverse Engineering and Rapid prototyping, Computer aided manufacturing (CAM), Numerical Control (NC), CNC & DNC (Introduction and programming), Concurrent engineering (CE) and Group Technology (GT), Flexible manufacturing systems (FMS), Cellular and just in time (JIT) Manufacturing, Computer integrated Manufacturing (CIM).

List of Experiments

1. Introduction and overview of 3D modeling software.
2. Sketch plane, Datums, 2D sketching module (lines, curves, constraints), Part modelling with simple features (Extrude, revolve, hole, chamfer, round, rib, shell)
3. Part modelling with advanced features (Mirror, pattern, Blend, Sweep, Swept blend).
4. Assembly modelling (mating conditions, hierarchy, creating new features and part within assembly)
5. Engineering drawing (part drawing, custom and default views, annotations, tables, assembly drawing, exploded view)
6. Finite Element analysis (introduction, static structural analysis, material properties, boundary conditions, results, and failure estimation)
7. Computer aided manufacturing (CNC machines control, part programming on machining simulator, part programming on CNC turning machine)

Books and Reading List

- CREO Parametric 7.0 Step by Step Guide, by CADFolks, 2021.
- Mastering CAD/CAM, by Ibrahim Zeid, McGraw Hill, 2005.
- Automation, Production Systems and Computer Integrated Manufacturing", 2nd Edition, Mikell P. Groover, Prentice Hall 2003.

Course Code: MEE328

Course Title: Engineering Fluid Mechanics Lab

Credit Hours: 1(0, 1)

Prerequisite: MEE225

Course Objectives: The Engineering Fluid Mechanics laboratory provides a "hands-on" environment that is crucial for developing students' understanding of theoretical concepts. The laboratory contains equipment for the measurement of various fluid properties and flows characteristics. Facilities are available for investigating the fundamentals of fluid statics as well as kinematics and kinetics of fluid flow to enhance the hands-on experience of our students. The lab is equipped with test rigs for experiments pertinent to fluid mechanics, pumping machinery, and fluid power systems. These include viscometers, various types of pumps, turbines, axial flow fan unit, a fluid power training kit, fluid friction in pipes and fittings test rig, etc. The lab is also equipped with a subsonic wind tunnel related to computational fluid dynamics.

List of Experiments:

1. To perform pressure calibration on a Bourdon tube pressure gauge using dead weight tester.
2. To measure the discharge flow rate and calculate the head loss using venturi meter.
3. To measure the discharge flow rate and calculate the head loss using orifice plate meter.
4. To determine the magnitude of a hydrostatic force on submerged surface and locate the center of the pressure.
5. To determine the characteristics of flow over a rectangular and a triangular weir using flow over a notch apparatus.
6. To determine the Metacentric Height of the floating body using Metacentric Height Apparatus.
7. To determine the coefficient of velocity and coefficient of discharge using orifice and jet flow apparatus.
8. To investigate the reaction force produced by the impact of a jet of water on various target vanes.
9. To demonstrate the laminar, transition and turbulent flows in a pipe using Osborne Reynolds Apparatus.
10. To determine the viscosity of given oils using falling sphere viscometer.
11. To demonstrate the cavitation phenomenon in a liquid using Cavitation Panel.
12. To visualize flow patterns around immersed objects in an open channel using Mini flow channel apparatus.
13. To investigate the relationship between head loss due to fluid friction and velocity for the flow of water in pipes.
14. To determine the minor head loss coefficients for flow through a range of pipe fittings.
15. To determine the volumetric flow rate and output performance characteristics through the measurement of the differential pressure across the fan.
16. To determine the performance characteristics of a Compact Reciprocating Pump at a constant speed.
17. To determine the system and single pump characteristics curves with variable flow rate and pump speeds.
18. To investigate the operational characteristics of two centrifugal pumps connected in series and in parallel.
19. To find the performance and efficiency of the Pelton Wheel Turbine with different spear valve settings.
20. To find the performance and efficiency of the Kaplan Turbine with different guide vane settings.
21. To find the performance and efficiency of the Francis Turbine with different guide vane settings.

22. To determine the lift, drag and pitching moment variations with different angles of attack in subsonic wind tunnel.
23. To determine pressure distribution around pressure wing with different angles of attack in subsonic wind tunnel.

Books and Reading List

- Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Wade W. Huebsch - Fundamentals of Fluid Mechanics, 6th Edition.
- Fluid Mechanics lab apparatus manuals.

Course Code: MEE401

Course Title: Mechanical Vibrations

Credit Hours: 3 (3, 0)

Course Objectives: The course is designed to provide basic understanding of the vibration phenomenon which everyone comes across in daily life especially in mechanical engineering. Students will apply the knowledge of differential equations and complex numbers together with statics and dynamics to solve engineering vibration problems. It is expected that after this course students will attain a level of understanding of the subject that will help them in their practical life.

Course Outline

Introduction and Concept of Vibrations, Single Degree of Freedom Systems - Free Vibratory Systems, Single Degree of Freedom Systems – Forced Vibratory Systems, Transient Vibrations, Systems with Two Degrees of Freedom, Eigen Values and Eigen Vectors

Books and Reading List

- Mechanical Vibration, Singiresu S. Rao Pearson Education Publishing Company, 5th Edition, ISBN-10: 0132128195
- Vibration Theory and Applications. William T. Thomson, CRC Press; 1st edition Kindle Edition(February 6, 2018) , ASIN : B07BYG2MG6
- Engineering Vibration 4th Edition by D.J Inman Prentice Hall, 2013, Indian International ASIN B01LP3FZJ6, ISBN-10 : 0132871696

Course Code: MEE432

Course Title: Finite Element Analysis

Credit Hours: 2(2, 0)

Course Objectives: This course develops the basic understanding of the finite element method and its applications to real life structural, thermal, and dynamic problems. This course also aims to train students in the use of a commercial FEA package and interpretation of results obtained for engineering design and analysis.

Course Contents

Historic background and overview of FEA, Basic terminologies and introduction to various finite element methods, Direct or stiffness method for one-dimensional (1D) problems in structural mechanics, Stiffness Matrix formulation and solution of algebraic equations, Stiffness matrix formulation for stress analysis of two-dimensional (2D) truss structures, Shape Functions in FEA of Structural, Heat Transfer and Dynamic Analysis, Stiffness matrix formulation of Beam and planar element, Finite element formulation of Heat transfer problems, Dynamics system analysis using FEM.

Books and Reading List

- A First Course in the Finite Element Method, 6th Edition by Daryl. A. Logan Published by Cengage Learning, Inc, 2016.
- Finite Element Analysis, Theory and Application with ANSYS: 5th Edition, revised by Saeed Moaveni, Published by Prentice Hall, 2020.

Course Code: MEE433

Course Title: Finite Element Analysis Lab

Credit Hours: 1(0, 1)

Course Objectives: The Finite element analysis (FEA) Lab is designed to implement the knowledge of FEA on real world structural, thermal, and fluid mechanics problems. The problems will be solved using the commercially available software tools for the students.

List of Simulations

Analysis of the following problems using FEA software tools

1. Rectangular plate under tension
2. Rectangular plate under compression
3. Plate with a Hole
4. Cantilever Beam
5. Simply supported beam
6. Linear buckling of I-beam
7. Thermal analysis of thin rectangular plate
8. Thermal analysis of heat sink
9. Transient convection analysis of bar in air
10. Flow analysis in a diversion pipe
11. Laminar flow in a pipe
12. Heat transfer analysis of composite wall

Heat transfer analysis of composite cylinder

Books and Reading List

- Software Help/Tutorials
- Lab Manual

Course Code: MEE405

Course Title: Air Conditioning and Refrigeration

Credit Hours: 2(2, 0)

Prerequisite: MEE223

Course Objectives: Students will be able to identify the various components of the refrigeration and air-conditioning systems by resuming the basic knowledge. They will apply the fundamental concepts related to design and selection of various components (Evaporator, condensers etc.) of refrigeration. Moreover, they will analyze the factors affecting thermal comfort in AC zones and air treatment/handling requirements for public buildings. Upon successful completion, the students will be able to calculate the heating and cooling load for various structures/buildings.

Course Outline

Pure substance properties, Refrigeration system basics, Refrigeration system analysis, Refrigeration load estimation (Refrigeration), Psychrometric properties of air, HVAC basics, HVAC systems, Heating and Cooling Load, Pressure loss, Duct design and Air flow balancing.

Books and Reading List

- McQuiston, Parker and Spitler, Heating, Ventilating, and Air-conditioning Analysis and Design, John Wiley & Sons
- W. F. Stoecker ,Refrigeration and Air Conditioning
- Ed. Kreider, Curtiss &Rabl, Heating and Cooling of Buildings ,McGraw-Hill
- Dossat, R. J., John Wiley, Principles of Refrigeration.
- Haines, Roger W. Wilson, Lewis, HVAC Systems Design Handbook, McGraw-Hill Companies
- Dincer, Ibrahim, Ratlamwala, Tahir Abdul Hussain ,Integrated Absorption Refrigeration Systems, Comparative Energy and Exergy Analyses, Springer
- ASHRAE Fundamentals Handbook 8. Shan K. Wang, Handbook of Air Conditioning and Refrigeration

Course Code: MEE402

Course Title: Mechanisms and Mechanical Vibrations Lab

Credit Hours: 1(0, 1)

Prerequisite: MEE201

Course Objectives: This lab is about the distinctive features of machines and how a machine works. In this course, students will first study kinematics, working of machines, and related effects of speed and acceleration. The second part is related to mechanical vibration. The aim is to study and visualize the different mechanisms and to study the possible occurrence of vibrations in mechanical equipment and how to control it, i.e., whirling of shafts, spring damper systems, etc.

List of Experiments:

1. Study of Cam-follower mechanism and draw displacement diagrams
2. Velocity, acceleration diagrams of Four Bar Mechanism
3. Velocity, acceleration diagrams of Slider crank mechanism
4. Investigation of the properties (Time period and natural frequency) of a simple wood and metal pendulum.
5. Investigation of the properties (Time period and natural frequency) of rod pendulum.
6. Comparison of rod and thread pendulum with same reduced pendulum length
7. Determination of natural frequencies of free undamped oscillations.
8. Properties of bar oscillator with damping effect and to find properties of bar oscillator with Forced oscillation
9. Rod length effect on the natural frequency of torsional oscillation system.

Books and Reading List

- Lab manual

Course Code: MEE422

Course Title: Heat Transfer Lab

Credit Hours: 1(0, 1)

Prerequisite: MEE324

Course Objectives: The objective of heat transfer lab is to enhance the understanding the basic concepts of students which are pre-covered in their class lectures via performing experiments on it. The scope of these experiments is to enable students to perform experiments on different heat transfer apparatus to compare different modes of heat transfer and analyze key parameters of different types of heat exchangers to investigate their performance. The lab also focuses on how to find the total rate of heat transfer and thermal conductivity of specific materials. The lab will demonstrate students the practical applications of above equipment and they will learn to analyze the relationship between different parameters of equipment and how to design equipment for gaining maximum efficiency.

List of Experiments:

1. Investigate Linear and Radial heat conduction through different materials and verify Fourier's law of heat conduction and effect of insulation.
2. To determine the rate of heat transfer (Q) through a composite bar using Fourier's law.
3. Find the thermal conductivity of insulating solid materials using the steady state method.
4. Investigate the convective heat transfer coefficient (h) through different shapes of same material and analyze the effect of free and force convection.
5. To determine the relationship between input power and surface temperature of pin fin and flat surfaces during free and forced convection.
6. Evaluate the effect of temperature difference in concentric tube heat exchangers for parallel and counter flow heat exchanger and analyze effect of flow rate on heat transfer.
7. Evaluate the effect of temperature difference in concentric tube heat exchangers for counter flow heat exchanger and analyze effect of flow rate on heat transfer.
8. Determine the mean temperature of parallel and counter flow heat exchanger using the Logarithmic Mean Temperature Difference (LMTD) method by varying flow of hot and cold water.
9. Investigate the heat transfer in fluid for counter and parallel and compare results for laminar and viscous flow with help of Reynolds number and analyze effect of Reynolds number on heat transfer.
10. Determine and analyze the relationship between Nusselt and Reynolds Number and find the variation in convective heat transfer coefficient around a cylinder in cross flow.
11. To prove that the intensity of radiations on a surface is inversely proportional to the square of the distance between the surface and the radiating/light source.
12. To prove that the energy radiated at an angle to a surface is equal to the normal radiation multiplied by the Cosine of the angle between the direction of radiation and normal to the surface.

Books and Reading List

1. Lab manual
2. Heat and Mass Transfer, A practical Approach, *Third Edition*, Yunus A. Çengel, ISBN-13: 978-0071257398

Course Code: MEE412

Course Title: Air Conditioning and Refrigeration Lab

Credit Hours: 1(0, 1)

Course Objectives: The objective of Refrigeration and HVAC Lab is to enhance the understanding of concepts of students which are pre-covered in their class lectures via performing experiments on it. The scope of these experiments is to enable students to perform experiments on different refrigeration and HVAC lab apparatuses and compare the results on different refrigeration cycles to investigate their performance and select the optimal parameter condition to obtain comfortable environments using modern engineering tool. The lab will demonstrate students the practical applications of above equipment and they will learn to analyze the relationship between different parameters of equipment and how to design equipment for gaining maximum efficiency.

List of Experiments:

1. To calculate overall heat-transfer coefficient between refrigerant gas and air of the condenser.
2. To determine COP of refrigeration system using air-air (and air-water) heat pump.
3. To determine COP of refrigeration system using water-water heat pump.
4. To calculate the refrigerating effect of the heat pump and the performance of heat pump at different flow rates of cooling water.
5. To determine the cooling effect through a vortex tube type refrigeration principle.
6. To determine mass flow rate of cold and hot air, cold air temperature difference and cold air mass ratio in a vortex tube refrigeration system.
7. To calculate the Inlet Power, heat transferred and COP using air cooled condenser and air-cooled evaporator.
8. To calculate the Inlet Power, heat transferred and COP using water cooled condenser and water-cooled evaporator.
9. To calculate the Inlet Power, heat transferred and COP using water cooled condenser and air-cooled evaporator
10. To calculate the Inlet Power, heat transferred and COP using air cooled condenser and water-cooled evaporator.
11. Find the increase in humidity due to temperature rise in air using HVAC setup.
12. Calculate the humidity/ratio and other psychometric properties through known wet/dry bulb temperature with a psychometric chart.

Books and Reading List

1. Lab manual
2. Refrigeration & Air Conditioning Technology, 7th Edition, by Bill Whitman, Bill Johnson, John Tomczyk, Eugene Silberstein
3. Thermodynamics: An Engineering Approach, 8th Edition, Yunus A. Çengel, Michael A. Boles.
4. Refrigeration and Air-conditioning, 3rd Edition, by A. R. Trott, T. Welch, Published by Butterworth-Heinemann, 2000, ISBN 075064219X, 9780750642194
5. ASHRAE Handbook, by American Society of Heating, Refrigerating and Air-Conditioning Engineers, Published by ASHRAE, 1992, ISBN 0910110867, 9780910110860

Course Code: MEE423

Course Title: Control Systems

Credit Hours: 3(3, 0)

Course Objectives

The objective of the course is to teach the students about the basic analysis and synthesis tools used in the design of feedback control systems. The students are also familiarized with industry standard software tools such as Matlab, Simulink, Scilab, and/or Octave to analyze, design, and evaluate control systems.

Course Outlines

Basic Concepts of control systems, Quick review of mathematical modeling, Transfer functions, Block Diagrams and Signal Flow Graphs, Response of First and Second Order Systems, Asymptotic/BIBO Stability and Routh-Hurwitz Stability Criterion, Performance Specifications of Linear Time-Invariant Control Systems, PID controller design, Root Locus Analysis, Root Locus Design, Frequency Response Analysis, Frequency Response Design, Bode plots, and Nyquist criterion, State space analysis and design.

Recommended Books

1. Design of Feedback Control Systems, by R. T. Stefani, C. J. Savant, B. Shahian, G. H. Hostetter, OUP, USA, Latest Edition.
2. Feedback control systems, by Phillips and Harbor, Prentice Hall, Latest Edition
3. Control Systems Engineering, by N. Nise, Wiley-VCH. Latest Edition
4. Modern Control Engineering, by K. Ogata, Pearson Education, Latest Edition
5. Modern Control Systems, by Richard C. Dorf, and Robert H. Bishop, Pearson Education Ltd., Latest Edition
6. Automatic Control Systems, by F. Golnaraghi, and Benjamin C. Kuo, JohnWiley & Sons, Latest Edition.

Course Code: MEE437

Course Title: Instrumentation and Control lab

Credit Hours: 1(0, 1)

Course Objectives:

During lab session students will be introduce with different types of sensors / transducers used in the industrial application that include temperature, pressure, linear variable differential transformer (LVDT), strain gauge, infrared sensor, ultrasonic sensor, smoke detector, touch sensors, rotational transducer trainer containing techo-generator, servo motors and encoders, position control system, speed control system, pressure control system, temperature control system, flow control system, and level control system. Students will learn how to construct circuit and how to calibrate the apparatus and perform measurement.

List of Experiments:

1. Basic construction, working and characteristic of Wheatstone bridge measurement. Construction for balance condition and null configuration. Calculation of unknown resistance from the bridge values at balance.
2. Basic construction, working and characteristic of IC Temperature sensor LM35 and that of Platinum RTD Temperature Transducer
3. Basic construction, working and characteristics of NTC Thermistor .and those of NTC Thermistor in bridge circuit configuration
4. Basic construction, working and characteristic of Thermocouple and those of
5. Basic construction, working and characteristic of Air Flow Transducer and those of Pressure Transducer
6. Basic construction, working and characteristics of Linear Variable Differential Transformer LVDT.
7. Basic construction, working and characteristic of Strain Gauge and Calibration of Strain Gauge Transducer for different weights
8. Basic construction, working and characteristic of Position Control System
9. Basic construction, working and characteristic of Speed Control System
10. Basic construction, working and characteristic of Pressure Control System
11. Basic construction, working and characteristic of Temperature Control System
12. Basic construction, working and characteristic of Flow Control System
13. Basic construction, working and characteristic of Level Control System

Books and Reading List

- Lab manual

Course Code: MEE428

Course Title: IC Engines

Credit Hours: 2(2, 0)

Course Objectives: The students will be able to explain the basic knowledge, construction and working of various types of IC engines and its components. They will solve numerical problems related to the design and operation of IC engines. They will also analyze the design and operation of various IC Engine systems including preparation of air/fuel mixture, combustion control and emission reduction. Upon successful completion of the course, they will be able to analyze the effect of engine operating parameters (air/fuel ratio, ignition timing, fuel properties etc.) on engine performance and emissions.

Course Outline

Introduction to I.C engines, SI & CI engines systems: Basic engine cycle and operation, Fuel and combustion, Gas exchange processes and mixture preparation, Combustion in SI and CI engines, Exhaust Flow, Pollution control, Heat Transfer in Engines and engine cooling system, Friction and Lubrication of engine, Lubrication systems.

Books and Reading List

- W. W. Pulkrabek, Engineering Fundamentals of IC engine, Pearson Education Inc, USA
- J. B. Heywood, Internal Combustion Engine Fundamentals, Heywood McGraw-Hill
- Richard Stone Palgrave Macmillan, Introduction to I. C. Engines
- C. F Taylor, Internal combustion engines. MIT Press.
- R. V. Schäfer, F. Schäfer, Internal Combustion Engine Handbook - Basics, Components, Systems, and Perspectives, Fred SAE International.
- C. R. Ferguson, Internal Combustion Engines: Applied Thermosciences, Wiley Science

Course Code: MEE430

Course Title: IC Engines Lab

Credit Hours: 1(0, 1)

Course Objectives: This IC Engines and Power Plants Lab course forms an integral form of the basic course in internal combustion engines and powerplants at the undergraduate level. the experiments to be performed in a laboratory are ideally designed in such a way as to reinforce the understanding of the basic principles as well as help the students visualize the various phenomenon encountered in different applications.

List of Experiments:

1. The construction and working demonstration of the 4-Stroke Petrol Engine model.
2. The construction and working demonstration of 4-Stroke Diesel Engine model.
3. Construction and working demonstration of the Wankel Engine model.
4. Construction and working demonstration of the Cutaway engine model.
5. Construction and working demonstration of the Turbo Jet Engine model.
6. The characteristics of petrol engine power with different Engine speeds, and specific fuel consumption to draw performance Curves.
7. The characteristics of diesel engine power with different engine speeds, and specific fuel consumption to draw performance curves.

Books and Reading List

- Lab manual

Course Code: MEE406

Course Title: Health, Safety and Environment

Credit Hours: 1 (1, 0)

Course Objectives: This course is aimed to educate the engineering students regarding the importance of safety measures in industry, the possible types of acidents, health hazards, pollution and ISO standards.

Course Outline

Introduction of Health and Safety, Types of accidents and preventions, Safety management techniques, Hazard analysis, First aid and emergency procedures, Environment and health, Environmental act. Health and safety act, Atmospheric pollution, Industrial waste, Noise pollution, ISO standards for health, safety, and environment.

Books and Reading List

- J. Ridley and J. Channing, Safety at Works, Routledge. 8th Edition, 2014
- K. G. Lockyer, Factory & Production Management, Pitman Publishing
- Industrial Safety and Health Management by C Ray Asfahl, David W. Rieske, 2010

Course Code: MEE403

Course Title: Deformation and Failure

Credit Hours: 3 (3, 0)

Course Objectives:

This is an advanced course in the field of Applied Mechanics and Design. This course will enable students to identify the causes of common types of failures which occur in industrial components. This will also introduce the students to various analytical, numerical, and experimental techniques used to predict deformation and failure of materials.

Course Outline

Deformation behavior, Overview of historic engineering failures, Elastic and plastic deformation, Dislocation theory, Strengthening mechanisms in steel, Environmental effects on materials, Oxidation resistance in materials, Creep mechanism, creep resistant steel, Failure in structural materials, Fatigue failure and fracture mechanics.

Books and Reading List

- Failure of Materials in Mechanical Design: Analysis, Prediction, Prevention, Jack A. Collins, Published by Wiley-IEEE, 1993
- Failure Analysis of Engineering Materials, by Charlie R. Brooks, Ashok Choudhury, Published by McGraw-Hill Professional, 2001

Course Code: MEE404

Course Title: Mechanical Engineering Design and Analysis

Credit Hours: 3 (3, 0)

Course Objectives: This is an advanced course in the field of Mechanical Engineering Design that introduces various methodologies used for successful product development as applied to the field of mechanical engineering. This course will enable students to break down the design process into distinct steps and use a systematic approach to tackle design problems. In addition, it will also enable students to integrate various customer requirements into final product design.

Course Outline

Philosophy and concept of engineering design, Engineering creativity, Phases and procedure in design, Management of engineering projects, Computer aided design, Computer aided manufacturing, Optimization and reliability, Application of industrial design codes.

Books and Reading List

- Engineering Design: A Materials and Processing Approach, 3rd Edition, by George Ellwood Dieter, Published by McGraw-Hill, 2000
- Engineering Design: A Practical Guide, by Madara Ogot, Gul Okudan-Kremer, Gül Kremer, Published by Trafford Publishing, 2004

Course Code: MEE411

Course Title: Advanced Material Processing

Credit Hours: 3 (3, 0)

Course Objectives: This is an advanced course in the field of manufacturing technology through which students will be able to understand various advanced techniques in material processing covering both metals and non-metals.

Course Outline

Mechanics of cutting, Chip formation, Cutting forces, Heat generation during metal removal, Wear considerations, Finite element analysis of metal cutting, Forming techniques, Plasticity and yield criteria, Work hardening, Plastic instability, Strain rate and temperature, Hot working, Extrusion and drawing, Complex stamping.

Books and Reading List

- Machining Technology: Machine Tools and Operations, by Helmi A. Youssef, Hassan El-Hofy, Published by CRC Press, 2008
- Material Forming Processes, by Anne Marie Habraken, Published by Kogan Page Science, 2003

Course Code: MEE413

Course Title: Gas Dynamics

Credit Hours: 3 (3, 0)

Course Objectives: This course is designed to introduce undergraduate students to the fundamentals of compressible fluid flow, with a focus on steady, one-dimensional flow problems Instruction will enable students to comprehend the meaning and significance of the governing mass, momentum and energy conservation laws which form the theoretical framework of gas dynamics.

Course Outline

Basic governing laws of conservation of mass, momentum and energy, limitations, Sub-sonic and supersonic gas flow, Mach number and Mach angle, Isentropic Flow and Applications; Operation of nozzles under varying pressure ratios, Normal and oblique shocks, Prandtl-Meyer compression and expansion with applications, Rayleigh flow and Fanno flow, Busemann's shock polar diagram.

Books and Reading List

- M. J. Zucrow and J.D. Hoffman, Gas Dynamics, John Wiley & Sons, 1976
- A. H. Shapiro, R. Wiley, The Dynamics and Thermodynamics of Compressible Fluid Flow-Vol. 1, 1st Edition
- J. E. John, Allyn and Bacon, Gas Dynamics, 2nd Edition
- B.W. Imrie, Compressible Flow

Course Code: MEE415

Course Title: Maintenance Engineering

Credit Hours: 3 (3, 0)

Course Objectives: This is an advanced course in Manufacturing Technology in which students will be introduced to various types of maintenance methodologies used in the industry as well basic repairs performed on common mechanical systems.

Course Outline

Introductory concepts of maintenance engineering, Maintenance Types, Maintenance Management, Safety Engineering, Basic Mechanical Aspects, Basic Repairs.

Books and Reading List

- Maintenance Engineering Handbook, R. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff, Published by McGraw-Hill Professional, 2008,
- Engineering Maintenance: A Modern Approach, By B. S. Dhillon, Published by CRC Press, 2002

Course Code: MEE421

Course Title: Computational Fluid Dynamics

Credit Hours: 3 (3, 0)

Course Objectives: This course provides an introduction to computational fluid dynamics. The students will train the numerical solution of model problems. The students will be able to determine the quality of numerical results and the efficiency of numerical methods for basic fluid flow model problems.

Course Outline

Types of ordinary and partial differential equations, solution of equation sets, boundary value and initial value problems, control volume approach, time stepping, accuracy, stability, consistency, linearization, diffusion, dispersion, vorticity stream function and primitive variable formulations, Turbulence modeling. Examples of external flow across various configuration, internal flows through pipes, ducts and valves.

Books and Reading List

- J. D. Anderson Jr., Computational Fluid Dynamics, 1 st Edition, McGraw-Hill Science
- Müller, J., `Essentials of Computational Fluid Dynamics," CRC Pressure, Taylor & Francis Group2016. ISBN: 978-1-4822-2730-7 (Paperback)
- Ferziger, J. H. and Peric, M., `Computational Methods for Fluid Dynamics,' Springer,
- Cummings, R. M., Mason, W. H., Morton, S. A., and McDaniel, D. R., `Applied Computational Aerodynamics,' Cambridge, University Press, 2015.
- Tannehill, J. C., Anderson, D. A., and Pletcher, R. H., `Computational Fluid Mechanics and Heater Transfer,' Taylor and Francis, 1997.
- Anderson, J., `Computational Fluid Dynamics,' McGraw-Hill, 1995.
- Reports and scientific papers

Course Code: MEE424

Course Title: Renewable Energy Technology

Credit Hours: 3 (3, 0)

Course Objectives: in this course students will learn about renewable energy in the context of our primary energy needs, status of the world's present primary energy situation. Energy in buildings – how energy is used in domestic buildings and how its use can be reduced with insulation and more efficient heating systems. Solar thermal energy, Solar photovoltaics, Bioenergy from biomass, Hydroelectricity, Tidal power, Wind energy, Wave energy, Geothermal energy, and how renewable energy sources can contribute to world energy needs, particularly for electricity generation, and scenarios for future renewable energy growth.

Course Outline

Introduction of renewable energy in the context of our primary energy needs, overview of the status of renewable energy in the context of the world's present primary energy situation. Energy in buildings, Solar thermal energy, Solar photovoltaics, Bioenergy, Hydroelectricity, Tidal power, Wind energy, Wave energy, Geothermal energy, Integrating renewable energy and renewable energy.

Books and Reading List

- Renewable Energy Resources, by John Twidell, published by Routledge, 2015
- Introduction to Renewable Energy by Vaughn Nelson published by CRC Press
- Renewable Energy: Physics, Engineering, Environmental impact, Economics and Planning by Bent Sorensen published by Academic Press

Course Code: MEE425

Course Title: Power Plants

Credit Hours: 3 (3, 0)

Course Objectives: The Power Plant Engineering course is designed by keeping in view the thermodynamic aspects of powerplant equipment and processes. Besides the comprehensive review of advanced thermodynamics and energy resources, this course will cover a wide range of topics related to the Power Plants. These topics include steam generators & turbines, steam power plants, gas turbine power plants, combined cycle power plants, cogeneration, diesel engine power plants, nuclear power plant, nuclear power plant, renewable energy power plants and power plant economics & management. The final report of assigned project may include a field trip and thermodynamic analysis.

Course Outline

Review of basic concepts and fundamentals of thermodynamics, Steam generators and turbines, Steam powerplants, Gas turbine power plants, Combined cycle power plants, Cogeneration, Diesel engine power plant, Nuclear power plant, Renewable energy power plant, Power plant economics and management.

Books and Reading List

- "Power Plant Technology"by M. M. El-Wakil
- "Power Plant Engineering"by Lawrence F. Drbal, Patricia G. Boston, Kayla L. Westra & R. Bruce Erickson
- Pedersen, E.S., Nuclear Power, Ann Arbor Science
- Internal Combustion Engine Fundamentals by John B. HeywoodI. Dincer, C. Zamfirescu, Advanced Power generation systems, Elseveir
- Everett Woodruff, Herbert Lammers, Thomas Lammers, "Steam Plant Operation", McGraw-Hill.
- Thomas Elliott, Kao Chen, Robert Swanekamp, "Standard Handbook of Powerplant Engineering", McGraw-Hill.
- Reports/Notes/Publications

Course Code: MEE426

Course Title: HVAC

Credit Hours: 3(3, 0)

Course Objectives: In this course of HVAC (Heating, Ventilation and Air Conditioning), the students will Identify the various components of the refrigeration and air-conditioning systems by resuming the basic knowledge. They will be able apply the fundamental concepts related to design and selection of various components (Evaporator, condensers etc.) of refrigeration and HVAC systems. Moreover, the students will analyze the factors affecting thermal comfort in AC zones and air treatment/handling requirements for public buildings. Upon successful conclusion of the course, students will be able to calculate the heating and cooling load for various structures/buildings.

Course Outline

Fundamentals of Refrigeration, Basic Air Conditioning, Heating Fundamentals, Gas Heating Principles, Commercial Refrigeration, Heat Pumps, Advanced Air Conditioning, Residential Load Calculations, Advanced Refrigeration, Advanced Controls.

Books and Reading List

- David H. Myszka, Machines and Mechanisms.
- Thomas Bevan, The Theory of Machines.
- John J. Uicker, Gordon R. Pennock, Joseph E. Shigley, Theory of Machines and Mechanisms.
- Robert Ferrier McKay, The Theory of Machines
- J. A. Collins, Mechanical Design of Machine Elements and Machines, J. Wiley
- W. B. Green, Theory of Machine 7. R. L. Norton, Design of Machinery

Course Code: MEE434

Course Title: Smart Manufacturing

Credit Hours: 3 (3, 0)

Course Objectives: The students will get an insight into smart technologies, computer simulation tools for production development & operations, and future manufacturing environment. The objectives of this course also include sustainability and social responsibility.

Course Outline

Introduction to Industry 4.0, Hardware and Software for Smart Manufacturing, Computer Simulation of Manufacturing, Simulation Methods, Intelligent Systems, Modern Research Trends in Smart Manufacturing, Case Studies.

Books and Reading List

- Smart Manufacturing – Concepts and Methods, Masoud Soroush, Michael Baldea, Thomas F. Edgar, 1st Edition, 2020
- Smart Manufacturing: The Lean Six Sigma Way, Anthony Tarantino, 2022
- Smart Manufacturing Technologies for Industry 4.0 - Integration, Benefits, and Operational Activities, Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena, 2023.

Course Code: MEE435

Course Title: Composite Materials

Credit Hours: 3 (3, 0)

Course Objectives: The course will introduce the students to composite materials, fabrication methods and their applications. This course also includes fundamental concepts of composite materials' mechanics and their mechanical properties.

Course Outline

Introduction to Composite Materials, Classification of Composite Materials, Types of Composites Fabrication Processes, Applications of Composite Materials, Mechanics of Composites, Mechanical Properties and characterization of Composite Materials.

Books and Reading List

- Mechanics of Composite Materials, Autar K. Kaw, 2nd Edition, CRC Press 2006, ISBN: 100849313430
- Dai Gil Lee and Nam Pyo Suh. Axiomatic Design and Fabrication of Composite Structures: Applications in Robots, Machine Tools, and Automobiles, Oxford University Press. 2005, ISBN: 0195178777

Course Code: MEE409

Course Title: Robotics and Automation.

Credit Hours: 3(3, 0)

Course Objectives

To develop a working knowledge of the mathematical aspects of robot manipulator analysis and control.

Course Content

Types of robots, Types of joints used in robots, Degree of freedom and constraints, Types of planar and spatial mechanisms, Transformations from one system to the other, Forward and Inverse kinematics, Jacobian, Velocity and Force Analysis, Dynamics of robots, Path planning and trajectory analysis, Mechanism design (serial and parallel) used in robots, Linear control of manipulators, Sensors and actuators used in robotics, current trends in robotics.

Books and Reading List

1. Introduction to Robotics, by J. J. Craig, Addison-Wesley, Latest Edition
2. Introduction to Robotics, by O. Khatib and K. Kolarov, Latest edition
3. Robot dynamics and Control, by M. W. Spong and M. Vidyasagar, Wiley & Sons, Latest Edition
4. Robotics and Automation: An introduction to Cams, Mechanisms, and Robotics, by D. Tesar and S. Todunoglu., Latest edition
5. Robot Analysis: The Mechanics of Serial and Parallel Manipulators, by Lung-Wen Tsai, John Wiley & Sons, Latest edition

Course Code: MEE431

Course Title: Introduction to Automobile Engineering

Credit Hours: 3 (3, 0)

Course Objectives:

Understand the functions of various parts (and systems of automobile including cooling, ignition, braking, steering and electrical systems. Also, to reduce the environmental effects of emissions.

Course Outline

Introduction to parts of an automobile, Cooling system, Transmission and suspension systems, Braking and steering systems, Emissions from automobiles, Fuels.

Books and Reading List

- Willam H Crouse, Donald L. Anglin, —Automobile Engineering, McGraw-Hill, 10th Edition, 2006.
- Manzoor, Nawazish Mehdi, Yosuf Ali, —A Text Book Automobile Engineering, Frontline Publications, 1st Edition, 2008.

Course Code: ATE335

Course Title: Chassis System Design

Credit Hours: 3 (3, 0)

Course Objectives:

This course will enable the students to design parts associated with chassis system.

Course Outline

Design of Wheels and Tires, Suspensions System, Steering System, Brake System, Transmission System, Chassis Design, Chassis Evaluation

Books and Reading

- G. Genta, "The Automotive Chassis Volume 1: Components Design", Springer Science & Business Media, 2009
- G. Genta, "The Automotive Chassis Volume 2: System Design", Springer Science & Business Media, 2018

Course Code: ATE453

Course Title: Metrology & Quality Assurance

Credit Hours: 3 (3, 0)

Course Objectives:

Enable the students to understand the type and use of measuring/inspection tools and quality assurance in automobiles.

Course Outline

Principle of Engineering Metrology, Linear Measurements, Measurement Equipment, Geometric Feature Control, Standardization related to Metrology, Quality Assurance, Documentation.

Books and Reading

- E. Doeblin, "Measurement Systems Applications and Design", McGraw Hill, 2004
- Fundamentals of quality control and improvement by Amitava Mitra
- Introduction to Statistical Quality Control by Douglas C. Montgomery
- J F W Gayler and Charles R Schotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th Revised edition.

Course Code: ATE452

Course Title: Electric and Hybrid Electric Vehicles

Credit Hours: 3 (3, 0)

Course Objectives:

Enable the students to understand the type and use of measuring/inspection tools and quality assurance in automobiles.

Course Outline

Introduction to Electric Vehicles (EV) & Hybrid EV (HEV), Current Major Issues, Recent Development Trends, EV Motor Drive, DC Motor, HEV, Configuration of HEV (Series, Parallel, Series-parallel &Complex), Energy Sources, Batteries and their characteristics, Charging, types and mechanisms of charging.

Books and Reading

- C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
- Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
- James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Course Code: EEE119

Course Title: Circuits and Electronics

Credit Hours: 4 (3, 1)

Course Objectives: Introduction, Basic concepts of Electrical Quantities and their System of Units, Charge, Current, Voltage, Power & Energy, Circuit Elements, Simple Resistive Circuits, Constant Voltage & Constant Current Sources, Ohm's Law, Kirchhoff's Laws, Analysis of Single-Lop and Single-Node Circuits, Resistance & Source Combinations, Current and Voltage Division, Nodal Analysis, Mesh Analysis.

Atomics structure, Semiconductor material and properties, Covalent bonding and Intrinsic material, Energy Levels, Extrinsic Material (p-type and n type), Semiconductors Diode, Ideal vs practical, Resistance Levels, Diode equivalent circuits, Diode specification sheets, Diode Notations, Diode testing, Zener Diode and Light emitting diodes, Series diode configurations, parallel and series-parallel configurations, Sinusoidal inputs, half wave rectification, Full wave rectification, Clippers, Clampers, Voltage multiplier circuits, Practical applications.

Course Outline

DC circuits Basic concepts, Basic Laws: Ohm's Law, Nodes, Branches and Loops, Kirchhoff's Current Law, Kirchhoff's voltage Law, Voltage Divider Rule (VDR), Current Divider Rule (CDR), Method of Analysis: Nodal analysis, Nodal analysis with Voltage Sources, Mesh analysis, Mesh analysis with current sources, Basic Concepts of Electronics: Atomic structure, Semiconductor, Shells, Energy levels, Energy Band theory, Doping, PN Junction, Forward and reverse biased diodes.

List of Experiments

1. Introduction to lab equipment and color coding of resistors
2. To Calculate the equivalent resistance of series, parallel and combination of series and parallel circuits.
3. Verification of Ohm's Law and its applications
4. Verification of Kirchhoff's Voltage Law
5. Verification of Kirchhoff's Current Law
6. Verification of nodal Analysis
7. Verification of mesh Analysis
8. Verification of the Superposition Theorem in multisource circuits
9. Verification of the Thevenin's Theorem
10. Verification of the Norton's Theorem
11. Verification of the maximum power transfer Theorem
12. To study PN Junction diode characteristics
13. To study half wave rectification
14. To study full wave rectification

Books and Reading List

- Fundamentals of Electronics Circuits, 5th Edition, by Charles K. Alexander, Matthew N.O. Sadiku, Published by McGraw-Hill, 2013, ISBN 978-0-07-338057-5
- Electronics Devices, 9th Edition by Thomas L. Floyd, Published by Prentice Hall, 2012, ISBN13: 978-0-13-254985-1, ISBN-10: 0-13-254985-9
- Basic Engineering Circuit Analysis, 10th Edition by J. David Irwin, 2011, Published by John Wiley & Sons, Inc. ISBN-13 978-0-470-63322-9.

Note: Content of the courses from other departments will be followed as approved by their respective departments.

Internship Policy

Course Code: EGG497

Course Title: Internship

Credit Hours: 0 (0, 0)

Objective

- To provide clarifications of the mandatory internship requirement of the Bachelor of Science in Mechanical Engineering (BSME) program.
- To provide the framework and guidelines for the implementation of the internship program.

Duration

- A student of BSME must complete an internship of 6 to 8 weeks before graduation (preferably undertaken during summer breaks or in the semester).
- The internship may be availed in an industry, laboratory, educational institute, or any other office where relevant engineering knowledge may be practiced.
- Carrying out internship activities during class hours is not allowed. Fulfilment of CUI attendance policy regarding classes must be followed.
- For any reason, if a student internship attachment cannot be continued with a single host institution, then he/she can work flexibly with different host institutions and in different semesters to complete the requirement in 2 to 3 phases.

Monitoring and Evaluation

- The internship is a non-graded course, but it will be evaluated, and the students have to qualify the course.
- The student will have to submit an internship report to the department within one month of the internship completion date. The department will evaluate the report in collaboration with the field supervisor of the internee. The department may also call the student for a presentation or viva if it decides so. The department will provide an internship report format to all the students. Each student must link his/her internship work with a relevant Sustainable Development Goal (SDG) of United Nation, which shall be mentioned in the internship report.
- The department will provide an internship feedback form to the corresponding host institution to get feedback from the employer. This evaluation will be shared with DQEC for Quality Enhancement purposes.

Special Cases

- In case of national/international crises e.g., medical emergencies, lockdowns, political unrest etc., the department may assign alternate assignments/projects to the students, only if HEC/PEC allows.

Community Services Policy

Course Code: MEE496

Course Title: Community Services

Credit Hours: 0 (0, 0)

Objectives

- To regulate community services as mandatory requirement for BSME program.
- To provide the framework and guidelines for the implementation of the community services program.

Implementation

- Each student of BS Mechanical Engineering program will have to be involved in the community services during his/her study duration.
- A departmental community services committee (preferably consisting of class councilors) will monitor and evaluate the community services activities of the students. The committee will maintain the data semester wise.
- A list of proposed community service activities is given at the end of this document. Each activity carries 5 points. A student must earn 5 points in each semester, a total of 40 points during their entire degree.
- A student will provide pictorial proof or certificate(s) of his/her activities to the committee within two weeks of the activity. The committee will update his points accordingly.
- The committee will submit data to the HoD at the end of each semester.

Special Cases

- In case of disabilities or medical emergencies, a student may write an application to the Head of Department (HoD). He/She will be facilitated by the department in fulfilling the community services requirements.
- In case a student does not take part in any community service activity during a semester, he/she may write an application to the HoD specifying valid reasons. He can be given an opportunity to carry out additional activities in the next semester to meet the requirements. However, this will not be allowed in consecutive semesters as a habit.
- In unavoidable situations, the department may relax this policy for a specified semester or year. Additional activities may be carried out to fil the remaining gap.

Sustainable Development Goals (SDGs):

The students must link their activities with the United Nation's SDGs. Any activity with no linking to an SDG will not be accepted as community service.

Proposed List of Community Service Tasks:

The following list contains proposed community service activities. Each activity carries 5 points. Any other activity may be added to the list after the approval of the Community Services committee of the department.

Sr #	Activities	Category
1	Food Drive (Food Collection for Poor People)	Social
2	Recycling Program / Go Green Project	Environmental
3	Community Garden / Plantation Drive	Environmental
4	Community Cleanup Drive	Environmental
5	Blood Donation Drive	Social
6	Clothes Drive for poor people	Social
7	Community Newsletters (Networking)	Education Outreach
8	Volunteer Services	Social
9	Teaching / Coaching for poor children	Education Outreach
10	Raise money for indigenous problems	Social
11	Hold bake sale for charity	Social
12	Visit to hospital / charity institution	Social
13	Organize wheelchair for special persons	Social
14	Participate in youth activities/competition	Social
15	Help / guide impartially register voters to vote	Social
16	Help deliver meals and gifts to patients in local hospitals	Social
17	Write article / give speech to advocate literacy.	Education Outreach
18	Donate toys to needy children in hospital	Social
19	Collect baby clothes and supplies to donate to poor parents	Social
20	Organize events / games for children and teenagers	Health And Sport
21	Collect used sports equipment to donate to families and after school activities	Health And Sport
22	Sponsor child education (individual or group)	Education Outreach
23	Coach a youth sports team	Health And Sport
24	Put a performance / play for children in hospitals	Health And Sport
25	Guidance counseling to poor children	Education Outreach
26	Donate used children's books to school library	Education Outreach
27	Coordinate with local health department to set up immunization day or clinic to immunize children against childhood disease. (eg. Polio)	Health And Sport
28	Visit to a nursing home for senior citizen. (eg. Reading, other chores)	Social
29	Deliver groceries and meals to elderly neighbour	Social
30	Teach computer skills to elderly people	Education Outreach
31	Drive seniors / elderly to doctor appointment	Social
32	Make birthday / event cards for children and elderly	Social
33	Ask residents of retirement home / nursing home for elderly to tell you about their life	Education And Outreach
34	Help elderly neighbors to clean their house and organize their belongings	Environmental

35	Take care of pets in animal shelter	Environmental
36	Place a bird feeder and bird fountain in your backyard	Environmental
37	Start a butterfly/insects garden in your community	Environmental
38	Sponsor a recycling contest	Environmental
39	Help create /repair new/old walking trail at nature center or park	Environmental
40	Update / redecorate signs along the nature trail / parks	Social
41	Participate in the cleanup of local rivers, ponds or lake	Environmental
42	Build and setup bird house	Environmental
43	Organize a carpool to reduce car emissions	Environmental
44	Promoting bicycles for short commute to reduce emissions	Environmental
45	Volunteer at nature camp and teach kids about the environment	Environmental
46	Test the water quality of lake or river near you	Environmental
47	Donate your old clothes	Social
48	Help repair / maintenance of local homeless shelter	Social
49	Raise money / make first aid kits for homeless shelters	Social
50	Volunteer at police station or firehouse	Social
51	Organize self-defense workshop	Health And Sports
52	Organize drug free campaign	Health And Sport
53	Learn / teach first aid and CPR for emergency response	Health And Sports
54	Create and distribute list of hotlines / emergency numbers for who might need help	Social
55	Paint park benches	Social
56	Raise money / install new playground equipment in the local community park	Social
57	Promote awareness to reduce energy crisis	Environmental
58	Attending Seminars / Workshops / Conference	Education Outreach
59	Clean up the campus	Environmental
60	Traffic regulations awareness	Education Outreach
61	Say no to drugs	Health And Sports