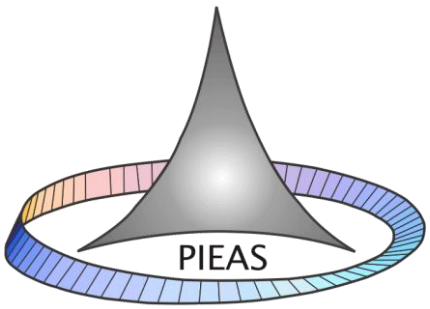
Department of Mechanical Engineering

Pakistan Institute of Engineering and Applied Sciences



Curriculum

for

Bachelor of Science

in

Mechanical Engineering

2019

(Outcome Based Education)

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Program Learning Outcomes (PLOs)

Pakistan Engineering Council (PEC) has already defined following Program Learning Outcomes on the basis of the Knowledge Attributes defined in the Washington Accord. The same have been adopted by DME PIEAS. These are listed below:

PLO-1: **Engineering Knowledge**: An ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO-2: **Problem Analysis**: An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PLO-3: **Design/Development of Solutions**: An ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO-4: **Investigation**: An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO-5: **Modern Tool Usage**: An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PLO-6: **The Engineer and Society**: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO-7: **Environment and Sustainability**: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO-8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-9: **Individual and Team Work**: An ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.

PLO-10: **Communication**: An ability to communicate effectively, orally as well as in writing on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions.

PLO-11: **Project Management**: An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team to manage projects in a multidisciplinary environment.

PLO-12: **Lifelong Learning**: An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

DETAILS OF COURSE LEARNING OUTCOMES, COURSE CONTENTS AND RECOMMENDED TEXTS

Mechanical Engineering Courses

ME-101T Engineering Drawing and Graphics

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**REPRODUCE** the concepts of basic drawing techniques.	Cognitive	1	1
2.	**EXPRESS** the basic knowledge of drawing & graphics as a language of engineering communication.	Cognitive	2	1
3.	Adequately **CONSTRUCT** various curves and surfaces encountered in engineering practice.	Cognitive	3	1

Course Contents:

Introduction; types of lines; lettering; dimensioning; use of pencil and drawing instruments; planning of drawing sheet; types of projections; orthographic projections; plane of projections; quadrants; projection of points and straight lines; examples with different quadrants; traces of a line; true length of a line; inclination to the planes; projection of oblique and auxiliary planes; loci of points and generated curves; loci of points and straight lines; cycloid; epicycloid; involute; Archimedean spiral; development of solids; types of solids: polyhedra; solids of revolution; prism, pyramid, cylinder, cone, sphere; intersection of surfaces; intersection of various solids; projection of solids; projection of various solids in simple position and inclined positions; section of solids; true shape of section on auxiliary plane of various solids.

Recommended Texts:

1. F Giesecke *et al*., *Technical Drawing with Engineering Graphics*, 15th Ed, Peachpit Press, 2016.
2. Bertoline, Wiebe, Miller, Mohler, Irwin, *Technical Graphics Communication*, 2008.
3. A C Parkinson, *A First Year Engineering Drawing*, Pitman, 1939.

ME-101L Engineering Drawing and Graphics (Lab)

Contact Hours:
Theory = **0**
Practical = **96**
Total = **96**

Credit Hours:
Theory = **0.0**
Practical = **2.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** the concepts of basic drawing techniques.	Psychomotor	3	1
2.	**DRAW** projections of mechanical components/assemblies.	Psychomotor	3	1
3.	Clearly **CONSTRUCT / SKETCH** projections of various mechanical components / assemblies.	Psychomotor	4	1

Course Contents:

Lettering; geometric constructions of engineering curves; orthographic projections of various solids; orthographic projections of machine elements such as nuts, bolts, threads, flanges, bearings, etc.; drawing of assemblies.

Recommended Texts:

A C Parkinson, *A First Year Engineering Drawing*, Pitman, 1939.

ME-102 Engineering Statics

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**COMPREHEND** the concepts of force, moment, and couple and express them as Cartesian vector.	Cognitive	2	1
2.	**SOLVE** equilibrium problems of particles and rigid bodies with and without friction.	Cognitive	3	1
3.	**ANALYZE** forces in members of trusses, frames and machines.	Cognitive	4	2
4.	**APPLY** frictional force analysis to wedges, screws, belts and bearings**.**	Cognitive	3	2

Course Contents:

Introduction to statics and special emphasis on the idealization used in this subject; expressing force as cartesian vector; vector addition of forces; resolving force into components; application of dot product; concept of free body diagram and equilibrium of particle subjected to a system of 2d/3d forces; concepts of moments and couples; procedure for simplification of force and couple system; procedure for reducing a simple distributed loading; free body diagrams of rigid bodies; equilibrium conditions of rigid body; identification of two and three force members.

Determination of forces in members of truss using method of joints and method of sections; analysis of the forces acting on the members of frames and machines composed of pin-connected members; concept of dry friction and solution of problems involving dry friction; specific application of frictional force analysis on wedges, screws, belts and bearings; introduction to the concept of rolling resistance.

Recommended Texts:

1. R C Hibbler, *Engineering Mechanics: Statics,* 14th Ed, Prentice Hall, 2016.
2. J L Meriam, L G Kraige, *Engineering Mechanics: Statics,* 7th Ed, Wiley, 2012.
3. F P Beer, E R Johnston *Vector Mechanics: Statics,* 11th Ed, McGraw Hill Education, 2015.

ME-202 Engineering Dynamics

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **ME-102 Engineering Statics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**COMPREHEND** key concepts related to particles and rigid bodies moving with variable acceleration.	Cognitive	2	1
2.	**SOLVE** problems involving particle dynamics in 2D.	Cognitive	3	2
3.	**SOLVE** problems involving rigid body dynamics in 2D.	Cognitive	3	2

Course Contents:

Kinematics of particles; rectilinear motion; curvilinear motion; normal and tangential coordinates; polar coordinates; kinetics of particles; force, mass and acceleration; equations of motion; kinetic diagrams; rectilinear motion; curvilinear motion; work and energy; potential energy; impulse and momentum; conservation of momentum; plane kinematics of rigid bodies; angular motion relations; absolute motion; relative velocity; instantaneous center of zero velocity; relative acceleration; plane kinetics of rigid bodies: force, mass, and acceleration; equation of motion; translation; fixed axis rotation; general plane motion; work and energy relationship; impulse and momentum equation.

Recommended Texts:

1. R C Hibbler, *Engineering Mechanics: Dynamics*, 14th Ed, Pearson, 2015.
2. J L Meriam, L G Kraige, *Engineering Mechanics: Dynamics*, 7th Ed, Wiley, 2012.
3. F P Beer, E R Johnston, P J Cornwell, B Self, *Vector Mechanics for Engineers: Dynamics*,11th Ed, McGraw Hill Education, 2015.

ME-202L Engineering Mechanics Lab

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Prerequisite: **ME-102 Engineering Statics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**PERFORM** the experiment following the demonstration and/or instruction.	Psycho-motor	3	4
3.	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4.	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
5.	**PERFORM** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

This lab-course comprises many simple experiments demonstrating force equilibrium, moment equilibrium, friction between surfaces etc.

ME-103L Workshop Practice

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**RECOGNIZE** the basic workshop tools their usage.	Cognitive	1	1
2.	**DEVELOP** elementary skills for making various simple parts using basic manufacturing tools.	Psycho-motor	4	1
3.	**BEHAVE** responsibly regarding the safety of oneself and others.	Affective	3	8

Course Contents:

Fitter shop: assembly / disassembly of basic mechanical components, e.g. bearings, keys, belts etc.; basic processes in wood work shop: timber, its defects and preservation methods, different types of wood joints; basics of electric shop: types and uses of cables; study of household electrical appliances; functions of forge & foundry shop: brief introduction, tools and accessories, furnace types, heat treatment furnaces; carbon dioxide casting; machine shop: introduction to machine tools, basic lathe operations including turning, facing, screw cutting; welding: introduction to soldering, brazing and welding, brief details of gas, and electric arc welding; students will be assigned practical jobs in various workshops.

Recommended Texts:

1. K C John, *Mechanical Workshop Practice*, 2nd Ed, Prentice Hall, 2010.
2. W A J Chapman, *Workshop Technology Part-I*, 5th Ed, Butterworth-Heinemann, 1972.
3. H P Schwan, *Electrical Wiring*, McGraw Hill, 1982.
4. *Wiring Manual,* Pak Cables Limited.

ME-205 Mechanics of Materials – I

Contact Hours:
Theory = **48**
Practical = **0**
Total = **48**

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

Prerequisite Course: **ME-102 Engineering Statics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**COMPREHEND** the concepts of stress, strain and stress-strain relationship.	Cognitive	2	1
2.	**CALCULATE** stress and deformation related to the problems involving axial, torsional and bending loading for statically determinate as well as indeterminate situations.	Cognitive	3	2
3.	**APPLY** the learned concepts on simple design problems.	Cognitive	4	2

Course Contents:

Introduction to the concept of stress & strain, along with their types & components at a point; allowable stress and its application to the design of simple connections; tension and compression tests; stress-strain diagrams of ductile and brittle materials; mechanical properties of materials; shear stress-strain diagram; saint-Venant's principle and principle of superposition; elastic deformation of an axially loaded member; statically indeterminate axially loaded member; thermal stress; stress concentrations; inelastic axial deformation and residual stress; torsional deformation of a circular shaft; the torsion formula; power transmission; angle of twist; statically indeterminate torque-loaded members; inelastic torsion and residual stress; shear and moment diagrams; bending deformation of a straight member; the flexure formula; asymmetric bending; composite beams; reinforced concrete beams; curved beams; inelastic bending and residual stress; the shear formula; shear flow in built members; shear flow in thin-walled members; the elastic curve; slope and displacement by integration; discontinuity functions; method of superposition; statically indeterminate beams; critical load; ideal column with pin supports; columns having various types of supports.

Recommended Texts:

1. R C Hibbeler, *Mechanics of Materials,* 8th Ed, McGraw Hill, 2011.
2. F P Beer, E R Johnston, *Mechanics of Materials, 6*th Ed, McGraw Hill, 2012.
3. P P Benham, RJ Crawford, *Mechanics of Engineering Materials,* 2nd Ed, Prentice Hall, 1996.

ME-305T Mechanics of Materials – II

Contact Hours:
Theory = **48**
Practical = **0**
Total = **48**

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

Prerequisite Course: **ME-205 Mechanics of Materials – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** the concepts of hardness, toughness, fatigue, creep, fracture and fundamentals of experimental stress analysis.	Cognitive	2	1
2.	**CALCULATE** stresses in thick and thin cylinders.	Cognitive	3	2
3.	**APPLY** theories of failure using the concepts of stress/ strain transformations.	Cognitive	3	2
4.	**ANALYZE** the cases of combined loading.	Cognitive	4	2

Course Contents:

Stresses in thin-walled pressure vessels (cylindrical & spherical); combined loading; plane-stress transformation using analytical and graphical approach (Mohr's stress circle); principal stresses; maximum shear stress (in-plane & absolute); plane-stain transformation using analytical and graphical approach (Mohr's strain circle); principal strains; maximum shear strain (in-plane & absolute); strain rosettes; theories of failure of ductile and brittle materials; basis for beam design; prismatic beam design; fully stressed beams; shaft design; external work and strain energy; elastic strain energy for various types of loading; conservation of energy; impact loading; principle of virtual work and Castigliano's theorem along with their application to trusses and beams; misc. topics of thick cylinders; hardness, toughness, fatigue, creep; introduction to fracture mechanics; theory of electrical resistance strain gauges & photo-elastic stress analysis.

Recommended Texts:

1. R C Hibbeler, *Mechanics of Materials*, 8th Ed, McGraw Hill, 2011.
2. F P Beer, E R Johnston, *Mechanics of Materials*, 6th Ed, McGraw Hill, 2012.
3. R G Budynas, J K Nisbett, Shigley's Mechanical Engineering Design, 10th Ed McGraw Hill, 2014.
4. J W Dally, W F Riley, Experimental Stress Analysis, McGraw-Hill, 1991.

ME-305L Mechanics of Materials (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Prerequisite Course: **ME-205 Mechanics of Materials – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**PERFORM** the experiment following the demonstration and/or instruction.	Psycho-motor	3	4
3.	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4.	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
5.	**PERFORM** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

The experiments in this lab complement the knowledge gained in theory lectures.

ME-302T Mechanics of Machines

Contact Hours:
Theory = **48**
Practical = **0**
Total = **48**

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

Prerequisite Course: **ME-202T Engineering Dynamics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**COMPREHEND** key concepts of kinematics required for design of mechanisms.	Cognitive	2	1
2.	**ANALYZE** the motion of cam-followers and gear-trains.	Cognitive	4	2
3.	**ANALYZE** the forces acting on a system which relate to the dynamic behavior of a system and use these for prediction of vibrations, shocks and stress distribution.	Cognitive	4	2
4.	**SYNTHESIZE** linkages that follow a simple desired motion.	Cognitive	6	3

Course Contents:

Review of kinematics; links, joints and mechanisms; kinematics of four-bar and slider-crank mechanisms; two-point & three-point graphical synthesis of four-bar mechanisms; quick-return mechanisms; position analysis of mechanisms; kinematics of gears; conditions for transmission of constant velocity ratio; gear nomenclature; interference and undercutting; compound and reverted gear trains; epicyclic gear trains; compound epicyclic trains; types of cams and followers; motion for a given cam profile; designing cam profiles; dynamics of engines / slider-crank mechanism; velocity and acceleration of piston; angular velocity and acceleration or crankshaft; forces and couples transmitted in a direct acting engine; fluctuation of energy and speed; flywheels; balancing of rotating and reciprocating masses; balancing of engines.

Recommended Texts:

1. R L Norton, *Design of Machinery*, 5th ed, McGraw Hill, 2011.
2. D H Myszka, *Machines and Mechanisms, Applied Kinematic Analysis*, 4th ed, Pearson, 2012.
3. Erdman, Sandor, *Mechanism Design*, 4th ed, Prentice Hall, 2001.
4. J Uicker, G R Pennock, J E Shigley, *Theory of Machines & Mechanisms*, 5th ed, Oxford University Press, 2016.

ME-302L Mechanics of Machines (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Prerequisite Course: **ME-202T Engineering Dynamics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**PERFORM** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3.	**PLAN / FORMULATE / COMPOSE** an experiment for the problem related to mechanics of machines.	Psychomotor	4	4
4.	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
5.	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
6.	**PERFORM** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

This lab-course comprises some simple experiments demonstrating motion of linkages, gear trains and cam-followers; there are also a few experiments on balancing rotating imbalance.

ME-201 Thermodynamics – I

Contact Hours:		**Credit Hours:**	
Theory	= **48**	Theory	= **3.0**
Practical	= **0**	Practical	= **0.0**
Total	= **48**	Total	= **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the basic concepts and scope of fundamental laws of thermodynamics.	Cognitive	2	1
2.	**DETERMINE** state characteristics for working substances (gas and vapor) undergoing various thermodynamic processes.	Cognitive	3	2
3.	**ANALYZE** closed and open systems using 1st and 2nd Law of Thermodynamics.	Cognitive	4	2

Course Contents:

Basic concepts; dimensions and units; system and control volume; properties of system; state and equilibrium; process and cycles; temperature and zeroth law; pressure and pressure measurement devices; energy and energy transfer; first law of thermodynamics; energy conversion efficiencies; pure substance, phases of pure substance, phase change process of pure substance; property diagrams for phase change process; evaluating the properties of vapors using property tables; ideal gas equation; compressibility factor and using generalized compressibility charts; other equation of states; energy analysis of closed systems (understanding p-v diagrams with application of 1st law of thermodynamics on constant pressure, constant volume, isothermal, reversible adiabatic and polytropic process' for vapors and ideal gases); internal energy, enthalpy and specific heats for ideal gases, solids and liquids; mass and energy analysis of control volumes; introduction to 2nd law of thermodynamics and its perspectives, Kelvin and Clausius statements; reversible and irreversible process; Carnot cycles (forward and reversed); Carnot principle; thermodynamic temperature scale; introduction to entropy; increase of entropy principle; understanding T-s diagrams for reversible processes (for vapors and ideal gases); determination of heat, work and change in entropy for reversible processes in closed systems; entropy change for liquids and solids; isentropic efficiencies of steady flow devices; entropy balance for closed and open systems.

Recommended Texts:

1. Y A Cengel, M A Boles, *Thermodynamics, An Engineering Approach, 8th Ed,* McGraw Hill, 2014.
2. C Borgnakke, R E Sonntag, *Fundamentals of Thermodynamics,* 8th Ed, Wiley, 2012.
3. M J Moran, H N Shapiro, *Fundamentals of Engineering Thermodynamics*, 8th Ed, Wiley, 2014.
4. T D Eastop, A Mcckonkey, *Applied Thermodynamics for Engineering Technologists*, 5th Ed, Pearson, 1996.

ME-207T Thermodynamics – II

Contact Hours:
Theory = **48**
Practical = **0**
Total = **48**

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

Prerequisite Course: **ME-201 Thermodynamics – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** the concepts of thermodynamic properties relations, combustion process, exergy and second law efficiency.	Cognitive	2	1
2.	**APPLY** the laws of thermodynamics to the combustion process.	Cognitive	3	2
3.	**ANALYZE** the performance of power cycles, boilers, nozzles, compressors and turbines.	Cognitive	4	2

Course Contents:

Exergy; gas power cycles; vapor and combined power cycles; thermodynamic property relations; chemical reactions involving combustion; simple reaction equation; stoichiometric chemical reaction; rich & lean air-fuel ratio mixture; enthalpy of formation and reaction; adiabatic flame temperature; first law analysis of reacting systems; entropy change of reacting systems; second law analysis of reacting systems; revision of compressible flow; nozzle shape, convergent nozzle, convergent-divergent nozzle, nozzle efficiency; coefficient of velocity and discharge; steam nozzle; super saturation; stagnation conditions; jet propulsion; introduction to steam turbine; impulse turbine; pressure and velocity compounding of impulse steam turbine; turbine blade height; reaction turbine; overall efficiency; stage efficiency; reheat factor; introduction to gas turbine; radial and axial flow gas turbines; compressors; classification and working principles; single stage and multistage compressors; inter-cooling; efficiencies and *p-v* diagrams of reciprocating compressors; velocity diagrams of centrifugal compressors; performance characteristics & working regimes; boilers, generation of steam through boilers; classification and configurations of boilers and their applications; boiler efficiencies & heat balance sheet.

Recommended Texts:

1. Y A Cengel, M A Boles, *Thermodynamics, An Engineering Approach, 8th Ed*, McGraw Hill, 2014.
2. C Borgnakke, R E Sonntag, *Fundamentals of Thermodynamics*, 8th Ed, Wiley, 2012.
3. M J Moran, H N Shapiro , *Fundamentals of Engineering Thermodynamics*, 8th Ed, Wiley, 2014.
4. T D Eastop, A Mcckonkey, *Applied Thermodynamics for Engineering Technologists*, 5th Ed, Pearson, 1996.
5. R Joel, *Basic Engineering Thermodynamic*, 5th Ed, Prentice Hall, 1996.

ME-207L Thermodynamics (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Prerequisite Course: **ME-201 Thermodynamics – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Explain** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2	**Perform** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3	**Communicate** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4	**Comply** with the safety instructions, rules and regulations.	Affective	2	8
5	**Perform** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

Some experiments demonstrating the working using various engine models and a few experiments on diesel and gasoline engines' performance characteristics.

ME-206 Fluid Mechanics – I

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** the basic concepts to hydrostatic fluid problems.	Cognitive	3	1
2.	**ANALYZE** the fluid kinematics and dynamics parameters using basic laws of mechanics.	Cognitive	4	2
3.	**PRESENT** experimental data or governing equations in non-dimensional form.	Cognitive	2	1
4.	**SOLVE** internal flow problems Moody Chart or the head loss equation.	Cognitive	3	2

Course Contents:

Basic concepts of fluid mechanics; fluid statics; absolute, gauge and vacuum pressures; difference between static and dynamic pressure; pressure gradient; manometry and bourdon gauge; hydrostatic pressure; forces on plane and curved surfaces; buoyancy and stability; integral relations for a control volume and incompressible flow; Reynold's transport theorem; Bernoulli's theorem; integral conservation equations of mass; linear momentum and energy with their applications; impact of jets on curved surfaces; dimensional analysis; similitude and its applications; viscous flow in ducts; steady, quasi-steady and unsteady flow; underdeveloped and fully developed; laminar and turbulent flow; flow between parallel plates; flow in tubes; losses in pipes; Moody's chart and pumping power; minor losses; flow measuring devices; multiple pipe systems.

Recommended Texts:

1. P M Gerhart, A L Gerhart, J I Hochstein, "*Munson, Young and Okiishi's, Fundamentals of Fluid Mechanics"*, 8th Ed, Wiley, 2016.
2. F M White, *Fluid Mechanics*, 8th Edition McGraw Hill, 2015.
3. Y Cengel, J Cimbala, *Fluid Mechanics: Fundamentals and Applications*, 4th Ed, McGraw Hill, 2018.
4. D F Elger, B A LeBret, C T Crowe, J A Robertson, *Engineering Fluid Mechanics*, 11th Ed, Wiley, 2015.

ME-301T Fluid Mechanics – II

Contact Hours:
Theory = **48**
Practical = **0**
Total = **48**

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

Prerequisite Course: **ME-206 Fluid Mechanics – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy level	PLO
1.	**APPLY** differential analysis to solve incompressible fluid flow problems.	Cognitive	3	2
2.	**APPLY** the boundary layer theory to calculate the drag and lift forces under different flow/geometry conditions.	Cognitive	3	2
3.	**APPLY** the basic compressible flow principles to design 1D geometries with area changes.	Cognitive	3	3
4.	**ANALYZE** the performance of various Turbo-machines.	Cognitive	4	3

Course Contents:

Fluid element kinematics; derivation of basic differential equations describing fluids in motion; rotational and irrotational flows; concept of stream function and velocity potential; analysis of incompressible fluid flows using Navier-Stokes equations; introduction to boundary layer flows; boundary layer equations; flat plate boundary layer; effect of pressure gradient; separation and wake; lift and drag of immersed bodies; introduction to compressible flow; mass, momentum and energy conservation equations of compressible flow; speed of sound and Mach number; isentropic flow; converging and diverging nozzles and diffusers; introduction to turbomachinery; types of hydraulic pumps and hydraulic turbines; solution of turbomachinery problems using velocity triangle; pump and turbine characteristics curves and similarity rules; concept of specific speed; dimensionless pump performance.

Recommended Text

1. P M Gerhart, A L Gerhart, J I Hochstein, "*Munson, Young and Okiishi's Fundamentals of Fluid Mechanics",* 8th Ed, Wiley, 2016.
2. F M White, *Fluid Mechanics*, 8th Edition McGraw Hill, 2015.
3. Y Cengel, J Cimbala, " *Fluid Mechanics: Fundamentals and Applications*", 4th Edition, McGraw Hill, 2018.

ME-301L Fluid Mechanics (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Prerequisite Course: **ME-206 Fluid Mechanics – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**Explain** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**Perform** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3.	**Communicate** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4.	**Comply** with the safety instructions, rules and regulations.	Affective	2	8
5.	**Perform** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

This lab-course comprises some simple experiments on both fluid statics and fluid dynamics.

Recommended Texts:

Lab manuals

ME-303 Manufacturing Processes – I

Contact Hours:		**Credit Hours:**	
Theory	= **48**	Theory	= **3.0**
Practical	= **0**	Practical	= **0.0**
Total	= **48**	Total	= **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** various manufacturing processes.	Cognitive	2	1
2.	**DETERMINE** correct parameters for performing specific manufacturing process.	Cognitive	3	1
3.	**IDENTIFY** right type of operation for performing certain manufacturing processes.	Cognitive	3	1

Course Contents:

Forming & shaping processes and equipment; rolling; flat rolling; rolling mills; shapes rolling; production of seam less tubing and piping; extrusion and drawing; hot and cold extrusion; extrusion and drawing equipment; hydrostatic extrusion; sheet metal forming; sheet metal characteristics; formability of sheet metals; bending sheet and plate; tube bending & forming; deep drawing; supper plastic forming; explosive forming; equipment for sheet metal forming; forming & shaping plastics & composite materials; extrusion; injection molding; blow molding; thermo-forming; processing elastomers; processing reinforcer plastics; manufacturing honeycomb material; processing metal matrix and ceramic matrix composites; joining process & equipment; fusion welding process: oxy-fuel gas welding; arc welding; electrodes; thermite welding; electron beam welding; solid state welding process: cold welding; ultrasonic welding; friction welding; resistance welding; weld quality weldability; weld design and process selection; brazing; soldering; adhesive bonding; joining plastics; metal casting process & equipment; molding and molding sands; classification of foundry process; casting and its types; pattern and pattern making; core and core making; furnaces; crucibles; molding tools and foundry equipment; powder metallurgy; production of metal powders; compaction; sintering; design considerations; surface treatment; coating and cleaning; mechanical surface treatment and coating; painting and its testing; thermal spraying; vapor deposition; electroplating and electro-forming; anodizing; hot dipping; surface texturing and cleaning.

Recommended Texts:

1. S Kalpakjian, S Schmid, *Manufacturing Engineering and Technology*, 7th Ed, Pearson, 2013.
2. S C Black, V Chiles, A J Lissaman, S J Martin, *Principle of Engineering Manufacture*, 3rd Ed, Butterworth-Heinemann 1996,
3. R A Higgins, *Engineering Metallurgy* 6th Ed, Butterworth-Heinemann, 1993.
4. M; P; Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 6th Ed, John Wiley & Sons, 2015.
5. E P Degarmo, *Materials and Processes in Manufacturing*, 10th Ed, Wiley, 2007.

ME-307T Manufacturing Processes – II

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **ME-303 Manufacturing Processes – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** various machining processes.	Cognitive	2	1
2.	**IDENTIFY** the right type of technique & its parameters for performing certain machining process.	Cognitive	3	1
3.	**APPLY** effectively various machining operations for engineering applications.	Cognitive	3	1

Course Contents:

Material removal; mechanics of chips formation; types of chips produced; forces and pressures involved; surface finishing and integrity; machinability; calculation of material removal rate; cutting tools; single point tool geometry; mill cutters; factors which affect tool life; tool life relationships; tool materials; types and properties of cutting fluids; machine processes for producing various shapes; milling operation; milling machines; planning and shaping; broaching and broaching machines; and gear manufacturing machining; abrasive machining & finishing operations; abrasive, bonded abrasives (grinding wheels), grinding process, grinding fluids, design considerations for grinding; ultrasonic machining; non-conventional machining process; machining; electrochemical; electrical–discharge machining; wire EDM control of machine tools; machine tools control; numerical control system; sequence control; PLC; servo copying; computerized numerical control (CNC); adaptive control; programming for numerical control jigs & fixtures; general design principle; elements of jig; locating devices and clamping devices; computer integrated manufacturing system; manufacturing system; computer integrated manufacturing (CIM); computer aided manufacturing (CAM); computer simulation of manufacturing process and system; group technology; flexible manufacturing system (FMS); artificial intelligence (AI); cellular manufacturing; introduction to process planning.

Recommended Texts:

1. S Kalpakjian, S Schmid, *Manufacturing Engineering and Technology*, 7th Ed, Pearson, 2013.
2. S C Black, V Chiles, A J Lissaman, S J Martin, *Principle of Engineering Manufacture,* 3rd Ed, Butterworth-Heinemann 1996.
3. R A Higgins, *Engineering Metallurgy* 6th Ed, Butterworth-Heinemann, 1993.
4. M; P; Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 6th Ed, John Wiley & Sons, 2015.

ME-307L Manufacturing Processes (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Prerequisite Course: **ME-303 Manufacturing Processes – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**PERFORM** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3.	**PLAN / FORMULATE / COMPOSE** an experiment for the problem related to manufacturing processes.	Psychomotor	4	4
4.	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
5.	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
6.	**PERFORM** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

This lab mainly comprises using conventional and computer-aided machine tools in addition to some manufacturing processes.

Recommended Texts:

Lab manuals

ME-308T Measurements and Instrumentation

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the basic concepts related to measurements.	Cognitive	2	1
2.	**EXPLAIN** the construction, working and applications of various sensors/measurement devices.	Cognitive	2	1

Course Contents:

Introduction and significance of measurement; general measurement system; instrument types; static and dynamic characteristics of instruments; uncertainty of instruments; measurement errors; instruments for measurement of displacement, velocity, acceleration, force, torque, pressure, flow and temperature; introduction to data acquisition through computers; A/D and D/A converters.

Recommended Texts:

1. T G Beckwith, R D Marangoni, J H LienHard, *Mechanical Measurements*, 6th Ed, Pearson, 2006.
2. A S Morris, R Langari, *Measurement and Instrumentation: Theory and Application*, 2nd Ed, Academic Press, 2015.
3. R Figliola, D Beasley, *Theory & Design for Mechanical Measurements*, 6th Ed, Wiley, 2014.
4. D G Alciatore, M B Histand, *Introduction to Mechatronics & Measurement Systems;* 4th Ed, McGraw Hill, 2011.

ME-308L Measurements and Instrumentation (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Explain** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2	**Perform** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3	**Communicate** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4	**Comply** with the safety instructions, rules and regulations.	Affective	2	8
5	**Perform** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

Experiments complimenting the theory lectures will be performed.

Recommended Texts:

Lab manuals

ME-312T Refrigeration and Air-Conditioning

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **ME-201 Thermodynamics – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**ANALYZE** the performance of different refrigeration cycles.	Cognitive	4	2
2.	**EXPLAIN** different air-conditioning processes, comfort conditions, configurations and working of components of air-conditioning components/systems.	Cognitive	2	1
3.	**EXPLAIN** the requirements and standards of indoor air quality and working of HVAC components used for maintaining indoor air quality.	Cognitive	2	1
4.	**EVALUATE** the heating and cooling load requirements of buildings.	Cognitive	5	3
5.	**DESIGN** HVAC ducts for air-conditioning purpose.	Cognitive	4	3

Course Contents:

Introduction; definitions and basic terminology; revision of 2nd law of thermodynamics and reversed Carnot cycle for vapor and gases; limitations of reversed Carnot cycle; refrigeration cycles: vapor compression cycle; CoP; pressure- enthalpy chart; multi-pressure systems; types of refrigerants; condensers and evaporators; compressor and expansion devices; air refrigeration cycles and systems; vapor absorption system; air conditioning: fundamentals of psychrometry and psychrometric processes; introduction to psychrometric chart and its usage; thermodynamics analysis of common psychrometric processes; indoor and outdoor air conditions; comfort conditions and comfort zone; indoor air quality; central air-conditioning system; essential components of central air-conditioning plant; water chiller and water heater; air handling unit; chilled water and hot water recirculation system; return air supply system; fresh air supply system air mixture chamber; supply fan; air dust cleaning and bacteria removal; air supply and air return terminals; diffusers and grilles; CFM rating and tons of air-conditioning of a central air-conditioning plant; cooling load and heating load calculation procedures; duct sizing and piping design; pumps and fans selection air ventilation: calculation of fresh air supply of a multi-story building; air handling unit for untreated fresh air; dust and bacteria removal systems; forced convection based air ventilator design.

Recommended Texts:

1. R S Khurmi, J K Gupta, *Textbook of Refrigeration & Air conditioning*, S Chand & Co, 2006.
2. C P Arora, *Refrigeration & Air conditioning*, 3rd ed McGraw-Hill, 2010.
3. W F Stoeker, J W Jones, Refrigeration and Air Conditioning, 2nd Ed, McGraw-Hill,1982.
4. F C McQuiston, J D Parker, J D Spitler, *Heating, Ventilating and Air Conditioning Analysis and Design*, 6th Ed, Wiley 2004.
5. W P Jones, *Air Conditioning Engineering*,5th Ed, Butterworth-Heinemann, 2001.
6. ASHRAE Handbook.

ME-312L Refrigeration and Air-Conditioning (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Prerequisite Course: **ME-201 Thermodynamics – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2	**PERFORM** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
	PLAN / FORMULATE / COMPOSE an experiment for the problem related to psychrometry and air-conditioning.	Psychomotor	4	4
3	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
5	**Perform** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

This lab-course comprises some simple experiments demonstrating thermodynamics of refrigeration and psychrometry.

Recommended Texts:

Lab manuals

ME-315T Machine Design-I

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Prerequisite Courses: **ME-205 Mechanics of Materials – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** design methodology to solve machine component design problems.	Cognitive	3	1
2.	**ANALYZE** designed machine components.	Cognitive	4	2
3.	**DESIGN** Machine components.	Cognitive	6	3

Course Contents:

Introduction to the design philosophy and mechanical design of machine components; structural design and analysis of shafts and miscellaneous shaft components; structural design and analysis of fasteners (temporary and permanent); structural design and analysis of springs.

Recommended Texts:

1. R G Budynas, J K Nisbett, *Shigley's Mechanical Engineering Design*, 10th Ed McGraw Hill, 2014.
2. R L Norton, *Machine Design, an Integrated Approach*, 5th Ed, Pearson, 2013.
3. M F Spotts, T E Shoup, L H Hornberger, *Design of Machine Elements*, 8th Ed, Pearson, 2003

ME-315L CAD – I (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Prerequisite Courses: **ME-101T Engineering Drawing & Graphics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** engineering drawing knowledge for precise and accurate communication of mechanical design.	Cognitive	3	1
2.	**BUILD** solid models using CAD part / assembly modules using given drawings / details.	Psycho-motor	4	5
3.	**BUILD** CAD models using CAD part / assembly modules for the required features.	Psycho-motor	5	5

Course Contents:

Fundamentals of computer-aided design, introduction to Creo® parametric; part and assembly modeling; part and assembly drawings; introduction to surface modeling.

Recommended Texts:

Lab manuals

ME-316T Machine Design– II

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Courses: **ME-315T Machines Design – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** methodology to solve machine component design problem.	Cognitive	3	1
2.	**ANALYZE** machine components.	Cognitive	4	2
3.	**DESIGN** machine components.	Cognitive	6	3

Course Contents:

Structural design, analysis and selection of bearings; structural design and analysis of gears; analysis and selection of clutches, brakes and flywheel; analysis and selection of belts, chains and ropes; power transmission components design case study.

Recommended Texts:

1. R G Budynas, J K Nisbett, Shigley's Mechanical Engineering Design, 10th Ed McGraw Hill, 2014.
2. R L Norton, *Machine Design, an Integrated Approach*, 5th Ed, Pearson, 2013.
3. M F Spotts, T E Shoup, L H Hornberger, *Design of Machine Elements,* 8th Ed, Pearson, 2003.

ME-316L CAD – II (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Prerequisite Course: **ME-315L CAD – I (lab)**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**CONSTRUCT** a computer aided manufacturing program using CAD software.	Psycho-motor	4	5
2.	**ANALYZE** a mechanism for dynamic properties of the mechanical assembly.	Cognitive	4	5
3.	**BUILD** CAD models of machine assemblies for required features / given conditions.	Psycho-motor	5	5

Course Contents:

Interference and clearance of an assembly, mechanism module; introduction to computer-aided manufacturing (CAM).

Recommended Texts:

Lab manual

ME-317 Engineering Safety and Ethics

Contact Hours:

Theory = **16**

Practical = **0**

Total = **16**

Credit Hours:

Theory = **1.0**

Practical = **0.0**

Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DEMONSTRATE** knowledge of industrial safety.	Cognitive	3	6
2.	**ANALYZE** various types of hazards at work and living places.	Cognitive	4	6
3.	**RECOGNIZE** relevant ethical and moral issues in engineering practice.	Cognitive	2	8
4.	**Evaluate** issues arising in engineering practice from ethical perspective.	Cognitive	5	8

Course Contents

Importance of safety in an industry; industrial accidents; effects of accidents; types of accidents incidence of fire; techniques of safety management: principles of accident prevention; hazard analysis; legal, humanitarian and economic reason for action; safety inspection procedures; safety training, first aid and emergency procedures; ethics and professionalism; moral reasoning and codes of ethics; workplace responsibilities and rights; commitment to safety: safety and risk; assessing and reducing risk; truth and truthfulness: whistleblowing, honesty and research integrity; some case studies.

Recommended Texts:

1. J Ridley and J Channing, *Safety at Work*, 7th Ed, Butterworth-Heinemann, 2007.
2. K Lockyer, *Production management: Factory & Production Management*, English Language Book Society, 1983.
3. M W Martin and R Schinzinger, *Introduction to Engineering Ethics*, 2nd Ed, McGraw-Hill, 2010.

ME-403 Heat and Mass Transfer

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Courses: **ME-301T Fluid Mechanics – II**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** the fundamental concepts of Heat and mass transfer and heat exchangers.	Cognitive	2	1
2.	**SOLVE** mathematical problems relevant to heat and mass transfer.	Cognitive	3	2
3.	**DESIGN** heat exchangers for given requirements of heat transfer process.	Cognitive	5	3

Course Contents:

Conduction heat equation; Fourier's law; one dimensional steady state heat conduction through plane and composite walls; cylinders and spheres with and without heat generating sources; conduction heat transfer through extended surfaces; transient conduction; heat transfer lumped capacitance method; convection; newton's law of cooling; boundary layer; natural (free) and forced convection heat transfer; coefficient of heat transfer for free and forced convection; effect of laminar; transition and turbulent flow on coefficient of heat transfer; flow over flat plates; heat transfer through pipes and ducts flows; critical thickness of insulation; non-dimensional parameters related to heat transfer and their applications; shear stress; friction coefficient for fully developed flow; Reynolds analogy; radiation; Stefan Boltzmann's law; black-body radiation; absorptivity; reflectivity; transmissivity; Wien's law; Kirchhoff's law; gray-body radiation; radiation shape factor and its applications; heat exchangers; classification; overall heat transfer co-efficient; LMTD and NTU methods; FICK's law of diffusion and mass diffusivity; concept of concentration boundary layer; solving mass transfer problems using convective heat transfer analogy.

Recommended Texts:

1. T L Bergman, A S Lavine, F P Incropera, D P Dewitt, *Fundamentals of Heat and Mass Transfer*, 7th ed, Wiley, 2011.
2. Y A Cengel, A J Ghajar, Heat *Transfer: Fundamentals and Applications*, 5th Ed, McGraw Hill, 2014.
3. J P Holman, *Heat Transfer*, 10th Ed, McGraw Hill, 2009.

ME-403L Heat Transfer (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**PERFORM** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3.	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4.	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
5.	**PERFORM** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

Various experiments covering conduction, convection, radiation and heat exchangers will be carried out.

Recommended Texts:

Lab manuals

ME-405T Mechanical Vibrations (Th)

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **ME-202T Engineering Dynamics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** various techniques to model vibration response of single / multiple degrees of freedom mechanical systems.	Cognitive	3	1
2.	**ANALYZE** the physical parameters involved in natural frequency and system response to free and forced inputs.	Cognitive	4	2
3.	**INVESTIGATE** the dynamic response of a vibrating system by measuring and analyzing its vibration parameters.	Cognitive	5	4

Course Contents:

Elements of vibrating systems; harmonic motion; free vibration; viscous damping; modeling and energy methods; stiffness; logarithmic decrement; stability; introduction to non-linear systems: dry friction and pendulum; harmonically excited vibration of damped and undamped systems; base excitation; rotating unbalance; measurement devices; two degrees of freedom model; eigenvalues and natural frequencies; modal analysis; 2DoF systems with viscous damping; forced response of 2DoF systems; systems with more than 2DoF; classical computational method: Holzer's method; vibration isolation; vibration absorbers; vibration dampers; critical speed of rotating shafts; distributed parameter systems: free and forced vibration of cables, bars, thin beams and membranes; modal analysis of forced response; numerical simulations of vibration phenomena.

Recommended Texts:

1. D J Inman, *Engineering Vibration*, 5th Ed, Pearson, 2014.
2. WT Thompson, M D Dahleh, C Padmanabhan, *Theory of Vibrations with applications,* Pearson, 5th Ed, 2008.
3. S S Rao, *Mechanical Vibrations*, 6th Ed, Pearson, 2018.

ME-405L Mechanical Vibrations (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Prerequisite Course: **ME-202T Engineering Dynamics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2.	**PERFORM** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3.	**COMMUNICATE** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4.	**COMPLY** with the safety instructions, rules and regulations.	Affective	2	8
5.	**PERFORM** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

The experiments in this lab complement the knowledge gained in theory lectures.

Recommended Texts:

Lab manuals

ME-411 Power Plants

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **ME-207T Thermodynamics – II**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**REVIEW** different energy sources and environmental impacts of various power plants.	Cognitive	2	7
2.	**ANALYZE** strengths and weaknesses of different types of power plants by performing Thermodynamic calculations.	Cognitive	4	2
3.	**ILLUSTRATE** the construction and operation of different components of a power plant.	Cognitive	4	2
4.	**DESIGN** major components/ systems of a power plant.	Cognitive	5	3
5.	**ESTIMATE** the unit cost of electricity generation from a power plant.	Cognitive	3	2

Course Contents:

Thermodynamics of conventional power plants; fossil fuel steam generator; Brayton cycle; open and closed cycle power plants; combined cycle power plants; combustion chamber configuration; fuel injection system; combustion; flame stabilization; gas turbine power plants; diesel engine power plant; combined heat and power plants (CHP); nuclear power plants; steam turbine systems; evaporative cooling towers; condensers thermal design and performance; environmental impacts of power plants; power plant economics and management.

Recommended Texts:

1. P K Nag, Power Plant Engineering, 4th Ed, McGraw Hill India, 2014.
2. A K Raja, Power Plant Engineering, 1st Ed, New Age International Pvt Ltd Publishers, 2006.
3. M M El Wakil, *Power Plant Technology*, McGraw Hill, 2002.

ME-412 Internal Combustion Engines

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **ME-207T Thermodynamics – II**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** the basic knowledge, construction and working of various types of IC engines and its components.	Cognitive	2	1
2.	**SOLVE** numerical problems related to the design and operation of IC engines.	Cognitive	3	2
3.	**ANALYZE** the effect of engine operating parameters on engine performance and environmental effects of emissions.	Cognitive	4	7

Course Contents:

Engine classification; combustion; real engine cycle; working principles of SI and CI engines; ignition delay and combustion phases; testing and performance characteristics of petrol and diesel engines under variable condition of load and speed; knocking characteristics; octane and cetane numbers; engine valve timing and ignition advance and retard; pressure-crank angle diagram; working principle of turbo-charged engine; its performance characteristics and comparison with naturally aspirated engine of equal power; engine emissions and their control through in-cylinder and out-cylinder techniques; exhaust gas recirculation (EGR) system; thermal reactor and catalytic converters; trade off of NOx and HC emissions; fuel injected petrol engine and its performance; advantages over conventional petrol engine; engine performance under part cut-out conditions and fuel savings introduction to duel fuel / multi fuel engines; CNG engines; engine lubrication and lubricants; fuel additives.

Recommended Texts:

1. W W Pulkrabek, *Engineering Fundamentals of The Internal Combustion Engines*, 2nd Ed, Pearson Education, 2003.
2. J B Heywood, *Internal Combustion Engine Fundamentals*, 2nd Ed, McGraw Hill, 2018.
3. R Stone, *Introduction to Internal Combustion Engines*, 4th Ed, Palgrave MacMillan, 2014.

ME-499A Design Project

Contact Hours:

Theory = **0**

Practical = **144**

Total = **144**

Credit Hours:

Theory = **0.0**

Practical = **3.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**FORMULATE** the mechanical engineering problem and provide an engineering solution;	Cognitive	5	4
2.	**APPLY** engineering knowledge to **DESIGN** and **DEVELOP** components, systems and / or processes to achieve specified requirements;	Psycho-motor	5	3
3.	**COMMUNICATE** effectively engineering design details through a technical report and oral presentations;	Affective	4	10
4.	**DISPLAY MOTIVATION** for acquiring extra technical knowledge in order to solve real life problems;	Affective	5	12
5.	**EXECUTE** the project as part of a team and fulfill his individual responsibilities;	Affective	5	9
6.	**PLAN** and **MANAGE** the project to achieve the targets in a specified timeframe;	Affective	5	11

Course Contents:

Students are required to select a design project; the project can be to solve a problem being faced in industry or it may be oriented towards designing a product; the project can also be motivated from a research problem taken from literature; at the end of 7th semester, students will have to submit a preliminary report of the project and have to clear a viva voce examination.

Recommended Texts:

As advised by the Project Supervisor

ME-499B Design Project

Contact Hours:

Theory = **0**

Practical = **144**

Total = **144**

Credit Hours:

Theory = **0.0**

Practical = **3.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** engineering knowledge to **DESIGN** and **DEVELOP** components, systems and / or processes to achieve specified requirements.	Psycho-motor	5	3
2.	**COMMUNICATE** effectively engineering design details through a technical report and oral presentations.	Affective	4	10
3.	**DISPLAY MOTIVATION** for acquiring extra technical knowledge in order to solve real life problems.	Affective	5	12
4.	**ANALYZE** & **INVESTIGATE** the engineering design in thorough details.	Cognitive	6	4
5.	**EXECUTE** the project as part of a team and fulfill his individual responsibilities.	Affective	5	9
6.	**PLAN** and **MANAGE** the project to achieve the targets in a specified timeframe.	Affective	5	11

Course Contents:

Students will continue their work in the 8th semester; the final evaluation will be based on project report and viva voce.

Recommended Texts:

As advised by the Project Supervisor

Interdisciplinary Optional Courses

EE-402T Application of Micro-controllers in Mechanical Engg

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Prerequisite Course: **EE-152T Electronics**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**UNDERSTAND** common daily life problems where automation can be applied.	Cognitive	2	1
2.	**USE** PIC18Fxxx series for interfacing and programming for solving automation problems.	Psycho-motor	4	3
3.	**UNDERSTAND** devices such as I/O ports, timers, serial port, interrupt programming, ADC, DAC, etc.	Cognitive	2	5
4.	**DESIGN** solution for relatively complex automation problems by using basic interfacing and programmable skills.	Cognitive	5	3

Course Contents:

PIC micro-controller history and features; interfacing using assembly and C languages; I/O ports; timers; serial port; interrupt programming; CCP and ECCP programming; SPL; interfacing LCD; keyboards; ADC; DAC; sensors; full step and half step stepper motor control; DC motor control, applications in mechanical engineering.

Recommended Texts:

1. M A Mazidi, R D McKinlay, R D Causey, *PIC Micro-controller & Embedded Systems using Assembly and C for PIC18*, Prentice Hall, 2007.
2. H W Huang, L Chartrand, *PIC Micro-controller: An introduction to software & hardware interfacing*, Cengage Learning, 2004.
3. Datasheets of PIC18Fxxxx series.

EE-402L Application of Micro-controllers in Mech Engg. (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**BUILD** IC programming skills for I/O ports, timers, serial port, interrupt programming, ADC, DAC, etc.	Psycho-motor	5	5

Course Contents:

The experiments in this lab complement the knowledge gained in theory lectures.

Recommended Texts:

Lab Manual

Technical Elective Courses

ME-408 Total Quality Management

Contact Hours:		**Credit Hours:**	
Theory	= **32**	Theory	= **2.0**
Practical	= **0**	Practical	= **0.0**
Total	= **32**	Total	= **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**UNDERSTAND** the fundamental principles and historic foundations of total quality management practices.	Cognitive	2	1
2.	**APPLY** the six sigma principles.	Cognitive	3	11
3.	**EVALUATE** process improvements using TQM tools.	Cognitive	5	11

Course Contents:

Fundamental principles; standards; techniques for quality analysis and improvements; statistical methods and statistical process control (SPC); acceptance sampling; quality function deployment (QFD); value engineering; cross-functional management and benchmarking; ISO9000: application, classes and implementation issues.

Recommended Texts:

1. W J Stevenson, *Production / Operations Management*, 11th ed;, McGraw-Hill, 2011.
2. A Mitra, *Fundamentals of Quality Control & Improvement*, 3rd ed;, Wiley, 2008.
3. D L Montgomery, *Introduction to Statistical Quality Control*, 6th ed;, Wiley, 2008.
4. D H Besterfield, *Total Quality Management*, 3rd ed;, Pearson Education Inc, 2003.
5. A V Feigenbaum, *Total Quality Control*, McGraw Hill, 1991.

ME-413 Renewable Energy Resources

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the impact of non-renewable energy resources on environment and sustainability of renewable energy resources.	Cognitive	1	7
2.	**DESCRIBE** the basic principles of different renewable energy harvesting systems;	Cognitive	2	1
3.	**EVALUATE** sites for the installation of renewable energy conversion systems;	Cognitive	5	2

Course Contents:

Environmental issues of non-renewable energy conversion systems; introduction to renewable energy resources; hydropower: site assessment, major components of hydroelectric power plants, selection of turbines, tidal power, wave power, environmental issues; wind power: aerodynamics of wind turbine rotor blades, control of wind turbines, wind speed distributions and capacity factor, compatible electrical generators, environmental issues; solar power: incident solar radiation, estimation of altitude and azimuth angles of the sun, tracking and non-tracking systems, solar photovoltaics, concentrating systems, solar chimneys; geothermal energy: ocean thermal energy conversion systems (OTEC); biomass energy conversion methods, detailed description of biomass energy conversion plant, operational and maintenance problems and their remedies; energy storage.

Recommended Texts:

1. G M Masters, *Renewable Energy and Efficient Electric Power Systems*, 2nd Ed, John Wiley and Sons, 2013.
2. G Boyle, *Renewable Energy*, 2nd Ed;, Oxford University Press, 2004
3. J Twidell, T Weir, *Renewable Energy Resources*, 2nd Ed, Spon Press, 2005

ME-421 Engineering Law

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** basic legal processes, concepts of law, and principles of law contract relevant to engineers.	Cognitive	2	1
2.	**RECOGNIZE** various aspects of employment law and duty of care in professional engineering practice.	Cognitive	2	6
3.	**DEMONSTRATE** an understanding of legal rights and duties important to engineers in their career.	Cognitive	3	8

Course Contents

Introduction to legal studies, concepts and sources of law, basic principles of the law contract as it relates to engineers; The duty of care for engineers and the concept of negligence; Aspects of employment law; Intellectual property; Designs, patents, copyright in engineering; Enforcing rights to intellectual property.

Recommended Texts

1. R E laidlaw, C R Young, A R Dick, *Engineering Law*, University Press, 1958.
2. C F Allen, *Business law for engineers,* University of Michigan library, 1919.

ME-422 Automotive Technology

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**IDENTIFY** automobile chassis and its classification, body design, major components and systems;	Cognitive	2	1
2.	**EXAMINE** function of automotive electrical, electronic, HVAC systems;	Cognitive	4	4
3.	**EVALUATE** the performance of various drivetrain, differentials, tires, wheels, suspension, steering and braking system;	Cognitive	5	4

Course Contents

Engine basics; Engine Foundation; automobile chassis; major components and systems of automobile; auxiliary systems; electrical, electronic and HVAC systems; Power train; clutches; differentials; tires and wheels; suspension; steering; brake systems.

Recommended Texts

2. K Vangelder, *Fundamentals of Automotive Technology: Principles and Practice*, 2nd Ed, Jones and Bartlett Learning, 2018.
3. J Erjavec, R Thompson, *Automotive Technology: A Systems Approach*, 7th Ed, Cengage learning, 2019.
4. W; H; Crouse & D; L; Anglin “Automotive Mechanics”, 10th Edition, Career Education, 1993.

ME-423 Principles of Tribology

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**IDENTIFY** causes of wears and friction in different contact surfaces and **DESCRIBE** their measurement techniques.	Cognitive	2	1
2.	**APPLY** the concepts of hydrostatic and hydrodynamic lubrication to basic tribological problems.	Cognitive	3	2
3.	**ANALYZE** the performance of bearings and other tribological systems.	Cognitive	3	5

Course Contents

Friction; wear mechanism; wear debris classification; surface roughness; friction and wear measurement techniques; lubrication of sliding and rolling parts; Types of lubricants, grades and their properties; theories of lubrication; hydrodynamic and elasto-hydrodynamics lubrication of journal bearing and squeeze film bearings; Tribological considerations in various applications;

Recommended Texts

1. A Cameron, C M Ettles, *Basic Lubrication Theory*, 3rd Ed, Prentice Hall, 1981.
2. T Stolarski, *Tribology in Machine Design*, 2nd Ed, Butterworth-Heinemann, 1999;
3. Bharat Bhushan, *Modern Tribology Handbook*, Vol-I, CRC, 2001.

ME-424T Introduction to Finite Element Analysis (Th)

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** major theories and methods used in FEA to solve engineering problems	Cognitive	2	1
2.	**DEVELOP FEA** model for practical engineering problems;	Cognitive	5	3

Course Contents

Overview of the finite element modeling procedure; common element types and their properties; convergence and sources of error; Structural analysis in 1D, 2D and 3D trusses, beams and frames, plates and shell elements, solid elements; thermal strains and heat transfer analysis; introduction to dynamic analysis; modal, harmonic and transient analysis;

Recommended Texts

1. S Moaveni, *Finite Element Analysis, theory and applications with ANSYS*, 4th ed, Pearson, 2015
2. H H Lee, *Finite Element Simulations using ANSYS Workbench 19*, SDC, 2018

ME-424L Introduction to Finite Element Analysis (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** available FEA software for solid & structural analysis of mechanical components;	Cognitive	3	5

Course Contents:

Hands-on training sessions using available finite element analysis software.

Recommended Texts

Lab manuals

ME-425T Introductory Computational Fluid Dynamics (Th)

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** major theories and methods used in CFD to solve engineering problems.	Cognitive	2	1
2.	**DEVELOP** CFD model for practical engineering problems.	Cognitive	5	3

Course Contents

Introduction to CFD; generic form of the governing equations for CFD; physical boundary conditions of the governing equations; discretization of governing equations; numerical solutions to algebraic equations; pressure–velocity coupling—"SIMPLE" scheme; multi-grid method; consistency; stability; convergence; accuracy; efficiency; meshing types and techniques; practical guidelines for CFD simulations and analysis on ANSYS-FLUENT/CFX.

Recommended Texts:

1. J Tu, G H Yeoh, C Liu, *Computational Fluid Dynamics: A Practical Approach*, 3rd Ed, Butterworth-Heinemann, 2018;
2. H K Versteeg, W Malalsekera, *An Introduction to Computational Fluid Dynamics*, 2nd Ed, Pearson, 2010;
3. J H Ferziger, M Peric, *Computational Methods for Fluid Dynamics*, 3rd Ed, Springer 2001.

ME-425L Introductory Computational Fluid Dynamics (Lab)

Contact Hours:
Theory = **0.0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Prerequisite Course: Nil

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** available CFD software for the analysis of given fluid systems and components	Cognitive	3	5

Course Contents

CFD simulations and analysis of various flow conditions and geometries in ANSYS-FLUENT/CFX.

Recommended Texts:

Lab Manuals

ME-426 Mechanical Engineering Design

Contact Hours:

Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:

Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**COMPREHEND** fundamentals of design methodology.	Cognitive	2	1
2.	**APPLY** design methodology to system design.	Cognitive	3	2

Course Contents:

Philosophy and concepts of mechanical engineering design; engineering creativity; phases and procedures in design; uncertainty; zero-failure design methodology; system design methodology.

Recommended Texts:

1. A Kossiakoff System Engineering Principles and Practices, 2nd ed, 2011.
2. W E Eder, S Hosnedl, *Design Engineering: A Manual for Enhanced Creativity*, CRC Press 2007.
3. A H Burr, J B Cheetham, Mechanical Analysis and Design, 2nd ed, Prentice Hall, 1995.

ME-427 Operations Research

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**SOLVE** linear programming problems using appropriate techniques.	Cognitive	4	2
2.	**DEMONSTRATE** the concepts of sensitivity analysis, duality and dynamic programming.	Cognitive	3	1
3.	**ANALYZE** and **SOLVE** network, transportation, replacement and queuing models arising from wide range of applications.	Cognitive	4	2
4.	**USE** mathematical software to solve the operation research models.	Cognitive	3	5

Course Contents

Operations research techniques and basics; linear programming; graphical method; simplex method; geometric programming; dynamic programming; network analysis; sensitivity and duality; transportation models; replacement models; queuing model; simulation; basic principles; discrete models vs. continuous system simulation; applications; use of digital computer for simulation.

Recommended Texts

1. H A Taha, *Operations Research; An Introduction*, 10th Ed, Pearson, 2016.
2. A Ravindran, *Operations Research and Management Science Handbook*, CRC Press, 2000.
3. M Anderson, R J Lievano, *Quantitative Management: An Introduction*, Kent Publishing Co; 1986.

ME-428 Maintenance Engineering

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the importance and various types of maintenance in industry.	Cognitive	2	1
2.	**APPLY** various maintenance performance techniques.	Cognitive	3	2
3.	**DIAGNOSE** faults and perform basic repairs/replacement of defected parts after assessment.	Cognitive	4	4

Course Contents

Introduction and types; preventive maintenance, its objectives, benefits and economics; inspection and implementation; routine maintenance and monitoring of fault indicators; main concepts and implementation; proper assembly/disassembly; alignment aspects; machine handling; record keeping and maintenance scheduling; stocking spares and cost effectiveness; safety in maintenance; basic repairs of electro-mechanical equipment; fault diagnosis and assessment; introduction to predictive maintenance; condition base monitoring; basic repairs; replacement/refurbishment of defectiveness parts e.g. bearings, brakes, shafts.

Recommended Texts

1. K Mobley, L R Higgins, D Wikof, *Maintenance Engineering Handbook*,7th Ed, McGraw-Hill,2008.

ME-429 Introduction to Compressible flows

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**ANALYZE** the change in flow conditions through normal, oblique, and Prandtl-Meyer expansion/compression waves.	Cognitive	4	2
2.	**FORMULATE** and **SOLVE** problems of 1D steady compressible flows including constant area flows with friction and heat addition.	Cognitive	6	3

Course Contents:

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

Recommended Texts:

1. J D Anderon, *Modern Compressible Flow with Historical Perspectives*, 3rd Ed, McGraw-Hill, 2012.
2. R D Zucker, O Biblarz , *Fundamentals of Gas Dynamics* 3rd Ed, Wiley, 2019.
3. M J Zucrow, J D Hoffman, *Gas Dynamics* , Wiley, 1976.

ME-430 Fundamentals of Aerodynamics

Contact Hours:
Theory =**32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **2.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**APPLY** the concepts relevant to the dynamics of incompressible, inviscid flow field to aerodynamic flows.	Cognitive	3	1
2	**CALCULATE** aerodynamic parameters for incompressible flow around airfoil and wing of finite span.	Cognitive	4	2
3	**Analyze** how an airplane responds to drag, lift, thrust, and power in relation to its performance.	Cognitive	4	3

Course Contents:

Concept of aerodynamic forces and moment; center of pressure; circulation; coefficient of pressure; Euler equation and Bernoulli's equation for irrotational flows; pitot tube; potential flow theory; superposition of potential flow; coefficient of pressure; thin airfoil theory; Kutta-Joukowski condition; finite wing theory; aircraft performance during steady and accelerated flight.

Recommended Texts:

1. J D Anderson, *Fundamentals of Aerodynamics*,6th Ed, McGraw-Hill Education, 2016.
2. J D Anderson, *Aircraft Performance and Design*,1st Ed, McGraw-Hill Education, 2010.

CMS-XXX Project Management

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Prerequisite Course: Nil

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**EXPLAIN** the project life cycle process.	Cognitive	2	1
2	**SELECT** the required human resource for identification, planning and estimation of project cost/ schedule.	Cognitive	2	11
3	**DESIGN** and develop the WBS (Work Breakdown Structure) of project for budget and schedule estimation.	Cognitive	5	11
4	**EXECUTE** the developed WBS and control the deviation.	Cognitive	3	11
5	**UTILIZE** modern software packages for evaluation of the budget and schedule estimates.	Cognitive	3	5

Course Contents

Fundamental principles; project life cycle; project organization and human resource management; pm planning; work breakdown structure; estimating time and cost; precedence relationships; project scheduling, networking and control techniques; project risk analysis; time compression and resource leveling; project execution and controlling; computerized project management; special software packages.

Recommended Texts

1. H Kerzner, Project Management: *A Systems Approach to Planning, Scheduling, and Controlling*, 12th Ed, John Wiley & Sons, 2017.
2. E W Larson, *Project Management: The Managerial Process*, 6th Ed, McGraw Hill, 2017.
3. J R Meredith, S J Mantel, S M Shafer, *Project Management in Practice*, 6th Ed, John Wiley & Sons, 2016.
4. Project Management Institute (PMI), *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 6th Ed, PMI, 2016.

Interdisciplinary Courses

EE-151T Electrical Engineering

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** basic concepts, network laws and theorems used to analyze linear circuits.	Cognitive	2	1
2.	**ANALYZE** linear circuits using network laws and steady state response of resistive and reactive elements to AC excitation.	Cognitive	4	2
3.	**EXPLAIN** operating principles of fundamental components of electric machines such as motors, generators and transformers including synchronous, asynchronous, DC and special purpose AC, DC generators and transformers.	Cognitive	2	2

Course Contents:

Introduction to dc circuits: series and parallel circuits, dc circuit analysis; theory of alternating current; series and parallel circuits, resistance, inductance and capacitance of ac circuits, power factor, resonance in RLC circuits, single phase and polyphase circuits; power and power factor measurement, current and voltage relationship in phase and line circuits; types, characteristics and testing of ac motors, motor starters and switch gears, electric traction and braking, solenoids; transformers; voltage and current relationship of primary and secondary types of transformers, losses and efficiency; generators and motors; types, construction and characteristics; motor starters; testing and efficiency of machines.

Recommended Texts:

1. G Rizzoni , J A Kearns, *Principles and Applications of Electrical Engineering*, 6th Edition, McGraw-Hill, 2015.
2. A H Robbins , W C Miller, *Circuit Analysis: Theory and Practice*, 5th Edition, Delmar Cengage Learning, 2012.
3. S Chapman, *Electric Machinery Fundamentals*, 5th Ed, McGraw Hill, 2011.
4. T Wildi, *Electric Power Technology*, John Wiley & Sons, 1981.
5. M Nahvi, J Edminister, *Electric Circuits, Basic Electricity, Schaum's Series*, 4th Ed, McGraw Hill, 2002.

EE-151L Electrical Engineering (Lab)

Contact Hours:

Theory = **0**

Practical = **48**

Total = **48**

Credit Hours:

Theory = **0.0**

Practical = **1.0**

Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**ILLUSTRATE** knowledge of primary electronic lab instruments including DMM, function generator, oscilloscope & electronic trainer.	Psycho-motor	3	1
2.	**IMPLEMENT & TEST** electronic circuits using Digital Lab Trainer.	Psycho-motor	3	5

Course Contents:

This lab consists of experiments on electric circuits comprising common important electronic components.

Recommended Texts:

Lab Manual

EE-152T Electronics

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Prerequisite Course: **EE-151T Electrical Engineering**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** and explain the basic construction, operation and characteristics of semiconductor devices.	Cognitive	2	1
2.	**APPLY** acquired knowledge to solve the small-scale circuits consisting of semiconductor devices.	Cognitive	4	2
3.	**EXPLAIN** fundamental concepts of digital logic design including basic and universal gates, number systems, binary coded systems and basic components of combinational and sequential circuits.	Cognitive	2	2

Course Contents:

Semiconductors, rectifiers, transistors, relays, operational amplifiers; number systems, Boolean algebra, gates; combinational logic (adders, comparators, decoders, multiplexers, etc.) sequential logic (flip-flops, registers, counters, ROM, PROM, EPROM); microprocessors (registers; ALU; CU; memory, address, data and control buses); ADC and DAC; micro-controllers.

Recommended Texts:

1. T L Floyd, *Electronic Devices,* 10th Ed, Pearson, 2017.
2. T L Floyd, *Digital Fundamentals*, 11th Ed, Pearson, 2014.
3. J A Brown, A P Malvino, *Digital Computer Electronics,* 3rd Ed, McGraw Hill,2017.

EE-152L Electronics (Lab)

Contact Hours:
Theory = **0**
Practical = **48**
Total = **48**

Credit Hours:
Theory = **0.0**
Practical = **1.0**
Total = **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Explain** Engineering Knowledge related to lab experiments.	Cognitive	2	1
2	**Perform** the experiment following the demonstration and/or instruction.	Psychomotor	3	4
3	**Communicate** the activity and its main points through different media such a written, verbal etc.	Affective	2	10
4	**Comply** with the safety instructions, rules and regulations.	Affective	2	8
5	**Perform** the experiment as an individual or in a team or group.	Affective	2	9

Course Contents:

Experiments related to concepts learned in theory classes will be conducted.

Recommended Texts:

Lab Manuals

EE-401 Control Engineering

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DEVELOP** mathematical models for different types of physical systems.	Cognitive	5	3
2.	**ANALYZE** the behavior of the system i.e. stability, transient and steady-state responses of the system.	Cognitive	4	2
3.	**DESIGN** classical compensators/controllers to achieve the desired response of the system.	Cognitive	5	3

Course Contents:

Basic concepts and definitions of system, control systems, input, output, open-loop and closed-loop control systems; elements of a general control system; examples of control systems; transfer functions and characteristic polynomial; mathematical modeling of electrical, mechanical and electromechanical systems; block diagrams; mason's gain formula; transient and steady state response analysis; steady state error; impulse, step, and ramp responses of first and second order systems; stability analysis using Routh Hurwitz criteria; analysis and compensator design using root locus method; tuning of PID controllers.

Recommended Texts:

1. N S Nise, *Control Systems Engineering*, 7th Edition, Wiley, 2015.
2. K Ogata, *Modern Control Engineering*, 5th Edition, Pearson, 2011.
3. F Golnaraghi and B C Kuo, *Automatic Control Systems*, 9th Edition, Wiley, 2009.
4. R C Dorf and R H Bishop, *Modern Control Systems*, 13th Edition, Pearson, 2016.

MME-203 Introduction to Engineering Materials

Contact Hours:		**Credit Hours:**	
Theory	= **48**	Theory	= **3.0**
Practical	= **0**	Practical	= **0.0**
Total	= **48**	Total	= **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** and **GIVE EXAMPLES** of different types of engineering materials based on bonding, crystal structure and mechanical properties.	Cognitive	2	1
2.	**IDENTIFY** different types of microstructures obtained in phase diagrams and after heat treatment of engineering alloys.	Cognitive	1	2
3.	**COLLECT** and **APPLY** the knowledge obtained from phase diagrams, SAE & ASTM designations.	Cognitive	3	3
4.	**ANALYZE**, **DIFFERENTIATE** and **DISTINGUISH** between the properties of interest in metals, polymers, ceramics and composites and their implication in terms of environment and sustainability.	Cognitive	4	7

Course Contents:

Introduction of engineering materials, metals and alloys, polymers, ceramics and composites; bonding in different classes of materials; physical, mechanical and chemical properties of engineering materials; crystal structure of metals and ceramic; crystallographic planes and directions; slip and slip systems; dislocation; twinning; yield phenomenon and strain aging; classification of metals and alloy systems; steels, cast irons, aluminum alloys, copper alloys, super alloys; the SAE and ASTM designations; the iron-iron carbide phase diagram; ferrite, austenite, cementite, pearlite, martensite, bainite, etc.; alloying elements and their effect on the properties of alloy steel; heat treatment of steel, annealing, normalizing, tempering, quenching, austempering, hardening etc.; hot and cold forming; recovery and recrystallization; types and properties of structural ceramics; classification of polymeric materials and their engineering properties.

Recommended Texts:

1. W D Callister, D G Rethwisch, *Material Science and Engineering: An Introduction* , 9th Ed, John Wiley, 2013.
2. M F Ashby, H Shercliff, D Cebon, *Materials Engineering, Science, Processing and Design*, Butterworth-Heinemann, 2007.
3. W F Smith, J Hashemi, Foundation of *Material Science and Engineering*, 6th Ed, McGraw Hill, 2018.
4. M F Ashby, *Materials Selection in Mechanical design*, 4th Ed, Butterworth-Heinemann, 2011.

Computing

CIS-104T Computer Fundamentals

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** basics of computers and computer programming.	Cognitive	2	1
2.	**DESCRIBE** Fundamental Programming Concepts such as variables, operators, conditional statements (if-else, if-else-if, switch statement), loops, arrays, functions, pointers, file handling.	Cognitive	2	1

Course Contents:

Fundamentals of computer hardware and software; introduction to programming in C; data types; input and output operators; arithmetic operators; operator precedence; relational operators; conditional statements (if, if-else, and switch statements); loop statements (for, while, do-while statements); Arrays, functions, pointers; file handling and structures.

Recommended Texts:

1. B W Kernighan and D M Ritchie, *The C programming Language*, 2nd Ed, Prentice Hall, 1988.
2. Y Kanetkar, *Let Us C*, 16th Ed, BPB Publications, 2017.
3. B S Gottfried, *Schaum's Outline of programing with C*, 2nd Ed, McGraw-Hill,1996.
4. B Jones and P G Aitken, *Sams Teach yourself C in 21 days*, 6th Ed, Sams Publishing, 2002.
5. R Lafore, C++ interactive course: Fast mastery of C++, Wait Group Pr, 1996.

CIS-104L Computer Fundamentals (Lab)

Contact Hours:		**Credit Hours:**	
Theory	= **0**	Theory	= **0.0**
Practical	= **48**	Practical	= **1.0**
Total	= **48**	Total	= **1.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** programming skills to write basic level programs.	Cognitive	3	2
2.	**TRANSLATE** problems into programs and solve them.	Cognitive	5	5

Course Contents:

In the lab part, students will be writing computer programs that cover all the topics covered in lectures and solve relevant problems in science and engineering.

Recommended Texts:

1. R Lafore, *Waite Group's Turbo C Programming for the PC*, Revised ed, Sams Pub;, 1990.
2. B S Gottfried, *Schaum's Outline of Programming with C*, McGraw Hill, 2nd Edition, 1996.

Natural Sciences

PAM-101 Calculus – I

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the concepts of Calculus of one variable (like limits, continuity, rates of change and integration) and conic sections.	Cognitive	2	1
2.	**CALCULATE** derivatives and integrals of single variable functions.	Cognitive	3	2
3.	**DESCRIBE** the Mathematical concepts relevant to algebra of complex numbers.	Cognitive	2	1
4.	**APPLY** the mathematical concepts on real world problems.	Cognitive	3	2

Course Contents:

Functions, limits and continuity; derivatives and its applications; rules of differentiation; implicit differentiation; extreme values of functions; mean value theorem; linearization and differentials integration and its applications; indefinite integrals; rules of integration; Riemann sum; definite integrals; improper integrals; integration by parts; partial fractions; trigonometric substitution; L'Hospital rule; infinite series; limits of sequence of numbers; series of non-negative terms; power series; Taylor and maclaurin series; application of power series; complex numbers and their algebra, D'movires theorem.

Recommended Texts:

1. J R Hass, C E Heil, M D Weir, *Thomas' Calculus* , 14th Ed, Pearson 2017.
2. E Kreyszig, *Advanced Engineering Mathematics*: *International Student Version*,10th Ed, Wiley 2015.
3. W Kaplan, *Advanced Calculus*, 5th Ed, Addison-Wesley, 2002.
4. R Ellis, D Gulick, *Calculus: One and Several Variables*, Saunders College Publishing, 1991.

PAM-131 Engineering Physics

Contact Hours:		**Credit Hours:**	
Theory	= **48**	Theory	= **3.0**
Practical	= **0**	Practical	= **0.0**
Total	= **48**	Total	= **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**UNDERSTAND** key concepts of units and measurements (standards, conversions, significant figures, etc.).	Cognitive	2	1
2.	**UNDERSTAND** the basics of waves and light propagation along with associated physical quantities and phenomena.	Cognitive	2	1
3.	**SOLVE** problems of dynamics of particles and rigid bodies moving at constant acceleration.	Cognitive	3	2

Course Contents:

Measurement; motion in a plane; forces and equilibrium; newton's laws; applications of newton's law; rotation; torque; rigid bodies and rotational dynamics; work and potential energy; collisions and conservation laws; universal gravitation; sound waves; waves & oscillations; simple harmonic motion; wave speed; energy and power of traveling waves; doppler's effect; nature and propagation of light.

Recommended Texts:

1. D Halliday, R Resnick, J Walker, *Fundamentals of Physics, Vol-1 & 2*, 10Th Ed, Wiley, 2015.
2. H D Young, R A Freedman, *University Physics with Modern Physics*, 14th Ed, Pearson, 2015.
3. R A Serway, J W Jewett, *Physics for Scientists and Engineers with Modern Physics: Technology Update*, 9th Ed, Cengage Learning, 2015.

PAM-202 Calculus – II

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Prerequisite Course: **PAM-201 Calculus – I**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the concepts of Calculus like limits, continuity, rates of change and integration for multi-variable functions.	Cognitive	2	1
2.	**CALCULATE** derivatives and integrals of multivariable functions.	Cognitive	3	2
3.	**APPLY** the mathematical concepts on real world problems.	Cognitive	3	2

Course Contents:

Motivation and geometric background (conic sections, parameterized curves, polar coordinates, vectors in space; dot and cross product; lines and plane in space; cylinders and quadric surfaces; vector valued functions and motion in space); multivariable functions and their derivatives; limits and continuity in higher dimensions; partial derivatives; the chain rule; linearization and differentials; extreme values and saddle points; Lagrange multiplier; partial derivatives with constrained variables; Taylor's formula for two variables; multiple integrals; double integrals; areas, moments and center of mass; double integral in polar and rectangular coordinates; masses and moments in three dimensions; triple integrals in rectangular and spherical coordinates; integration in vector field; work, circulation and flux; path independence; potential functions and conservative fields; green's theorem in planes; surface area and surface integrals; parameterized surface; stokes theorem; divergence theorem and unified theory.

Recommended Texts:

1. J R Hass, C E Heil, M D Weir, *Thomas' Calculus* , 14th Ed, Pearson 2017.
2. E Kreyszig, *Advanced Engineering Mathematics*: *International Student Version*,10th Ed, Wiley 2015.
3. H Anton, I C Bivens, S Davis, *Calculus*, 11th Ed, Willey, 2016.

PAM-2XX Engineering Mathematics

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** the concepts of linear algebra to solve mathematical problems.	Cognitive	3	2
2.	**SOLVE** first and higher order ODEs using various methods.	Cognitive	3	2
3.	**DEMONSTRATE** the concepts of Fourier series and Laplace transform to solve mathematical problems.	Cognitive	3	2
4.	**DEVELOP** mathematical models to solve real world problems.	Cognitive	5	3

Course Contents:

Matrix algebra ; reduction of matrices into echelon and reduced echelon form; rank of a matrix; solution of system of linear algebraic equations; gaussian elimination and Gauss-Jordan method; vector spaces; linear dependent and independent vectors; basis; eigenvalue and eigenvectors; first and second order differential equations and their solution techniques; higher order linear differential equations; applications of differential equations; power series solutions and systems of linear differential equations; Laplace transform and its applications to solve initial value problems; Fourier series and its applications.

Recommended Texts:

1. D G Zill, *A First Course in Differential Equations with Modeling Applications,* 11th Ed, Cengage Learning, 2017.
2. E Kreyszig, *Advanced Engineering Mathematics*: *International Student Version*,10th Ed, Wiley 2015.
3. D C Lay, *Linear Algebra and Its Applications*, 5th Ed, Pearson, 2015.
4. M R Boelkins, L G Jack, M C Potter, *Differential Equations with Linear Algebra*, 1st Ed, Oxford University Press, 2009.

PAM-267 Probability and Statistics

Contact Hours:

Theory = **48**

Practical = **0**

Total = **48**

Credit Hours:

Theory = **3.0**

Practical = **0.0**

Total = **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the basic concepts of statistics, difference between descriptive and inferential statistics and sampling techniques.	Cognitive	2	1
2.	**ANALYZE** data to determine measures of central tendency and measures of dispersion.	Cognitive	4	2
3.	**EXPALIN** the concepts of probability, Bayes theorem and types of probability distributions, Hypothesis testing.	Cognitive	2	1
4.	**APPLY** different hypothesis tests for statistical significance.	Cognitive	3	2

Course Contents:

Frequency distributions, histograms, and frequency polygons; mean, median, mode and other measures of central tendency; standard deviation and other measures of dispersion; moments, skewness and kurtosis; combinatorial analysis; probability and conditional probability; dependent and independent events; mutually exclusive events; probability distributions; binomial, normal, and Poisson distribution; mathematical expectation; curve fitting and method of least squares.

Recommended Texts:

1. A Papoulis, S U Pillai, *Probability, Random Variables and Stochastic Processes*, 4th Ed, McGraw Hill, 2002.
2. D Freedman, R Pisani, Roger Purves, Statistics, 4th Ed, W; W; Norton & Company, 2007.
3. C M Grinstead, J L Snell, *Introduction to Probability*, American Mathematical Society, Revised Ed, 2012.

PAM-360 Numerical Methods

Contact Hours:		**Credit Hours:**	
Theory	= **48**	Theory	= **3.0**
Practical	= **0**	Practical	= **0.0**
Total	= **48**	Total	= **3.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** theoretical & practical concepts behind different numerical methods.	Cognitive	2	1
2.	**APPLY** learned numerical methods to solve different problems.	Cognitive	4	2
3.	**DEVELOP** skills for design and implementation of various numerical algorithms using mathematical software/computer language.	Cognitive	4	5

Course Contents:

Floating point number system; sources of errors; error definitions and analysis; Taylor's theorem; solutions of equations of one variable; interpolation and polynomial approximation; numerical differentiation and integration; iterative methods for system of linear equations; approximating eigenvalues; numerical solution of ordinary differential equations.

Recommended Texts:

1. R L Burden, J D Faires, A M Burden, *Numerical Analysis*, 10th Ed, Cengage Learning, 2014.
2. J D Faires, R L Burden, *Numerical Methods*, 4th Ed, Brooks/Cole,2012.
3. S C Chapra, R P Canale, *Numerical Methods for Engineers*, 7th Ed, Mc Graw Hill,2016.
4. E Kreyszig, *Advanced Engineering Mathematics*, 10th Ed, Wiley, 2015.

CHE-200 Applied Chemistry

Contact Hours:
Theory = **32**
Practical = **0**
Total = **32**

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**COMPREHEND** key concepts of bonding, crystals, thermodynamics, chemical equilibrium & kinetics, phase equilibrium and phase rule.	Cognitive	2	1
2.	**APPLY** these concepts for metallurgy of copper, aluminum, iron & steel manufacturing, fabrication of polymers, resins, plastics & elastomers, composites, ceramics and refractories.	Cognitive	3	1
3.	**APPLY** learned concepts in battery industry, corrosion, coating & lubricants, fuel & combustion and pollution control.	Cognitive	3	7
4.	**APPLY** knowledge of physical chemistry for analyzing chemical substances using instrumental technique.	Cognitive	3	2

Course Contents:

Atomic and molecular structure; thermodynamics; chemical equilibrium and dynamics; phase equilibrium and phase rule; polymers, resins, plastics and elastomers; composite materials; metallurgy of copper, iron and aluminum etc.; steel manufacturing; crystal structures; structures of solids; ceramics; refractories; electrochemistry; battery and battery technologies; corrosion; lubricants; protective coating; fuel and combustion; environmental chemistry and pollution control; instrumental techniques in chemistry.

Recommended Texts:

1. S S Dara, S Chand, *A textbook of Engineering Chemistry*, S Chand & Co., 2005.
2. Salahuddin, *Chemistry for Engineers*, National book Foundation, 1985.
3. Maron, Landau, *Fundamentals of Physical Chemistry*, Macmillan, 1974.

Humanities & Management Sciences

CMS-101 Islamic Studies

Contact Hours:		**Credit Hours:**	
Theory	= **32**	Theory	= **2.0**
Practical	= **0**	Practical	= **0.0**
Total	= **32**	Total	= **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**DESCRIBE** the basic beliefs of Islam in the light of Holy Quran and Hadith.	Cognitive	2	8
2.	**DESCRIBE** the practicality of Islam as code of life for all times.	Cognitive	2	6
3.	**RELATE** Islamic teachings to modern social and economic developments.	Cognitive	3	6

Course Contents:

Tauheed: arguments for the existence and oneness of Allah; purpose of creation; impact of *tauheed* on human life; *Risalat*: need for prophets; finality of prophethood; seerat (The life of the Holy Prophet); *Khutba Hijjat-ul-Wida*; the importance of *Sunnah*; *Aakhirat*: the life after death; the day of judgment; the concept of accountability and its impact on daily life; The Holy Quran: its revelation and compilation; introduction to *Aijaaz-ul-Quran* and the principles of *Tafseer-ul-Quran*; *Sura al-Fatiha*; 1st *Raku* of *Sura al-Baqarah*; *Sura Al-Hujraat* and lessons from *Sura Yaseen*; *Hadith*: its authenticity and importance; an introduction to *Sihah-i-Sitta*; types of *Ahadith*; *Chehal hadith* (Forty Ahadith); *Ibadah*: the concept of *Ibadah*; major *Ibadaat* (*Salaat, Saum, Zakat, Hajj* and *Jihad*); moral, social and political philosophy of Islam; the concept of good and evil; *Akhlaq-i-Hasanah, Kasb-i-Hilal*; responsibilities of the head of state; rights and duties of the citizens; applications of Islamic teachings to social and economic developments of the modern age such as interest free economy etc.

Recommended Texts:

1. Ibn-i-Kasir, *Tafseer Ibn-i-Kasir*, Dar Ibn Hazam, Beirut, Lebanon, 2005.
2. A B Baqilani, *Al-Intisaar Lil-Quran*, Dar Ibn Hazam, Beirut, Lebanon, 2005.
3. *Majalisul Abrar (for forty Ahadith)*, Mir Muhammad Kutabkhana, Markaz-i-Ilm-o-Adab Karachi, 2005.
4. Imam Nauwwi, *Arbaeen Hadith*, (for forty *Ahadith*).
5. M Naumani, *Deen-o-Shariat*, Mir Muhammad Kutabkhana, Markaz-i-Ilm-o-Adab Karachi, 2005.

CMS-103 Pakistan Studies

Contact Hours:		**Credit Hours:**	
Theory	= **32**	Theory	= **2.0**
Practical	= **0**	Practical	= **0.0**
Total	= **32**	Total	= **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**RECALL** the ancient history of the geographical region of Pakistan.	Cognitive	1	6
2.	**RECALL** important phases of freedom movement of Indian Subcontinent.	Cognitive	1	6
3.	**DESCRIBE** the key features of political structure and constitution of Pakistan.	Cognitive	2	6
4.	**IDENTIFY** resources and current issues of Pakistan.	Cognitive	2	6

Course Contents:

Important geological and geographical features of Pakistan; Pakistan's geographical location in a regional and global perspective; earliest human settlements in Pakistan; the Indus valley civilization; Aryan settlement and the Gandhari civilization; the advent of Islam in Pakistan; the work of Al-Beruni and early Sufi-savants in Pakistani lands; the British domination and its causes; brief chronology of the freedom movement; the founding documents of Pakistan including Allama Iqbal's 1930 Allahabad address, the Lahore resolution of 23rd march 1940, and Quaid-i-Azam's presidential address to the constituent assembly of Pakistan; political and constitutional phases in Pakistan since 1947; important features of the 1973 constitution and its current status; current issues in Pakistan including: administrative infrastructure; population growth; water, energy and mineral resources; agricultural resources and industrial infra-structure; educational problems; economic growth pattern and budgetary issues; environmental problems; foreign policy issues.

Recommended Texts:

1. K A Saeed, *The Economy of Pakistan, Oxford University Press, Karachi*, 2007.
2. J Briscoe, U Qamar, *Pakistan's Water Economy: Running Dry*, Oxford University Press, 2006.
3. J M Kenoyer, *Ancient Cities of the Indus Valley Civilization*, Oxford University Press, Karachi, 1998.
4. L A Sherwani (Editor), Speeches, *Writings and Statements of Iqbal*, Iqbal Academy, Lahore, 1995.
5. *The New Oxford Atlas for Pakistan*, Oxford University Press, Karachi, 1998.
6. *Jinnah: Speeches and Statements 1947-48*, Oxford University Press, Karachi, 2000.

CMS-104 Composition and Grammar

Contact Hours:		**Credit Hours:**	
Theory	= **32**	Theory	= **2.0**
Practical	= **0**	Practical	= **0.0**
Total	= **32**	Total	= **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** different writing and active reading strategies to comprehend texts.	Cognitive	3	10
2.	**ANALYZE** critical reading texts.	Cognitive	4	10
3.	**ORGANIZE** ideas in paragraphs, Letters, resumes, research articles and essays with clarity.	Cognitive	5	10

Course Contents:

Pre-writing techniques (mind-maps, brainstorming, free-writing, narrowing and focusing); audience; voice; critical reading and analysis; thesis statements; outlining and organizing the essay; introductory paragraphs; developing the different types of essay; paragraphing; summary and paraphrase; synthesis essays; basic sentence analysis/usage; correct sentences; paragraph types including exemplification, narration, comparison/contrast, cause/effect, and persuasion; revision techniques and editing; peer reviews grammar: figure of speech; sentence elements; sentence types; coordination & subordination; verb tenses; sentence types; fragments; run-ons; subject-verb agreement; and modals; mechanics: commas, capitalization and punctuation.

Recommended Texts:

1. M Swan, *Practical English Usage, 4th Ed*; Oxford University Press; 2017.
2. L Brandon and K Brandon, *At a Glance: Writing Essays and beyond with integrated readings*, 6th Ed; Cengage Learning, 2014.
3. S Scarry, and J Scarry, *The writer's Workplace with Readings: Building College writing skills*, 9th Ed, Cengage Learning, 2017.
4. S K Bland, *Intermediate Grammar: From Form to Meaning and Use*, Oxford University Press, USA; Teacher's edition, 1996.

CMS-105 Communication Skills

Contact Hours:		**Credit Hours:**	
Theory	= **32**	Theory	= **2.0**
Practical	= **0**	Practical	= **0.0**
Total	= **32**	Total	= **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	**EXPLAIN** the foundations of human communication process.	Cognitive	2	10
2	**PRESENT** information through different communication channels in an effective manner.	Cognitive	2	10
3	**DESIGN** and **DELIVER** oral presentations in an appropriate manner.	Affective	2	10
4	**ENGAGE** in interpersonal communication in a well-suited manner.	Affective	3	8

Course Contents:

Overview and importance of effective communications; business communication and the ethical context; business communication and the technology context; successful listening; communicating in teams and mastering listening and nonverbal communication skills; strategies for successful speaking and successful listening; general principles of communication; the seven C's of effective communication; communication barriers; format and layout of business documents; preparing effective business messages; good news; bad news and neutral messages; persuasive written messages; writing resumes and application letters; interviewing for employment and following up; reports; proposals and presentations; research process; communicating information through visuals; short reports; formal reports; proposals; oral communication; individual talks; meetings and group dynamics; communicating in teams; mastering listening; nonverbal communication skills; strategies for business and group meetings; preparation for presentations; planning, writing, and completing oral presentations.

Recommended Texts:

1. R B Adler, G Rodman, A D Pre, *Understanding Human Communication*, 13*th* Ed, Oxford University Press, 2016.
2. J V Thill and C L Bovee, *Excellence in Business Communication*, 12*th* Ed, Pearsons, 2016.
3. J V Thill and C L Bovee, *Business Communication Today*, 14*th* Ed, 2014.

CMS-106 Technical Writing

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = 2.0

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**APPLY** formal technical communication conventions found in workplace.	Cognitive	3	10
2.	**DEMONSTRATE** skills in effective organization and presentation of ideas in reports, letters, resumes, proposals and long reports.	Cognitive	3	10
3.	**CREATE** technical documents correctly and effectively.	Cognitive	5	10
4.	**DEMONSTRATE** knowledge of conventions / ethics in preparing communication for an audience of diverse cultures.	Cognitive	3	10

Course Contents:

Introduction to technical communication and writing; understanding purpose and audience; ethics and communication; understandable structure: paragraphing, chunking, sequencing, outlining; readable style: conciseness, fluency, clarity, tone, nondiscriminatory style; types of visuals; resumes and cover letters; memos and letters; writing short report; long reports; proposals; designing online and print documents; organizing and summarizing; writing definitions; descriptions, and instructions; research articles, researching your subject, sources of information; collaborative writing; oral presentations; documenting sources.

Recommended Texts:

1. M Markel and S A Selber, *Technical Communication,* 12th Ed; Bedford/St. Martin's, 2018.
2. L J Gurak and J M Lannon, *Strategies for Technical Communication in the Workplace* , 3rd Ed; Pearson; 2016.

CMS-109 Entrepreneurship

Contact Hours:		**Credit Hours:**	
Theory	= **32**	Theory	= **2.0**
Practical	= **0**	Practical	= **0.0**
Total	= **32**	Total	= **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** key concepts related to entrepreneurship, startup, and economic growth.	Cognitive	2	6
2.	**APPLY** the key concepts of entrepreneurship to create a business model and articulate an effective elevator pitches to gain support for the venture.	Cognitive	3	11
3.	**DEVELOP** a well-presented business plan that is feasible for student led enterprises.	Cognitive	4	12

Course Contents:

Introduction to entrepreneurship; entrepreneurial process; effectual entrepreneurship, entrepreneurship in Islam and Pakistan; ideas generation and screening; business opportunity identification; market assessment; case studies (Akhuwat, Freej, Craigslist); financing the emerging firm; new product innovation; intellectual property rights (IPRS), technology commercialization; business plan development; setting up a new business, managing the growing firm.

Recommended Texts:

1. David H; Holt, Entrepreneurship: New Venture Creation, PHI Learning, 2010.
2. Peter F; Drucker, *Innovation and Entrepreneurship*, 2nd Ed, Harper Business, 2006.
3. Simon Sinek, Start with Why: How Great Leaders Inspire Everyone to Take Action, Portfolio, 2011.
4. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Currency, 2011 .
5. Sean Wise, Brad Feld, Dave Heal, Startup Opportunities: Know When to Quit Your Day Job, FG Press, 2015.
6. M N Iftikhar, J B Justice, D B Audretsch, , *Urban Studies and Entrepreneurship*, Springer; 2019
7. Peter Thiel, Zero to One, Currency; 2014.

CMS-202 Engineering Economics

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**EXPLAIN** the basic knowledge of engineering economics and conventions.	Cognitive	2	1
2.	**DRAW** the cash flow diagrams in order to calculate time value of money.	Cognitive	2	2
3.	**SOLVE** economics problems involving comparison & selection of alternatives.	Cognitive	4	2
4.	**DESCRIBE** the concepts of depreciation and depletion and their role in income tax, capital gain tax, etc.	Cognitive	2	1
5.	**INVESTIGATE** the problems involving exchange rates issues, and replacement analysis.	Cognitive	4	2

Course Contents:

Principles of engineering economy; cost concepts and design economics; time value of money; applications of time-money relationships; minimum attractive rate of return; present worth method; future worth method; annual worth method; internal rate of return; external rate of return and payback period methods; comparison methods for evaluating projects; equal life versus un-equal life of project; depreciation and income taxes; depreciation methods and terminology; cost estimation techniques; replacement analysis; impact of exchange rate and inflation in assessing projects; purchasing power parity.

Recommended Texts:

1. DG Newnan, TG Eschenbach, JP Lavelle, Neal Lewis, *Engineering Economic Analysis*, 14th ed., Oxford University Press; 2019.
2. WG Sullivan, EM Wicks, CP Koelling; *Engineering Economy*, 16th ed, Prentice Hall, 2015.
3. Leland Blank, Anthony Tarquin; *Engineering Economy*, 12th ed, McGraw-Hill, 2012.
4. William R Peterson, Ted G Eschenbach, *Cases in Engineering Economy*, 2nd Edition, Oxford University Press, 2009.

CMS-301 Principles of Management

Contact Hours:

Theory = **32**

Practical = **0**

Total = **32**

Credit Hours:

Theory = **2.0**

Practical = **0.0**

Total = **2.0**

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**UNDERSTAND** the basic knowledge of management principles.	Cognitive	2	11
2.	**APPLY** the management principles for process analysis and product design.	Cognitive	3	11
3.	**ANALYZE** a total system approach to planning and controlling the organizational resources.	Cognitive	4	11
4.	**DESCRIBE** different decision-making styles and **EXPLAIN** the qualities of leadership.	Cognitive	2	12

Course Contents:

Introduction to management and organizations; organizational vision, mission and strategies; organizational culture; socially responsible organizations; foundations of planning; planning tools and techniques; organizational structure and design; human resource management; foundations of behavior; leadership and motivation; understanding individual and group behavior; operations and value chain management; performance management; control of organizational process.

Recommended Texts:

1. S P Robbins, D A Decenzo, M Coulter, *Fundamentals of Management*, 8th Ed, Pearson, 2014.
2. R L Daft, *Management*, 12th Ed, South-West Cengage Learning, 2015.
3. J R Schermerhorn , D G Bachrach, *Management*, 13th Ed, John Wiley & Sons, 2016.