OFFICE OF THE REGISTRAR :: DIBRUGARH UNIVERSITY :: DIBRUGARH

Ref. No. DU/DR-A/130th AC/Modified Syllabus-B.Tech.(ME)/2024/1167 Date: 07.06.2024

NOTIFICATION

As recommended by the meeting of the Board of Studies in Mechanical Engineering held on 26.03.2024, the 130th Meeting of the Academic Council, Dibrugarh University held on 09.04.2024 vide ***Resolution No. 19*** has approved the ***modified syllabus of B. Tech. Programme in Mechanical Engineering for the batches 2021 onwards at DUIET with immediate effect.***

A copy of the modified syllabus is attached herewith.

Issued with due approval.

Alaganka 07/06/2024

Deputy Registrar (Academic)
Dibrugarh University

Copy for kind information and necessary action to:

1. The Hon'ble Vice-Chancellor, Dibrugarh University.
2. The Deans, Dibrugarh University.
3. The Registrar, Dibrugarh University.
4. The Director, Dibrugarh University Institute of Engineering & Technology, Dibrugarh University.
5. The Head, Department of Mechanical Engineering, DUIET, Dibrugarh University.
6. The Controller of Examinations i/c, Dibrugarh University.
7. The Joint / Deputy Controller of Examinations – 'B', 'C' & 'A', Dibrugarh University.
8. The Programmer, Dibrugarh University with a request to upload the notification in the Dibrugarh University Website.
9. File.

Alaganka 07/06/2024

Deputy Registrar (Academic)
Dibrugarh University

Scanned with CamScanner

Course Structure

of

Department of Mechanical Engineering

Dibrugarh University Institute of Engineering and Technology (DUIET)

Dibrugarh University

Dibrugarh

(For the batches 2021 onwards)

Semester III (Second year)

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours	Credits
				Lecture	Tutorial	Practical		
1	Basic Science Courses	BSC- 201	Physics II (Optics & Waves)	3	0	0	3	3
2	Basic Science Courses	BSC- 202	Mathematics III (PDE, Probability & Statistics)	3	0	0	3	3
3	Professional Core courses	PCC-ME 201	Materials Engineering	3	0	0	3	3
4	Engineering Science courses	ESC- 201	Basic Electronics Engineering	3	0	0	3	3
5	Engineering Science courses	ESC- 202	Engineering Mechanics	3	0	0	3	3
6	Professional Core courses	PCC- ME 202	Thermodynamics	3	1	0	4	4
7	Basic Science Courses	BSC-211	Physics-II Laboratory	0	0	1	2	1
8	Engineering Science courses	ESC-212	Engineering Mechanics Laboratory	0	0	1	2	1
9	Project/Seminar/Internship etc.	PROJECT-ME 213	Internship-I	0	0	3	6	3
10	Mandatory Course	MC-201	Indian knowledge system	0	0	0	0	0
							Total credits	**24**

Semester IV (Second year)

Sl. No.	Category	Code	Course Title	Credit structure			Total contact hours	Total Credits
				Lecture	Tutorial	Practical		
1	Professional Core courses	PCC-ME 203	Applied Thermodynamics	3	1	0	4	4
2	Professional Core courses	PCC-ME 204	Fluid Mechanics and Fluid Machines	4	1	0	5	5
3	Professional Core courses	PCC-ME 205	Strength of Materials	3	1	0	4	4
4	Engineering Science courses	PCC-ME 206	Kinematics & Theory of Machines	3	1	0	4	4
5	Humanities and Social Sciences including Management	HSMC-222	Technical English	0	0	2	4	2
6	Professional Core courses	PCC-ME-211	Strength of materials Laboratory	0	0	1	2	1
7	Professional core Courses	PCC-ME-212	Applied Thermo Laboratory	0	0	1	2	1
8	Professional core Courses	PCC-ME-213	Fluid Mechanics & Hydraulics Laboratory	0	0	1	2	1
							Total credits	**22**

Semester V (Third year)

Sl. No.	Category	Code	Course Title	Credit Structure			Total contact hours	Total Credits
				Lecture	Tutorial	Practical		
1	Professional Core courses	PCC- ME 301	Heat Transfer	3	1	0	4	4
2	Professional Core courses	PCC- ME 303	Manufacturing Processes	3	0	0	3	3
3	Professional Core courses	PCC- ME 304	Instrumentation & Control	3	0	0	3	3
4	Professional Elective courses	PEC- MEL-321/322	Elective-I	3	0	0	3	3
5	Humanities and Social Sciences including Management courses	HSMC-301	Managerial Economics	3	0	0	3	3
6	Professional Core courses	PCC- ME 311	Heat transfer Laboratory	0	0	1	2	1
7	Professional core courses	PCC-ME-312	Dynamics of Machinery Laboratory	0	0	1	2	1
8	Mandatory course	MC -301	Constitution Of India	0	0	0	0	0
9	Professional Core courses	PCC- ME 314	Workshop (Design)	0	0	1	2	1
10	Project/Seminar/Internship etc.	PROJECT-ME-315	Internship-II	0	0	4	8	4
						Total Credits		23

Semester VI (Third year)

Sl. No.	Category	Code	Course Title	Credit structure			Total contact hours	Total Credits
				Lecture	Tutorial	Practical		
1	Professional Core courses	PCC-ME 305	Manufacturing Technology	3	0	0	3	3
2	Professional Core courses	PCC-ME 306	Design of Machine Elements	3	1	0	4	4
3	Open Elective courses	OEC-301	Open Elective-I	3	0	0	3	3
4	Professional Elective courses	PEC-MEL-323/324	Elective-II	3	0	0	3	3
5	Humanities and Social Sciences including Management	HSMC-303	Management & Accountancy	3	0	0	3	3
6	Mini project	PCC-ME 315	Project-I	0	0	1	2	1
						Total	**credits**	**17**

Semester VII (Fourth year)

Sl. No.	Category	Code	Course Title	Credit Structure			Total contact hours	Total Credits
				Lecture	Tutorial	Practical		
1	Open Elective courses	OEC-401	Open Elective-II	3	0	0	3	3
2	Professional Elective courses	PEC-MEL-421/422	Elective-III	3	0	0	3	3
3	Professional Elective courses	PEC-MEL-423/424	Elective-IV	3	0	0	3	3
4	Open Elective courses	OEC-402	Open Elective-III	3	0	0	3	3
5	Project/Seminar/Internship etc.	PROJ-ME 411	Internship-III	0	0	4	8	4
6	Project	PROJ-ME 412	Project-III	0	0	4	8	4
							Total credits	**20**

Semester VIII (Fourth year)

Sl. No.	Category	Code	Course Title	Credit Structure			Total contact hours	Total Credits
				Lecture	Tutorial	Practical		
1	Professional Elective Courses	PEC-MEL-425/426/427	Elective V	3	0	0	3	3
2	Professional Elective Courses	PEC-MEL-428/429	Elective VI	3	0	0	3	3
3	Open Elective courses	OEC- 403	Open Elective-IV	3	0	0	3	3
4	Open Elective courses	OEC- 404	Open Elective-V	3	0	0	3	3
5	Project	PROJ-ME 413	Project-IV	0	0	4	8	4
6		ME-414	Composite viva voce	0	0	0	0	2
							Total credits	**18**

TOTAL CREDITS – 162
(including 38 for 1st year)

Professional Elective Courses

	Code	Subject	Semester	Credits
Elective-I	PEC-MEL-321	Numerical Methods and computation	V	3-0-0-3
	PEC-MEL-322	Finite Element Analysis	V	3-0-0-3
Elective-II	PEC-MEL-323	Power Plant Engineering	VI	3-0-0-3
	PEC-MEL-324	Computational Fluid Dynamics	VI	3-0-0-3
Elective-III	PEC-MEL-421	Composite Material	VII	3-0-0-3
	PEC-MEL-422	Gas Dynamics and jet propulsion	VII	3-0-0-3
Elective-IV	PEC-MEL-423	Refrigeration & Air conditioning	VII	3-0-0-3
	PEC-MEL-424	Microprocessor in Automation	VII	3-0-0-3
Elective-V	PEC-MEL-425	Design of Transmission system	VIII	3-0-0-3
	PEC-MEL-426	Total Quality Management	VIII	3-0-0-3
	PEC-MEL-427	Concurrent Engineering	VIII	3-0-0-3
Elective-VI	PEC-MEL-428	Automobile Engineering	VIII	3-0-0-3
	PEC-MEL-429	Additive Manufacturing	VIII	3-0-0-3
			Total Credits	18

Open Electives

	Code	Subject	Semester	Credits
Open Elective-I	OEC-301	IC Engine	VI	3-0-0-3
Open Elective-II	OEC-401	Industrial Engineering and Management	VII	3-0-0-3
Open Elective-III	OEC-402	Operation Research	VII	3-0-0-3
Open Elective-IV	OEC-403	Statistical Quality Control	VIII	3-0-0-3
Open Elective-V	OEC-404	Non-Conventional Energy	VIII	3-0-0-3
			Total Credits	15

(FOR BATCHES 2021 ONWARDS)

Semester – III (Second Year)

Course Code	Course Name	L-T-P-Credits
BSC-201	**Physics II (Optics and Waves)**	**3-0-0-3**

Contents

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion: Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

The propagation of light and geometric optics: Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Wave optics: .Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach- Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Lasers.: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Text/Reference Books

1. Ian G. Main, Oscillations and waves in physics.
2. H.J. Pain, The physics of vibrations and waves.
3. E. Hecht, Optics.
4..A. Ghatak, Optics.
5.O. Svelto, Principles of Lasers.

Course Code	Course Name	L-T-P-Credits
BSC-202	Mathematics III	3-0-0-3

Contents

Partial Differential Equations: Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Flows, vibrations and diffusions, second-order linear equations and their classification, Initial and boundary conditions (with an informal description of well-posed problems), D'Alembert'ssolution of the wave equation; Duhamel's principle for one dimensional wave equation. Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, Solutions with Bessel functions andLegendre functions. One dimensional diffusion equation and its solution by separation ofvariables.Boundary-value problems: Solution of boundary-value problems for various linear PDEs in various geometries.

Complex Analysis :Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, Singularities, Laurent's series; Residues, Cauchy-Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour. Evaluation of definite integral involving sine and cosine. Evaluation of certain improper integrals using the Bromwich contour.

Transform Calculus: Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials; Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier transforms, Fourier Integrals. Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform. Z-transform and Wavelet transforms: properties, methods, inverses and their applications.

Text Books

1.B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36th Edition, 2010.
2.H. K. Dass, *Advanced Engineering Mathematics*, S Chand and Company Pvt. Ltd, Reprint 2014.
3.M. D. Raisinghania, *Advanced Differential equations*, S Chand and Company Pvt. Ltd

Reference Books

1.G.B. Thomas and R.L. Finney, *Calculus and Analytic geometry*, 9thEdition, Pearson, Reprint, 2002.
2.ErwinKreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons, 2006.
3.W. E. Boyce and R. C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 9th Edition, Wiley India, 2009.
4.S. L. Ross, *Differential Equations*, 3rd Edition, Wiley India, 1984.
5.E. A. Coddington, *An Introduction to Ordinary Differential Equations*, Prentice Hall India, 1995.
6. E. L. Ince, *Ordinary Differential Equations*, Dover Publications, 1958.

7. J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, 7th Edition, Mc-Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, *A text book of Engineering Mathematics*, 9th Editions Laxmi Publications, 2014.

Course Code	Course Name	L-T-P-Credits
PCC-ME-201	**Material Engineering**	**3-0-0-3**

Contents:

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength, NDT.

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoidandmonotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium

Alloys

Text/Reference Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Course Code	Course Name	L-T-P-Credits
ESC-201	Basics Electronics Engineering	4-0-0-4

Contents

Semiconductor Devices and Applications:Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Operational amplifier and its applications:Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Timing Circuits and Oscillators:RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Digital Electronics Fundamentals : Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Text /Reference Books:

1.Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

Course Code	Course Name	L-T-P-Credits
ESC-202	Engineering Mechanics	3-0-0-3

Contents

Introduction to Engineering Mechanics covering:ForceSystems, Basic concepts, System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces

and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams.

Friction covering: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction.

Basic Structural Analysis covering: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Centroid and Centre of Gravity covering: Centroid of simple figures, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia , Theorems of moment of inertia, Moment of inertia of standard sections .

Review of particle dynamics: Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). curvilinear motion; Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular).

Introduction to Kinetics of Rigid Bodies:Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies.

Text/Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications.

Course Code	Course Name	L-T-P-Credits
PCC-ME-202	**Thermodynamics**	**3-1-0-4**

Contents

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work;

Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Text/Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals ofThermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.

Semester – IV (Second Year)

Course Code	Course Name	L-T-P-Credits
PCC-ME-203	Applied Thermodynamics	3-1-0-4

Contents

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Vapor power cycles Rankine cycle with superheat, reheat and regeneration,exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle,effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines

Jet propulsion: Turbojet, turboprop, turbofan, ramjet, thrust and propulsive efficiency; Rocket propulsion.

Direct energy conversion- thermoionic and thermoelectric converter, photovoltaic generators, MHD generators, fuel cells .

Text/Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals ofThermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4 Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd
5. H. I. H Saravanamuttoo, G. F. C. Rogers and H. Cohen, *Gas Turbine Theory,* 4th Ed., Pearson, 2003

Course Code	Course Name	L-T-P-Credits

PCC-ME-204	Fluid Mechanics And Fluid Machines	4-1-0-5

Contents:
Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass
density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through
circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness–Darcy-Weisbachequation,frictionfactor,Moody's diagram.

Need for dimensional analysis–methods of dimension analysis–Similitude–types of similitude Dimensionlessparameters–applicationofdimensionlessparameters–Modelanalysis.

Euler's equation–theory of Rotodynamic machines–various efficiencies–velocity components at entry and exit of the rotor, velocity triangles–Centrifugal pumps, working principle, work done by the impeller, performance curves–Cavitation in pumps-Reciprocating pump–working principle.

Classification of water turbines, heads and efficiencies, velocity triangles-Axial, radial and mixed flow turbines-Pelton wheel, Francis turbine and Kaplan turbines, working principles–draft tube-Specific speed, unit quantities, performance curves for turbines–governing of turbines.

Text/Reference Books:

1. Som, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education India 2011
2. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005.
3. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
4. Yahya S. M, Fans, Blower and Compressor, Tata McGraw Hill, 2005.
5. Shepherd D. G, Principles of Turbo Machinery, Macmillan, 1969.
6. Stepanoff A. J, Centrifugal and Axial Flow Pumps, John Wiley & Sons, 1991.
7. Rajput R. K, Fluid Mechanics and Hydraulic Machines, S. Chand & Co., 2006.
8. Subramanya, Fluid mechanics and hydraulic machines, 1e McGraw Hill Education India, 2010.

Course Code	Course Name	L-T-P-Credits
PCC-ME-205	Strength of Materials	3-1-0-4

Contents :

Deformation in solids- Hooke's law, Poisson's ratio; stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle for plane stress and plane strain. Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.Testing of materials with universal testing machine; testing of hardness and impact strength.

Text/Reference Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.

Course Code	Course Name	L-T-P-Credits
PCC-ME-206	Kinematics &Theory of Machines	3-1-0-4

Contents:

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics-

Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation

Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

Gyroscopic Couple, Fly wheel , Governor

Text/ Reference Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

Semester V (Third year)

Course Code	Course Name	L-T-P-Credits
PCC-ME-301	Heat Transfer	3-1-0-4

Contents :

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins-

Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Heat convection,basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Interaction of radiation with materials, definitions of radiative properties, Wien's displacement law, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method, radiation network analysis.
Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods
Boiling and Condensation heat transfer, Pool boiling curve
Introduction mass transfer, Similarity between heat and mass transfer

Text/Reference Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

Course Code	Course Name	L-T-P-Credits
PCC-ME-303	**Manufacturing Process**	**3-0-0-3**

Contents:

Conventional Manufacturing processes**:**Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Additive manufacturing: Rapid prototyping and rapid tooling

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish.

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

Text/Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

Course Code	Course Name	L-T-P-Credits
PCC-ME-304	**Instrumentation &Control**	**3-0-0-3**

Contents:

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram; control method
– P, PI, PID, when to choose what, tuning of controllers;System models, transfer function and system response, frequency response; Nyquist diagrams and their use.
Practical group based project utilizing above concepts.

Text/Reference Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

Course Code	Course Name	L-T-P-Credits
PEC-MEL-321	**Numerical Methods and computation**	**3-0-0-3**

Solution Of Equations And Eigen Value Problems:

Iterative method, Newton-Raphson method for single variable and for simultaneous equations with two variables. Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobi and Gauss-Seidel methods. Inverse of a matrix by Gauss-Jordan method. Eigen value of a matrix by Powerand Jacobi Methods.

Interpolation:

Newton's divided difference formulae, Lagrange's polynomials, Newton forwardand backward difference formulae, Stirling's and Bessel's Central difference formulae.

Numerical Differentiation and Integration:

Numerical differentiation with interpolation polynomials, Numerical integration byTrapezoidal and Simpson's (both 1/3 rd and 3/8 th) rules. Two and Three point Gaussianquadrature formula. Double integrals using Trapezoidal and Simpson's rule.

Initial Value Problems for Ordinary Differential Equations:

Single Step Methods - Taylor Series, Euler and Modified Euler, Runge-Kutta method of orderfour for first and second order differential equations. Multistep Methods - Milne and Adam's Bashforth predictor and corrector methods.

Texts/References:

1. T. VeeraRajan and T. Ramachandran, Numerical Method, Tata MCgraw hill (2008).
2. C. Chapra, Numerical Methods for Engineers, Tata MCgraw hill, 2ndrevised edition edition (1988).
3. E. Balaguruswamy, Numerical Methods, Tata MCgraw hill4th Edition(2017).
4. Sastry, S.S., Introductory Methods of Numerical Analysis, Printice Hall of India, Fifth edition (2012).

Course Code	Course Name	L-T-P-Credits
PEC-MEL-322	**Finite Element Analysis**	**3-0-0-3**

Contents:

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Natural coordinate systems, iso-parametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Text/Reference Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
4. Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Course Code	Course Name	L-T-P-Credits
HSMC-301	**Managerial Economics**	**3-0-0-3**

Contents:

Nature, scope and methods of managerial economics.
Managerial Economic Concepts – Incremental concept; Opportunity Cost concept; Equi-marginal concept; discounting concept; Risk & Uncertainty.
Law of Diminishing Marginal Utility.
Demand Analysis – Meaning & type; Law of Demand – features; Exceptions; Market Demand Schedule & Curve; Elasticity of Demand – Price elasticity, cross elasticity& income elasticity.
Indifference Curve approach and its properties.
Supply – its law, elasticity & curve.
Types of markets; Pricing under various market conditions – Perfect competition, imperfect competition & monopolistic competition.
Profit & Profit measurement.
Inflation – meaning; Demand-pull, cost-push inflation; Inflationary gap; Causes and steps to control inflation.
National Income – Concepts & methods of measurement; Difficulties in measuring national income.

Text Book /References

1. Managerial Economics by William F. Samuelson and Stephen G. Marks
2. Managerial Economics: Theory, Applications, and Cases by W. Bruce Allen, Keith Weigelt, Neil Doherty and Edwin Mansfield
3. Managerial Economics by Christopher Thomas and S. Charles Maurice

Semester VI (Third year)

Course Code	Course Name	L-T-P-Credits
PCC-ME-305	Manufacturing Technology	4-0-0-4

Contents

Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and work piece quality.

Lathes, capstan & turret lathe, drilling and boring machine -Classification - principles of working components, work holding & tool holding devices.

Shaper, planner &slotter, machines - Classification - principles of working components, work holding & tool holding devices.

Milling, hobbing, broaching & grinding machines - Classification - principles of working components, work holding & tool holding devices.

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools –configuration, design of die and punch; principles of forging die design.

Text/Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol II , Dhanpat Rai & Sons, 1992.
3. Choudhry, S.K.H., Elements of Work Shop Technology, VoL II, Media Promoters & Publishers, 1994.
4. Production Technology by HMT, Tata McGraw-Hill, 2002.
5. Manufacturing Technology, Vol. 1, 2, 3, P N Rao, TMH

Course Code	Course Name	L-T-P-Credits
PCC-ME-306	Design of Machine Elements	3-1-0-4

Contents

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure),

Design of shafts under static and fatigue loadings, fatigue strength and the S-N diagram;

Analysis and design of sliding and rolling contact bearings, Design of transmission elements: spur, helical; belt and chain drives, Design of springs: helical compression, tension, torsional and leaf springs,

Design of joints: pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings, Analysis of clutches and brakes.

Text/Reference Books:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5..R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998
6. B.V. Bhandari, Machine design

Course Code	Course Name	L-T-P-Credits
OEC-301	Internal Combustion Engines	3-0-0-3

Contents:

Introduction to heat engines: classification of engines, review of basic thermodynamic principles: review of air standardideal cycles; 2 stroke and 4 stroke engines, CI & SI engine working principles, valve timing diagram.

Fuel-air cycles, actual cycles, Combustion in SI andCI engines, Combustion stages, Combustion chambers and Abnormal combustion

Fuel supply systems in SI and CI engines, carburettors, Port fuel injection, Direct injection and Common rail injection. Ignition system, Lubrication system and Cooling system.

Testing and performance of IC engines, Engine emissions and control. Advanced IC Engine concepts.

Text/Reference Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.

2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
4. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", TheGoodheart, Wilcox Co. Inc., Illinois, 1996.

Course Code	Course Name	L-T-P-Credits
PEC-MEL 323	**Power Plant Engineering**	**3-0-0-3**

Contents:

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text/Reference Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

Course Code	Course Name	L-T-P-Credits
PEC-MEL 324	**Computational Fluid Dynamics**	**3-0-0-3**

Contents:

Governing equations of fluid dynamics:

Substantial derivative, Divergence of velocity, continuity, momentum, energy equations.

Physical boundary conditions. Forms of governing equation suited for CFD- shock fitting and shock capturing approach. Mathematical behavior of Partial difference equations- hyperbolic, parabolic and elliptic equations.

Discritization:

Finite difference method- Central, Forward, Backward difference for a uniform grid – Central difference expressions for a non-uniform grid - Numerical error - Accuracy of solution. Explicit and implicit approach.Errors and Stability analysis.

Grid Transformation:

Direwct and In-direct transformation, Metric and Jacobians. Stretched grids, boundary fitted grids. Structured and unstructured grids.

Heat transfer:

Conduction Heat Transfer- Applications of Heat conduction - Steady and Unsteady conductions –numerical solutions of one and two dimensional steady and unsteady state problems.

Some simple CFD techniques:

Numerical solution of the incompressible Navier-Stokes equations: Stream function-vorticity formulation; Primitive variable formulation; Pressure correction techniques like SIMPLE, SIMPLER.

Texts/References:

1. Muralidhar, K., and Sundararajan, T., “Computational Fluid flow and Heat Transfer", Narosa Publishing House.
2. Ghoshdasdidar, P.S., “Computer simulation of flow and heat transfer", Tata McGraw – Hill, New Delhi.
3. Anderson, D. A., Tannehill, J. L, and Pletcher, R.H., “Computational fluid mechanics and Heat Transfer", Hemisphere Publishing Corporation.
4. John David Anderson, "Computational Fluid Dynamics: The Basics with Applications", McGraw Hill, New York

Course Code	Course Name	L-T-P-Credits
HSMC 303	Management and Accountancy	3-1-0-4

Contents:

Introduction to Management Challenges for Engineers: Introduction, definitions, employment trend in industries, STEM professionals as effective technical contributors, management and leadership, becoming effective manager in the new millennium.

Planning: Introduction, types of planning, who should do planning, inexact nature of strategic planning, planning roles for engineering managers, tools for planning, planning activities, some specific advice on planning.

Organizing: Introduction, definitions, activities of organizing, organizing one's own workplace for productivity, developing organizational structure, enhancing corporate performance by organizing examples, concurrent engineering teams, delegating, establishing working relationships, informal organizations.

Leading: Introduction, styles of leadership, leading activities, deciding, communicating, motivating, selecting engineering employees, developing people, special topics on leading.

Controlling: Introduction, setting performance standards, benchmarking, measuring performance, evaluating performance, correcting performance, means of control, general comments, control of management time, control of personnel, control of business relationships, control of projects, control of quality, control of knowledge.

Cost accounting for engineering managers: Introduction, product or service costing, application of ABC in industry, risk analysis and cost estimation under uncertainty, miscellaneous topics.

Financial Accounting and Management for Engineering Managers: Introduction, financial marketing principles, key financial statements, fundamentals of financial analysis, balanced score card, capital formation, capital assets valuation

Accounting : Principles, Concepts and conventions, Double entry system of Accounting, Introduction of basis books of accounts of sole proprietary concern, Control accounts for debtors l and creditors, closing of books of accounts and preparation of Trail Balance. Final Accounts : Trading, Profit and Loss Accounts and Balances Sheet of Sole Proprietary concern with normal closing entries, Introduction to Manufacturing accounts of partnership firms, Limited Company. Financial Management: Meaning and role. Ratio Analysis : Meaning advantage, limitations, types of ratios and their usefulness.

Text/Reference Books:

1. Management Accounting: Principles & Practice by- M.A. Sahaf
2. Real Numbers: Management Accounting in a Lean Organization by- Jean E. Cunningham and Orest Fiume

3. “Best” Management Accounting: Successful Business – Decision Making & Budgeting by- Deepak Gupta
4. Advanced Management Accounting by- Robert Kaplan and Anthony A. Atkinson

Semester VII (Fourth year)

Course Code	Course Name	L-T-P-Credits
OEC-401	Industrial Engineering and Management	3-0-0-3

Contents

Introduction to industrial engineering, Production Planning and Control. Value analysis and value engineering,

Plant location and layout.Job, batch, and continuous production methods.

Work study, Method study and work Measurement.
Principle of motion Economy, Therbligs, Job rating and job evaluation,

Inventory control, Classification of inventory, inventory cost, Economic order quantity, reorder point, Break-even analysis.

Replacement analysis, Replacement of items that fails, Replacement of items that Deteriorate.

Texts/References:

1. S L Narasimhan, D W McLeavey, P J Billington, Production, Planning and Inventory Control, Prentice Hall,
2. J L Riggs, Production Systems: Planning, Analysis and Control, Wiley.
3. A Muhlemann, J Oakland and K Lockyer, Productions and Operations Management, Macmillan.
4. H A Taha, Operations Research - An Introduction, Prentice Hall of India.
5. J K Sharma, Operations Research, Macmillan
6. P Kumar , Industrial Engineering and Management , Pearson India.

Course Code	Course Name	L-T-P-Credits
PEC-MEL-421	Composite Material	3-0-0-3

Contents:

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield

criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

Text/Reference Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

Course Code	Course Name	L-T-P-Credits
PEC-MEL-422	Gas Dynamics and Jet Propulsion	3-0-0-3

Contents:

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

Text/Reference Books:

1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing,

2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Course Code	Course Name	L-T-P-Credits
PCC-MEL-423	**Refrigeration and Air Conditioning**	**3-0-0-3**

Contents:

Introduction to refrigeration systems, classification of refrigeration systems, review of basic thermodynamic principles: 1^{st}&2^{nd} law of thermodynamics, Heat pump Refrigerator and Heat engine difference, Joule Thomson coefficient, Tonne Refrigeration

Carnot cycle using gas and vapour as refrigerant, Vapor compression refrigeration cycle (VCR), effect of operating parameters on VCR cycle performance, Multipressurerefrigeration systems

Vapour absorbtion refrigeration system and simple analysis thereon, gas cycle refrigeration systems; simple, bootstrap, regenerative

Properties of moist air: psyrometric properties, introduction to psychrometry chart, air washer, basicpsychrometry processes: process involving heating/cooling, humidification/dehumidification, total heat process, mixing of air streams, cooling load calculations,summer and winter air conditioning,introduction to comfort chart

Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues - System components: Compressors, Condensers, Expansion devices and Evaporators -Performance matching of components of refrigeration systems

Text/Reference Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

Course Code	Course Name	L-T-P-Credits
PEC-MEL-424	**Microprocessors in Automation**	**3-0-0-3**

Contents:

Number Systems, codes, digital electronics: Logic Gates, combinationalcircuits design,Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features,

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm.

Text/Reference Books:

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.
3. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
4. Digital Control Systems, Benjamin C.Kuo, Oxford University Press (2/e, Indian Edition, 2007).
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

Course Code	Course Name	L-T-P-Credits
OEC-402	**Operation Research**	**3-0-0-3**

Contents:

Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Case Studies of LPP, Graphical Methods to Solve Linear Programming Problems, Applications, Advantages, Limitations

Graphical Analysis of Linear Programming Problems: Introduction, Graphical Analysis, Some Basic Definitions, Graphical Methods to Solve LPP, Some Exceptional Cases, Important Geometric Properties of LPP

Simplex Method: Introduction , Standard Form of LPP, Fundamental theorem of LPP, Solution of LPP – Simplex Method, The Simplex Algorithm, Penalty Cost Method or Big M-method, Two Phase Method, Solved Problems on Minimisation

Duality in Linear Programming Problem: Introduction, Importance of Duality Concepts, Formulation of Dual Problem, Economic Interpretation of Duality, Sensitivity Analysis

Transportation Problem: Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), the Initial Basic Feasible Solution, Moving Towards Optimality

Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Routing Problem, Travelling Salesman Problem

Project Scheduling and PERT-CPM: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT

Texts/References:

1. A Muhlemann, J Oakland and K Lockyer, Productions and Operations Management, Macmillan.
2. H A Taha, Operations Research - An Introduction, Prentice Hall of India.
3.J K Sharma, Operations Research, Macmillan
4. P Kumar , Industrial Engineering and Management , Pearson India.

Semester VIII (Fourth year)

Course Code	Course Name	L-T-P-Credits
PEC-MEL-425	**Design of Transmission Systems**	**3-0-0-3**

Contents:

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid

couplings, Torque converters for automotive applications.

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text/Refernce Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Course Code	Course Name	L-T-P-Credits
PEC-MEL 426	Total Quality Management	3-0-0-3

Contents:

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Text Books:

1. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Course Code	Course Name	L-T-P-Credits
PEC-MEL-427	Energy Conservation and Management	3-0-0-3

Contents:

Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.
Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Text/Reference Books:

1. Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
4. Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

Course Code	Course Name	L-T-P-Credits
PEC-MEL-428	**Automobile Engineering**	**3-0-0-3**

Contents:

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Text/Reference books:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

Course Code	Course Name	L-T-P-Credits	Semester
PCC-MEL-429	**Additive manufacturing**	**3-0-0-3**	**5**

Contents:

Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.
Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS),

Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transfer redarc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM),Metal inert gas additive manufacturing (MIGAM).
Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process

Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.

Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials. Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.

Thermal model to predict size of deposition such as width and height of deposition, Finite element simulation of additive process.

Text/Reference Books:

1. Gibson, I., Rosen, D.W., & Stucker, B. (2010). Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing. Springer.
2. Chua, C.K., Leong, K.F., & Lim, C.S. (2010). Rapid Prototyping: Principles and Applications (3rd ed.). World Scientific Publishers.
3. Chua, C.K., Leong, K.F., & Lim, C.S. (2014). 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping. World Scientific Publishers.
4. Gebhardt, A. (2003). Rapid Prototyping. Hanser Gardener Publications.
5. Liou, L.W., &Liou, F.W. (2007). Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development. CRC Press.
6. Kamrani, A.K., & Nasr, E.A. (2006). Rapid Prototyping: Theory and Practice. Springer.
7. Mahamood, R.M. (2018). Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes. Springer International Publishing AG.
8. Toyserkani, E., Khajepour, A., & Corbin, S.F. (2004). Laser Cladding. CRC Press.

Course Code	Course Name	L-T-P-Credits
OEC-403	**Statistical Quality control**	**3-0-0-3**

Contents

The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, quality improvement).

Control Charts For Attributes:- Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit. Numerical problems

Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems

Properties of O-C curves, consumer product relationship.

Sampling plan design, average outgoing quality, Average sample number, average total Inspection, sequential sampling plan.

Texts/References:

1. A Muhlemann, J Oakland and K Lockyer, Productions and Operations Management, Macmillan.
2. H A Taha, Operations Research - An Introduction, Prentice Hall of India.
3. J K Sharma, Operations Research, Macmillan
4. P Kumar , Industrial Engineering and Management , Pearson India.

Course Code	Course Name	L-T-P-Credits
OEC-404	Non conventional energy resources	3-0-0-3

Contents:

The fundamentals of energy, energy scenario and status of energy scenario of non conventional energy resources relating to India and world.

Basics of solar energy, solar photovoltaic s, application of solar thermal systems such as solar flat plate collectors and concentrators for heating needs, developing skills to determine the efficiency of the systems.

Resources of biomass energy, learning the concepts of conversion of biomass energy to useful energy sources through, gasification, biogas, liquefaction & ethanol production and also developing skills to solve real life problems.

The origin and distribution of geothermal energy, types of resources, analysis of geothermal resources and environmental impact of the systems.

Tidal, ocean thermal and wave energy technologies, their impact on environment.

Micro and Small hydro plants, the advantages and disadvantages of big dams and small hydro schemes, concept on water turbine, turbine classification, characteristics and selection of turbine & generators.

The origin of winds and wind turbines, wind turbine aerodynamics, classification, wind energy conversion system and their efficiencies, the environmental impacts of wind turbines

Texts and References

(1) B.H Khan, Non Conventional Energy Resources, Tata McGraw Hill, 2nd Edition, New Delhi, India2016.
(2) S. Hasan Saeed & D.K. Sharma, Non Conventional Energy Resources, S.K. Kataria& Sons, New Delhi , 4th Edition, 2017.
(3) Sobh N. Singh, Non Conventional Energy Resources, Pearson, 3rd Edition, New Delhi, India, 2018.
(4) R. D. Begamudre, Energy Conversion systems, New Age International Publishers, New Delhi, India , 2000.
(5) B.C. Smith, Energy Management Principles, Pergamon Press, 1981.
(6) J.W, Twiddel, Energy Resources, ELBS/E and F.N. Spon UK, 1986.