APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree

Semesters III & IV

2016

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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BRANCH: *Mechanical Engineering*

SEMESTER - 3

Course Code	***Course Name***	***L-T-P***	***Credits***	***Exam Slot***
MA201	Linear Algebra & Complex Analysis	3-1-0	4	A
ME201	Mechanics of Solids	3-1-0	4	B
ME203	Mechanics of Fluids	3-1-0	4	C
ME205	Thermodynamics	3-1-0	4	D
ME210	Metallurgy and Materials Engineering	3-0-0	3	E
HS200/ HS210	Business Economics/Life Skills	3-0-0/ 2-0-2	3	F
ME231	Computer Aided Machine Drawing Lab	0-0-3	1	S
CE230	Material Testing Lab	0-0-3	1	T

Total Credits = 24 Hours: 28/29

Cumulative Credits= 71

SEMESTER - 4

Course Code	***Course Name***	***L-T-P***	***Credits***	***Exam Slot***
MA202	Probability Distributions, Transforms and Numerical Methods	3-1-0	4	A
ME202	Advanced Mechanics of Solids	3-1-0	4	B
ME204	Thermal Engineering	3-1-0	4	C
ME206	Fluid Machinery	2-1-0	3	D
ME220	Manufacturing Technology	3-0-0	3	E
HS210/ HS200	Life Skills/Business Economics	2-0-2/ 3-0-0	3	F
ME232	Thermal Engineering Lab	0-0-3	1	S
ME230	Fluid Mechanics & Machines Lab	0-0-3	1	T

Total Credits = 23 Hours 28/27

Cumulative Credits= 94

Course No.	Course Name	L-T-P - Credits	Year of Introduction
MA201	LINEAR ALGEBRA AND COMPLEX ANALYSIS	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

COURSE OBJECTIVES

- To equip the students with methods of solving a general system of linear equations.
- To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering.
- To understand the basic theory of functions of a complex variable and conformal Transformations**.**

Syllabus

Analyticity of complex functions-Complex differentiation-Conformal mappings-Complex integration-System of linear equations-Eigen value problem

Expected outcome .

At the end of the course students will be able to
(i) solve any given system of linear equations
(ii) find the Eigen values of a matrix and how to diagonalize a matrix
(iii) identify analytic functions and Harmonic functions.
(iv)evaluate real definite Integrals as application of Residue Theorem
(v) identify conformal mappings(vi) find regions that are mapped under certain Transformations

Text Book:

Erwin Kreyszig: Advanced Engineering Mathematics, 10th ed. Wiley

References:

1.Dennis g Zill&Patric D Shanahan-A first Course in Complex Analysis with Applications-Jones&Bartlet Publishers
2.B. S. Grewal. Higher Engineering Mathematics, Khanna Publishers, New Delhi.
3.Lipschutz, Linear Algebra,3e **(** Schaums **Series)**McGraw Hill Education India 2005
4.Complex variables introduction and applications-second edition-Mark.J.Owitz-Cambridge Publication

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Complex differentiation Text 1[13.3,13.4] Limit, continuity and derivative of complex functions	3	
	Analytic Functions	2	
	Cauchy–Riemann Equation(Proof of sufficient condition of analyticity & C R Equations in polar form not required)-Laplace's Equation	2	
	Harmonic functions, Harmonic Conjugate	2	15%
II	Conformal mapping: Text 1[17.1-17.4] Geometry of Analytic functions Conformal Mapping,	1	
	Mapping $w = z^2$ conformality of $w = e^z$.	2	15%

	The mapping $w = z + \frac{1}{z}$ Properties of $w = \frac{1}{z}$ Circles and straight lines, extended complex plane, fixed points Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes Conformal mapping by $w = \sin z$ & $w = \cos z$ (Assignment: Application of analytic functions in Engineering)	1 3 3	
FIRST INTERNAL EXAMINATION			
III	Complex Integration. Text 1[14.1-14.4] [15.4&16.1] Definition Complex Line Integrals, First Evaluation Method, Second Evaluation Method Cauchy's Integral Theorem(without proof), Independence of path(without proof), Cauchy's Integral Theorem for Multiply Connected Domains (without proof) Cauchy's Integral Formula- Derivatives of Analytic Functions(without proof)Application of derivative of Analytical Functions Taylor and Maclaurin series(without proof), Power series as Taylor series, Practical methods(without proof) Laurent's series (without proof)	2 2 2 2 2	15%
IV	Residue Integration Text 1 [16.2-16.4] Singularities, Zeros, Poles, Essential singularity, Zeros of analytic functions Residue Integration Method, Formulas for Residues, Several singularities inside the contour Residue Theorem. Evaluation of Real Integrals (i) Integrals of rational functions of $\sin\theta$ and $\cos\theta$ (ii)Integrals of the type $\int_{-\infty}^{\infty} f(x)dx$ (Type I, Integrals from 0 to ∞) (Assignment : Application of Complex integration in Engineering)	2 4 3	15%
SECOND INTERNAL EXAMINATION			
V	Linear system of Equations Text 1(7.3-7.5) Linear systems of Equations, Coefficient Matrix, Augmented Matrix Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it.	1 5	20%

	Linear independence-rank of a matrix Vector Space-Dimension-basis-vector space$\mathbf{R^3}$ Solution of linear systems, Fundamental theorem of non-homogeneous linear systems(Without proof)-Homogeneous linear systems (Theory only	2 1	
VI	Matrix Eigen value Problem Text 1.(8.1,8.3 &8.4) Determination of Eigen values and Eigen vectors-Eigen space Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof) Basis of Eigen vectors- Similar matrices Diagonalization of a matrix-Quadratic forms- Principal axis theorem(without proof) (Assignment-Some applications of Eigen values(8.2))	3 2 4	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME201	MECHANICS OF SOLIDS	3-1-0-4	2016

Prerequisite: nil

Course Objectives:

1. To acquaint with the basic concepts of stress and deformation in solids.
2. To practice the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

Syllabus

Analysis of deformable bodies : stress, strain, material behaviour, deformation in axially loaded bars, biaxial and triaxial deformation. Torsion of elastic circular members, design of shafts. Axial force, shear force and bending moment in beams. Stresses in beams: flexure and shear stress formulae, design of beams. Deflection of beams. Transformation equations for plane state of stress and strain, principal planes and stresses, Mohr's circle. Compound stresses: combined axial, flexural and shear loads – eccentric loading. Buckling: Euler's theory and Rankine's formula for columns.

Expected outcomes: At the end of the course students will be able to

1. Understand basic concepts of stress and strain in solids.
2. Determine the stresses in simple structural members such as shafts, beams, columns etc. and apply these results in simple design problems.
3. Determine principal planes and stresses, and apply the results to combined loading case.

Text Books:

1. Rattan, Strength of Materials, 2e McGraw Hill Education India, 2011
2. S.Jose, Sudhi Mary Kurian, Mechanics of Solids, Pentagon, 2015

References Books:

1. S. H. Crandal, N. C. Dhal, T. J. Lardner, An introduction to the Mechanics of Solids, McGraw Hill, 1999
2. R. C. Hibbeler, Mechanics of Materials, Pearson Education,2008
3. I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2006
4. James M.Gere, Stephen Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, New Delhi,2012
5. F. Beer, E. R. Johnston, J. T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2011
6. A. Pytel, F. L. Singer, Strength of Materials, Harper & Row Publishers, New York,1998
7. E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, Pearson Education, 2012
8. R. K. Bansal, Mechanics of solids, Laxmi Publications, 2004
9. P. N. Singh, P. K. Jha, Elementary Mechanics of Solids, Wiley Eastern Limited, 2012

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Introduction to analysis of deformable bodies – internal forces – method of sections – assumptions and limitations. Stress – stresses due to normal, shear and bearing loads – strength design of simple members. Definition of linear and shear strains.	3	15%
	Material behavior – uniaxial tension test – stress-strain diagrams concepts of orthotropy, anisotropy and inelastic behavior – Hooke's law for linearly elastic isotropic material under axial and shear deformation	3	
	Deformation in axially loaded bars – thermal effects – statically indeterminate problems – principle of superposition - elastic strain energy for uniaxial stress.	4	
II	Definition of stress and strain at a point (introduction to stress and strain tensors and its components only) – Poisson's ratio – biaxial and triaxial deformations – Bulk modulus - Relations between elastic	4	15%
	Torsion: Shafts - torsion theory of elastic circular bars – assumptions and limitations – polar modulus - torsional rigidity – economic cross-sections – statically indeterminate problems – shaft design for torsional load.	4	
FIRST INTERNAL EXAM			
III	Beams- classification - diagrammatic conventions for supports and loading - axial force, shear force and bending moment in a beam	2	15%
	Shear force and bending moment diagrams by direct approach	3	
	Differential equations between load, shear force and bending moment. Shear force and bending moment diagrams by summation approach – elastic curve – point of inflection.	5	
IV	Stresses in beams: Pure bending – flexure formula for beams assumptions and limitations – section modulus - flexural rigidity - economic sections – beam of uniform strength.	4	15%
	Shearing stress formula for beams – assumptions and limitations – design for flexure and shear.	4	
SECOND INTERNAL EXAM			
V	Deflection of beams: Moment-curvature relation – assumptions and limitations - double integration method – Macaulay's method - superposition techniques – moment area method and conjugate beam ideas for simple cases.	6	20%
	Transformation of stress and strains: Plane state of stress - equations of transformation - principal planes and stresses.	4	
VI	Mohr's circles of stress – plane state of strain – analogy between stress and strain transformation – strain rosettes	3	20%
	Compound stresses: Combined axial, flexural and shear loads – eccentric loading under tension/compression - combined bending and twisting loads.	4	

	Theory of columns: Buckling theory –Euler's formula for long columns – assumptions and limitations – effect of end conditions - slenderness ratio – Rankin's formula for intermediate columns.	3	
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME203	MECHANICS OF FLUIDS	3-1-0-4	2016

Prerequisite: nil

Course Objectives:

1. To study the mechanics of fluid motion.
2. To establish fundamental knowledge of basic fluid mechanics and address specific topics relevant to simple applications involving fluids
3. To familiarize students with the relevance of fluid dynamics to many engineering systems

Syllabus

Fluid Properties, Kinematics of fluid flow, Fluid Statics, Dynamics of fluid flow, Flow through pipes, Concept of Boundary Layer, Dimensional Analysis and Hydraulic similitude

Expected outcome: At the end of the course students will be able to

1. Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations
2. Become conversant with the concepts of flow measurements and flow through pipes
3. Apply the momentum and energy equations to fluid flow problems.
4. Evaluate head loss in pipes and conduits.
5. Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity

Text Books:

1. Balachandran.P, Engineering Fluid Mechanics, PHI,2012
2. A S Saleem, Fluid Mechanics, Fathima Books,2016

References Books:

1. Cengel, Fluid Mechanics, McGraw Hill Education India 2014
2. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005
3. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002
4. Streeter V. L., E. B. Wylie and K. W. Bedford, Fluid Mechanics, Tata McGraw Hill, Delhi, 2010.
5. Joseph Karz, Introductory Fluid Mechanics, Cambridge University press,2010
6. Fox R. W. and A. T. McDonald, Introduction to Fluid dynamics, 5/e, John Wiley and Sons, 2009.
7. Shames I. H, Mechanics of Fluids, McGraw Hill, 1992.
8. White F.M., Fluid Mechanics, 6/e, Tata McGraw Hill, 2008

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Introduction: Fluids and continuum, Physical properties of fluids, density, specific weight, vapour pressure, Newton's law of viscosity. Ideal and real fluids, Newtonian and non-Newtonian fluids. Fluid Statics- Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, center of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations, measurement of pressure.	8	15%
II	Kinematics of fluid flow: Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations,	8	15%
FIRST INTERNAL EXAM			
III	Dynamics of Fluid flow: Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy, Equations of fluid dynamics: Differential equations of mass, energy and momentum (Euler's equation), Navier-Stokes equations (without proof) in rectangular and cylindrical co-ordinates, Bernoulli's equation and its applications: Venturi and Orifice meters, Notches and Weirs (description only for notches and weirs). Hydraulic coefficients, Velocity measurements: Pitot tube and Pitot-static tube.	10	15%
IV	Pipe Flow: Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, shear stress and velocity distribution in a pipe, law of fluid friction, head loss due to friction, Hagen Poiseuille equation. Turbulent flow: Darcy- Weisbach equation, Chezy's equation Moody's chart, Major and minor energy losses, hydraulic gradient and total energy line, flow through long pipes, pipes in series, pipes in parallel, equivalent pipe, siphon, transmission of power through pipes, efficiency of transmission, Water hammer, Cavitation.	12	15%
SECOND INTERNAL EXAM			
V	Concept of Boundary Layer : Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub layer, velocity profile, Von- Karman momentum integral equations for the boundary layers, calculation of drag, separation of boundary and methods of control.	10	20%

VI	Dimensional Analysis and Hydraulic similitude: Dimensional analysis, Buckingham's theorem, important dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynold, Weber, Cauchy and Mach laws- Applications and limitations of model testing, simple problems only	8	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME205	THERMODYNAMICS	3-1-0-4	2016

Prerequisite: nil

Course Objectives:

1. To understand basic thermodynamic principles and laws
2. To develop the skills to analyze and design thermodynamic systems

Syllabus

Basic concepts, zeroth law of thermodynamics and thermometry, energy, first law of thermodynamics, second law of thermodynamics, entropy, irreversibility and availability, third law of thermodynamics pure substances, equations of state, properties of gas mixtures, Introduction to ideal binary solutions, general thermodynamic relationships, combustion thermodynamics

Expected outcome: At the end of the course the students will be able to

1. Understand the laws of thermodynamics and their significance
2. Apply the principles of thermodynamics for the analysis of thermal systems

Text Books

1. P.K.Nag, Engineering Thermodynamics, McGraw Hill,2013
2. E.Rathakrishnan Fundamentals of Engineering Thermodynamics, PHI,2005

References Books:

1 Y. A. Cengel and M. A.Boles,Thermodynamics an Engineering Approach,McGraw Hill, 2011

2 G.VanWylen, R.Sonntag and C.Borgnakke, Fundamentals of Classical Thermodynamics, John Wiley & Sons,2012

3. Holman J.P, Thermodynamics, McGraw Hill, 2004
4. M.Achuthan, Engineering Thermodynamics, PHI,2004

Steam Tables/Data book

5. R.S.Khurmi, Steam table with Mollier chart, S.Chand,2008

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Role of Thermodynamics in Engineering and Science -- Applications of Thermodynamics Basic Concepts - Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function. (Review only- self study) Zeroth Law of Thermodynamics, Measurement of Temperature- Thermometry, reference Points, Temperature Scales, Ideal gas temperature scale, Comparison of thermometers-Gas Thermometers, Thermocouple, Resistance thermometer Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity.	7	15%
II	Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE, Transient flow –Filling and Emptying Process. (Problems), Limitations of the First Law.	8	15%
FIRST INTERNAL EXAM			
III	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump - Performance factors, Kelvin-Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, Corollaries of second law, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Causes of Entropy Change, Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation in open and closed system, Entropy and Disorder, Reversible adiabatic process- isentropic process	10	15%
IV	Available Energy, Availability and Irreversibility- Useful work, Dead state, Availability function, Availability and irreversibility in open and closed systems - Gouy-Stodola theorem , Third law of thermodynamics. Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface, Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property calculations using steam tables.	10	15%
SECOND INTERNAL EXAM			

V	The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances- Vander Waals Equation of State, Berthelot, Dieterici, and Redlich-Kwong equations of state , Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law -Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy, Introduction to real gas mixtures- Kay's rule. *Introduction to ideal binary solutions, Definition of solution, ideal binary solutions and their characteristics, Deviation from ideality, Raoult's Law, Phase diagram, Lever rule(*in this section numerical problems not)	11	20%
VI	General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve. #Introduction to thermodynamics of chemically reacting systems, Combustion, Thermochemistry – Theoretical and Actual combustion processes- Definition and significance of equivalence ratio, enthalpy of formation , enthalpy of combustion and heating value (#in this section numerical problems not included)	10	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
Approved steam tables permitted
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME210	METALLURGY AND MATERIALS ENGINEERING	3-0-0-3	2016

Prerequisite: nil

Course Objectives:

1. To provide fundamental science relevant to materials
2. To provide physical concepts of atomic radius, atomic structure, chemical bonds, crystalline and non-crystalline materials and defects of crystal structures, grain size, strengthening mechanisms, heat treatment of metals with mechanical properties and changes in structure
3. To enable students to be more aware of the behavior of materials in engineering applications and select the materials for various engineering applications.
4. To understand the causes behind metal failure and deformation
5. To determine properties of unknown materials and develop an awareness to apply this knowledge in material design.

Syllabus:-Chemical bonds – crystallography- imperfections- crystallization- diffusion- phase diagrams-heat treatment – strengthening mechanisms- hot and cold working – alloying- ferrous and non ferrous alloys- fatigue-creep- basics, need, properties and applications of modern engineering materials.

Expected outcome: At the end of the course students will be able to

1. Identify the crystal structures of metallic materials.
2. Analyze the binary phase diagrams of alloys Fe-Fe_3C, etc.
3. Correlate the microstructure with properties, processing and performance of metals.
4. Recognize the failure of metals with structural change.
5. Select materials for design and construction.
6. Apply core concepts in materials science to solve engineering problems.

Text Books

1. Raghavan V, Material Science and Engineering, Prentice Hall,2004
2. Jose S and Mathew E V, Metallurgy and Materials Science, Pentagon, 2011

Reference

1 Anderson J.C. *et.al*., Material Science for Engineers,Chapman and Hall,1990
2 Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964
3. Reed Hill E. Robert, Physical metallurgy principles, 4th Edn. Cengage Learning,2009
4. Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill,2009
5. Callister William. D., Material Science and Engineering, John Wiley,2014
6. Dieter George E, Mechanical Metallurgy,Tata McGraw Hill,1976
7. Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998
8. Myers Marc and Krishna Kumar Chawla, Mechanical behavior of materials, Cambridge University press,2008
9. Van Vlack -Elements of Material Science - Addison Wesley,1989
10. http://nptel.ac.in/courses/113106032/1
11. http://www.myopencourses.com/subject/principles-of-physical-metallurgy-2
12. http://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-

solid-state-chemistry-fall-2010/syllabus/

13. http://www.msm.cam.ac.uk/teaching/partIA.php

Course Plan

Module	Contents	Hours	Semester Exam. Marks
I	Earlier and present development of atomic structure; attributes of ionization energy and conductivity, electronegativity and alloying; correlation of atomic radius to strength; electron configurations; electronic repulsion Primary bonds: - characteristics of covalent, ionic and metallic bond: attributes of bond energy, cohesive force, density, directional and non-directional and ductility. properties based on atomic bonding:- attributes of deeper energy well and shallow energy well to melting temperature, coefficient of thermal expansion - attributes of modulus of elasticity in metal cutting process -Secondary bonds:- classification- hydrogen bond and anomalous behavior of ice float on water, application- atomic mass unit and specific heat, application. *(brief review only, no University questions and internal assessment from these portions).*	2	15%
	Crystallography:- Crystal, space lattice, unit cell- BCC, FCC, HCP structures - short and long range order - effects of crystalline and amorphous structure on mechanical properties.	1	
	Coordination number and radius ratio; theoretical density; simple problems - Polymorphism and allotropy.	1	
	Miller Indices: - crystal plane and direction *(brief review)* - Attributes of miller indices for slip system, brittleness of BCC, HCP and ductility of FCC - Modes of plastic deformation: - Slip and twinning.	1	
	Schmid's law, equation, critical resolved shear stress, correlation of slip system with plastic deformation in metals and applications.	1	
II	Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity.	1	15%
	Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall - Petch theory, simple problems	1	
	Classification of crystal imperfections: - types of dislocation – effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation.	1	

	Burgers vector –dislocation source, significance of Frank Read source in metals deformation - Correlation of dislocation density with strength and nano concept, applications.	1	
	Significance high and low angle grain boundaries on dislocation – driving force for grain growth and applications during heat treatment.	1	
	Polishing and etching to determine the microstructure and grain size.	1	
	Fundamentals and crystal structure determination by X – ray diffraction, simple problems –SEM and TEM.	1	
	Diffusion in solids, Fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.	1	
	FIRST INTERNAL EXAMINATION		
III	Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule - equilibrium diagram of common types of binary systems: five types.	2	**15%**
	Coring - lever rule and Gibb`s phase rule - Reactions: - monotectic, eutectic, eutectoid, peritectic, peritectoid.	1	
	Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite, ledeburite, ferrite, cementite, special features of martensite transformation, bainite, spheroidite etc.	1	
	Heat treatment: - Definition and necessity – TTT for a eutectoid iron–carbon alloy, CCT diagram, applications - annealing, normalizing, hardening, spheroidizing.	1	
	Tempering:- austempering, martempering and ausforming - Comparative study on ductility and strength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming.	1	
	Hardenability, Jominy end quench test, applications- Surface hardening methods:- no change in surface composition methods :- Flame, induction, laser and electron beam hardening processes- change in surface composition methods :carburizing and Nitriding; applications.	2	

IV	Types of Strengthening mechanisms: - work hardening, equation - precipitation strengthening and over ageing- dispersion hardening.	1	15%
	Cold working: Detailed discussion on strain hardening; recovery; re-rystallization, effect of stored energy; re-crystallization temperature - hot working Bauschinger effect and attributes in metal forming.	1	
	Alloy steels:- Effects of alloying elements on steel: dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties	1	
	Nickel steels, Chromium steels etc. - Enhancement of steel properties by adding alloying elements: - Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead.	1	15%
	High speed steels:- Mo and W types, effect of different alloying elements in HSS	1	
	Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc, composition, microstructure, properties and applications.	1	
	Principal Non ferrous Alloys: - Aluminum, Copper, Magnesium, Nickel, study of composition, properties, applications, reference shall be made to the phase diagrams whenever necessary.	1	
	SECOND INTERNAL EXAMINATION		
V	Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests, S-N curve.	1	20%
	Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress.	1	
	Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in metal cutting	1	
	Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture – Stress concentration, stress raiser – Effect of plastic deformation on crack propagation.	1	
	transgranular, intergranular fracture - Effect of impact loading on ductile material and its application in forging, applications - Mechanism of fatigue failure.	1	

	Structural features of fatigue: - crack initiation, growth, propagation - Fracture toughness (definition only) - Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications.	1	
V1	Creep: - Creep curves – creep tests - Structural change:- deformation by slip, sub-grain formation, grain boundary sliding	1	**20%**
	Mechanism of creep deformation - threshold for creep, prevention against creep - Super plasticity: need and applications	1	
	Composites:- Need of development of composites - geometrical and spatial Characteristics of particles – classification - fiber phase: - characteristics, classifications - matrix phase:- functions – only need and characteristics of PMC, MMC, and CMC – applications of composites: aircraft applications, aerospace equipment and instrument structure, industrial applications of composites, marine applications, composites in the sporting goods industry, composite biomaterials..	2	
	Modern engineering materials: - only fundamentals, need, properties and applications of, intermetallics, maraging steel, super alloys, Titanium – introduction to nuclear materials, smart materials and bio materials.	2	
	Ceramics:-coordination number and radius ratios- AX, A_mX_p, $A_mB_mX_p$ type structures – applications.	1	

Question Paper Pattern

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
HS210	LIFE SKILLS	2-0-2	2016

Course Objectives

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

Syllabus

Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking.

Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

Leadership Skills: Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

Expected outcome

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.

References:

- Barun K. Mitra; (2011), *"Personality Development & Soft Skills*", First Edition; Oxford Publishers.
- Kalyana; (2015) "*Soft Skill for Managers*"; First Edition; Wiley Publishing Ltd.
- Larry James (2016); "*The First Book of Life Skills*"; First Edition; Embassy Books.
- Shalini Verma (2014); *"Development of Life Skills and Professional Practice"*; First Edition; Sultan Chand (G/L) & Company
- John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.

Course Plan

Module	Contents	Hours L-T-P T	P	Sem. Exam Marks
I	Need for Effective Communication, Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. **Technical Writing:** Differences between technical and literary style, Elements of style; Common Errors, **Letter Writing:** Formal, informal and demi-official letters; business letters, **Job Application**: Cover letter, Differences between bio-data, CV and Resume, **Report Writing:** Basics of Report Writing; Structure of a report; Types of reports. **Non-verbal Communication and Body Language:** Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language **Interview Skills**: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, **Group Discussion**: Differences between group discussion and debate; Ensuring success in group discussions, **Presentation Skills**: Oral presentation and public speaking skills; business presentations, **Technology-based Communication:** Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.	2 3	2 4 4	
II	Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity	2		

	Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence. Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections. Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems.	2	2 2	
III	Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations. Group Problem Solving, Achieving Group Consensus. Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams. Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development.	3 3	2 2	
IV	Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories. Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on. The challenger case study, Multinational corporations, Environmental ethics, computer ethics, Weapons development, engineers as managers, consulting	3 3 3	2 2	

	engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.	3		
V	Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises. Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits. Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership	4 2 2	 2 2	
END SEMESTER EXAM				

EVALUATION SCHEME

Internal Evaluation

(Conducted by the College)

Total Marks: 100

Part – A

(To be started after completion of Module 1 and to be completed by 30th working day of the semester)

1. Group Discussion – Create groups of about 10 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation is as follows;

(i)	Communication Skills	–	10 marks
(ii)	Subject Clarity	–	10 marks
(iii)	Group Dynamics	-	10 marks
(iv)	Behaviors & Mannerisms	-	10 marks

(Marks: 40)

Part – B

(To be started from 31st working day and to be completed before 60th working day of the semester)

2. Presentation Skills – Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation is as follows;

(i)	Communication Skills*	-	10 marks
(ii)	Platform Skills**	-	10 marks
(iii)	Subject Clarity/Knowledge	-	10 marks

(Marks: 30)

* Language fluency, auditability, voice modulation, rate of speech, listening, summarizes key learnings etc.

** Postures/Gestures, Smiles/Expressions, Movements, usage of floor area etc.

Part – C

(To be conducted before the termination of semester)

3. Sample Letter writing or report writing following the guidelines and procedures. Parameters to be used for evaluation is as follows;

(i)	Usage of English & Grammar	-	10 marks
(ii)	Following the format	-	10 marks
(iii)	Content clarity	-	10 marks

(Marks: 30)

External Evaluation

(Conducted by the University)

Total Marks: 50 Time: 2 hrs.

Part – A

Short Answer questions

There will be one question from each area (five questions in total) will be asked for the examination. Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows;

(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content

(Marks: 5 x 6 = 30)

Part – B

Case Study

The students will be given a case study with questions at the end the students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows;

(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion
(ix) Answer the question at the end of the case

(Marks: 1 x 20 = 20)

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME231	COMPUTER AIDED MACHINE DRAWING LAB	0-0-3-1	2016

Course Objectives:

1. To introduce students to the basics and standards of engineering drawing related to machines and components.
2. To teach students technical skills regarding assembly, production and part drawings.
3. To familiarize students with various limits, fits and tolerances.
4. To help students gain knowledge about standard CAD packages on modeling and drafting.

Syllabus

Introduction to Machine Drawing, Drawing Standards, Fits, Tolerances, Production drawings. Introduction to CAD, assembly drawings, etc.

Expected outcome

At the end of the course students will be able to

1. Acquire the knowledge of various standards and specifications about standard machine components.
2. Make drawings of assemblies with the help of part drawings given.
3. Ability to select, configure and synthesize mechanical components into assemblies.
4. Apply the knowledge of fits and tolerances for various applications.
5. Able to model components of their choice using CAD software.
6. Get exposure to advanced CAD packages.

Text Books:

1. N. D. Bhatt and V.M. Panchal, Machine Drawing, Charotar Publishing House,2014
2. K C John, Machine Drawing, PHI,2009
3. P I Vargheese and K C John, Machine Drawing, VIP Publishers ,2011
4. K.L.Narayana, P.Kannaiah & K. Venkata Reddy,Machine Drawing, New Age Publishers,2009
5. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-hill,2012
6. P S Gill, Machine Drawing, Kataria & Sons,2009

Course Plan		
Module	**Contents**	**Hours**
0	Introduction Principles of drawing, free hand sketching, manual drawing, CAD drawing etc.	01
I	Drawing standards**:** 2 exercises Code of practice for Engineering Drawing, BIS specifications – lines, types of lines, dimensioning, sectional views, Welding symbols, riveted joints, keys, fasteners –bolts, nuts, screws, keys etc.	05
II	Fits ,Tolerances and Surface Roughness**:** 2 exercises Limits, Fits – Tolerances of individual dimensions – Specification of Fits – basic principles of geometric & dimensional tolerances. Preparation of production drawings and reading of part and assembly drawings, surface roughness, indication of surface roughness, etc.	06
FIRST INTERNAL EXAM		
III	Introduction to drafting package: Introduction, input, output devices, introduction to drafting software like Auto CAD, basic commands and development of simple 2D and 3D drawings. Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Matching, Detailing, Detailed drawings.	06
IV	Assembly drawings(2D)**:** 10 exercises Preparation of assembled views. (Manually): Shaft couplings – Connecting rod - Machine Vice – Stuffing box – Plummer block. (Using software package, 2D Drawing) :– Universal joint - Screw jack – Lathe Tailstock – Rams Bottom Safety Valve – Steam stop valve. Preparation of Bill of materials and tolerance data sheet.	24
SECOND INTERNAL EXAM		
Note: 50% of assembly drawings (Module IV) must be done manually and remaining 50% of assembly drawings must be done using any 2D drafting package.		
FINAL INTERNAL EXAM		

Examination scheme

(1) End semester examination shall be for 30 marks and of 2 hours duration.

(2) End semester exam shall be based on Module IV. It shall be conducted as a CAD examination

(3) 50 marks are allotted for internal evaluation: first internal exam 25 marks, second internal exam 25 marks and class exercises 20 marks.

(4) The first internal exam will be based on modules I and II and the second internal exam will be a based on Module IV alone. (Both will be conducted as manual drawing examinations)

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CE230	MATERIAL TESTING LAB	0-0-3-1	2016

Course Objectives:

1. To provide knowledge on mechanical behaviour of materials
2. To acquaint with the experimental methods to determine the mechanical properties of materials.

Syllabus

List of experiments:

1. Tension test on mild steel/ tor-steel/ high strength steel and cast iron using Universal Testing Machine and extensometers.
2. Tests on springs (Open and closed coiled)
3. Torsion pendulum (mild steel, aluminium and brass wires)
4. Hardness test (Brinell, Vickers and Rockwell)
5. Impact test (Izod and Charpy)
6. Torsion test on mild steel rods.
7. Shear test on mild steel rods.
8. Fatigue test – Study of testing machine.
9. Bending test on wooden beams.
10. Strut test (Column buckling experiment)
11. Verification of Clerk Maxwell's law of reciprocal deflection and determination of Young's modulus of steel.
12. Photo elastic methods for stress measurements.
13. Jominy hardenability test
14. Measurement using strain gauges
15. Determination of moment of inertia of rotating bodies

Note: A minimum of 10 experiments are mandatory.

Expected outcome: At the end of the course the students will be able to

1. Acquire the knowledge on mechanical behaviour of materials
2. Conduct experiments determine the mechanical properties of materials.

References Books:

1. G E Dieter. Mechanical Metallurgy, McGraw Hill,2013
2. Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991
3. Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book Distributors,2015

Course No.	Course Name	L-T-P - Credits	Year of Introduction
MA202	Probability distributions, Transforms and Numerical Methods	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.
- To know Laplace and Fourier transforms which has wide application in all Engineering courses.
- To enable the students to solve various engineering problems using numerical methods.

Syllabus

Discrete random variables and Discrete Probability Distribution.
Continuous Random variables and Continuous Probability Distribution.
Fourier transforms.
Laplace Transforms.
Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.
Numerical solution of system of Equations. Numerical Integration, Numerical solution of ordinary differential equation of First order.

Expected outcome .

After the completion of the course student is expected to have concept of
(i) Discrete and continuous probability density functions and special probability distributions.
(ii) Laplace and Fourier transforms and apply them in their Engineering branch
(iii) numerical methods and their applications in solving Engineering problems.

Text Books:

1. Miller and Freund's "Probability and statistics for Engineers"-Pearson-Eighth Edition.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

References:

1. V. Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009.
2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics"-Sixth Edition.
3. Jay L. Devore, "Probability and Statistics for Engineering and Science"-Eight Edition.
4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers"-Sixth Edition-Mc Graw Hill.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Discrete Probability Distributions.** (Relevant topics in section 4.1,4,2,4.4,4.6 Text1)		
	Discrete Random Variables, Probability distribution function, Cumulative distribution function.	2	
	Mean and Variance of Discrete Probability Distribution.	2	
	Binomial Distribution-Mean and variance.	2	
	Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance.	2	15%

II	**Continuous Probability Distributions.** (Relevant topics in section 5.1,5.2,5.5,5.7 Text1) Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance. Normal Distribution, Mean and variance (without proof). Uniform Distribution.Mean and variance. Exponential Distribution, Mean and variance.	 2 4 2 2	15%
FIRST INTERNAL EXAMINATION			
III	**Fourier Integrals and transforms. (**Relevant topics in section 11.7, 11.8, 11.9 Text2) Fourier Integrals. Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform.	 3 3 3	15%
IV	**Laplace transforms. (**Relevant topics in section 6.1,6.2,6.3,6.5,6.6 Text2**)** Laplace Transforms, linearity, first shifting Theorem. Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. Unit step function, second shifting theorem. Convolution Theorem (without proof). Differentiation and Integration of transforms.	 3 4 2 2 2	15%
SECOND INTERNAL EXAMINATION			
V	**Numerical Techniques**.(Relevant topics in section.19.1,19.2,19.3 Text2) Solution Of equations by Iteration, Newton- Raphson Method. Interpolation of Unequal intervals-Lagrange's Interpolation formula. Interpolation of Equal intervals-Newton's forward difference formula, Newton's Backward difference formula.	 2 2 3	20%
VI	**Numerical Techniques**. (Relevant topics in section 19.5,20.1,20.3, 21.1 Text2) Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method. Numeric Integration-Trapezoidal Rule, Simpson's 1/3 Rule. Numerical solution of firstorder ODE-Euler method, Runge-Kutta Method (fourth order).	 3 3 3	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME202	ADVANCED MECHANICS OF SOLIDS	3-1-0-4	2016

Prerequisite: ME201 Mechanics of solids

Course Objectives:

1. To impart concepts of stress and strain analyses in a solid.
2. To study the methodologies in theory of elasticity at a basic level.
3. To acquaint with the solution of advanced bending problems.
4. To get familiar with energy methods for solving structural mechanics problems.

Syllabus

Introduction, concepts of stress, equations of equilibrium, strain components, strain-displacement relations, compatibility conditions, constitutive relations, boundary conditions, 2D problems in elasticity, Airy's stress function method, unsymmetrical bending of straight beams, bending of curved beams, shear center, energy methods in elasticity, torsion of non-circular solid shafts, torsion of thin walled tubes.

Expected outcome: At the end of the course students will be able to

1. Apply concepts of stress and strain analyses in solids.
2. Use the procedures in theory of elasticity at a basic level.
3. Solve general bending problems.
4. Apply energy methods in structural mechanics problems.

Text Books:

1. L. S. Sreenath, Advanced Mechanics of Solids, McGraw Hill, 2008
2. S. Jose, Advanced Mechanics of Materials, Pentagon Educational Services, 2013

References Books:

1 S. P. Timoshenko, J. N. Goodier, Theory of elasticity, McGraw Hill,1970
2 R.J. Atkin, and N. Fox, An introduction the theory of elasticity, Longman,1980
3. J. P. Den Hartog, Advanced Strength of Materials, McGraw Hill,1987
4. C. K. Wang, Applied Elasticity, McGraw Hill,1983
5. S. M. A. Kazimi, Solid Mechanics, McGraw Hill,2008
6. L. Govindaraju ,TG Sitharaman, Applied elasticity for Engineers, NPTEL
7. U. Saravanan, Advanced Solid Mechanics, NPTEL
8. www.solidmechanics.org/contents.htm - Free web book on Applied Mechanics of Solids by A.F. Bower.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Introduction to stress analysis in elastic solids - stress at a point – stress tensor – stress components in rectangular and polar coordinate systems - Cauchy's equations – stress transformation – principal stresses and planes - hydrostatic and deviatoric stress components, octahedral shear stress - equations of equilibrium	6	15%
	Displacement field – engineering strain - strain tensor (basics only) – analogy between stress and strain tensors - strain-displacement relations (small-strain only) – compatibility conditions	4	
II	Constitutive equations – generalized Hooke's law – equations for linear elastic isotropic solids - relation among elastic constants – Boundary conditions – St. Venant's principle for end effects – uniqueness theorem	4	15%
	2-D problems in elasticity - Plane stress and plane strain problems – stress compatibility equation - Airy's stress function and equation – polynomial method of solution – solution for bending of a cantilever with an end load	4	
FIRST INTERNAL EXAM			
III	Equations in polar coordinates (2D) – equilibrium equation, strain-displacement relations, conversion of Airy's equation and definition of stress function and stress components	3	15%
	Application of stress function to Lame's problem - stress concentration problem of a small hole in a large plate.	3	
	Axisymmetric problems – governing equations – application to thick cylinders, interference fit and rotating discs.	4	
IV	Unsymmetrical bending of straight beams – curved beams (rectangular c/s) - shear center – shear stresses in thin walled open sections	6	15%
	Strain energy of deformation – special cases of a body subjected to concentrated loads, moment or torque - reciprocal relation – strain energy of a bar subjected to axial force, shear force, bending moment and torque	3	
SECOND INTERNAL EXAM			
V	Maxwell reciprocal theorem – Castigliano's first and second theorems – virtual work principle – minimum potential energy theorem - complementary energy theorem	5	20%
	Torsion of non-circular bars: Saint Venant's theory - solutions for circular and elliptical cross-sections	4	
VI	Prandtl's method - solutions for circular and elliptical cross-sections - membrane analogy - approximate solution methods for non-circular shafts	5	20%
	Torsion of thin walled tubes, thin rectangular sections, rolled sections and multiply connected sections	5	
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME204	THERMAL ENGINEERING	3-1-0-4	2016

Prerequisite: ME205 Thermodynamics

Course Objectives:

1. To acquire knowledge on the working of steam turbines, IC engines and gas turbines
2. To introduce the combustion process in IC engines
3. To understand air pollution from IC engines and its remedies.

Syllabus

Steam engineering, boilers, steam nozzles, steam turbines, internal combustion engines, performance testing of IC Engines, fuels and fuel combustion, air pollution from IC engines and remedies, combustion in I.C. engines, gas turbines

Expected outcome: At the end of the course the students will be able to

1. Integrate the concepts, laws and methodologies from the course in thermodynamics into analysis of cyclic processes
2. To apply the thermodynamic concepts into various thermal application like IC engines, steam turbines, compressors.

Text Books:

1. Rudramoorthy , Thermal Engineering, McGraw Hill Education India,2003
2. R.K Rajput, Thermal Engineering, Laxmi publications,2010

References Books:

1. V. Ganesan, Fundamentals of IC engines, Tata McGraw-Hill,2002
2. T.D. Eastop and A McConkey, Applied thermodynamics for engineering technology, Pearson education,1996
3. J.B.Heywood, I.C engine fundamentals. McGraw-Hill,2011
4. Gill, P.W., Smith, JR., J.H., and Ziurys, E.J Fundamentals of internal combustion engines Oxford and IBH,1959
5. Rathore, Thermal Engineering, McGraw Hill Education India, 2010

Steam Tables

6. R.S.Khurmi, Steam table with Mollier chart,S.Chand,2008

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Steam engineering- T- S diagram, Mollier chart, Steam cycles- Rankine cycle, Modified Rankine cycle, Relative efficiency, Improvement in steam cycles-Reheat, Regenerative and Binary vapor cycle Steam Boilers: Types of boilers –Cochran boiler, Babcock and Wilcox boiler, Benson boiler, La Mont boiler, Loeffler boiler, Velox boiler, Boiler Mountings and Accessories Steam nozzles:-Types of nozzle- Velocity of steam, mass flow rate, critical pressure ratio and its significance, effect of friction, super saturated flow	8	15%
II	Steam turbines: classification, compounding of turbines-pressure velocity variation, velocity diagrams, work done, efficiency, condition for maximum efficiency, multistage turbines-condition line, stage efficiency. Steam turbine performance-reheat factor, degree of reaction, cycles with reheating and regenerative heating, governing of turbines	8	15%
FIRST INTERNAL EXAM			
III	Internal combustion engines: classification of I.C. Engines- four stroke and two stroke I.C. Engines, Comparison of four stroke and two stroke Engine. Wankel Engine, Air standard cycle-Carnot cycle, Otto cycle; Diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles. Stirling and Ericsson cycles, air standard efficiency, specific work output, work ratio, Actual cycle analysis, deviation of actual engine cycle from ideal cycle. Rotary engines, Stratified charge engine , super charging of SI and CI Engines – turbo charging. Variable specific heats.	10	15%
IV	Performance Testing of I C Engines: Indicator diagram, mean effective pressure. Torque, Engine power- BHP, IHP. Engine efficiency- mechanical efficiency, volumetric efficiency, thermal efficiency and relative efficiency, Specific fuel consumption. Testing of I C engines- Morse test, Heat balance test and Retardation test Fuels and fuel combustion: flash point and fire point, calorific value, Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas. Analysis of fuel combustion-A/F ratio, equivalence ratio, minimum quantity of air, flue gas analysis, excess air.	10	15%
SECOND INTERNAL EXAM			
V	Air pollution from I.C. Engine and its remedies**:** Pollutants from S.I. and C.I. Engines, Methods of emission control, alternative fuels for I.C. Engines; the blending of fuels, Bio fuels. Combustion in I.C. Engines: Combustion phenomena in S.I. engines; Ignition limits, stages of combustion in S.I. Engines, Ignition lag, velocity of flame propagation, auto ignition, detonation; effects of engine variables on detonation; theories of detonation, octane rating of fuels;	10	20%

	pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.		
VI	Gas turbines: classification, Thermodynamic analysis of gas turbine cycles-open , closed and semi closed cycle; ideal working cycle- Brayton cycle-P-v and T-s diagram, thermal efficiency. Effect of compressor and turbine efficiencies. Optimum pressure ratio for maximum specific work output with and without considering machine efficiencies. Comparison of gas turbine and IC engines, Analysis of open cycle gas turbine, Improvements of the basic gas turbine cycles-regeneration, intercooling and reheating-cycle efficiency and work output-Condition for minimum compressor work and maximum turbine work. Combustion chambers for gas turbines. pressure loss in combustion process and stability loop.	10	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME206	**FLUID MACHINERY**	**2-1-0-3**	**2016**

Prerequisite: ME203 Mechanics of Fluids

Course Objectives:

1. To acquire knowledge on hydraulic machines such as pumps and turbines
2. To understand the working of air compressors and do the analysis

Syllabus

Impact of jets, Hydraulic Turbines, Rotary motion of liquids, Rotodynamic pumps, Positive displacement pumps**,** , Compressors

Expected outcome: At the end of the course the students will be able to

1. Discuss the characteristics of centrifugal pump and reciprocating pumps
2. Calculate forces and work done by a jet on fixed or moving plate and curved plates
3. Know the working of turbines and select the type of turbine for an application.
4. Do the analysis of air compressors and select the suitable one for a specific application

Text 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.

Reference Books:

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

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve),– Series of vanes - work done and efficiency Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles – Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, work done and efficiencies.	7	15%
II	Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power.	7	15%
FIRST INTERNAL EXAM			
III	Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps- centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and available- Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based on shape numbers.	7	15%
IV	Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiency- indicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.	7	15%
SECOND INTERNAL EXAM			
V	Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)	7	20%
VI	Centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME220	MANUFACTURING TECHNOLOGY	3-0-0-3	2016

Prerequisite: Nil

Course Objectives:-

1. To give an exposure to different techniques of casting and molds required.
2. To provide an exposure to different rolling processes and different rolled products
3. To familiarize with different forging methods, cautions to be adopted in die design.
4. To give an introduction to various work and tool holding devices used in manufacturing.
5. To introduce to the bending, shearing and drawing processes of sheet metal working and allied machines,
6. To give an understanding of welding metallurgy and weldability and to introduce various metal joining techniques.

SYLLABUS

Casting –patterns - Cores – Gating – Risering – Defects in Castings - Rolling –Defects in Rolled parts- forging – Coining – Heading – Piercing –Die Design– Extrusion Process– Extrusion Defects – Drawing Process -Principles of Location –Principles of Clamping – Types of Clamp -Sheet metal characteristics –Deep drawing –Spinning –Definition of Welding – Weldability – Solidification of Weld Metal – Heat Affected Zone – Welding Defects - Gas Welding -Arc Welding - Ultrasonic Welding – Friction Welding – Resistance Welding — Brazing- Soldering.

Expected outcomes: At the end of the course the students will be able to

1. Acquire knowledge in various casting processes and technology related to them.
2. Understand the rolling passes required for getting required shapes of rolled products.
3. Discuss important aspects of forging techniques
4. Discuss sheet metal working processes and their applications to produce various shapes and products.
5. Acquire knowledge in various types of welding processes.

Text books:-

1. Amitabha Ghosh and Ashok Kumar Mallick, Manufacturing Science Affiliated East West Press Ltd, New Delhi, 2002
2. S.Kalpakjian and Steven R Schimid, Manufacturing Engineering and Technology, Pearson,2001

Reference books:-

1. RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
2. RAO, Manutacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
3. Cyril Donaldson and George H LeCain, Tool Design,TMH
4. Handbook of Fixture Design – ASTME
5. Campbell J. S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1999
6. P R Beeley, Foundry Technology, Elsevier, 2001
7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting,

Tata McGraw-Hill Education, 2001
8. Paul Degarma E and Ronald A. Kosher ,Materials and Processes in Manufacturing, Wiley,20111
9. P. N. Rao,Manufacturing Technology Foundry, Forming and Welding, Tata McGraw-Hill Education,2011
10. HMT Production Technology, 1e McGraw Hill,2001

Course Plan			
Module	**Contents**	**Hours**	**Semester Examination Marks**
I	Sand Casting – Sand Molds-Types of Molding Sands and Testing	1	15%
	Type of patterns - Pattern Materials	1	
	Cores –Types and applications –Sand Molding Machines	1	
	Gating System – Risering	1	
	Shell Mold Casting – Ceramic Mold Casting	1	
	Investment Casting – Vacuum Casting – Slush Casting	1	
	Pressure Casting – Die Casting – Centrifugal Casting	1	
	Design Considerations based on Various Shapes - Defects in Castings – simple problems in casting	1	
II	Principles of Rolling –Types of rolling mills, Mechanics of Flat Rolling	1	15%
	Roll Force and Power Requirement - Neutral Point	1	
	Hot and Cold Rolling	1	
	Defects in Rolled Plates - Rolling Mills	1	
	Ring Rolling – Thread Rolling	1	
	Applications- Rolling of tubes, wheels, axles and I-beams	1	
FIRST INTERNAL EXAM			
III	Classification of forging – Forging methods – Forging under sticking condition	1	15%
	Precision Forging – Coining – Heading – Piercing	1	
	Die Design:- Preshaping, Design Features, Draft Angles – Die Materials and Lubrication	1	
	Forging Machines – Forging Defects and tests	1	
	Extrusion Process - Hot Extrusion – Cold Extrusion	1	
	Impact Extrusion – Extrusion Defects – Drawing Process, wire drawing process	1	

IV	Principles Location - Degrees of Freedom, 3-2-1 principle of locating	1	15%
	Locating from Planes - Locating from Circular Surfaces	1	
	Concentric Locating - Principles of Clamping	1	
	Types of Clamps - Strap Clamps Slide Clamps - Swing Clamps - Hinge Clamps	1	
	Vacuum Clamping - Magnetic Clamping	1	
SECOND INTERNAL EXAM			
V	Sheet metal characteristics – Typical shearing	1	20%
	Bending Sheet and Plate – Spingback - Bending Force	1	
	Press Brake Forming - Tube Bending	1	
	Stretch Forming - Deep Drawing	1	
	Rubber forming - Spinning Shear Spinning - Tube Spinning	1	
	Definition of Welding - Weldability – Solidification of the Weld Metal	1	
	Heat Affected Zone – correlation of strength of welded joint with structure - Welding Defects	1	
VI	Gas Welding: – Flame Characteristics	1	20%
	Equipment, fluxes and filler rods	1	
	Arc Welding – Applications and Equipment	1	
	Electrodes	1	
	Shielded Metal Arc Welding – Submerged Arc Welding	1	
	GTAW – Plasma Arc Welding	1	
	Ultrasonic Welding – Friction Welding	1	
	Resistance Spot Welding	1	
	Resistance Seam Welding – Stud Welding – Percussion Welding - simple problems in welding	1	
	Brazing:- Filler Metals, Methods - Soldering:- Techniques, Types of Solders and Fluxes	1	
END SEMESTER EXAM			

Question Paper Pattern

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The question paper should consist of three parts

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Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

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Course Number	Course Name	L-T-P	Credits	Year of introduction
HS200	Business Economics	3-0-0	3	2016

Course Objectives

- To familiarize the prospective engineers with elementary Principles of Economics and Managerial Economics;.
- To acquaint the students with tools and techniques that are useful in their profession in Managerial Decision Making which will enhance their employability;
- To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
- To prepare and understand balance sheet at an elementary level.

Syllabus

Nature of economics. Demand and Supply Analysis, demand curve, supply curve and equilibrium price determination. Production economics, economies of Scale, optimal quantity determination, Production and Cost functions, the law of Diminishing Marginal Productivity, Costs, Break-Even Analysis Chart Preparation and Cost-Volume-Profit Analysis. Market Structure and Price-Output Decisions under various competition situations and Collusion/Cartel formations in the real life situation. Monetary theory, functions of RBI and NI. Computation and some aspects of macro economics. Capital Budgeting decisions, forecasting techniques and elementary Balance Sheet..

Expected Outcome

A student who has undergone this course

- *would be able to make investment decisions based on capital budgeting methods in alignment with microeconomic and macroeconomic theories.*
- *would be able to analyse the profitability of the firm, economy of operation, determination of price under various market situations with good grasp on the effect of trade cycles in business.*
- *would gain knowledge on Monetary theory, measures by RBI in controlling interest rate and emerging concepts like Bit Coin.*
- *would gain knowledge of elementary accounting concepts used for preparing balance sheet and interpretation of balance sheet*

Course Plan			
Unit	**Topics**	**Hours Allotted**	**Percentage Marks**
I	**Nature of Economics** Definitions of Economics and their limitations, Economic Problems (2 Hrs.), Economic Systems, meaning of Business or Managerial Economics (2 Hrs.)and its role and relevance in managerial decision making in an industrial setting (2 Hrs).	6	15%
II	**Demand and Supply Analysis** Demand Curve, Demand function (2 Hrs.), Elasticity of demand and its estimation (2 Hrs.), Supply curve, equilibrium price and price mechanism (2 Hrs).	6	15%
FIRST INTERNAL EXAM			
III	**Production Economics** Economies of Scale and Diseconomies of Scale (1 Hr.), Production and Cost Functions. Factors of Production (2 Hrs.), Law of Diminishing marginal Productivity. Construction and analysis of Break Even Charts (3 Hrs.)	6	15%
IV	**Market Structure and Price-Output Decisions** Price and output determination under Perfect Competition, Monopoly and Monopolistic Competition (3 Hrs.). Collusion and Cartel, Nash Equilibrium (3 Hrs.).	6	15%
SECOND INTERNAL EXAM			
V	**Money, National Income and Taxation** Money, Emerging Bit Coin concept, Quantity Theory of Money, Interest Rate Management (2 Hrs), Open Market Operations by RBI, Selective Credit Controls, SLR, CRR (2 Hrs), Definition & Measurement of National Income, methods, sectors of economy (3 Hrs), inflation, deflation, trade cycles- Value-Added Tax (2 Hrs).	9	20%
VI	**Investment Decisions and Balance Sheet Analysis** Capital Budgeting, Investment Analysis – NPV, IRR, Profitability Index, ARR, Payback Period (3 Hrs), Depreciation, Time value of money. Business Forecasting– Elementary techniques (2 Hrs). Balance sheet preparation principles and interpretation (4 Hrs)	9	20%
END SEMESTER EXAM			

Text Book

Yogesh, Maheswari, *Management Economics* , PHI learning, NewDelhi, 2012

References

1. Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 11th edition, 2010.
2. Khan M Y, Indian Financial System, Tata McGraw Hill, 7th edition, 2011.
3. Samuelson, Managerial Economics, 6th edition, Wiley
4. Snyder C and Nicholson W, Fundamentals of Microeconomics, Cengage Learning (India), 2010.
5. Truett, Managerial Economics: Analysis, Problems, Cases, 8th Edition, Wiley Welch, Economics: Theory and Practice 7th Edition, Wiley

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME232	THERMAL ENGINEERING LABORATORY	0-0-3-1	2016

Prerequisite : Should have registered for ME204 Thermal Engineering

Course Objectives:

1. To study the various types IC engines and their parts
2. To conduct the performance test on IC engines, compressors and blowers
3. To familiarize equipment used for measuring viscosity, flash and fire point and Calorific value of petroleum products

Syllabus

List of experiments:

Study of I.C engines :-

a) Diesel engines - all systems and parts

b) Petrol engines - all systems and parts

Experiments

1. Determination of flash and fire points of petroleum products -flash and fire point apparatus
2. Determination of viscosity of lubricating oil- viscometer
3. Determination of calorific value of solid and liquid fuels- calorimeter
4. Determination of calorific value of and gaseous fuels - calorimeter
5. Performance test on petrol engines with various types of loading systems
6. Performance test on Diesel engines with various types of loading systems
7. Heat Balance test on petrol/Diesel engines
8. Cooling curve of IC engines
9. Valve timing diagram of IC engines
10. Economic speed test on IC engines
11. Retardation test on IC engines
12. Determination volumetric efficiency and Air-fuel ratio of IC engines
13. Morse test on petrol engine
14. Performance test on reciprocating compressor
15. Performance test on rotary compressor/blower
16. Draw velocity profile in a pipe flow using Prandtl -Pitot tube
17. Analysis of automobile exhaust gas and flue gas using exhaust gas analyser

Note: 12 experiments are mandatory

Expected outcome: At the end of the course the students will be able to

1. Determine the efficiency and plot the characteristic curves of different types of Internal Combustion engines, compressors and blowers
2. Conduct experiments for the determination of viscosity, calorific value etc of petroleum products

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME230	FLUID MECHANICS AND MACHINES LABORATORY	0-0-3-1	2016

Prerequisite: ME203 Mechanics of fluids

Course Objectives: The main objectives of this course is to demonstrate the applications of theories of basic fluid mechanics and hydraulic machines and to provide a more intuitive and physical understanding of the theory.

Syllabus

Study:

1. Study of flow measuring equipments - water meters, venturi meter, orifice meter, current meter, rotameter
2. Study of gauges - pressure gauge, vacuum gauge, manometers.
3. Study of valves - stop valve, gate valve and foot valve.
4. Study of pumps – Centrifugal, Reciprocating, Rotary, Jet.
5. Study of Turbines - Impulse and reaction types.
6. Study of Hydraulic ram, accumulator etc.

List of Experiments:

1. Determination of coefficient of discharge and calibration of Notches
2. Determination of coefficient of discharge and calibration of Orifice meter
3. Determination of coefficient of discharge and calibration of Venturimeter.
4. Determination of Chezy's constant and Darcy's coefficient on pipe friction apparatus
5. Determination of hydraulic coefficients of orifices
6. Determination of metacentric height and radius of gyration of floating bodies.
7. Experiments on hydraulic ram
8. Reynolds experiment
9. Bernoulli's experiment
10. Experiment on Torque converter
11. Performance test on positive displacement pumps
12. Performance test on centrifugal pumps, determination of operating point and efficiency
13. Performance test on gear pump
14. Performance test on Impulse turbines
15. Performance test on reaction turbines (Francis and Kaplan Turbines)
16. Speed variation test on Impulse turbine
17. Determination of best guide vane opening for Reaction turbine
18. Impact of jet

Note: 12 experiments are mandatory

Expected outcome: At the end of the course the students will be able to

1. Discuss physical basis of Bernoulli's equation, and apply it in flow measurement (orifice, Nozzle and Venturi meter), and to a variety of problems
2. Determine the efficiency and plot the characteristic curves of different types of pumps and turbines.