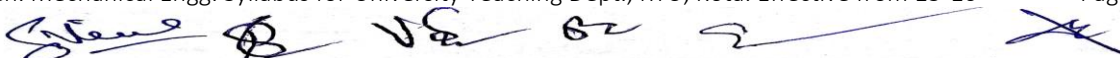


Department of Mechanical Engineering  
Syllabus  
Of

Bachelor of Technology  
Mechanical Engineering

From III to VIII Semester  
Effective from Academic session 15-16

University Teaching Departments  
Rajasthan Technical University, Kota



### 3MEU1: MECHANICS OF SOLIDS

**B.Tech. (Mechanical) 3<sup>rd</sup> semester**

**3L+0T**

CO 1: Understand the elastic behaviour of engineering materials.

CO 2: Learn the theories for axial, bending and torsion loading

CO 3: Analyse the response of structure and machine members under different load conditions.

CO 4: Evaluate the critical stress under considered load.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Stress and Strain:</b> Elementary definition of stress and strain, stress-strain relationship, elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, elastic constants and their relations for an isotropic hookean material, anisotropic and orthotropic materials.	3
	Tension, compression, shearing stress and strain, thermal stresses, composite bars, equations of static equilibrium, concept of free body diagram. Strain energy due to axial loading.	5
II	<b>Members Subjected to Flexural Loads:</b> Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams.	4
	Bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. Strain energy due to bending.	5
III	<b>Principal Planes, Stresses and Strains:</b> Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain.	5
	<b>Theories of Elastic Failures:</b> The necessity for a theory, different theories, significance and comparison, applications.	2
IV	<b>Torsion:</b> Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads.	4
	<b>Stability of Equilibrium:</b> Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.	4
V	<b>Transverse Deflection of Beams:</b> Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method.	6
	<b>Thin-walled Pressure Vessels:</b> Stresses in cylindrical and spherical vessels	2
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		
1	Bansal, R. K., "A Textbook of Strength of Materials Laxmi Publications.	2010
REFERENCE BOOKS		
SN	Name of Authors / Books / Publisher	Year of Pub.
1	Timoshenko, S.P., and Gere, J.M., "Mechanics of Materials", 2nd Ed., CBS Publishers	2002

*(Handwritten signatures and marks)*

2	Crandall, S.H., Dahl, N.C., and Lardner, T.J., "An Introduction to the Mechanics of Solids", Tata McGraw-Hill	1999
3	Pytel and Kiusalaas, "Mechanics of Materials" Cengage Learning	2011
4	Harbola, "Engineering Mechanics", Cengage Learning	2002
5	Popov, E.P., Nagarajan, S., and Lu, Z. A., "Mechanics of Materials", 2 <sup>nd</sup> Ed., Prentice-Hall of India	2002

### 3MEU2: MATERIAL SCIENCE AND ENGINEERING

**B.Tech. (Mechanical) 3<sup>rd</sup> semester**

**3L+0T**

CO1: Understand the basic concepts of material science, to learn about different types of crystal system.

CO2: Analyse different mechanism of plastic deformation.

CO3: Analyse the effect of heat treatment on properties of steel.

CO4: In depth knowledge and comparison of properties of different materials..

UNIT	CONTENTS	CONTACT HOURS
I	Crystal structure – BCC, FCC and HCP, unit cell, crystallographic planes and directions, miller indices. Crystal imperfections, point, line, surface and volume defects.	4
	Frank Reed source of dislocation, Elastic & plastic modes of deformation, Bauschinger's effect, slip & twinning, strain hardening, cold/hot working recovery, re-crystallization and grain growth.	4
II	Classification of Engineering Materials: Solidification of metals and of some typical alloys, mechanism of crystallization (i) nuclear formation (ii) crystal growth, general principles of phase transformation in alloys, phase rule and equilibrium diag., equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, binary isomorphous alloy system, Hume-Rothery rule, binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation, equilibrium diag of a system whose components are subject to allotropic change.	5
	Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram, eutectic, peritectic, eutectoid and peritectoid reactions and microstructures.	3
III	Isothermal transformation diagrams –cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate. (i) Formation of Austenite from Pearlite (ii) Transformation of Austenite into Pearlite.	4
	Full annealing, stress relief, spheroidizing – normalizing, hardening and tempering of steel. Hardenability, Jominey end quench test – Austempering, martempering. Case hardening, carburising, nitriding, cyaniding, carbonitriding. Flame and Induction hardening.	4
IV	Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO,PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes.	4
	Constitution of alloys: Solid solutions - substitutional and interstitial. Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA steel.	4
V	Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and Charpy, fatigue and creep test.	4
	Classification of steels and cast iron constitution and properties. BIS stds. Engineering Ceramics – Properties and applications of Al <sub>2</sub> O <sub>3</sub> , SiC,	4

*[Handwritten signatures and marks]*

	Si3N4, PSZ etc. Fiber and particulate reinforced composites and resin plastics. Introduction to Nano materials- Nano structured materials. Nano clusters & Nano crystals.	
		<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Material Science and Engg.An Introduction, William D.Callister, J Wiley	<b>2003</b>
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Material Science, Raghvan V., Prentice Hall India	<b>2012</b>
<b>2</b>	Principles of Material Science and Engineering, William F.Smith, TMH	<b>2008</b>
<b>3</b>	Engineering Physical Metallurgy, Lakhtin Y., Mir Publisher.	
<b>4</b>	Introduction to Engineering materials Tata McGraw-Hill Publications.	<b>2011</b>
<b>5</b>	Essentials of Material Science and Engineering, Askeland, Cengage	<b>2003</b>
<b>6</b>	Material Science and Engineering properties, Gilmore, Cengage Learning	<b>2015</b>

### 3MEU3: ENGINEERING THERMODYNAMICS

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

3L+1T

- CO 1 To understand the basic concepts and laws involves in energy interaction.  
CO 2 To evaluate the approach of exergy, reversibility and irreversibility.  
CO 3 To categorize the properties and evaluate by using standard thermal tables and charts.  
CO 4 To analyse the conceptions of various thermal relationships and equations.  
CO 5 To apply the concept of various heats related problems.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	<b>Basic Concepts and definitions of Thermodynamics:</b> System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	<b>2</b>
	<b>Zerorth and First Law of Thermodynamics:</b> Zerorth of Thermodynamics, Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	<b>5</b>
<b>II</b>	<b>Second Law of Thermodynamics:</b> Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Plank and Clausius statements. Reversible and Irreversible Processes, Carnot engine, Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausis Inequality.	<b>4</b>
	<b>Entropy:</b> Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume.	<b>3</b>
	<b>Availability:</b> Available energy, Loss in available energy, Availability Function, Irreversibility.	<b>3</b>
<b>III</b>	<b>Thermodynamic Properties of Fluids:</b> Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart	<b>4</b>
	<b>Ideal Gas and Real Gas:</b> Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures.	<b>4</b>
<b>IV</b>	<b>Thermodynamic Relations:</b> Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation.	<b>4</b>
	<b>Power Cycles:</b> Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and	<b>5</b>

*[Handwritten signatures and marks]*

	Ericsson cycle.	
<b>V</b>	Vapour power cycle: Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle	<b>3</b>
	Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	<b>3</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Nag P.K., Engineering Thermodynamics, Tata Mc-Graw Hill	
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Chattopadhyay P., Engg Thermodynamics, Oxford University Press.	<b>2011</b>
<b>2</b>	Van G.J. Wylen and Sonntag R.E., Fundamental of Thermodynamics, J Wiley	<b>2003</b>
<b>3</b>	Cengel Y.A. and Boles M.A, Thermodynamics-An Engg. Approach, TMH	<b>2011</b>
<b>4</b>	Jones J.B. and .Dugan R.E, Engineering Thermodynamics, PHI	<b>1996</b>
<b>5</b>	Rao Y.V.C., An Introduction to Thermodynamics, Wiley Eastern Ltd.	<b>1993</b>
<b>6</b>	Moran M.J and H.N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley and Sons	<b>1996</b>
<b>7</b>	Rogers, Gorden., Engineering Thermodynamics, Pearson Education	<b>1996</b>
<b>8</b>	Kroos & Potter, Thermodynamics for Engineers, Cengage learning	<b>2015</b>
<b>9</b>	Mishra, Engineering Thermodynamics, Cengage learning.	<b>2015</b>

### 3MEU4: MANUFACTURING PROCESSES

**B.Tech. (Mechanical) 3<sup>rd</sup> semester**

**3L+0T**

CO1: Basic knowledge of various manufacturing processes.

CO2: Evaluate different parameters and mechanics of the manufacturing process.

CO3: Analyze advantages, limitation and application of each process and compare among the available process.

CO4: Develop the ability to choose most appropriate manufacturing process, keeping in mind the design requirement, cost effectiveness, energy saving and productivity.

CO5: Apply manufacturing process solutions to the practice problems in the industry.

<b>Unit</b>	<b>Contents</b>	<b>Contact hours</b>
<b>I</b>	General Classification and Introduction to Manufacturing processes. <b>Foundry Technology:</b> Casting materials, Patterns: types, material and pattern allowances. Moulding sands; composition, preparation, properties and testing; Grain fineness; moisture content, clay content and permeability test. Core & core prints; Gating system: types, pouring basin, sprue, runner and risers; Melting, pouring and solidification.	<b>4</b>
	Principles and method of floor mould casting, shell mould casting, pit mould & loam mould casting; centrifugal casting, investment casting; Permanent mould casting. Casting defects; types, causes & remedy	<b>5</b>
<b>II</b>	<b>Forming Processes:</b> Classification; Hot working and cold working; principle, advantages, disadvantages and applications.	<b>3</b>
	Forging: Classification, drop forging and press forging methods and use; Forging dies; types, materials.	<b>4</b>
	Rolling: Characteristics and applications of hot rolling and cold rolling;	<b>4</b>
<b>III</b>	Extrusion; Work materials and products; Press tool works; Basic principles, system, operations and applications. Shearing; Parting, notching, trimming, nibbling, blanking and piercing,	<b>4</b>
	Drawing: wire drawing, tube drawing and deep drawing.	<b>4</b>

*(Handwritten signatures and marks)*

IV	<b>Metal Joining Processes:</b> Welding, Brazing and soldering, classification of welding process, Principle, characteristics and applications of gas welding, thermit welding, TIG and MIG welding; Resistance welding; Spot welding; Butt welding; Seam welding; Projection welding.	6
	Principles and process details of Forge welding; Friction welding; Diffusion welding; Welding defects; Types, causes, effects & remedy. Electrodes and Electrode Coatings	3
V	<b>Powder Metallurgy:</b> Properties and manufacturing of Powder, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, compacting of powders sintering, adv.& applications of Powder metallurgy.	3
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		
1	Rao.P.N., Manufacturing Technology, Vol. 1,2 and 3, Tata McGraw Hill	2013
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub.
1	Ghosh, A., & Mallik, A. K. 1986. Manufacturing Science: Ellis Horwood.	
2	Schey, Introduction to Manufacturing Processes, Tata McGraw Hill	1999
3	Kalpakjian, S., Schmid, S., Manufacturing processes for engg materials, Pearson Education.	2000
4	Campbell, J. S. Principles of manufacturing materials & processes: TMH	2008
5	Heine, R., Loper, C.R., and Rosenthal, P.C., "Principles of Metal casting", TMH	1999
6	Groover, M.P., Fundamentals of Modern Manufacturing: Materials, , PHI	1976
7	Kalpakjian, S. & Schmid S.R, Manufacturing Engg & Tech, Addison Wesley	2007
8	Little, R.L., Welding and welding technology Tata McGraw-Hill Education	2000

### 3MEU5: FLUID MECHANICS & MACHINES

**B.Tech. (Mechanical) 3<sup>rd</sup> semester**

**3L+0T**

- CO 1 Learn the basic properties of fluid and its characteristics.  
CO 2 Analyse the characteristics of flowing fluid and its basic governing equations.  
CO 3 Examine the concept of different flow conditions involved in flowing fluid.  
CO 4 Demonstrate the concept of measuring various properties under different conditions using various instruments

UNIT	CONTENTS	CONTACT HOURS
I	<b>Fluid Properties:</b> Definition of a fluid, Viscosity-dynamic and kinematic, Surface Tension.	3
	<b>Fluid Statics:</b> Basic equation of fluid statics, Manometers, Force on plane areas and curved surfaces, center of pressure, Buoyant force, Stability of floating and submerged bodies.	5
II	<b>Fluid flow concepts and Basic control volume equations:</b> General control equation, conservation of mass, energy equation and its application, Momentum equation and its applications	4
	<b>Basic governing differential equation:</b> Reynolds transport equation, continuity equation, momentum equation, energy equation, Bernoulli's equation.	4
III	<b>Viscous flow:</b> Laminar flow through pipe and between parallel plate.	4
	<b>Turbulent flow:</b> Relation, Prandtl mixing length, Losses in open and closed conduit	4
IV	Measurements: Pressure, velocity, flow measurement-orifices, venturimeter, orificemeter, nozzle meter, notches and weirs.	3

	<b>Flow through pipe:</b> Major and minor Losses in pipe, Hydraulic and energy gradient line, Network of pipes-series and parallel.	<b>5</b>
<b>V</b>	<b>Hydraulic Turbines:</b> Classification of hydraulic turbines, work done and efficiencies of Pelton, Francis and Kaplan turbines, Draft tube, Specific speed and unit quantities	<b>5</b>
	<b>Hydraulic systems:</b> Hydraulic press, Hydraulic accumulator, Hydraulic Intensifier, Hydraulic Ram, Hydraulic lift, Hydraulic coupling, Hydraulic torque convertor Gear pump.	<b>3</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Yunus A. Cengel and Cimbala, Fluid Mechanics, Tata McGrawHill,	<b>2006</b>
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Streeter V.L., K.W. Bedford and E.B.Wylie , Fluid Mechanics , Tata McGraw Hill	<b>2010</b>
<b>2</b>	Robert W. Fox and Alan T. McDonald, Introduction to Fluid Mechanics, John Wiley & Sons.	<b>2009</b>
<b>3</b>	Potter, Mechanics of Fluids, Cengage Learning.	<b>2012</b>
<b>4</b>	Frank M. White, Fluid Mechanics, Tata McGraw Hill.	<b>2003</b>
<b>5</b>	John F. Douglas, Fluid Mechanics, Pearson Education.	<b>2007</b>
<b>6</b>	Munson, B. R., Young, D. F., & Okiishi, T. H. Fundamentals of Fluid Mechanics, Wiley	
<b>7</b>	Som, S. K., & Biswas, G. Introduction to fluid mechanics and fluid machines, Tata McGraw Hill.	<b>2010</b>
<b>8</b>	K.Subramaanya, Hydraulic Machines, McGrawhill,	<b>2013</b>
<b>9</b>	Modi and Seth, Fluid Mechanics and Hydraulic Machinery, Standard Book House	<b>1991</b>

### 3MEU6: ADVANCED ENGINEERING MATHEMATICS -1

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

3L+1T

CO1: Solve linear differential equations using Laplace, Fourier transforms and Z transform.

CO2: Analysis of numerical problems using interpolation.

CO3: Apply concept of numerical differentiation and integration to solve problems.

CO4: Understand and apply various methods to solve ODE numerically.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	<b>Laplace Transform:</b> Definition and existence of Laplace transform, properties and formulae, unit step function, Dirac Delta function, Heaviside function, inverse Laplace transform, Convolution theorem, application of Laplace transform to ordinary differential equation, solution of integral equations.	<b>10</b>
<b>II</b>	<b>Fourier Transforms:</b> Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations).	<b>9</b>
<b>III</b>	<b>Z-Transform:</b> Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	<b>7</b>
<b>IV</b>	<b>Numerical Analysis:</b> Interpolation, difference operators- forward, backward, central, shift and average operators, Newton's forward and backward interpolation formulae, Gauss's forward and backward	<b>7</b>

	interpolation formulae, Stirling's formula, Lagrange interpolation formula for unequal intervals. Inverse interpolation.	
<b>V</b>	Numerical differentiation by Newton's, Gauss's and Stirling's formula. Numerical integration: Trapezoidal Rule, Simpson's 1/3 and 3/8 Rule. Numerical solution of ODE of first order: Picard's method, Euler's method, Modified Euler's method, Runge-Kutta fourth order method, Milne's Method.	<b>7</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		<b>Pub</b>
	1. <i>Advanced Engineering Mathematics</i> , Jain and Iyengar, Narosa Publications.	<b>2011</b>
	2. <i>Engineering Mathematics for semesters III and IV</i> , C.B. Gupta, McGraw Hill Education, India.	<b>2009</b>
	3. <i>Advanced Engineering Mathematics</i> , Denis Zill and Warren Wright, Jones & Bartlett India Private Limited.	<b>2002</b>
	4. <i>Advanced Engineering Mathematics</i> , O'neil, Cengage Learning, India.	<b>2001</b>
<b>REFERENCE BOOKS</b>		
<b>SN</b>	Name of Authors /Books /Publisher	<b>Year of Pub.</b>
	1. <i>Advanced Engineering Mathematics</i> , Irvin Kreyszig, Wiley, India.	
	2. <i>Advanced Engineering Mathematics</i> , M. Greenberg, Pearson Education, India.	
	3. <i>Advance Engineering Mathematics</i> , Potter, Oxford, India.	
	4. <i>Engineering Mathematics</i> , Pal and Bhunia, Oxford, India.	
	5. <i>Higher Engineering Mathematics</i> , B. V. Ramana, McGraw Hill Education, India.	
	6. <i>Numerical Methods for Scientific &amp; Engineering Computation</i> , Jain and Iyengar, Jain, New Age International Publication, India.	
	7. <i>A First Course in Numerical Methods</i> , Uri M Asher and Chen Greif, SIAM Publication, India.	
	8. <i>Introductory Methods of Numerical Analysis</i> , S. S. Sastry, PHI Learning, I	
	9. <i>Numerical Methods for Engineers</i> , Chapra, McGraw Hill Education,	

### 3MEU7 PRODUCTION PRACTICE LAB-I

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

**0L+0T+3P**

CO1: To know the practical aspects of machining, working principle and machining process.

CO2: Learn and practice the machining operation and tools used in machining.

CO3: Understand the foundry techniques.

CO4: Learn and perform the gas, arc, spot, welding operations.

CO5: Learn to operate the machine used in manufacturing.

CO6: To know the basic concept of production technology

<b>SN</b>	<b>NAME OF EXPERIMENT</b>
	<b>Machine Shop</b>
<b>1</b>	To study lathe machine construction and various parts including attachments, lathe tools cutting speed, feed and depth of cut.
<b>2</b>	To perform step turning, knurling and chamfering on lathe machine as per drawing.
<b>3</b>	To perform taper turning (a) by tailstock offset method as per drawing (b) Using compound rest.
<b>4</b>	To prepare the job by eccentric turning on lathe machine.
<b>5</b>	To study shaper machine, its mechanism and calculate quick return ratio. To prepare a job on shaper from given mild steel rod.
	<b>Foundry Shop</b>



6	To prepare mould of a given pattern requiring core and to cast it in aluminium.
7	To perform moisture test and clay content test.
8	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
9	To perform permeability test
10	A.F.S. Sieve analysis test.
	<b>Welding Shop</b>
11	Hands-on practice on spot welding.
12	Hands-on practice on submerged arc welding
13	Hands-on practice on metal inert gas welding (MIG) and tungsten inert gas welding (TIG).

### 3MEU8 MECHANICAL ENGINEERING DRAWING AND CAD LAB

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

0L+0T+3P

CO1: Develop and present the engineering drawings as per standards (BIS).

CO2: Construct assembly drawing of various machine mechanical systems.

CO3: Develop the skills for drafting using CAD software.

CO4: Construct the orthographic views and solid models using the software.

SN	CONTENTS
	<p>Assembly drawing with sectioning and bill of materials of the following: Lathe tail stock, shaper tool head, swivel machine vice etc (1 drawing sheet of any assembly)</p> <p>Detailed part drawings from assembly drawing indicating fits, tolerances and surface finish symbols by referring BIS codes: Check-valve, Junction Valve etc</p> <p>Computer Aided Drafting: Introduction to different features of the CAD Software (AutoCAD/ProE/ Creo/Solidworks). At least one drawing problem related to</p> <ol style="list-style-type: none"> <li>2-D Drafting.</li> <li>3-D Modeling.</li> <li>3-D Advanced Modeling.</li> <li>Assembly modeling.</li> <li>Feature Modification and Manipulation</li> <li>Detailing.</li> <li>Surface Modeling</li> </ol>

TEXT BOOK		
1	Laxminarayan and M.L. Mathur, Machine Drawing, Jain Brothers	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Gill P S, Machine Drawing, Kataria & Sons	2009
2	Basudeb Bhattacharya, Machine Drawing, Oxford University Press	2011
3	Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company,	1998
4	Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS,	1995
5	Siddeshwar N., P Kannaiyah, VVS Shastry, Machine Drawing, TMH	2001

### 3MEU9: MATERIAL SCIENCE AND TESTING LAB.

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

0L+0T+2P

CO1: Discuss and inspect different microstructure of selected materials.

CO2: Determine the material properties by different test.

CO3: Demonstrate the heat treatment processes on different materials.

CO4: Summarise the behaviours of materials on different situation and loads.

CO5: Apply the knowledge of material properties in material selection for any practical problem.

SN	NAME OF EXPERIMENT
1	(a) Study of various crystals structures through models BCC, FCC, HCP, tetrahedral and octahedral voids. (b) Material identification of, say, 50 common items kept in a box.
2	Specimen preparation for metallographic examination /micro structural examination-cutting, grinding, polishing, etching.
3	Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
4	Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
5	Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
6	To perform Tensile/Compressive/Shear/torsion test on a given material and to determine its various mechanical properties under tensile/compression/Shear/torsional loading
7	To determine Rockwell/ Vickers/Brinell hardness of a given material
8	To perform Impact test on a given material and to determine its resilience.
9	To study and perform Fatigue test on a given material and to determine fatigue strength of the material
10	To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam.
11	Creep testing on creep testing machine

REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Vander Voort, Metallography: Principles and Practice, McGraw-Hill,	1984
2	Prabhudev K.H., Handbook of Heat Treatment of Steels, TMH	2000
3	Suryanarayanan, A.V.K. "Testing of Metallic materials" TMH	1993
4	Abbaschian, Physical metallurgy principles, Cengage Learning	

### 3MEU10 FLUID MECHANICS LAB

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

OL+OT+2P

CO 1 To study the concept of stabilization of floating body.

CO 2 To inquire the flow rate and various coefficients involves using different flow measuring instruments.

CO 3 To determine the various losses involves during flow of fluid in pipes.

CO 4 To calibrate the dimensionless parameter for different flow arrangements of fluid.

CO 5 To perform the characteristics and distribution of velocity profiles of fluid flowing under different conditions.

SN	NAME OF EXPERIMENT
1	Determination of Meta-centric height of a given body.
2	Determination of Cd, Cv & Cc for given orifice.
3	Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate.
4	Determination of velocity of water by Pitot tube.
5	Verification of Bernoulli's theorem.
6	Calibration and flow rate determination using Venturimeter & Orifice meter and Nozzle meter
7	Determination of head loss in given length of pipe.
8	Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.
9	Determination of Coefficient for minor losses in pipes.

*(Handwritten signatures and marks)*

10	To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
11	To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

### 3MEU11 PROFESSIONAL SKILL WORKSHOP

#### B.Tech. (Mechanical) 3<sup>rd</sup> semester

OL+OT+2P

- CO 1 Perform the activities related to self-analysis and management.  
 CO 2 Exercise the activities for managing and developing the various skills.  
 CO 3 Understand the various professional behaviour and activities.  
 CO 4 Prepare and develop the personality by performing different actions.

SN	CONTENTS
	<p><b>Personality Assessment Skills:</b> Personal SWOT Analysis activities, leveraging personal strengths, Self Evaluation, self discipline, self criticism, Mock Interviews</p> <p><b>Time Management Skills:</b> Practice by game play and other learning methodology for achieving targets and setting priorities</p> <p><b>Conflict Management Skills:</b> Learning negotiation and conflict resolution skills through simulation exercise</p> <p><b>Leadership Skills:</b> Assertiveness, Innovation &amp; Creativity, discussions on successful leaders and entrepreneurs</p> <p><b>Motivational Skills:</b> Motivational Theories and their practical applications, Ability to motivate self and others</p> <p><b>Stress Management Skills:</b> Practice different methods of Stress management, Introduction to Yoga &amp; Pranayam, Use of prayer and Meditation, Effective use of music for relieving stress and enhancing concentration &amp; consistency</p> <p><b>Group Dynamics:</b> Group Discussion, Role plays, In-Basket exercises, Video samples of mock GD</p> <p><b>Behavioural Skills:</b> Attitude and Altitude, Lateral Thinking, Psychometrics, Case study and Video samples</p>

**4MEU1: KINEMATICS OF MACHINES****B.Tech. (Mechanical) 4<sup>th</sup> semester****3L+1T**

- CO 1 Understand the mechanism and kinematic analysis of machines.  
 CO 2 Examine and understand the concept of steering mechanism used in automotive vehicles.  
 CO 3 Access the various methods of transmitting the power.  
 CO 4 Verify the laws of friction and study its applications in belt drive and clutch.  
 CO 5 Analyse the various mechanisms like gear train, slider crank, cam follower, belt drive, etc.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Kinematics:</b> Elements, pairs, mechanisms, four bar chain and its inversions,	3
	velocity and acceleration, Klein's construction, coriolis component, instantaneous center method	5
II	Synthesis of mechanisms, pantograph, scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms	5
	<b>Automotive vehicle mechanisms:</b> Overhead valve mechanism, Davis and Ackerman steering mechanism, Trifler suspension and Hooke's joint.	3
III	<b>Power transmission:</b> Belts and ropes, effect of centrifugal force, creep, chain drive	4
	<b>Friction:</b> Laws of static, dynamic and rolling friction, dry and viscous friction, inclined plane and screw jack, pivots and friction axis, bearing, Theory of film lubrication.	4
IV	<b>Brakes:</b> Band, block and band & block brakes, braking action, braking system of automobiles. <b>Clutches</b>	6
	<b>Dynamometers:</b> absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers	2
V	<b>Cams:</b> Type of cams, displacement, velocity and acceleration curves for different cam followers consideration of pressure angle and wear, analysis of motion of followers for cams with specified contours.	8
<b>TOTAL</b>		<b>40</b>

TEXT BOOK		
1	Rattan, S.S., "Theory of Machines", 2nd Ed., Tata McGraw Hill	2006
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Bevan, T., "Theory of Machines", Pearson Education.	2013
2	Uicker, J.J., Pennocle, G.R, and Shigley, J.E, "Theory of Machines and Mechanisms", 3rd Ed., Oxford University Press.	2009
3	Ambekar, A. G., "Mechanism And Machine Theory", Prentice-hall Of India	2007
4	Ghosh, A., "Theory of Mechanisms and Machines", Affiliated East West Press.	
5	Singh, S., "Theory of Machines", Pearson Education	2013
6	Stanisic., "Mechanisms and Machines-Kinematics, Dynamics & Synthesis", Cengage leasrning	2014

**4MEU2 IC ENGINE****B.Tech. (Mechanical) 4<sup>th</sup> semester****3L+0T**

- CO1: Understand engineering involved in using engines, various testing and performance parameters.

- CO2: Learn about characteristics and concept supercharging.  
 CO3: Examine various fuel supply systems and various ignition systems.  
 CO4: Apply principles of engine friction and different lubrication methods.  
 CO5: Analyse multi fuel engines, special engines.

UNIT	CONTENTS	CONTACT HOURS
I	<b>History of IC engines:</b> Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles.	4
	<b>Testing &amp; Performance:</b> Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission.	4
II	<b>Fuel &amp; Combustion:</b> Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber.	4
	<b>Fuel:</b> Conventional Petroleum, structure, Refining Fuels for SI & CI engines, Knock rating, Additives, Fuels for Turbine & Jet Propulsion.	2
	<b>Alternative Fuels:</b> Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.	2
III	<b>Engine Systems &amp; Components:</b> Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburetors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations.	3
	<b>CI engine:</b> Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors.	2
	<b>Ignition system:</b> Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs.	3
IV	<b>Engine Friction &amp; Lubrication :</b> Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	5
	<b>Supercharging:</b> Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines.	3
V	<b>Dual &amp; Multi fuel engines:</b> Principle, fuels, Combustion, performance Advantages, Modification in fuel system.	4
	<b>Special Engines:</b> Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.	4
		40

TEXT BOOK	
1	Mathur & Sharma, Internal Combustion Engines, Dhanpat Rai & Sons
REFERENCE BOOKS	

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SN	Name of Authors /Books /Publisher	Year of Pub.
1	Gupta H.N., Fundamentals of Internal Combustion Engines, Prentice Hall of India	
2	F.Edward Obert, Internal Combustion Engines, Harper and Raw Publisher.	
3	John B. Heyword, Internal Combustion Engines Fundamentals, McGraw Hill	
4	Lichty, Internal Combustion Engines, McGraw Hill.	
5	Gill, Smith, Ziurs, Fundamentals of Internal Combustion Engine, Oxford & IBH Publishing	
6	Rogowsky, IC Engines, International Book Co.	
7	Ganeshan, V., Internal Combustion Engine, Tata Mc Graw Hill.	
8	R. Yadav, I.C Engine, Central Publishing House, Allahabad	

### 4MEU3 MACHINING AND MACHINE TOOLS

#### B.Tech. (Mechanical) 4<sup>th</sup> semester

3L+0T

CO1: Acquires the fundamental knowledge and principles in material removal processes.

CO2: Demonstrate the fundamentals of machining, finishing, SPM processes and machine tools.

CO3: Evaluate the importance of input and output metal cutting parameters.

CO4: Learn about tool materials, cutting fluid and tool wear mode / mechanism.

CO5: Understand and analyse about high velocity forming methods.

Unit	Contents	Contact Hours
I	Classification of metal removal process and machines: Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS. Concept of orthogonal and oblique cutting.	
	Type of chips, Mechanics of metal cutting; interrelationships between cutting force, shear angle, strain and strain rate. Thermal aspects of machining and measurement of chip tool interface temperature.	
II	Concept of machinability, machinability index, factors affecting machinability, Different mechanism of tool wear. Types of tool wear (crater, flank etc), Concept of tool life.	
	Taylor's tool life equation. Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods	
III	Basic machine tools: Constructional configuration, estimation of machining time on lathe, drilling, shaping, milling, grinding, Gear cutting on milling, Gear hobbling.	
	Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines, operational planning and turret tool layout, sequence of operations.	
IV	Introduction to Grinding and different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications. Honing, lapping, super-finishing.	
V	High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.	

#### TEXT BOOK

1	Rao. P.N., Manufacturing Technology, Vol. 1,2 and 3, Tata McGraw Hill	2013
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#### REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Lal G.K., Introduction to Machining Science, New Age international	2007

	Publishers.	
2	Ghosh, A., & Mallik, A. K. 1986. Manufacturing Science: East West Press Private Limited.	1999
3	Schey, Introduction to Manufacturing Processes, Tata McGraw Hill	2000
4	Kalpakjian, S., & Schmid, S. R., Manufacturing processes for engineering materials, Pearson Education.	2008
5	Pandey & Singh, Production Engineering Science, Standard Publishers Distributer, Delhi.	1999
6	Stephenson, D. A., & Agapiou, J. S. Metal cutting theory and practice: CRC Taylor & Francis.	2006
7	Karl H.Heller, All About Machine Tools, Wiley Eastern Ltd., New Delhi	1972
8	Kalpakjian, S. & Schmid S.R, Manufacturing Engineering and Technology, Addison Wesley Pub. Co.	2000
9	Sen, G. C., & Bhattacharyya, A. Principles of Machine Tools: New Central Book Agency	1988
10	Bhattacharyya A, Theory & Practice of Metal Cutting, New Central Book Agency	2006
11	Shan, H.S., Manufacturing Process, Pearson Education.	2012
12	Boothroyd, G., & Knight, W. A. Fundamentals of machining and machine tools: Taylor and Francis.	2006
13	Milton C. Shaw, Metal Cutting Principles, CBS Publishers.	2005
14	Trent, E. M. Metal cutting: Butterworth Heinemann	2000

#### 4MEU4 DESIGN OF MACHINE ELEMENTS – I

##### B.Tech. (Mechanical) 4<sup>th</sup> semester

3L+0T

CO 1 Learn the material properties, coding and consideration for selecting the material.

CO 2 Apply concept of FBD to identify the load on each machine element/members of mechanical system.

CO 3 Analyse the machine members under application of external load.

CO 4 Evaluate the size/dimension of the machine members on the basis of failure theories.

CO 5 Develop skills to design a mechanical system.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Materials:</b> Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects.	3
	<b>Manufacturing Considerations in Design:</b> Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.	4
II	<b>Design for Strength:</b> Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures.	4
	<b>Design of Members subjected to direct stress:</b> pin, cotter and keyed joints.	5
III	<b>Design of Members in Bending:</b> Beams, levers and laminated springs. <b>Design for stiffness of beam:</b> Use of maximum deflection formula for various end conditions for beam design	7
IV	<b>Design of Members in Torsion</b> <b>Shaft and Keys:</b> Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys.	5
	<b>Couplings:</b> Design of muff coupling, flanged couplings: rigid and flexible	3

<b>V</b>	<b>Design of Threaded fasteners:</b> Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading	<b>4</b>
	Power screws like lead screw, screw jack	<b>2</b>
	Design of members which are curved like crane hook, body of C-clamp, machine frame etc.	<b>3</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Bhandari, V. B., Introduction to Machine Design, McGraw Hill Education (India)	<b>2013</b>
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Bahl and Goel, Mechanical Machine Design, Standard Publishers Distributors	<b>2002</b>
<b>2</b>	Shigley, Joseph E., Mechanical Engineering Design, McGraw Hill Education (India)	<b>2002</b>
<b>3</b>	Sharma and Aggarwal, Machine Design, S.K.Kataria and Sons, Delhi.	<b>1997</b>
<b>4</b>	Sharma and Purohit, Design of Machine Elements, Prentice Hall India.	<b>2002</b>
<b>5</b>	Jindal U C, Machine Design, Pearson Education India	<b>2010</b>

#### 4MEU5: INDUSTRIAL ENGINEERING

##### B.Tech. (Mechanical) 4<sup>th</sup> semester

**3L+0T**

CO1: Learn the basic concepts of industrial engineering.

CO2: Gain understanding of procedure of work study, forms of business, financial aspect like time value of money, financial statement and depreciation.

CO3: Apply the tool and techniques of work study, financial analysis for improvement of productivity

UNIT	CONTENTS	CONTACT HOURS
<b>I</b>	Concept and definition of Industrial Engineering, Historical development of IE, Role of Industrial Engineer, Applications of IE. Concept of Productivity, Work Study and Productivity,	<b>3</b>
	Techniques of work study, basic procedure, approach to method study, method study charts and diagrams, principles of motion economy,	<b>4</b>
<b>II</b>	Work measurement; basic procedure, techniques: Stop watch time study and work sampling, rating, determination of standard time	<b>4</b>
	Evolution of Management Theory, scientific management, Contributions of Taylor, Fayol, Mayo to scientific management, Levels of Management, Administration and Management, fundamental functions of management, Decision making.	<b>4</b>
<b>III</b>	Business Forms and Organization: Forms of Business: Single proprietorship, partnership, joint stock company, co-operative society, State undertakings, Joint Stock Companies: Organization: meaning, Types of organization; Line, Functional, Line Staff organization and line Staff Committee organization, span of control.	<b>5</b>
	Finance & Financial Statements: Introduction, Needs of Finance, Kinds of Capital, Sources of fixed capital, Shares. Borrow capital, surplus profits.	<b>3</b>
<b>IV</b>	Sources of working capital and its management, Profit & Loss Statement, Balance Sheet, Financial ratios: Liquidity ratio, Profits investment ratio, equity ratio, inventory ratio.	<b>5</b>
	Time value of money: Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation	<b>4</b>



	of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal life, comparison of deferred investments,	
	Time value of money II: Future worth comparison, payback period comparison. Rate of return, internal rate of return, comparison of IRR with other methods	<b>3</b>
<b>V</b>	Depreciation: Causes, Basic methods of computing depreciation charges; Straight line, Sinking fund, Declining Balance and Sum of year's digits method.	<b>3</b>
	Breakeven analysis: Basic concepts, Linear Breakeven analysis for single product, Breakeven charts, Dumping.	<b>2</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Motion and Time Study and Measurement of Work, Ralph, M Barnes, John Wiley and Sons.	2001
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Pub.</b>
<b>1</b>	Introduction to Work Study, George Kanawaty, ILO.	2002
<b>2</b>	Prasad, L.M., Principles and practice of Management, Sultan Chand	2015
<b>3</b>	Sushil Kumar Basu, K. C. Sahu, N. K. Datta, Works Organisation & Management, Oxford & IBH.	2002
<b>4</b>	Dexter S. Kimball, Principles of Industrial Organization, Read Books.	2009
<b>5</b>	Leon Pratt Alford, Henry Russell Beatty, Principles of Industrial Management, Revised Edition, Ronald Press Co.	2001
<b>6</b>	Essentials of Industrial Management, McGraw-Hill Industrial organization and management series, Lawrence L. Bethel, McGraw-Hill.	2003
<b>7</b>	Riggs, J.L., Bedworth, D.J., Randhawa, S.U., Engineering Economics, Tata McGraw-Hill.	2006
<b>8</b>	Raju, Industrial Engg and Management, Cengage learning	2015

#### 4MEU6 ADVANCED ENGINEERING MATHEMATICS II

##### **B.Tech. (Mechanical) 4<sup>th</sup> semester**

**3L+1T**

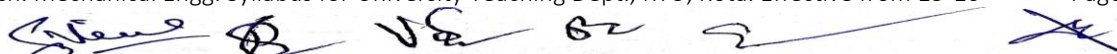
CO1: Solve various functions through complex analysis.

CO2: Apply different series and theorem to solve complex integrals.

CO3: Understand various special functions.

CO4: Analyze various probability methods and distributions.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
	<b>Complex Analysis:</b> Differentiability and Analytic functions, Cauchy-Riemann equations (Cartesian and Polar forms), Harmonic functions. Conformal mapping.	
	Complex Line integral, M-L inequality, Cauchy theorem, Morera's theorem, Cauchy integral formulae, Taylor series and Laurent series. Singularities and Zeros, residues at poles and infinity, residues at isolated essential singular point, Cauchy residue theorem, evaluation of real definite integrals and improper integrals.	
	<b>Special Functions:</b> Legendre's function, Rodrigues formula, generating function, Simple recurrence relations, orthogonal property. Bessel's functions of first and second kind, generating function, simple recurrence relations, orthogonal property.	
	<b>Statistics &amp; Probability:</b> Basic concepts of probability, conditional probability, Baye's theorem. Random variable and distributions: Discrete and continuous random variables, Moments, Expectation,	



	Moment generating function, Binomial, Poisson and Normal distribution.	
<b>TEXT BOOK</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
1	Advanced Engineering Mathematics, Jain and Iyengar, Narosa Publications.	
2	Advanced Engineering Mathematics, Denis Zill and Warren Wright, Jones & Bartlett India Private Limited.	
3	Introduction to Probability and Statistics, Seymour Lipschutz and John J. Schiller, McGraw Hill Education, India.	
4	Advanced Engineering Mathematics, O'neil, Cengage Learning, India.	
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
1	Advanced Engineering Mathematics, Irvin Kreyszig, Wiley, India.	
2	Advanced Engineering Mathematics, M. Greenberg, Pearson Education, India.	
3	Advance Engineering Mathematics, Potter, Oxford, India.	
4	Engineering Mathematics, Pal and Bhunia, Oxford, India.	
5	Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, India.	
6	Complex Variables and Applications, J.W. Brown & R.V. Churchill, McGraw Hill Education, India.	
7	Probability and Statistics, Murray Spiegel, John Schiller, R. AluSrinivasan, McGraw Hill Education, India.	
8	Engineering Mathematics, Paras Ram, CBS Publisher, India.	

#### 4MEU7: PRODUCTION PRACTICE LAB.-II

**B.Tech. (Mechanical) 4<sup>th</sup> semester**

**OL+OT +3P**

CO1: Acquire knowledge about the mechanism of chip formation.

CO2: Make decisions on various cutting parameters for different materials in various machining operations.

CO3: Understanding of metal forming calculations such as rolling, extrusion, shearing and punching.

Unit	Name Of Experiment
1	To study of single point cutting tool geometry and to grind the tool as per given tool geometry.
2	To study the milling machine, milling cutters, indexing heads and indexing methods and to prepare a gear on milling machine.
3	To machine a hexagonal /octagonal nut using indexing head on milling machine.
4	To cut BSW/Metric internal threads on lathe machine.
5	a) To cut multi-start Square/Metric threads on lathe machine. b) Boring using a boring bar in a centre lathe.
6	Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
7	Demonstration on milling machine for generation of plane surfaces and use of end milling cutters.
8	Grinding of milling cutters and drills.
9	Exercise on cylindrical and surface grinders to machine surfaces as per drawing.
10	Cylindrical grinding using grinding attachment in a centre lathe

### 4MEU8 MACHINE DESIGN SESSIONAL-I

**B.Tech. (Mechanical) 4<sup>th</sup> semester**

**OL+OT +3P**

CO 1 Know the material properties, coding and design consideration for selecting the material.

CO 2 Apply the concept of FBD to evaluate the loads on a machine element.

CO 3 Learn the efficient design criteria (design for strength and stiffness).

CO 4 Apply the concept of designing under static load to various machine elements like shaft, shaft coupling, pin-joints, levers, etc.

SN	Sessional Work	Contact Hours
1	Material selection and relevant BIS nomenclature	
2	Selecting fit and assigning tolerances	
3	Examples of Production considerations	
4	Problems on:	
	(a) Knuckle & Cotter joints	
	(b) Torque: Keyed joints and shaft couplings	
	(c) Design of screw fastening	
	(d) Bending: Beams, Levers etc.	
	(e) Combined stresses: Shafts, brackets, eccentric loading.	

#### TEXT BOOK

1. Design Data Book, PSG College of Technology

### 4MEU9 THERMAL ENGINEERING LAB-I

**B.Tech. (Mechanical) 4<sup>th</sup> semester**

**OL+OT +2P**

CO1: Study of cut section models of different IC engines.

CO2: Understand various types of boilers, mountings and accessories.

CO3: Demonstration of different braking, transmission, fuel supply, lubrication, cooling and ignition systems.

CO4: Learn to draw valve timing diagram for single cylinder diesel engine.

Unit	Name Of Experiment
1	Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models
2	Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.
3	To draw valve timing diagram for a single cylinder diesel engine.
4	Study of various types of boilers.
5	Study of various types of mountings and accessories.
6	Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
7	Study of braking system with specific reference to types of braking system, master cylinder, brake shoes.
8	Study of transmission system including clutches, gear box assembly and differential.
9	Study of fuel supply system of a petrol engine (fuel pump and simple carburetor)
10	Study of fuel supply system of a Diesel engine (fuel pump and fuel injector)
11	Study of Ignition systems of an IC Engine (Battery and Magneto ignition system) and Electronic ignition system.
12	Study of Lubrication system of an IC Engine (mist, splash and pressure lubrication)
13	Study of cooling systems of an IC Engine (air cooling and water cooling)

#### 4MEU10: BASIC MECHANICAL ENGINEERING LAB

**B.Tech. (Mechanical) 4<sup>th</sup> semester**

**OL+OT +2P**

CO1: Demonstrate and explain the wide range of application of basic mechanical engineering systems.

CO2: Explain the construction of various mechanical machines by assembly and disassembly concept.

CO3: Determine and identify the specifications of machines.

CO4: Presentation to write on experiment performed.

SN	LABORATORY WORK
	Exposure to a wide range of applications of mechanical engineering through a variety of activities, including hands-on assembly and disassembly of machines, such as, bicycle, sewing machine, pumps, engines, air-conditioners, machine-tools, amongst others; observational study of complex systems via cut sections, visits, videos and computer simulations; design of simple machines/systems including specifications formulation; visits to industries.
	Note: Student will be required to submit written report indicating the learning achieved by Hands on assembly/Disassembly.

#### 4MEU11 BUSINESS COMMUNICATION LAB

**B.Tech. (Mechanical) 4<sup>th</sup> semester**

**OL+OT +2P**

CO 1 Understand the basic terminologies of business communication.

CO 2 Know the pattern of different business letters and formats used in written communications.

CO 3 Practice various body language and skills relevance for business through videos and teleconferencing.

CO 4 Exercise the way of presentation using proper communication methods.

UNIT	NAME OF EXPERIMENT
1	Business English - Business terminology, antonyms, synonyms, business communication etiquettes pertaining to different culture- Middle East, Japanese, American, European. Common communication errors related to verb, adjective, adverb, prepositions, conjunctions, interrogation, tense, gender, number etc., common pronunciation errors.
2	Practices of appreciation, motivation, criticism
3	Different types of Business Letters- their format and suitability.
4	Other forms of written communication – different situations and formats for issuing notices, memos etc. Format of invoice, offer letters, export-import documents like Letter of Credit, Bills of Exchange.
5	Oratory Skills – Structure of different types of business speeches, public speaking, Voice modulation. Quotations by prominent business personalities – case studies to justify their relevance.
6	Body language – Appropriate body postures in standing or sitting position, body movements during presentations and speeches, gestures, facial expressions, eye movements in response to different situations. Video samples
7	Demonstrating Video conferencing & teleconferencing in the class.
8	Data Interpretation and report writing: Short and Long reports: Report presentation methods, ex: Power Point Presentation, etc
	Students should read the foll. book & make presentation, carry out activities and exercises keeping the content in focus. “You Can Win” by Shiv Kherra.
	Reference Books: 1. Chaturvedi P. D., & Chaturvedi M. (2013). Business Communication: Skills, Concepts, and Applications. South Asia, Dorling Kindersley (India) Pvt. Ltd. 2. Ober S. (2004). Contemporary Business Communication. New Delhi, Biztantra, An Imprint of Dreamtech Press. 3. Ray R. (2004). Communication Today: Understanding Creative Skill. Mumbai, Himalaya Publishing House.

## 5MEU1 HEAT TRANSFER

**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**3L+1T**

CO1: Understand the modes of heat transfer.

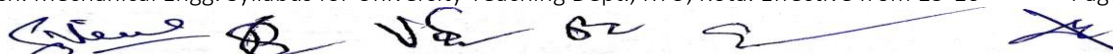
CO2: Evaluate the performance factors to select the process and product of heat transfer.

CO3: Optimize the heat exchangers.

CO4: Demonstrate and examine the existing correlations.

UNIT	CONTENTS	CONTACT HOURS
<b>I</b>	<b>Introduction:</b> Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient.	<b>4</b>
	<b>Conduction:</b> General 3-Dimensional conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation	<b>3</b>
<b>II</b>	<b>Heat transfer from extended surfaces:</b> Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions.	<b>3</b>
	Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart.	<b>2</b>
	<b>Convection:</b> Review of Navier – Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.	<b>4</b>
<b>III</b>	<b>Natural convection:</b> Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.	<b>4</b>
	<b>Heat transfer with change of phase:</b> Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation.	<b>4</b>
<b>IV</b>	<b>Heat exchanger:</b> Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.	<b>8</b>
<b>V</b>	<b>Thermal Radiation:</b> Plank distribution law, Krichoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.	<b>8</b>
		<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	J.P. Halman, Heat Transfer, Mc Graw Hill	
<b>REFERENCE BOOKS</b>		
SN	Name of Authors / Books / Publisher	Year of Pub.
<b>1</b>	Incropera and Dewitt, Fundamental of Heat and Mass transfer, John Wiley	<b>2007</b>
<b>2</b>	Cengel, Heat and Mass transfer, Mc Graw Hill	<b>2011</b>
<b>3</b>	M.Thirumaleshwar, Fundamental of Heat and Mass Transfer, Pearson Education	<b>2006</b>



4	Ozisk, Heat and Mass Transfer, Mc Graw Hill	2009
5	Rolle, Heat and Mass Transfer, Cengage learning	2016

### 5MEU2: DYNAMICS OF MACHINES

**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**3L+1T**

CO1: To understand different types of machine elements and mechanisms.

CO2. Demonstrate the various principles involved in the working of machine elements.

CO3: Acquire the knowledge of standard gearing practice and able to compare and analyze various gear profiles and types.

CO4: Implement & Examine the concept of balancing for machine elements.

CO5: Compute & Evaluate the performance of machine elements.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Governors:</b> Comparison between flywheel and governor, Types of governor, Watt, Porter, Proell, Hartnell and spring controlled governors, sensitiveness of governors, stability of governors, isochronous and hunting, governor effort, power, controlling force diagram.	8
II	<b>Gyroscope:</b> Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on aeroplanes, ships and vehicle taking a turn, stabilization of sea vessels, stability of four wheeled vehicle moving in a curved path, curved path with banking, stability of two wheeled vehicle, gyroscopic effect on inclined rotating disc	5
	<b>Inertia force analysis:</b> Velocity and acceleration of slider crank and four bar mechanism, inertia force, piston thrust and forces on connecting rod, turning moment diagram, flywheel.	3
III	<b>Gears:</b> Classification, terminology, law of gearing, velocity of sliding, gear tooth profile, comparison of cycloidal and involute tooth profile, standard interchangeable tooth profile, length of path of contact, arc of contact, contact ratio, interference, undercutting, minimum number of teeth on pinion in contact with gear or rack, bevel, helical and spiral gears.	9
IV	<b>Gear Trains:</b> Simple, compound, reverted and epicyclic gear trains, analytical, tabular, graphical and vector methods for finding velocity ratio, gear boxes- sliding and constant mesh, synchromesh and differential gear box.	7
V	<b>Balancing:</b> Need of balancing, Balancing of rotating masses, single plane, different planes, balancing of reciprocating masses, single cylinder engine, multi-cylinder inline engines, V-engines, concept of direct and reverse cranks, partial balancing of locomotives, IC engines, V engines and balancing machines.	8
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		
1	Rattan, S.S., "Theory of Machines", 2nd Ed., Tata McGraw Hill.	2006
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Bevan, T., "Theory of Machines", Pearson Education.	2013
2	Uicker, J.J., Pennocle, G.R, and Shigley, J.E, "Theory of Machines and Mechanisms", 3 <sup>rd</sup> Ed., Oxford University Press.	2009
3	Ambekar , A. G., "Mechanism And Machine Theory", Prentice-hall Of India	2007
4	Ghosh, A., "Theory of Mechanisms and Machines", Affiliated East West Press.	
5	Singh, S., "Theory of Machines", Pearson Education	2013

### 5MEU3: QUALITY ASSURANCE AND RELIABILITY

**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**3L+0T**

CO1: Understand the basics of quality and SQC methodologies.

CO2: Use the various tools for continuous improvement in the system using SPC concepts.

CO3: Learn the quality assurance and quality systems like ISO-9000 and TQM.

CO4: Determine the reliability, availability and maintainability of the system.

CO5: Analyze robustness in the systems using design of experiments and Taguchi methods.

UNIT	CONTENTS	CONTACT HOURS
I	The meaning of Quality and quality improvement dimensions of quality, history of quality methodology, quality control, Quality of design and quality of conformance, Quality policy and objectives, Economics of quality.	5
	Modeling process quality: Describing variation, frequency distribution, continuous and discrete, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance.	4
II	Statistical Quality Control: Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, analysis of patterns on control charts. The magnificent seven.	4
	Control chart for variables,: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts.	4
III	Control chart for attributes: control chart for fraction non conforming P-chart, np-chart, c-chart and u-chart. Demerit systems, choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma.	7
IV	Quality Assurance: Concept, advantages, field complaints, quality rating, quality audit.	2
	Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ.	4
	Introduction to Quality systems like ISO 9000 and ISO 14000.	2
V	Reliability and Life Testing- Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability	4
	Introduction to Taguchi Method of Design of Experiments, Quality loss function.	4
<b>TOTAL</b>		<b>40</b>

TEXT BOOK		
1	Introduction to Statistical Quality Control, Douglas C. Montgomery, 2nd Edition, Wiley.	1991
2	Charles E. Ebeling, An introduction to reliability and maintainability engineering, Tata McGraw-Hill Education.	2004
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Quality Planning and Analysis, J.M.Juran and F.M. Gryna, McGraw Hill	
2	Quality Control, Dale H. Besterfield, 8th Edition, Pearson/Prentice Hall	2008

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3	Statistical Quality Control, E. L. Grant and Richard S. Leavenworth, Tata McGraw-Hill	2000
4	Fundamentals of Quality Control and Improvement, Amitava Mitra, 2nd Edition, Prentice Hall	1998
5	Design and Analysis of Experiments, 5th Edition, Douglas C. Montgomery, Wiley-India	2007

#### 5MEU4: DESIGN OF MACHINE ELEMENTS- II

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

3L+0T

- CO 1 To account the static and dynamic loading conditions in different materials.  
CO 2 To design for various components and analyse the stresses induced in them.  
CO 3 To conduct the force analysis on different power transmitting components.  
CO 4 To apply and examine the elements under different operating conditions.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Fatigue Considerations in Design:</b> Variable load, loading pattern, endurance stresses, Influence of size, surface finish, notch sensitivity and stress concentration.	3
	Goodman line, Soderberg line, Design of machine members subjected to combined, steady and alternating stresses.	3
	Design for finite life, Design of Shafts under Variable Stresses, Bolts subjected to variable stresses.	2
II	<b>Design of IC Engine components:</b> Piston, Cylinder, Connecting Rod and Crank Shaft.	8
III	Design of helical compression, tension, torsional springs, springs under variable stresses.	4
	Design of belt, rope and pulley drive system,	4
IV	<b>Design of gear teeth:</b> Lewis and Buckingham equations, wear and dynamic load considerations.	4
	Design and force analysis of spur, helical, bevel and worm gears, Bearing reactions due to gear tooth forces.	4
V	<b>Design of Sliding and Journal Bearing:</b> Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium.	4
	<b>Selection of anti-friction bearings</b> for different loads and load cycles, Mounting of the bearings, Method of lubrication.	4
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		
1	Design of Machine Elements, Bhandari V.B, 3rd Ed., Tata McGraw-Hill, New Delhi	2010
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Machine Design, Sharma and Aggarwal, Kataria and Sons, Delhi.	1997
2	Mechanical Engg Design, Shigley, Mischke, Budynas and Nisbett, Tata McGraw-Hill	2002
3	PSG Design Data Book, P.S.G. College of Technology, Coimbatore.	1966
4	A Text Book of Machine Design, Karwa A., Laxmi Publication.	2002
5	Machine Design, Hall, Holwenko and Laughlin, Schaum's Outlines Series, Tata McGraw Hill.	

*(Handwritten signatures and marks)*



## 5MEU5: OPERATIONS RESEARCH

**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**3L+0T**

CO1 Understand the concepts of operations research modeling approaches by formulating and solving engineering and managerial situations as LPP.

CO2 Evaluate engineering and managerial situations as Transportation and Assignment problems.

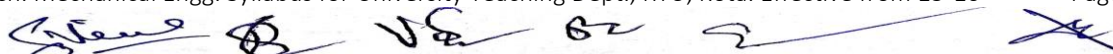
CO3 Understand game, queuing and decision theories

CO4 Solve Integer programming problems.

CO5 Simulate and analyse engineering and managerial problems

UNIT	CONTENTS	CONTACT HOURS
I	<b>Overview of Operations Research</b>	1
	<b>Linear Programming:</b> Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis.	4
	Transportation Model and Assignment Model including travelling salesman problem.	4
II	<b>Integer Linear Programming:</b> Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming.	5
	<b>Replacement Models:</b> Capital equipment replacement with time, group replacement of items subjected to total failure.	3
III	<b>Queuing Theory:</b> Analysis of the following queues with Poisson pattern of arrival and exponentially distributed service times, Single channel queue with infinite customer population, Multichannel queue with infinite customer population,	3
	<b>Competitive Situations and Solutions:</b> Game theory, two person zero sum game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy, approximate solution, and simplified analysis for other competitive situations. Application of linear programming	4
IV	Theory of Decision making: Decision making under certainty, risk and uncertainty. Decision trees.	5
	<b>Deterministic Inventory control models:</b> functional role of inventory, inventory costs, model building, Single item inventory control model without shortages, with shortage and quantity discount. Inventory control model with uncertain demand, service level, safety stock, P and Q systems, two bin system. Single period model. Selective Inventory control techniques.	4
V	<b>Probabilistic Inventory control models:</b> Instantaneous demand without setup cost and with setup cost, Continuous demand without setup cost	4
	<b>Simulation:</b> Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of Normal Random numbers. Use of random numbers for system simulation. , Monte Carlo simulation, simulation language ARENA, Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems	4
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		
1	Operations Research, Ravindran, Phillips and Solberg, Wiley India.	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.



1	Introduction to Operations Research, Hillier F.S. and Lieberman G.J., CBS Publishers.	
2	Operations Research, Taha H.A., Pearson Education	
3	Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali, Wiley India.	
4	Principles of Operations Research, Wagner H.M., Prentice Hall of India.	
5	Operations Research, Gupta and Heera, S. Chand Publications.	

### SMEU6.1: AUTOMOBILE ENGINEERING

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

**3L+0T**

CO1 Understand the basic lay-out of an automobile.

CO2 Classify automobiles according to variety developed.

CO3 Deal with automobile's operating systems.

CO4 Develop and apply the new safety measures.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Frame &amp; Body:</b> Layout of chassis, types of chassis frames and bodies, their constructional features and materials.	<b>3</b>
	<b>Clutches:</b> single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. <b>Brakes:</b> Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials.	<b>5</b>
II	<b>Gear Boxes:</b> Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter;	<b>4</b>
	<b>Drives:</b> Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive.	<b>4</b>
III	<b>Wheels and Tyres:</b> Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre,	<b>2</b>
	<b>Steering system:</b> steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types	<b>3</b>
	<b>Suspension system:</b> objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers.	<b>3</b>
IV	<b>Automotive Electrical System:</b> Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification.	<b>4</b>
	<b>Ignition System:</b> Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.	<b>4</b>
V	<b>Automotive Air Conditioning:</b> Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis.	<b>4</b>
	<b>Automotive Safety:</b> Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)	<b>4</b>
<b>TOTAL</b>		<b>40</b>

#### TEXT BOOK

1	RP SHARMA, A Course in Automobile Engineering, Dhanpat Rai & Sons	
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2	P S Gill, A Text book of Automobile Engineering, KATSON Books VOL 1&2	2010
3	Kirpal Singh, Automobile Engineering, Standard	2003
<b>REFERENCE BOOKS</b>		
<b>S N</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
1	R K Rajpoot, A Text book of Automobile Engineering, Laxmi Publications	2007
2	Jornsen Reimpell, Helmut Stoll, The Automotive Chassis: Engineering Principles, Jurgen Betzler (P) Ltd,	2001

### 5MEU6.2: CNC MACHINES AND PROGRAMMING

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

3L+0T

CO1: Understand applications and advantages of CNC machines and technology.

CO2: Identify the applications of CNC to industrial processes.

CO3: Identify and understand the basic programming codes and calculation of CNC Machining Parameters.

CO4: Learn NC software's, Sensors, NC modelling & Simulation and Robotics.

CO5: Know the basics of Adaptive control, FMS, CAM and Rapid Product Development

UNIT	CONTENTS	CONTACT HOURS
I	Introduction: Definition of NC, Applications of NC, Historical Developments in Automation, Classification of NC Systems, Comparison of NC and Conventional Machines, Advantages of NC	8
II	NC Hardware: Architecture of NC Systems, Design Considerations, Mechanical Elements, Structure, Guideways and Slides, Guideway Elements, Transmission Systems, Spindle Unit, Coolant system, Lubrication System, Tool and work Changing Mechanisms, Electrical Elements, Drives, Sensors, Control Loops, Computing Elements/ Firmware, Interpolators	8
III	NC Software: Introduction, Manual Part Programming, Computer-Assisted Part Programming, Language Based, Geometric Modeling Based, Automatic Part Program Generation,	8
IV	CAPP Systems, 5 Axis Programming, Post-Processing, Programming Robots and CMMs	4
	NC Simulation, Kinematic simulation, Volumetric simulation, Applications of Volumetric NC Simulation, Verification	4
V	Advanced Topics:, Adaptive Control, Off-line adaptive control, Various optimisation criteria, Hardware Based AC, Software Based AC, Tooling and Instruments for NC Special Considerations in High Speed Cutting (HSC) and Die Sinking, Rapid Product Development, CAM, FMS, CIM	8
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
1	Krar S. and Gill A., CNC: Technology and Programming, McGraw Hill	1990
<b>REFERENCE BOOKS</b>		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Koren Y., Computer Control of Manufacturing Systems, Tata McGraw Hill.	1983
2	Pressman R.S. and Williams J.E., Numerical Control and Computer-Aided Manufacturing, John Wiley & Sons	1977,
3	Jones B.L., Introduction to Computer Numerical Control, John Wiley & Sons.	1986
4	Kral I.H., Numerical Control Programming in APT, Prentice-Hall	1986

5	Chang C.H. and Melkanoff M.A., ,NC Machine Programming and Software Design, Prentice-Hall	1986
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### 5MEU6.3: MANAGEMENT INFORMATION SYSTEM

**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**3L+0T**

UNIT	CONTENTS	CONTACT HOURS
I	Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information,	3
	Cost & value of information, Various channels of information & MIS.	2
II	Foundation of Information System : Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System,	4
	Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc.	4
III	Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations,	5
	Information system for managerial Decision Support, Information System for Strategic Advantage	5
IV	Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change..	4
	Reports: Various types of MIS reports, GUI & Other Presentation tools	4
V	Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics.	5
	Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies.	4
<b>TOTAL</b>		<b>40</b>

#### TEXT BOOK

1	Information systems for Modern Management, G.R.Murdick, Prentice Hall of India	
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#### REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Management Information systems, S. Sadagopan, Prentice Hall of India	
2	Management Information Systems, Effy Oz, Cengage Learning	
3	Management Information Systems, James A O Brien, Irwin McGraw Hill	
4	Management Information Systems, Laudon and Laudon, Prentice Hall of India	

### 5MEU6.4: INTRODUCTION TO AERONAUTICS

**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**3L+0T**

UNIT	CONTENTS	CONTACT HOURS
I	<b>History of aviation and space flight:</b> Brief history of flight vehicle development with emphasis on key ideas: Indian aerospace activities	8

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	Classification of aircraft and space vehicles; Functions of major components of airplane and space vehicles <b>Standard Atmosphere:</b> Definition of altitude, the hydrostatic equation, Relation between geopotential and geometric altitudes, Definition of standard atmosphere, Pressure, Density & temperature altitudes	
<b>II</b>	<b>Airfoils and Wings:</b> Introduction of principles of flights: Principles of generation of lift, Basic characteristics of airfoils, NACA nomenclature, propagation of sound, Lift, drag and moment coefficients, centre of pressure, Attached Flow and Separated Flow, Bluff bodies v/s streamlined body, airfoil. Lift generation, significance of L/D ratio. Aerodynamic forces. Types of Drag, Infinite and Finite Wings, Pressure Coefficient primary control surfaces- Elevator, Aileron, stabilators and rudder. Secondary control surfaces-Trim Tabs, Flaps, Spoilers, Air-Brakes, Slats-Slots.	<b>8</b>
<b>III</b>	<b>Airplane Performance:</b> Introduction, Equation of motion, Thrust required for level unaccelerated flight, Thrust available and maximum velocity, Power required for level unaccelerated flight, Power available and maximum velocity for jet engine and reciprocating engine-propeller combination, Altitude effect on power required and available, Rate of climb, Gliding flight, Absolute and service ceilings, Time to climb, Range & endurance for propeller driven airplane and jet engine driven airplane, take-off and landing	<b>8</b>
<b>IV</b>	<b>Principles of Stability and Control:</b> Introduction, Definitions of Stability & Control, Moments on Airplane, Absolute angle of attack, Criteria for longitudinal static stability	<b>4</b>
<b>V</b>	<b>Aircraft structure and propulsion</b> General types of construction, Monocoque, semi-monocoque and geodesic construction, Typical wing and fuselage structure. Mechanism of thrust production – propellers – jet engines. Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications.	<b>8</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Anderson, J. D., Introduction to Flight, McGraw-Hill Professional	2005
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Anderson, J. D., The Aeroplane, a History of its Technology, AIAA Education Series,	2002
<b>2</b>	Ojha S.K., Flight Performance of Aircraft, AIAA Education Series,	1995
<b>3</b>	Kermode,A.C., 'Flight without Formulae', McGraw Hill,	1987.
<b>4</b>	Shevell,R.S., Fundamentals of flights, Pearson education	2004.

### 5MEU7 HEAT TRANSFER LAB

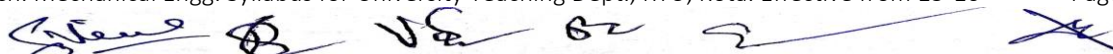
**B.Tech. (Mechanical) 5<sup>th</sup> semester**

**OL+OT+3P**

CO1: Analyze basic principles of heat transfer for various heat transfer applications.

CO2: Evaluate and optimize the heat transfer systems.

CO3: Evaluate the performance of different heat exchangers.



SN	NAME OF EXPERIMENT
1	To Determine Thermal Conductivity of Insulating Powders.
2	To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3	To determine the transfer Rate and Temperature Distribution for a Pin Fin.
4	To Measure the Emissivity of the Test plate Surface.
5	To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
6	To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
7	Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation.
8	To Determine Critical Heat Flux in Saturated Pool Boiling.
9	To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
10	To Find the Heat transfer Coefficient in Forced Convection in a tube.
11	To study the rates of heat transfer for different materials and geometries
12	To understand the importance and validity of engineering assumptions through the lumped heat capacity method.

### 5MEU8: MACHINE DESIGN SESSIONAL -II

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

OL+OT+3P

- CO 1 Account the static and dynamic loading conditions in different materials.  
CO 2 Understand and apply the concept of design for fatigue wear, finite life cycles, etc.  
CO 3 Examine the various machine elements under different operating conditions.  
CO 4 Design for the machine elements like shaft gears, bearings, springs, etc.

SN	SESSIONAL WORK
	<b>Problems on:</b>
1	Fatigue loading.
2	Helical compression, tension and torsional springs design.
3	Curved Beams.
4	Preloaded bolts and bolts subjected to variable stresses.
5	Belt, Rope and Chain drive system.
6	Gear Design.
7	Sliding contact bearing design.
8	Anti-friction bearing selection

### 5MEU9: THEORY OF MACHINES LAB

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

OL+OT+2P

- CO 1 To plot various performance curves of the machines elements.  
CO 2 To perform different balancing operations.  
CO 3 To determine the various operating parameters of oscillating machines.  
CO 4 To study the gear operated systems.

SN	NAME OF EXPERIMENT
1	To verify the torque relation for gyroscope.
2	To plot force vs. radius and lift vs. speed curves for governors.
3	To plot pressure distribution curves on a journal bearing.
4	To perform wheel balancing.
5	To perform static and dynamic balancing on balancing set up.
6	To determine mass moment of inertia of a flywheel.
7	Study of a lathe gear box.
8	Study of a sliding mesh automobile gear box.
9	Study of a planetary gear box.
10	To determine co-efficient of friction using two roller oscillating arrangement.

11	Study of various cam-follower arrangements. To plot displacement v/s angle of rotation curve for various cams
12	Perform study of the following using Virtual Lab <a href="http://www.vlab.co.in/">http://www.vlab.co.in/</a> a) Position, velocity and acceleration analysis of Grashof four bar mechanism b) Position, velocity and acceleration analysis of Slider Crank mechanism

### 5MEU10: INDUSTRIAL ENGINEERING LAB-I.

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

OL+OT+2P

CO1: Learn the statistical basics of control charts and sampling.

CO2: Construct the control charts, OC curves and evaluate the process performances.

CO3: Apply the SQC methods to problems using SPC software.

SN	SESSIONAL WORK	CONTACT HOURS
1	Case study on X bar charts and process capability analysis	
2	P Chart: (a) Verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) Plot a P-chart by taking a sample of n=20 and establish control limits	
3	To plot C-chart using given experimental setup	
4	Operating Characteristics Curve: (a) Plot the operating characteristics curve for single sampling attribute plan for n = 20; c = 1, 2, 3. Designate the red ball to defective. (b) Compare the actual O.C. curve with theoretical O.C. curve using approximation for the nature of distribution	
5	Distribution Verification: (a) Verification of Normal Distribution. (b) To find the distribution of numbered cardboard chips by random drawing one at a time with replacement. Make 25 subgroups in size 5 and 10 find the type of distribution of sample average in each case. Comment on your observations	
6	Verification of Poisson distribution	
7	Central Limit Theorem: (a) To show that a sample means for a normal universe follow a normal distribution (b) To show that the sample means for a non normal universe also follow a normal Distribution.	
8	Solve problems using available Statistical Process Control software in lab	

### 5MEU11: PROFESSIONAL ETHICS AND DISASTER MANAGEMENT

#### B.Tech. (Mechanical) 5<sup>th</sup> semester

OL+OT+2P

CO1: Learn the importance of human values, harmony and ethical behaviour in real life situations.

CO2: Understand the ethical problems and principles of their field.

CO3: Enhance the knowledge and understanding of the International strategy for disaster reduction and update the skills and abilities for implementing the disaster risk reduction strategy.

CO4: Create and implement information disaster prevention and recovery plan.

CO5: Understand studies which will facilitates in the preparation of rural development schemes and their effective implementation.

SN	CONTENTS	CONTACT HOURS
1	<b>Human values:</b> Effect of Technological Growth and Sustainable Development. Profession and Human Values: Values crisis in contemporary society. Nature of values. Psychological Values, Societal Values and Aesthetic Values. Moral and Ethical values.	
2	<b>Professional ethics:</b> Professional and Professionalism-Professional Accountability, Role of a professional, Ethic and image of profession; Engineering Profession and Ethics: Technology and society, Ethical obligations of Engineering professionals, Roles of Engineers in industry, society, nation and the world; Professional Responsibilities: Collegiality, Loyalty, Confidentiality, Conflict of Interest, Whistle Blowing.	
3	<b>Disaster management:</b> Understanding Disasters and Hazards and related issues social and environmental. Risk and Vulnerability. Types of Disasters, their occurrence/ causes, impact and preventive measures: Natural Disasters- Hydro-meteorological Based Disasters like Flood, Flash Flood, Cloud Burst, Drought, Cyclone, Forest Fires; Geological Based Disasters like Earthquake, Tsunami, Landslides, Volcanic Eruptions. <b>Man made Disasters:</b> Chemical Industrial Hazards, Major Power Break Downs, Traffic Accidents, Fire Hazards, Nuclear Accidents. Disaster profile of Indian continent. Case studies. Disaster Management Cycle and its components.	
4	In order to fulfill objectives of course, a) The institute shall be required to organize at least 3 expert lectures by eminent social workers/professional leaders. b) Each student shall compulsorily be required to: i. Visit a social institution/NGO for at least 7 days during the semester and submit a summary report. ii. II. Perform a case study of a disaster that has occurred in last decade and submit a summary report.	

REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Professional Ethics by R Subramanian, oxford publishers	
2	Engineering Ethics: Concepts and cases by Charles E. Harris, Jr., Michael S. Pritchard, Michael J. Rabins. CENGAGE Learning, Delhi	
3	Controlling Technology: Ethics and Responsible Engineers by Stephen H Unger. John Willey and Sons.	
4	Ethical Issues in Engineering, by Deborah Johnson. Prentice Hall	
5	Human Values in the engineering Profession, Moniograph by A N Tripathi. Published by IIM Calcutta.	
6	Towards Basics of Natural Disaster Reduction by Prof. D.K. Sinha. Researchco Book Center, Delhi.	
7	Understanding Earthquake Disasters by Amita Sinvhal. Tata McGraw Hill, New Delhi.	

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## 6MEU1: REFRIGERATION AND AIR CONDITIONING

**B.Tech. (Mechanical) 6<sup>th</sup> semester**

**3L+1T**

CO1: Understand the concepts of refrigeration and air conditioning.

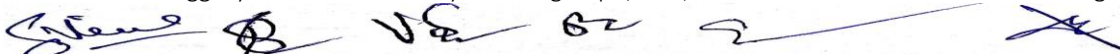
CO2: Evaluate & select the refrigerants for any process and product.

CO3: Determine the comfort cooling and heating conditions.

CO4: Analyse and compute the air conditioning system

UNIT	CONTENTS	CONTACT HOURS
I	<b>Introduction:</b> Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. <b>Vapour Compression Refrigeration System:</b> Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions	5
	<b>Multiple Evaporator and compressor system:</b> Application, air compressor system, Individual compressor, compound compression, cascade system. Application, air compressor systems, individual compressor, compound compression, cascade system.	3
II	<b>Gas Cycle Refrigeration:</b> Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger.	4
	Air cycle for air craft: Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle.	4
III	<b>Other refrigeration systems</b> (description only): Vapour absorption refrigeration system, Electrolux refrigerator, Lithium Bromide - Water system, Water vapour refrigeration system, Vortex tube refrigeration system, thermo electric refrigeration system.	4
	<b>Refrigerants:</b> Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. <b>Refrigeration Equipments:</b> Compressor, condenser, evaporator, expansion devices, types & working.	4
IV	<b>Psychrometry:</b> Psychrometric properties, psychrometric relations, psychrometric charts, psychrometric processes, cooling coils, Bypass factor, Apparatus Dew point temperature and air washers.	5
	<b>Human Comfort:</b> Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.	3
V	<b>Cooling load calculations:</b> Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling.	5
	<b>Selection of air conditioning:</b> Apparatus for cooling and dehumidification, Air conditioning system, year round air conditioning.	3
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		
1	Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw Hill	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Stoecker W.F., "Refrigeration & Air Conditioning" McGraw Hill Publication.	2000
2	Andrew D. Althouse., "Modern Refrigeration & Air Conditioning" GoodHeart-Willcox Co.	2002
3	Jorden & Priester, Refrigeration & Air Conditioning, Prentice Hall of India.	2003
4	Roy J. Dossat, Principal of Refrigeration, Pearson Education, New Delhi.	2014



5	Edward G. Pita, Air Conditioning Principles and Systems, Pearson Education, New Delhi.	2003
6	Jain V.K., Refrigeration & Air Conditioning, Tata McGraw Hill New Delhi.	2004

### 6MEU2: MEASUREMENT & METROLOGY

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

3L+0T

CO1: Describe the basic concepts of measurement.

CO2: Learn the various type of measurement systems and equipment.

CO3: Identify & classify the measurement process for particular application.

CO4: Apply the concepts for measuring the properties of the system.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Concept of measurement:</b> General concept of measurement, Need for measurement, Generalized measuring system, Units, Standards, Sensitivity, Readability, Range of accuracy, Precision, Accuracy Vs precision, Uncertainty.	4
	Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Calibration, Interchangeability.	3
II	<b>Linear and angular measurements:</b> Linear measuring instruments: Vernier caliper, Micrometer, Interval measurements:- Slip gauges, Checking of slip gauges for surface quality, Optical flat, Application of limit gauges	3
	Comparators:- Mechanical comparators, Electrical comparator, Optical comparator, Pneumatic comparator;	2
	Sine bar, Use of sine bar, Limitations of sine bars, Sources of error in sine bars, Bevel protractor, Applications of bevel protractor.	4
III	<b>Form measurement:</b> Introduction, Screw thread measurement, Thread gauges, Measurement of gears: Gear errors.	4
	Surface finish measurement:-Introduction, Elements of surface texture, Analysis of surface finish, Methods of measuring surface finish, Straightness measurement, Flatness testing, Roundness measurements	4
IV	Coordinate measuring machine (CMM):-Types of CMM, Features of CMM, Computer based inspection,	3
	<b>Measurement of power, flow and temperature related properties</b> Measurement of force, Accelerometer, Load cells, Bourdon tube. <b>Torque measurement:</b> Torque measurement using strain gauges, Torque measurement using torsion bars, Mechanical dynamometers.	5
V	<b>Measurement of flow:</b> Variable area meters – rotameter, Hot wire anemometer, Pitot tube.	4
	Temperature measurement, Bimetallic strip, Thermocouples (Thermo electric effects), Thermistors, Pyrometers	
	<b>TOTAL</b>	<b>40</b>

#### TEXT BOOK

1	G.K. Vijayaraghavan & R. Rajappan, Engineering Metrology and Measurements, A.R.S. Publications, Chennai, Fourth Edition June	2009
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#### REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Mechanical Measurements , Beckwith T.G. ,N.L. Buck, and R.D. Marangoni , Addison Wesley	2014
2	Dimensional Metrology . Khare & Vajpayee, Oxford & IBH	2011

*(Handwritten signatures and marks)*

3	Engineering Metrology, Jain R.K., Khanna Publishers	2012
4	Metrology & Precision Engineering , Scarr, McGraw Hill	2011
5	Handbook of Industrial Metrology, ASTME	2014
6		

### 6MEU3: TURBOMACHINES

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

3L+0T

- CO 1 Learn the basic laws and governing equation of hydraulic machines.  
CO 2 Analyse the flow phenomenon and characteristics of components.  
CO 3 Demonstrate and examine the operating aspects of different hydraulic machines.  
CO 4 Apply and evaluate the performance parameters of various components of machine.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Basic Concepts of Turbo Machines:</b> Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation(1st law of thermodynamics), 2nd law of thermodynamics applied to turbo machines, Newton's 2nd law of motion applied to turbomachines - Euler's pump equation and Euler's turbine equation	4
	Dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Range of specific speeds for various turbo machines, Dimensional analysis applied to compressible flow machines, pressure ratio as a Function of temperature ratio, mass flow rate parameter and speed parameter	4
II	<b>Centrifugal Compressors and Fans:</b> Components and description, velocity diagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stall and Choking	3
III	<b>Axial Flow Compressors and Fans:</b> Basic constructional features, Advantages of axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, operating characteristics	3
	<b>Reciprocating Compressors:</b> Basic constructional features, working principle, work done calculation, single and double acting compressors	2
IV	<b>Centrifugal Pumps:</b> Main parts, work done and velocity triangles, slip and slip factor, pump losses and efficiencies, minimum starting speed, net positive suction head, performance curve.	3
V	<b>Axial Flow Pumps:</b> Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitation.	3
	<b>Reciprocating Pumps:</b> Classification, component and working, single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, slip, effect of friction and acceleration, theory of air vessels.	2
<b>TOTAL</b>		<b>40</b>

#### TEXT BOOK

1	Gas turbines, V. Ganesan, Tata McGraw-Hill	2011
2	Subramanya, K., Hydraulic Machine, Tata McGraw Hill	2013

#### REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Pub.
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		Year
1	Principle of Turbo Machinery, Turton R.K., Springer Publication	1994
2	Fundamentals of Turbo Machinery, William W., John Wiley and Sons.	2008
3	Turbo Machinery Basic Theory and Application, Logan E.J.	1981
4	Principles of Turbo Machinery, Shepherd Dennis G., Mac Millan Pub, N.York.	1956
5	TurboMachines, A Valan Arasu, Vikas Publishing House Pvt. Ltd.	2009
7	Gas turbine theory, Cohen and Saravanamutto, Pearson Educational Pub.	2009
8	Hydraulic Machine: Turbines and Pumps, Nazarov N.T., Springer New York.	2003
9	Gas Turbine Theory, Cohen and Roger, Pearson Education.	
10	Hydraulic Machinery, Jagdish Lal, Metropolitan Books.	

#### 6MEU4: VIBRATION ENGINEERING

##### B.Tech. (Mechanical) 6<sup>th</sup> semester

3L+1T

CO 1 Understand the concept of frequency, sound pressure level and their effects on humans.

CO 2 Evaluate the cases of natural and forced vibration effects.

CO 3 Know the effects of damping on vibration analysis.

CO 4 Apply the knowledge of evaluating the frequency of systems involving various degree of freedom.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Introduction to Sound:</b> Frequency dependent human response to sound, Sound pressure dependent human response, Relationship among sound power, sound intensity and sound pressure level.	2
	<b>Introduction to Noise:</b> Auditory and Non auditory effects of Noise, Major sources of the noise, Industrial noise sources, Industrial noise control strategies.	3
	<b>Introduction to Vibration:</b> Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition.	3
II	<b>Undamped Single Degree of Freedom System:</b> Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion.	3
	<b>Damped vibrations of single degree of freedom systems:</b> Viscous damping, under-damped, critically damped and over-damped systems, Logarithmic decrement.	3
	Vibration characteristics of Coulomb damped system and Vibration characteristics of Hysteretic damped systems.	2
III	<b>Forced Vibrations of Single Degree of Freedom Systems:</b> Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support.	4
	<b>Vibration Isolation and Transmissibility:</b> Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation.	4
IV	<b>System with Two Degrees of Freedom:</b> principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber	5

	<b>Critical Speed of Shaft:</b> Critical speed of a light shaft without damping, critical speed of shaft having multiple discs, secondary critical speed.	<b>3</b>
<b>V</b>	<b>Many Degrees of Freedom Systems (Exact analysis):</b> Equation of Motion, The matrix method, Eigen Values and Eigen Vectors, Method of influence Coefficients and Maxwell's reciprocal theorem. Torsional vibrations of multi rotor system, vibrations of geared system, Generalized coordinates and coordinate coupling <b>Many Degrees of Freedom Systems (approximate methods):</b> Rayleigh's, Dunkerley's, Stodola's and Holzer's methods	<b>5</b>
	<b>Vibrations of continuous systems:</b> Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.	<b>3</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Rao S.S., "Mechanical Vibrations", Pearson Education, 2nd Indian reprint.	2004
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Publ</b>
<b>1</b>	Ambekar A.G., "Mechanical Vibrations and Noise Engineering", PHI	2006
<b>2</b>	Kelly, S.G., "Mechanical Vibrations, Theory and Applications, Cengage Lrg	2013
<b>3</b>	Thomson, W.T., and Dahleh, M.D., Padmanabhan, C., "Theory of Vibrations with Applications", Pearson Education.	2014
<b>4</b>	Meirovitch, L., "Elements of Vibration Analysis", Tata McGraw-Hill	2006
<b>5</b>	Tongue, B.H., "Principles of Vibration", Oxford Publication	2007

### 6MEU5: MECHATRONICS AND MEMS

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

**3L + 0T**

CO1 Model, analyze and control engineering systems.

CO2 Identify sensors, transducers and actuators to monitor and control the behavior of a processor product.

CO3 Demonstrate various technologies available for MEMS

CO4 Evaluate the performance of mechatronic systems.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	<b>Overview of Mechatronics:</b> Historical perspective, Definition, Applications, Block diagram of Mechatronic system, Functions of Mechatronics Systems, Systems Engineering, Verification Vs Validation, Benefits of mechatronics in manufacturing	<b>2</b>
	<b>Electrical and Electronic Systems:</b> Electrical circuits and Kirchhoff's laws, Network Theorems and AC circuit Analysis, Transformers, Analog Devices, Signal Conditioning, Digital Electronics, Data Acquisition systems.	<b>3</b>
<b>II</b>	<b>Modeling, Analysis and Control of Physical Systems:</b> Basics of System Modeling: LTI and LTV systems, Need for modeling, Types of modeling, Steps in modeling, Building blocks of models, Modelling of one and two degrees of freedom systems, Modeling of Electro-mechanical systems, Mechanical Systems, Fluid systems, Thermal systems; Dynamic Responses, System Transfer Functions, State Space Analysis and System Properties, Stability Analysis using Root Locus Method, Stability Analysis using Bode Plots, PID Controllers (with and without Time Delay)	<b>3</b>
<b>III</b>	<b>Sensors and Actuators:</b> Static characteristics of sensors and actuators, Position, Displacement and Proximity Sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration	<b>4</b>

	sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors, Actuators: Electrical Actuators (Solenoids, Relays, Diodes, Thyristors, Triacs, BJT, FET, DC motor, Servo motor, BLDC motor, AC motor, Stepper motors), Hydraulic and Pneumatic actuators, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys.	
IV	<b>Microprocessors, Microcontrollers and Programmable Logic Controllers:</b> Logic Concepts and Design, System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Synchronous and Asynchronous Sequential Systems, Architecture, Microcontrollers, Programmable Logic Controllers (PLCs): Architecture, Number Systems Basics of PLC Programming, Logics, Timers and Counters, Application on real time industrial automation systems.	5
V	<b>Micro-Electro Mechanical Systems (MEMS):</b> History, Effect of scaling, Fabrication techniques: Oxidation, Sputter disposition, CVD, Lithography, Etching, Wafer bonding, LIGA, DRIE, Applications: Lab on chip	5
	<b>Case Studies:</b> Design of pick and place robot, Car engine management system, Automated manufacturing system, Automatic camera, Automatic parking system, Safety devices and systems.	3
	<b>TOTAL</b>	<b>40</b>

TEXT BOOK		Ed.
1	W. Bolton, Mechatronics, Electronic control systems in mechanical and electrical engineering, Pearson Education, 5/e, 2011.	2004
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub Year .
2	James J Allen, Micro Electro Mechanical Systems Design, CRC Press.	2013
3	David G. Alcaiatore and Michel B. Histan, Introduction to Mechatronics and Measuring Systems, Mc. Graw Hill Int. Edition, 3/e,	2006
4	Craig K. C. and Stolfi, F. R., Introduction to Mechatronic System Design with Applications, IEEE Educational Activities Department,.	1994
5	Robert H. Bishop. The Mechatronics Handbook, CRC Press, 2/e	2007

### 6MEU6.1: RENEWABLE ENERGY SYSTEMS

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

3L+0T

- CO 1 To understand the various renewable systems  
CO 2 To learn the various sources of renewable energy  
CO 3 To examine the operating conditions of systems  
CO 4 To explore the systems and apply for various purposes

UNIT	CONTENTS	CONTACT HOURS
I	Global and National scenarios, Form and characteristics of renewable energy sources. <b>Solar Energy:</b> Solar radiation, its measurements and prediction, Solar thermal collectors, flat plate collectors, concentrating collectors, Basic theory of flat plate collectors, solar heating of buildings, solar still, solar water heaters, solar driers, conversion of heat energy in to mechanical energy, solar thermal power generation systems.	2
	<b>Solar Photovoltaic:</b> Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication, <b>Photovoltaic applications:</b>	3

	battery charger, domestic lighting, street lighting, water pumping, power generation schemes	
II	<b>Wind Energy:</b> Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS- classification, characteristics, applications.	<b>3</b>
III	<b>Ocean Energy:</b> Ocean energy resources, ocean energy routes, Principles of ocean thermal energy conversion systems, ocean thermal power plants, Principles of ocean wave energy conversion and tidal energy conversion.	<b>4</b>
IV	<b>Other Sources:</b> Nuclear fission and fusion, Geothermal energy- Origin, types of geothermal energy sites, site selection, geothermal power plants, Magneto-hydro-dynamic (MHD) energy conversion, Formation of biomass, photosynthesis, Biomass resources and their classification, Chemical constituents and physicochemical characteristics of biomass, Biomass conversion processes.	<b>5</b>
V	<b>Fuel Cells:</b> Thermodynamics and electrochemical principles, Basic design, types, applications. <b>Hydrogen Energy:</b> Economics of hydrogen, Production methods.	<b>5</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		<b>Ed.</b>
<b>1</b>	Power Generation through Renewable Source of Energy, Rai and Ram Prasad, Tata McGraw-Hill, New Delhi.	2004
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Pub Year</b>
<b>2</b>	Renewable Energy Sources and Conversion Technology, Bansal, Kleemann and Meliss, TMH	2013
<b>3</b>	Solar Energy: Fundamental and Applications, H. P. Garg J Prakash, Tata McGraw-Hill	2006
<b>4</b>	Solar Energy: Principles of Thermal Collection and Storage, S P Sukhatme, TMH	1994

### 6MEU6.2: COMPUTER AIDED DESIGN AND GRAPHICS

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

**3L+0T**

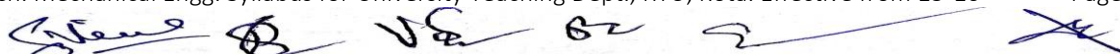
CO1: Learn basic concepts of geometric modeling.

CO2: Acquire the theory of mathematical representation of geometric entities like curves and surfaces.

CO3: Access the solid modeling concept.

CO4: Learn the various algorithms to display geometric model realistically.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	<b>Overview of Computer Graphics:</b> Picture representation, Coordinate Systems, Raster Scan Display, DDA for line generation and Bresenham's algorithm for line and circle generation; Graphics standards: GKS, IGES, STEP, DXF. Different types of models.	<b>5</b>
	<b>Parametric representation of plane curves:</b> line, circle, ellipse, parabola and hyperbola.	<b>4</b>
<b>II</b>	<b>Parametric representation of Space Curves:</b> Cubic spline curve, Bezier Curve and B Spline Curves. Blending of Curves.	<b>4</b>
	<b>Parametric representation of Surfaces:</b> Hermite Bicubic surfaces, Bezier surfaces and Bspline surfaces.	<b>4</b>



III	<b>Solid Representation:</b> B-rep. and CSG. Comparison between three types of models.	7
IV	<b>Two and Three Dimensional Transformation of Geometric Models:</b> Translation, Scaling Reflection, Rotation and Shearing, Homogeneous Representation, Combined Transformation.	4
	<b>Projection of Geometric models:</b> Parallel and Perspective Projection.	4
V	<b>Clipping:</b> Point clipping, Line clipping, Cohen- Sutherland algorithm etc., Viewing transformation.	4
	<b>Hidden line and surface removal:</b> Techniques and Algorithms. Shading and Rendering.	4
<b>TOTAL</b>		<b>40</b>

<b>TEXT BOOK</b>		
1	Zeid and Sivasubramanian, CAD/CAM: Theory and Practice, Tata McGraw Hill	
2	Rogers and Adams, Mathematical Elements for Computer Graphics, Tata McGraw Hill	
<b>REFERENCE BOOKS</b>		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Rao P.N., CAD / CAM Principles and Applications, McGraw Hill.	2004
2	Pao Y.C., Elements of Computer Aided Design and Manufacturing, John Wiley and Sons.	1984
3	Alavala C.R., CAD/CAM: Concepts and Applications, Prentice Hall of India.	2008
4	Xiang and Plastock, Computer Graphics, Schaum's Outlines, Tata McGraw Hill.	2007

### 6MEU6.3: ENGINEERING OPTIMIZATION

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

3L+0T

CO1: Describe the basic concepts of engineering optimization.

CO2: Solve the problems using different techniques of optimization.

CO3: Understand and implement the modern methods of optimizations.

UNIT	CONTENTS	CONTACT HOURS
I	<b>Introduction</b> -Engineering Applications of Optimization-Statement of an Optimization Problem- Classification of Optimization Problems - Optimization Techniques	5
II	<b>Classical Optimization Techniques</b> - Single-Variable Optimization - Multivariable Optimization with No Constraints - Multivariable Optimization with Equality Constraints- Multivariable Optimization with Inequality Constraints- Transportation	4
III	<b>Nonlinear Programming I:</b> 1D Minimization Methods - Unimodal Function, Elimination Methods-Unrestricted Search, Exhaustive, Dichotomous Search- Interval Halving Method- Fibonacci Method- Golden Section Method, Interpolation Methods -Quadratic, Cubic Interpolation Method - Direct Root Methods - Newton Method-Quasi-Newton, Secant Method	7
IV	<b>Nonlinear Programming II:</b> Unconstrained Optimization Techniques -Direct Search Methods - Indirect Search (Descent) Methods, Non-linear Programming III: Constrained Optimization Techniques- Direct Methods-Indirect Methods, Geometric	4

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	Programming, Dynamic Programming, Integer Programming - Integer Linear Programming - Stochastic Programming.	
<b>V</b>	<b>Modern Methods of Optimization</b> - Genetic Algorithms - Simulated Annealing - Particle Swarm Optimization - Ant Colony Optimization - Optimization of Fuzzy Systems - Neural-Network-Based Optimization, Practical Aspects of Optimization	<b>4</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Kalyanmoy Deb, "Optimization for Engineering design – algorithms & examples", PHI, New Delhi	1995
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Singiresu S. Rao, "Engineering optimization – Theory and practices", John Wiley and Sons,	1998.
<b>2</b>	Garfinkel, R.S. and Nemhauser, G.L., "Integer programming", John Wiley & Sons,	1972.

#### **6MEU6.4: EXPERIMENTAL FLUID MECHANICS**

**B.Tech. (Mechanical) 6<sup>th</sup> semester**

**3L+0T**

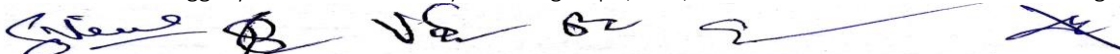
CO1: Measure and evaluate the fluid properties.

CO2: Compute the performance of hydraulic applications.

CO3: Understand the visualization techniques.

CO4: Evaluate & optimize the fluid flow system.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	<b>BASIC MEASUREMENTS IN FLUID MECHANICS</b> Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements – Analogue methods – static pressure and total temperature measurement – Flow visualization – Components of measuring systems – Measurements in boundary layers.	<b>5</b>
<b>II</b>	<b>WIND TUNNEL MEASUREMENTS</b> Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels – Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence – Wind tunnel balance – Principle and application and uses – Balance calibration.	<b>4</b>
<b>III</b>	<b>FLOW VISUALIZATION AND ANALOGUE METHODS</b> Visualization techniques – Smoke tunnel – Hele-Shaw apparatus – Interferometer – Fringe-Displacement method – Shadowgraph – Schlieren system – Background Oriented Schlieren (BOS) system.	<b>7</b>
<b>IV</b>	<b>PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS</b> Pitot-Static tube characteristics – Velocity measurements – Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Hot-film anemometry – Laser Doppler Velocimetry (LDV) – Particle Image Velocimetry (PIV) – Pressure Sensitive Paints – Pressure measurement techniques – Pressure transducers – Temperature measurements.	<b>4</b>
<b>V</b>	<b>SIGNAL CONDITIONING AND UNCERTAINTY ANALYSIS</b> Signal conditioning – Types of signals, Fourier Analysis, Analysis of periodic signals – Estimation of measurement errors – Systematic	<b>4</b>



	and random errors, Error analysis and uncertainty propagation – Uncertainty calculation - Uses of uncertainty analysis.	
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Rathakrishnan, E., “Instrumentation, Measurements, and Experiments in Fluids,” CRC Press	1995
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Robert B Northrop, “Introduction to Instrumentation and Measurements”, Second Edition, CRC Press,	1998.

### **6MEU7: PRODUCTION ENGINEERING LAB**

#### **B.Tech. (Mechanical) 6<sup>th</sup> semester**

**OL+OT+3P**

CO1: To understand the science of measurement using measuring instrument.

CO2: To learn the modern measuring tools used in industry / shop floor.

CO3: Practice and apply measuring tool to measure angles, gap, forces, thrust and torque.

CO4: Understand and analyse about surface finishing of product.

<b>SN</b>	<b>NAME OF EXPERIMENT</b>	<b>CONTACT HOURS</b>
<b>1</b>	Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges.	
<b>2</b>	Measurement of angle and width of a V-groove by using bevel protector.	
<b>3</b>	(a) To measure a gap by using slip gauges (b) To compare & access the method of small-bore measurement with the aid of spheres.	
<b>4</b>	Measurement of angle by using sine bar.	
<b>5</b>	(a) Measurement of gear tooth thickness by using gear tooth vernier caliper. (b) To check accuracy of gear profile with the help of profile projector.	
<b>6</b>	To determine the effective diameter of external thread by using three-wire method.	
<b>7</b>	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.	
<b>8</b>	To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface.	
<b>9</b>	Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.	
<b>10</b>	Forces measurements during orthogonal turning.	
<b>11</b>	Torque and Thrust measurement during drilling.	
<b>12</b>	Forces measurement during plain milling operation.	
<b>13</b>	Measurement of Chip tool Interface temperature during turning using thermocouple technique.	

### **6MEU8: THERMAL ENGINEERING LAB-II**

#### **B.Tech. (Mechanical) 6<sup>th</sup> semester**

**OL+OT+3P**

CO 1 To perform and evaluate the efficiencies of thermal systems

CO 2 To estimate the various performance parameters of system

CO 3 To study the performance of different rotating and reciprocating systems

*(Handwritten signatures and marks)*

CO 4 To determine the operating characteristics of thermal systems.

SN	LABORATORY WORK/NAME OF EXPERIMENT
1	To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power, and heat balance sheet.
2	To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine. (Morse Test)
3	Analysis of engine exhaust gases using Orsat apparatus / gas analyzer.
4	To study refrigeration cycle, determination of coefficient of performance of cycle and tonnage capacity of refrigeration unit.
5	To determine the COP and tonnage capacity of a Mechanical heat pump.
6	To study various controls used in Refrigeration and Air conditioning system.
7	Determination of dryness fraction of steam.
8	Study and Performance of Simple Steam Turbine
9	Performance characteristics of Pelton wheel turbine.
10	Performance characteristics of Francis turbine.
11	Performance characteristics of Kaplan turbine.
12	Performance characteristics of variable speed centrifugal pump.
13	Performance characteristics of rated speed centrifugal pump.

#### 6MEU9: VIBRATION & MAINTENANCE ENGINEERING LAB.

**B.Tech. (Mechanical) 6<sup>th</sup> semester**

**OL+OT+2P**

CO 1 Determine the radius of gyration of different systems.

CO 2 Evaluate the cases of natural and forced vibration effects and develop the understanding of practical processes

CO 3 Know the effects of damping on vibration analysis.

CO 4 Apply the knowledge of evaluating the frequency of systems involving various degree of freedom.

SN	NAME OF EXPERIMENT
1	To verify relation $T = 2\pi\sqrt{l/g}$ for a simple pendulum.
2	To determine radius of gyration of compound pendulum.
3	To determine the radius of gyration of given bar by using bifilar suspension.
4	To determine natural frequency of a spring mass system.
5	Equivalent spring mass system.
6	To determine natural frequency of free torsional vibrations of single rotor system. i. Horizontal rotor ii. Vertical rotor
7	To verify the Dunkerley's rule.
8	Performing the experiment to find out damping co-efficient in case of free damped torsional vibration
9	To conduct experiment of trifier suspension.
10	Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
11	Study of Vibration measuring instruments.
12	Perform study of the following using Virtual Lab <a href="http://www.vlab.co.in/">http://www.vlab.co.in/</a>
13	Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.
14	Harmonically Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio.
15	Perform study of the following using Virtual Lab <a href="http://www.vlab.co.in/">http://www.vlab.co.in/</a>
16	Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.

*(Handwritten signatures and marks)*

17	Harmonically Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio.
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### 6MEU10: MECHATRONICS AND MEMS LAB

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

OL+OT+2P

- CO1 Measure load, displacement and temperature using analogue and digital sensors.  
 CO2 Develop programs for control of traffic lights, water level, lifts and conveyor belts.  
 CO3 Simulate and analyse PID controllers for a physical system using MATLAB.  
 CO4 Develop pneumatic and hydraulic circuits using available software

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	-	-
CO2	2	-	3	1	3	-	-	-	-	-	-	-
CO3	2	-	3	1	3	-	-	-	-	-	-	2
CO4	2	-	3	3	3	-	-	-	-	-	-	2

SN	NAME OF EXPERIMENT
1	<b>Using Transducers Kit :-</b> <ul style="list-style-type: none"> <li>Characteristics of LVDT</li> <li>Principle &amp; Characteristics of Strain Gauge</li> <li>Characteristics of Summing Amplifier</li> <li>Characteristics of Reflective Opto Transducer</li> </ul>
2	<b>Mobile Robot</b> <ul style="list-style-type: none"> <li>Program for Operating Buzzer Beep</li> <li>Program for Operating Motion control</li> <li>Program for Operating Direction control</li> <li>Program for Operating White line follower for the given arena</li> </ul>
3	<b>PLC PROGRAMMING</b> <ul style="list-style-type: none"> <li>Ladder programming on Logic gates ,Timers &amp; counters</li> <li>Ladder Programming for digital &amp; Analogy sensors</li> <li>Ladder programming for Traffic Light control, Water level control and Lift control Modules</li> </ul>
4	<b>MATLAB Programming</b> <ul style="list-style-type: none"> <li>Sample programmes on Mat lab</li> <li>Simulation and analysis of PID controller using SIMULINK</li> </ul>

### 6MEU11: CAPACITY BUILDING LAB

#### B.Tech. (Mechanical) 6<sup>th</sup> semester

OL+OT+2P

- CO1: Communicate effectively like handling telephonic interviews, GD skills by full-fledged training on Written, Oral & Presentation Training in the Language Lab of the Institution.  
 CO2: Practice maths, aptitude, reasoning, GK, Current Affairs, interview skills for different test conducted by various industries.  
 CO3: Learn inter-personal skills like Team work & Leadership and will have exposure to business reality.  
 CO4: Learn time management and have pre-interview preparation.

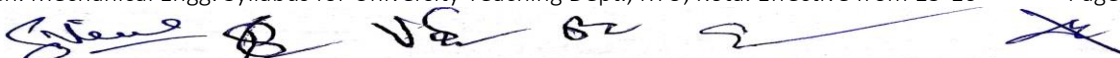
S.No	Knowledge/Traits/ skills desired	Input Proposed
1	Handling telephonic interview	Handling telephonic calls

2	GK , Current Affairs	Psychometry, Aptitude Reading habit of business dailies followed by periodic testing
3	GD Skills	Regular GD sessions on issues of topical interest
4	CV preparation Filling up of application forms	Guidance on CV preparation, etc,
5	English Language facility Communication	Full-fledged training on Written, Oral & Presentation Training in the Language Lab of the Institution.
6	Maths, Aptitude & Problem solving	Training and coaching
7	Interview skills	Mock interviews
8	Etiquette/Manners/Behaviour	Workshops
9	Self-confidence / Personality development	Counselling / Mentoring
10	Inter-personal skills (Team work & Leadership)	GDs / Group Projects / Debates
11	Industry awareness	Exposure to business reality
12	Technical / Domain knowledge	Adapted methodology during class sessions
13	Networking	Alumni activities
14	Strategizing for one's own career	Career planning & Goal setting Expectation management
15	Time Management	Exercises
16	Pre-interview preparation	Refresher training

### Suggested Readings:

1. The Seven Habits of Highly Effective People - Stephen R. Covey.
2. Who Moved My Cheese - Dr. Spenser Johnson.
3. Seven Spiritual Laws of Success - Deepak Chopra.
4. I'm OK are OK – Erric Seghal
5. Emotional Intelligence - David Goleman
6. Working with Emotional Intelligence - David Goleman.
7. *Good To Great - Jim Collins*
8. Goal - Eliyahu Goldratt.
9. Only the Paranoid Survive - Andrew Grove
10. All the books in the "Chicken Soup for the Soul" series.
11. "Effective Group Discussion: Theory and Practice" by Gloria J. Galanes, Katherine Adams , John K. Brillhart
12. "Effective Presentation", 3rd Edition by Ros Jay, Antony Jay published by Pearson
13. Effective Presentation Skills (A Fifty-Minute Series Book) by Steve Mandel
14. EatiQuette's "The Main Course on Dining Etiquette": A step-by-step guide to dining with confidence in the 21st Century, by David Rothschild
15. "The Complete Idiot's Guide to Etiquette" by Mary Mitchell – Published by Alpha Books
16. "Strategic interviewing" by Richaard Camp, Mary E. Vielhaber and Jack L. Simonetti – Published by Wiley India Pvt. Ltd
17. Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
18. Spoken English by V Sasikumar and PV Dhamija; Tata McGraw Hill
19. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India
20. Rich dad poor dad, By Robert T. Kiyosaki
21. Think & Grow Rich, Napoleon Hill.
22. How to win friends and Influence people, Dale Carnegie.
23. The millionaire next door, Thomas J. Stanley

24. The Richest man in Babylon, George Samuel Clause
25. The Science of getting rich, Wallace Wattles
26. The Intelligent Investor, Benjamin Graham
27. The 4-hour work week, Timothy Ferriss
28. The greatest salesman in the world, O G Mandino
29. The millionaire mind, Thomas J Stanely
30. The magic of thinking big, David Joseph Schwartz
31. The 48 laws of power, Robert Greene.



## 7MEU1 FINITE ELEMENT METHODS

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+1T**

CO1: Develop system level matrix equations from a given mathematical model of a field problem

CO2: Analyse engineering problems in structural, heat transfer and fluid flow by FEM

CO3: Determine parameters of interest for a potential field problem, using triangular and quadrilateral elements use

CO4: Examine the parameters to assess the performance and suggest modification in system design.

UNIT	CONTENTS	CONTACT HOURS
<b>I</b>	Introduction to FEM and its applicability, Review of : Matrix algebra, Gauss elimination method, Uniqueness of solution, Banded symmetric matrix and bandwidth.	<b>4</b>
	Structure analysis: Two-force member element, Local stiffness matrix, coordinate transformation, Assembly, Global stiffness matrix, imposition of Boundary conditions, Properties of stiffness matrix	<b>4</b>
<b>II</b>	One-dimensional Finite Element Analysis: Basics of structural mechanics, stress and strain tensor, constitutive relation, Principle of minimum Potential, General steps of FEM, Finite element model concept / Discretization, Derivation of finite elements, equations using potential energy approach for linear and quadratic 1-D bar element,	<b>5</b>
	shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain.	<b>3</b>
<b>III</b>	Two Dimensional Finite Element Analysis: Finite element formulation using three noded triangular (CST) element , Plane stress and Plain strain problems,	<b>4</b>
	Shape functions, node numbering and connectivity, Assembly, Boundary conditions, Isoparametric formulation of 1-D bar elements,	<b>2</b>
	Numerical integration using gauss quadrature formula, computation of stress and strain.	<b>2</b>
<b>IV</b>	Finite Element Formulation from Governing Differential Equation: Method of Weighted Residuals, Collocation, Sub domain method, Least Square method and Galerkin's method,	<b>5</b>
	Application to one dimensional problems, one-dimensional heat transfer, etc. introduction to variational formulation (Ritz Method.)	<b>3</b>
<b>V</b>	Higher Order Elements: Lagrange's interpolation formula for one and two independent variable, Convergence of solution, compatibility, element continuity, static condensation, p and h methods of mesh refinement, Aspect ratio and element shape,	<b>5</b>
	Application of FEM, Advantages of FEM, Introduction to concept of element mass matrix in dynamic analysis.	<b>3</b>
<b>TOTAL</b>		<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Seshu P., "Text Book of Finite Element Analysis", Prentice Hall India	<b>2003</b>
<b>REFERENCE BOOKS</b>		
SN	Name of Authors /Books /Publisher	Year of Pub.
<b>1</b>	Dixit, U. S., "Finite Element Methods for Engineers" Cengage Learning	<b>2003</b>
<b>2</b>	Finite Element Procedure in Engineering Analysis, Bathe K.J., Prentice Hall India.	<b>2001</b>
<b>3</b>	An Introduction to the Finite Element Method, Reddy J.N., Tata McGraw-Hill, New Delhi	<b>1993</b>

4	Concepts & Applications of Finite Element Analysis, Cook and Plesha, Willey India New Delhi.	2007
5	Introduction to Finite Elements in Engineering, Chandupatla and Belegundu, Prentice Hall India.	1999

### 7MEU2: COMPUTER INTEGRATED MANUFACTURING SYSTEMS

#### B.Tech. (Mechanical) 7<sup>th</sup> semester

3L+0T

CO1: Recall the fundamentals of CAD/CAM

CO2: Compare and Represent 2-D and 3-D entities

CO3: Apply transform techniques on 2-D and 3-D entities

CO4: Examine CNC program for production of component

CO5: Express the principles and methods of Rapid Prototyping..

UNIT	CONTENTS	CONTACT HOURS
I	<b>Introduction to CIM:</b> Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background,	2
	Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system.	3
II	NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification.	8
III	Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards.	4
	Group Technology: Introduction, part families, part classification and coding, coding system and machining cells.	4
IV	Computer Aided Production Management Systems: Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control.	6
	Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing.	2
V	Computer Aided Material Handling; Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly.	5
	Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS).	
	Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.	3
<b>TOTAL</b>		<b>40</b>

TEXT BOOK		
1	Mikell P. Groover, , Automation, Production Systems, and Computer-Integrated Manufacturing, 3rd ed., Pearson/Prentice Hall,	2008
REFERENCE BOOKS		

*[Handwritten signatures and marks]*



SN	Name of Authors /Books /Publisher	Year of Pub.
1	James A. Rehg and Henry W. Kraebber, 2005, Computer-Integrated Manufacturing, 3rd ed., Pearson/Prentice Hall,	
2	Nanua Singh, 1996, Systems Approach to Computer-Integrated Design and Manufacturing, John Willey & Sons.	
3	Computer Aided Manufacturing, Chang, Wysk & Wang, Pearson Edu.	
4	CAD/CAM: Principles and Applications, P.N. Rao, McGraw Hill	
5	Computer Control of Manufacturing Systems, Y. Koren, McGraw Hill	
6	Computer aided Manufacturing, Rao, Tiwari and Kundra, TMH.	
7	Computer Numerical Control: Machining and Turning Centres, Quesada and Jeyepoovan, Pearson Education	

### 7MEU3: STEAM ENGINEERING AND POWER GENERATION

B.Tech. (Mechanical) 7<sup>th</sup> semester

3L+1T

UNIT	CONTENTS	CONTACT HOURS
I	<b>Steam generators:</b> Classification of Boilers, water and fire tube boilers, High pressure boilers, Advantages of high pr. Boilers, Natural and forced circulation boilers, Water wall.	4
	Steam drum internal, steam super heaters, Economizers, air preheater, induced, forced and balanced draught boilers, Fluidized bed boilers	4
II	Definition and type of nozzle and diffuser equation of continuity, sonic velocity, mach no. and stagnation properties, the steady flow energy equation for nozzles, momentum energy equation for flow through steam nozzles nozzle efficiency, effect of friction, nozzle for uniform pressure drop, throat pressure for maximum discharge or chock flow, critical pressure ratio, design of nozzle and diffuser.	8
III	<b>Steam Turbines:</b> Principle and working of steam turbines, type of turbines, compounding for pressure and velocity. Overview and difference of various type of turbine, different types of governing of turbines.	3
	<b>Impulse turbine:</b> The effect of blade friction on velocity diagram. Force, work and power, Blade or diagram efficiency, Gross stage efficiency, steam speed to blade, speed ratio for optimum performance, turbine performance at various loads	5
IV	<b>Impulse reaction turbine:</b> Velocity diagram and work done, degree of reaction, Parson turbine, blade efficiency, gross stage efficiency comparison of enthalpy drop in various stages, size of blades in impulse reaction turbines for various stages of impulse reaction and impulse turbine.	5
	<b>Regenerative Feed Heating Cycles:</b> Introduction, Ideal regenerative feed heating cycle, Regenerative heating cycles and their representation on T-s and h-s Diagram, Representation of actual process on T-s and h-s Diagram Regenerative cycles, types of feed heating arrangements, Optimum feed water temperature and saving in Heat Rate. direct contact and surface heaters.	4
V	<b>Reheating of steam:</b> Practical reheating and Non- reheating cycles, advantage and disadvantages of reheating, reheat regenerative cycle, regenerative water extraction cycles.	4
	Process heat and by product power cycle, pass out turbine, Binary vapour cycle. Condensers.	3
		40

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<b>TEXT BOOK</b>		
<b>1</b>	Steam, Gas Turbine and Power Plant Engineering, Yadav R., CPH Allahabad	
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Pub.</b>
<b>1</b>	A Practical Guide to Steam Turbine, Heinz P. Bloch, McGraw Hill Publication	<b>1995</b>
<b>2</b>	Steam Turbines: Design Application and Rerating, Heinz P. Bloch, McGraw Hill Publication.	<b>1996</b>
<b>3</b>	Steam Turbine: Theory and Design, Shlykhin P., University press of Pacific.	<b>2006</b>
<b>4</b>	Steam Turbine: Theory and Construction, Wilde and Salter, Merchant Books.	<b>2007</b>
<b>5</b>	Power Plant Engineering, Nag P.K., Tata McGraw-Hill, New Delhi.	<b>1992</b>
<b>6</b>	Thermal Science & Engineering, Kumar D.S., S.K.Kataria & Sons	<b>2006</b>
<b>7</b>	Engineering Thermodynamics, Nag P.K., Tata McGraw-Hill, New Delhi	<b>1998</b>
<b>8</b>	Fundamentals of Classical Thermodynamics, G J Van Wylen, Willey Eastern	<b>1959</b>
<b>9</b>	Engineering Thermodynamics, Cengel & Boles, Tata McGraw-Hill, New Delhi.	<b>2006</b>
<b>10</b>	Engineering Thermodynamics, Chottopadhyay P., Oxford University Press.	<b>2009</b>

#### **7MEU4: SUPPLY AND OPERATIONS MANAGEMENT**

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+0T**

CO1: Describe the basic concepts of operations management and production systems

CO2: Analyse and solve the problems of production planning, scheduling & control.

CO3: Understand the concepts of MRP, JIT and SCM.

CO4: Solve the problems using project management & reliability.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity	<b>3</b>
	Demand Forecasting: components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Time series data. Associative forecasting techniques, Accuracy and control of forecasts, Selection of forecasting technique.	<b>4</b>
<b>II</b>	Product and Service design, Process selection, Process types, Product and process matrix, Process analysis.	<b>3</b>
	Capacity Planning: Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.	<b>2</b>
<b>III</b>	Facility Location: Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; line balancing. Material Handling	<b>4</b>
	Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning. Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning capacity requirements, Introduction to ERP	<b>4</b>

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IV	Techniques of production control in job shop production, batch production and mass production systems. sequencing: priority rules, sequencing jobs through two work centers, scheduling services	4
	Introduction to Just-in-time (JIT) and Lean Operations: JIT production, JIT scheduling, synchronous production, Lean operations system	4
V	Supply Chain Management (SCM): Need of SCM, Bullwhip effect, Elements of SCM, Logistics steps in creating effective supply chain, Purchasing and supplied management.	3
	<b>Project Management:</b> Nature of projects, project life cycle, Work breakdown structure, PERT and CPM, Time-Cost trade-offs: Crashing. Resource allocation, leveling	5
<b>TOTAL</b>		<b>40</b>

<b>TEXT BOOK</b>		
1	Stevenson, Operations Management, Tata McGraw Hill.	2009
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Pub.</b>
1	Roberta S. Russell, Bernard W. Taylor, Operations Management, John Wiley	2010
2	Joseph S. Martinich, Production And Operations Management, John Wiley	2008
3	S.N. Chary, Production and Operations Management, Tata McGraw Hill	2009
4	Norman Gaither, Greg Frazier, Operations Management, Thomson Learning	2002

### 7MEU5: MODELING AND SIMULATION

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+0T**

UNIT	CONTENTS	CONTACT HOURS
I	<b>Physical modeling :</b> Concept of system and environment, continuous and discrete system, linear and nonlinear system, stochastic activities, static and dynamic models, principles used in modeling, Basic simulation modeling,	4
	Role of simulation in model evaluation and studies, Advantages and Disadvantages of simulation. Modeling of Systems, iconic analog. Mathematical Modeling	4
II	<b>Computer system simulation:</b> Technique of simulation, Monte Carlo method, experimental nature of simulation, numerical computation techniques, continuous system models, analog and hybrid simulation, feedback systems,	4
	Buildings simulation models of waiting line system, Job shop, material handling and flexible manufacturing systems	4
III	<b>Probability concepts in simulation:</b> Stochastic variables, discrete and continuous probability functions, random numbers, generation of random numbers,	4
	Variance reduction techniques, Determination of the length of simulation runs, Output analysis.	4
IV	<b>System dynamics modelling:</b> Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship.	5
	Simulation of system dynamics model.	3
V	<b>Verification and validation:</b> Design of simulation experiments, validation of experimental models, testing and analysis.	4

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	Simulation languages comparison and selection, study of SIMULA, DYNAMO, STELLA, POWERSIM. Simulation softwares.	<b>4</b>
	<b>TOTAL</b>	<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Simulation Modeling and Analysis, Law A.M., McGraw Hill.	
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Discrete-Event System Simulation, Banks and Carsan, Prentice Hall of India	
<b>2</b>	Simulation Modeling and Analysis with ARENA, Altiok and Melamed, Academic Press	
<b>3</b>	Simulation with ARENA, Keltan, Sadowski and Turrock, McGraw Hill	
<b>4</b>	Simulation Modeling and ARENA, Rossetti and Taha, John Wiley and Sons	
<b>5</b>	Dynamic Systems: Modeling, Analysis and simulation, Finn Hangen, Tapir Academic Press	

### 7MEU6.1: COMPUTATIONAL FLUID DYNAMICS

#### **B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+0T**

CO1: Define and formulate the given fluid problem and heat transfer problem.

CO2: Discuss the concept of discretisation to fluid flow and heat transfer problems.

CO3: Understand and Apply the Finite difference method for solving the fluid flow and heat transfer problems.

CO4: Evaluate and use Finite volume method for solving the fluid flow and heat transfer problems.

CO5: Apply the knowledge of computational fluid dynamics in chemical and paint industries.

**Introduction:** Importance and applications of CFD in diverse fields; Different types of partial differential equations – hyperbolic, parabolic, elliptic and mixed types; Fundamental concepts of CFD.

**Governing equations:** Continuity, momentum and energy equations in conservative and non-conservative forms; Governing equations in boundary layers and inviscid flows; Initial and boundary conditions.

**Discretization:** Concept and need of discretization of differential equations; Different discretization techniques – finite difference, finite element and finite volume methods and their comparison; Fundamentals of FDM, forward, backward and central difference, ADI scheme, applications to simple problems such as transient one-dimensional and two-dimensional conduction; Stability criterion, errors, consistency, optimum step size.

**Grid generation:** Types of grid; Structured, unstructured and hybrid mesh in 2d & 3d, their relative merits and regions of application; Coordinate transformation; Elliptic grid generation; Grid independence test; Adaptive grids, modern developments in grid generation.

**Calculation of flow field:** Methods of solution, simple 1d computations using different methods; Convergence criterion; Implicit and explicit algorithms; Pressure and velocity corrections; Vorticity-streamfunction method; Solution of turbulent flows and turbulence modelling.

**TEXT BOOKS:-**

*(Handwritten signatures and marks)*

“Computational Fluid Dynamics – The basics with applications”, J. D. Anderson Jr., McGraw-Hill  
 “Computational Fluid Flow and Heat Transfer”, K. Muralidhar& T. Sundarajan, Narosa Publishing House

**REFERENCE BOOKS:-**

“Numerical Computation of Internal and External Flows”, C. Hirsch, Butterworth-Heinemann  
 “Fundamentals of Engineering Numerical Analysis”, P. Moin, Cambridge Univ. Press  
 “Numerical Methods for Engineering Application”, J. H. Ferziger, Wiley  
 “Computational Methods for Fluid Dynamics”, J. H. Ferziger& M. Peric, Springer  
 “Computational Fluid Dynamics”, T.J. Chung, Cambridge University Press

**7MEU6.2: FUEL CELL AND HYBRID ENGINE TECHNOLOGY**

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+0T**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction and types of Fuel cell: Introduction : the rational behind fuel cell development, basic principle of fuel cell, operational of fuel cell, efficiency of fuel cell, co generation of heat and power, important reaction such as hydrogen oxidation, methonal oxidation etc	3
	Types of fuel cell: DMFC (direct methanol fuel cell),PAFC (phosphoric acid fuel cells), MCFC ( molten carbonate fuel cells), SOFC ( solid oxide fuel cells)	4
II	Fuel processing and application of fuel cells: Fuel processing- general, producing hydrogen from alcohol, producing hydrogen from hydrocarbon, hydrogen from other sources, Gas cleanup, reformer system, hydrogen storage system Engineering	6
III	fuel cell engineering, vehicle cell design, stack engineering fuel processing system application: stationary power, propulsion of vehicle, portable application	4
	Electric Vehicle: Introduction, working. Electric car motors, electric car batteries, charging system of electric car, magna charge system. conversion system for transmission.	6
IV	Hybrid vehicle: Introduction, working. Power split devices. Hybrid car performance, gasoline hybrid structure. Gasoline Vs electric power	6
	Transmission components of hybrid vehicle. Advantage and limitation. Different types of hybrid vehicle.	4
V	Solar Vehicles: Introduction and working, photovoltaic cell, solar cell. Energy lose in solar cell. Solar powering house. Solar cost, anatomy of solar cells	7
	<b>TOTAL</b>	<b>40</b>

**TEXT BOOK**

1	Electric and Hybrid Vehicles: Design Fundamentals, Second Edition, By Iqbal Husain, CRC press	2009
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**REFERENCE BOOKS**

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Fuel cell technology, N. Sammes, Springer	2012
2	Microbial Fuel Cell, Bruce E. Logan , Willey publication	2008
3	Principle of Fuel Cell, Xiangeo Li, CRC Press	2006
4	Hydrogen fuel cells for road vehicles, corbo et.al, springers	2007
5	Electrical vehicle technology, James Iaraminie, Wiley	2008

### 7MEU6.3: PROJECT MANAGEMENT

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+0T**

UNIT	CONTENTS	CONTACT HOURS
<b>I</b>	Introduction to Project Management Project management: concepts & types of projects, project organizations; Project management knowledge area. Project life cycle	<b>8</b>
<b>II</b>	Project appraisal Concept, Types of appraisal: Technical, Economic, Financial, Social appraisal of the Industrial Projects, Numerical on Economic, financial appraisals Project scope management and break down structure Project scope, creating work break down structure (WBS); responsibility matrix, Activity relationship, Sequencing, activity duration, schedule development, Resource estimation, allocation & Leveling.	<b>7</b>
<b>III</b>	Project networking: Project networking, Networking techniques, critical path methods-CPM, PERT, network analysis, Network cost models -Crashing	<b>8</b>
<b>IV</b>	Project Quality Management: Definition of -Project quality planning, quality assurance and quality control, Tools and techniques for project Quality planning, quality assurance and quality.	<b>8</b>
<b>V</b>	Project Risk management Project Risk Management: risk identification, risk quantification Measuring risk; Contingency planning; scheduling resources; reducing project duration; Project Performance analysis and closure Project performance evaluation: Concept of earned value ' , Schedule & cost Variance S' curves for project completion and cost comparison;	<b>7</b>
<b>TOTAL</b>		<b>40</b>

#### TEXT BOOK

1. Project Management – Clifford F Gray , Erik W Larson- Mc Grawhill.

#### REFERENCE BOOKS

##### Name of Authors / Books / Publisher

1. Project management ( core text book ) – Samual J. Mantel, Scott M. shafer
2. Project management & control –Singh & Narendra
3. Pert & CPM – Dr BC Punmia, KK Khendelwal- Laxmi publication
4. Project management – Desai, Vasant
5. Project Management – K P Sharma- National publishing house- Dehli
6. Project Management – M R Agrawal
7. Fundamentals of Project Management - James P Lewis, Heritage
8. Prasanna Chandra, Projects: Planning, Analysis, Financing, Implementation & Review, Tata Mc-Graw Hill, 2002
9. John M. Nicholas, Project Management for Business, Engineering and Technology, Elsevier publications, 2008.
10. Goel B.S., Production and Operations Management, Pragati Prakashan, Merrut, 21 Edition, 2009

### 7MEU6.4: NON CONVENTIONAL MACHINING METHODS

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**3L+0T**

UNIT	CONTENTS	CONTACT HOURS
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*(Handwritten signatures and marks)*

<b>I</b>	Introduction and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process.	<b>3</b>
	<b>Abrasive finishing processes:</b> AFM, MAF (for Plain and cylindrical surfaces).	<b>4</b>
<b>II</b>	<b>Mechanical advanced machining process:</b> Introduction, Mechanics of metal removal, process principle, Advantages, disadvantages and applications of AJM, USM, WJC.	<b>6</b>
<b>III</b>	<b>Thermo electric advanced machining process:</b> Introduction, Principle, process parameters, advantages, disadvantages and applications about EDM, EDG,	<b>4</b>
	LBM, PAM, EBM	<b>6</b>
<b>IV</b>	<b>Electrochemical and chemical advanced machining process:</b> ECM, ECG, ESD, Chemical machining,	<b>5</b>
	Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process.	<b>3</b>
<b>V</b>	Intorduction to Micro and nanomachining,	<b>5</b>
<b>TOTAL</b>		<b>40</b>

<b>TEXT BOOK</b>		
<b>1</b>	Modern Machining Process, Pandey and Shan, Tata McGraw Hill	<b>1980</b>
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Advance Machining Process, Jain V.K., Allied Publishers Ltd.	<b>2002</b>
<b>2</b>	Non Traditional Manufacturing Process, Gary F. Bevedict, Marcel Dekker Inc New York.	<b>1987</b>
<b>3</b>	Non-Conventional Machining Process, Mishra P.K., Narosa Publishing House	<b>2006</b>
<b>4</b>	Non-Conventional Machining Process, J.A. McGeough	<b>1988</b>
<b>5</b>	Nano and Micromachining, J. Paulo Davim, and Mark J. Jackson, Wiley-ISTE	<b>2008</b>

### 7MEU7: FINITE ELEMENT LAB

#### **B.Tech. (Mechanical) 7<sup>th</sup> semester**

**OL+OT+3P**

CO1: Understand the discretization techniques.

CO2: Able to apply appropriate constraints and boundary conditions to finite element models

CO3: Demonstrate the commercial FEA code (ANSYS) to solve structural mechanics and steady state heat transfer problems.

CO4: Evaluate the performance from the FEM solution.

<b>SN</b>	<b>LABORATORY WORK/NAME OF EXPERIMENT</b>
<b>1</b>	Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems <b>by using FE packages such as NASTRAN/ ANSYS/ SIMULIA/ ABAQUS</b>
<b>2</b>	Introduction of GUI of the software in the above mentioned areas realistic problems.
<b>3</b>	Analysis of beams and frames (bending and torsion problems)
<b>4</b>	Plane stress and plane strain analysis problems
<b>5</b>	Problems leading to analysis of axisymmetric solids
<b>6</b>	Problems leading to analysis of three dimensional solids (a) Heat transfer problems (b) Modal analysis problem
<b>7</b>	One Dimensional problems of Finite Element Method

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Note: (These exercises may be performed by any of the following Advanced CAD Software such as Pro E /Unigraphics/ AotoCAD Inventor)
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**7MEU8: MATLAB & ENGINEERING APPLICATIONS LAB**

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**0L+0T+3P**

SN	NAME OF EXPERIMENT
	Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems by writing own code for finite element analysis using <b>MATLAB for:</b>
<b>1</b>	Plane stress and plane strain analysis problems
<b>2</b>	Modal Analysis problem
<b>3</b>	Numerical Analysis Problems
	Problems from Probability and statistics, Operations research, Inventory control, Quality control etc can be solved using software's available in the lab e.g. SPSS, TORA, LINDO under <b>Engineering Applications</b> lab.

**7MEU9: CAM & INDUSTRIAL ENGINEERING LAB.**

**B.Tech. (Mechanical) 7<sup>th</sup> semester**

**0L+0T+2P**

CO1: Understand the mechanism of CNC machines and G&M codes.

CO2: Develop the understanding to write part program for various machining processes.

CO3: Analyze the relation between CAD and CAM.

CO4: Apply the practical knowledge of CAM in process, medical, pharmacy industries.

SN	NAME OF EXPERIMENT
<b>1</b>	To prepare part programming for plain turning operation.
<b>2</b>	To prepare part program for turning operations using turning cycle.
<b>3</b>	To prepare part program for threading operation.
<b>4</b>	To prepare part program for gear cutting using mill cycle.
<b>5</b>	To prepare part program for multiple drilling in X and Z axis using drilling cycle.
	Case Study on the following:
<b>1</b>	Work Methods Design
<b>2</b>	Process Control Charts
<b>3</b>	Materials Management
<b>4</b>	Capacity Planning

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## SMEUA1: NEW ENTERPRISE AND INNOVATION MANAGEMENT

### B.Tech. (Mechanical) 8<sup>th</sup> semester

**3L+1T**

CO1: Understand entrepreneurship and entrepreneurial process and its significance in economic development.

CO2: Develop an idea of the support structure and promotional agencies assisting ethical entrepreneurship.

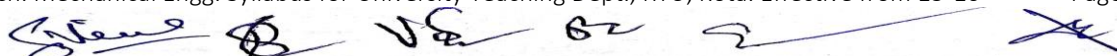
CO3: Identify entrepreneurial opportunities, support and resource requirements to launch a new venture within legal and formal framework.

CO4: Develop a framework for technical, economic and financial feasibility.

CO5: Evaluate an opportunity and prepare a written business plan to communicate business ideas effectively.

CO6: Understand the stages of establishment, growth, barriers, and causes of sickness in industry to initiate appropriate strategies for operation, stabilization and growth.

UNIT	CONTENTS	CONTACT HOURS
<b>I</b>	Entrepreneurship: Entrepreneurship and enterprise: Concept, role in economic development. Entrepreneurial competencies: awareness, assessment and development. Simulation exercise on goal setting in entrepreneurship. Entrepreneurial & Intrapreneurial mind. International entrepreneurship opportunities. Starting the venture: Generating business idea – sources of new ideas, methods of generating ideas, creative problem solving, opportunity recognition; environmental scanning, competitor and industry analysis; feasibility study – market feasibility, technical/operational feasibility, financial feasibility.	<b>8</b>
<b>II</b>	Business Plan: Emerging Business Opportunities-sources & assessment. Business Plan: Concepts, Methods, analysis & interpretation. Functional plans: Marketing plan – marketing research for the new venture, steps in preparing marketing plan, contingency planning; organizational plan – form of ownership, designing organization structure, job design, manpower planning; Financial plan: cash budget, working capital, proforma income Statement, proforma cash flow, proforma balance sheet, break even analysis.	<b>7</b>
<b>III</b>	Sources of finance: Sources of external finance, short term as well as long term, Debt or equity financing, commercial banks, venture capital; financial institutions supporting entrepreneurs; legal issues – intellectual property rights patents, trade marks, copy rights, trade secrets, licensing; franchising.	<b>8</b>
<b>IV</b>	Start Up: Institutional support to start up and incentives for SSI. Statutory obligation in starting a unit (general like Income Tax, VAT, CST or GST, Service tax, excise and customs, labour laws, etc. Start up strategies. Dealing with outside agencies like consultant, contractors, etc. Key marketing issue of new venture. Starting a franchising business. Starting an e-commerce venture. Buying a running business. Managing growing venture: Growth, objective and strategy. Managing growth. Assessing resource from external sources, for financing growth including public issue, merger, amalgamation, joint venture, collaboration & selling business.	<b>8</b>
<b>V</b>	Innovation Management: an introduction, organizational setups that facilitate innovations. Management of research and development. Strategic alliances and network. Incubators and Accelerators.	<b>7</b>
<b>TOTAL</b>		<b>40</b>



<b>TEXT BOOK</b>
1 Hisrich, Robert D., Michael Peters and Dean Shepherd, Entrepreneurship, Tata McGraw Hill, New Delhi.
<b>REFERENCE BOOKS</b>
<b>Name of Authors /Books /Publisher</b>
1. Barringer, Brace R., and R., Duane Ireland, Entrepreneurship, Pearson Prentice Hall, New Jersey, USA.
2. Lall, Madhurima, and Shikha Sahai, Entrepreneurship, Excel Book, New Delhi.
3. Charantimath, Poornima, Entrepreneurship Development and Small Business Enterprises, Pearson
4. Paul Trot, Innovation Management and New Product Development, Pearson Education
5. P Narayana Reddy, Entrepreneurship : Text and Cases, Cengage
6. Murdick, Ross & Claggett. Information Systems for Modern Management, PHI of India.

### **SMEUA2: PRODUCT DEVELOPMENT AND LAUNCHING**

#### **B.Tech. (Mechanical) 8<sup>th</sup> semester**

**3L+0T**

CO1: Understand the process of product development.

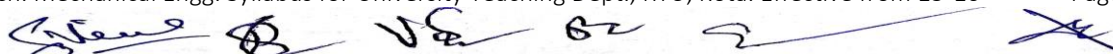
CO2: To know the need and its economic existence.

CO3: Develop the idea of product design using creative tools like simulation modeling & RPT.

CO4: To use the human engineering (ergonomics) in the product development process.

CO5: Knowledge about organizational structure and execution of product.

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	<b>Importance of New Product:</b> Definition-importance-Development Process, Importance of new product for growth of enterprise, Definition of product and new product,	<b>2</b>
	Responsibility for new product development, Demands on product development team, Classification of products from new product development point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products,	<b>3</b>
	New product development process and organization, Generic product development process for Market Pull Products, Modification of this process for other types of products.	<b>3</b>
<b>II</b>	<b>Need Analysis:</b> Problem Formulation Establishing economic existence of need, Need Identification and Analysis, Engineering Statement of Problem, Establishing Target Specification.	<b>8</b>
<b>III</b>	<b>Generation of Alternatives and Concept Selection:</b> Concept generation- a creative process, Creativity, Road Elects to creative thinking-Fear of criticism and Psychological set,	<b>4</b>
	Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process, Concept feasibility and Concept Selection, Establishing Engineering Specification of Products.	<b>4</b>
<b>IV</b>	<b>Preliminary and Detailed Design:</b> Design Review Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility, Detailed design of subsystems, component design,	<b>6</b>
	Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics.	<b>2</b>
<b>V</b>	<b>Management of New Product:</b> Development and Launch New Product Management's Challenges, Maintaining focus, Promotion of Right Culture, Management of Creativity, Top Management attention, Design Team Staffing and Organization, Setting key mile stone, Identification of Risk Areas, Project Execution and Evaluation Product Launch Strategies,	<b>8</b>
<b>TOTAL</b>		<b>40</b>



<b>TEXT BOOK</b>		
<b>1</b>	Product Design and Manufacturing, Chitale and Gupta. McGraw Hill.	
<b>REFERENCE BOOKS</b>		
<b>SN</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Pub.</b>
<b>1</b>	Product Design and Development, Ulrich and Eppinger, McGraw Hill	<b>2003</b>
<b>2</b>	Project Management in New Product Development, Barkley B.T., Tata McGraw Hill.	<b>2008</b>
<b>3</b>	Product Management, Anandan C., McGraw Hill.	<b>2009</b>
<b>4</b>	Engineering Design Methods, Cross, Nigel, John Wiley and Sons.	<b>1995</b>
<b>5</b>	Product Design and Manufacture, Lindbeck, J.R., Prentice Hall of India.	<b>1995</b>

### **SMEUA3: COST ACCOUNTING FOR MANAGEMENT**

#### **B.Tech. (Mechanical) 8<sup>th</sup> semester**

**3L+0T**

<b>UNIT</b>	<b>CONTENTS</b>	<b>CONTACT HOURS</b>
<b>I</b>	Cost Management, Cost Management Tools- A Strategic View to Cost Management.	<b>8</b>
<b>II</b>	Cost Sheet and Composition: Overheads, Classification & Collection, Difference between Cost Allocation & Cost Apportionment, Absorption of Overhead. Marginal Costing: - Nature and Scope- Applications-Break even analysis, Advantages and Disadvantages of Marginal Costing.	<b>7</b>
<b>III</b>	Budgetary Control: Objectives of Budgetary control, Functional Budgets, Master Budgets, Key Factor. Standard Costing:- Comparison with Budgetary control, analysis of Variance, Simple Problems on Material overheads and Labour variances only. New Techniques of Costing: Demerits of Traditional Costing, Activity Based Costing, Cost Drivers, Cost Analysis Under ABC.	<b>8</b>
<b>IV</b>	Cost Audit: Cost Audit,-objectives, Advantages, Areas and Scope of Cost Audit, Cost Audit in India. Management Audit- Aims and the objectives, Scope of Management Audit. Cost Control: Cost Reduction, and Cost Control, Target Costing - its Principles, Balanced Scorecard as a performance measure- Features- Purpose, Reasons for use of balanced scorecard.	<b>8</b>
<b>V</b>	Cost Reporting: Reporting to Management - Purpose of reporting- Requisites of a good report, Classifications of Report, Segment reporting, Applicability of Accounting Standard 17, Objectives, Uses of Segment reporting.	<b>7</b>
<b>TOTAL</b>		<b>40</b>

#### **TEXT BOOK**

1 Kumar, Vijay. Accounting for Management. Tata McGraw-Hill.

#### **REFERENCE BOOKS**

##### **Name of Authors /Books /Publisher**

1. Kuppapally. Accounting for Managers. Prentice Hall of India.
2. Maheshwari, S .N. & Maheshwari, S. K. Advanced Management Accounting Vol.1 & Vol.2. Vikas Publishing House.
3. Kaplan, Atkinson and Young. Management Accounting. Pearson Education.
4. Vij. Management Accounting. Macmillan Publishers India.
5. Paresh Shah. Management Accounting. Oxford University Press

*(Handwritten signatures and initials)*

### **8MEUA4: ENTREPRENEURSHIP LAB**

**B.Tech. (Mechanical) 8<sup>th</sup> semester**

**0L+0T+3P**

<b>SN</b>	<b>NAME OF EXPERIMENT</b>
<b>1</b>	At least one Case Study from each unit of 8MEUA1 Questions will be case/inferences/application based Practical: student can perform one of the following or combination according to the instruction of the faculty in charge: <ul style="list-style-type: none"><li>• Prepare a feasibility report/business plan and make presentation in the class.</li><li>• Prepare an assignment on at least three leading entrepreneurs</li><li>• Visit a franchisee and prepare a report and/or make presentation in the class</li></ul>

### **8MEUA5: ADVANCE SOFTWARE LAB**

**B.Tech. (Mechanical) 8<sup>th</sup> semester**

**0L+0T+3P**

CO1: Learn the basic features and commands of CAD software.

CO2: Develop the understanding of graphical detailing and modeling of objects.

CO3: Implement skills for 3-D modeling and designing for different problems.

CO4: Apply the practical understanding and skills in various R&D companies, Manufacturing and Plastic industries.

<b>SN</b>	<b>NAME OF EXPERIMENT</b>
<b>1</b>	Development of group /class projects and Hands on Practice on various platforms and applications software like AutoCAD (Drafting), Solid works (Design Modeling), CATIA (Surface Modeling), ANSYS (Analysis and Design), MS projects(Project Management concepts), LABview, FLUENT(Computational Fluid Dynamics), TECPlot, COMsol, NASTRAN(Finite element Modeling) & Arena(Simulation).

