

Department of Mechanical Engineering
Syllabus
of
Bachelor of Technology
Production & Industrial Engineering

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

University Teaching Departments
Rajasthan Technical University, Kota

3PIU1: MECHANICS OF SOLIDS

B.Tech. (P&I) 3rd 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	Stress and Strain: 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	Members Subjected to Flexural Loads: 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	Principal Planes, Stresses and Strains: 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
IV	Torsion: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads.	6
	Stability of Equilibrium: 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	Transverse Deflection of Beams: 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
	Thin-walled Pressure Vessels: Stresses in cylindrical and spherical vessels	2
	TOTAL	40

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
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	Punmia, Jain and Jain, "Mechanics of Materials", Laxmi Publication	2002

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5	Popov, E.P., Nagarajan, S., and Lu, Z. A., "Mechanics of Materials", 2 nd Ed., Prentice-Hall of India	2002
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3PIU2: MATERIAL SCIENCE AND ENGINEERING

B.Tech. (P&I) 3rd 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 ₂ O ₃ , SiC, Si ₃ N ₄ , PSZ etc. Fiber and particulate reinforced composites and resin plastics. Introduction to Nano materials- Nano structured materials. Nano clusters & Nano crystals.	4
		40

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

3PIU3: ENGINEERING THERMODYNAMICS

B.Tech. (P&I) 3rd 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.

UNIT	CONTENTS	CONTACT HOURS
I	Basic Concepts and definitions of Thermodynamics: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	2
	Zerorth and First Law of Thermodynamics: Zerorth of Thermodynamics, Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	5
II	Second Law of Thermodynamics: 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.	4
	Entropy: Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume.	3
	Availability: Available energy, Loss in available energy, Availability Function, Irreversibility.	3
III	Thermodynamic Properties of Fluids: Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart	4
	Ideal Gas and Real Gas: 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.	4
IV	Thermodynamic Relations: 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.	4
	Power Cycles: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and Ericsson cycle.	5
V	Vapour power cycle: Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle	3

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Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	3
TOTAL	40

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

3PIU4: FOUNDRY AND WELDING TECHNOLOGY

B.Tech. (P&I) 3rd semester

3L+0T

CO1: Understanding various patterns and moulds.

CO2: Analyze various casting processes and their applications.

CO3: Learn various techniques of welding and joining processes.

CO4: Test and identify defects in casting and welding by various destructive and nondestructive technics.

UNIT	CONTENTS	CONTACT HOURS
I	General Classification and Introduction to Manufacturing processes. Pattern Practice: Introduction, advantage and disadvantages of casting over other manufacturing process, conventional casting procedure, requirement of a good pattern, types of patterns, pattern materials, pattern allowances.	3
	Moulding Practice: Moulding sands: types, composition, preparation, properties, conditioning and testing - Grain fineness; moisture content, clay content and permeability test.; types of moulds, moulding processes, moulding machines; Cores: Functions of core, type of cores, core print, core box, Gating system: types, pouring basin, sprue, gating ratio, chills, runner and risers; Gating system design and risering design, pouring time.	5
II	Casting Practice: Basic rules for good casting design, Foundry equipment and furnaces. Melting, pouring and solidification. relative advantages, disadvantages and applications of casting processes, Sand casting,	3
	Shell-mould casting, plaster-mould casting, ceramic-mould casting, vacuum casting, evaporative pattern casting (lost foam), Investment casting, slush casting, die casting, centrifugal casting, continuous casting.	3
	Cleaning, finishing and heat treatment of casting	2
III	Welding processes: Introduction, advantages, disadvantages and application of welding, Classification of welding process; Types of joints, welding joint, safety feature in welding, weldability, welding symbols, soldering and brazing.	4

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	Welding electrodes, selection of welding electrodes, flux. Pressure welding: forge welding, resistance electric welding, butt welding, flash welding, spot welding, seam welding, projection welding. Fusion welding: gas welding, electric arc welding, metallic arc welding, carbon arc welding, shielded arc welding, Thermit welding.	4
IV	TIG welding, MIG welding, submerged arc welding, ultrasonic welding, plasma arc welding, laser beam welding, friction welding, cold welding, under water welding.	3
	Thermal cutting of metals, welding of dissimilar metals, welding of plastics, Residual welding stresses, heat treatment of weldments,	5
V	Testing of Castings and Weldments: Causes and remedies for casting defects, welding defects. Destructive testing methods: tensile test, compression test, bend test, impact test, hardness test.	4
	Non-destructive testing methods: visual inspection, leak test, x-ray and X-ray radiography, magnetic particle test, liquid penetration test, fluorescent penetration test, ultrasonic test, eddy-current test, allowable defects and quality control of welding as per ASME standard.	4
TOTAL		40

TEXT BOOK		
1	Rao.P.N., Manufacturing Technology, Vol. 1, Tata McGraw Hill	2013
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub.
1	Ghosh, A., & Mallik, A. K. 1986. Manufacturing Science: Ellis Horwood.	1999
2	Schey, Introduction to Manufacturing Processes, Tata McGraw Hill	2000
3	Kalpakjian, S., & Schmid, S. R., Manufacturing processes for engineering materials, Pearson Education.	2008
4	Campbell, J. S. Principles of manufacturing materials and processes: TMH	1999
5	Heine,, Loper, C.R., and Rosenthal, P.C., "Principles of Metal casting", TMH	1976
6	Groover, M.P., Fundamentals of Modern Manufacturing: Materials, Processes and systems, Prentice Hall, New Jersey	2007
7	Kalpakjian, S. & Schmid S.R, Manufacturing Engineering and Technology, Addison Wesley Longman	2000
8	Little, R.L., Welding and welding technology Tata McGraw-Hill Education	1973
9	Shan, H.S., Manufacturing Process, Pearson Education.	2012
10	Principle of Foundry Technology , P.L.Jain, Tata McGraw Hill, 2003	
11	Modern Welding Technology, B.Curry, Prentice Hall,	2002
12	Welding Principle & applications ,Larry Jeff in Delmar,	1997
13	Foundry Engineering ,Taylor HF Fleming, M.C. & Wiley Eastern Ltd.	

3PIU5: FLUID MECHANICS & MACHINES

B.Tech. (P&I) 3rd 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	Fluid Properties: Definition of a fluid, Viscosity-dynamic and kinematic, Surface Tension.	3

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	Fluid Statics: 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	Fluid flow concepts and Basic control volume equations: General control equation, conservation of mass, energy equation and its application, Momentum equation and its applications	4
	Basic governing differential equation: Reynolds transport equation, continuity equation, momentum equation, energy equation, Bernoulli's equation.	4
III	Viscous flow: Laminar flow through pipe and between parallel plate.	4
	Turbulent flow: 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
	Flow through pipe: Major and minor Losses in pipe, Hydraulic and energy gradient line, Network of pipes-series and parallel.	5
V	Hydraulic Turbines: Classification of hydraulic turbines, work done and efficiencies of Pelton, Francis and Kaplan turbines, Draft tube, Specific speed and unit quantities	5
	Hydraulic systems: Hydraulic press, Hydraulic accumulator, Hydraulic Intensifier, Hydraulic Ram, Hydraulic lift, Hydraulic coupling, Hydraulic torque convertor Gear pump.	3
	TOTAL	40

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

3PIU6: ADVANCED ENGINEERING MATHEMATICS -1

B.Tech. (P&I) 3rd 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.

UNIT	CONTENTS	CONTACT HOURS
I	Laplace Transform: Definition and existence of Laplace transform, properties and formulae, unit step function, Dirac Delta function,	10

	Heaviside function, inverse Laplace transform, Convolution theorem, application of Laplace transform to ordinary differential equation, solution of integral equations.	
II	Fourier Transforms: 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).	9
III	Z-Transform: Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	7
IV	Numerical Analysis: Interpolation, difference operators- forward, backward, central, shift and average operators, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Stirling's formula, Lagrange interpolation formula for unequal intervals. Inverse interpolation.	7
V	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.	7
	TOTAL	40

TEXT BOOK		
	<ol style="list-style-type: none"> 1. <i>Advanced Engineering Mathematics</i>, Jain and Iyengar, Narosa Publications. 2. <i>Engineering Mathematics for semesters III and IV</i>, C.B. Gupta, McGraw Hill Education, India. 3. <i>Advanced Engineering Mathematics</i>, Denis Zill and Warren Wright, Jones & Bartlett India Private Limited. 4. <i>Advanced Engineering Mathematics</i>, O'neil, Cengage Learning, India. 	
REFERENCE BOOKS		
	<ol style="list-style-type: none"> 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 & 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, India. 9. <i>Numerical Methods for Engineers</i>, Chapra, McGraw Hill Education, India. 10. <i>Engineering Mathematics</i>, Paras Ram, CBS Publisher, India. 	

3PIU7: PRODUCTION PRACTICE-I

B.Tech. (P&I) 3rd 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

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

3PIU8: INTRODUCTION TO MECHANICAL ENGINEERING LAB

B.Tech. (P&I) 3rd semester

OL+ OT + 3P

- 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.	

3PIU9: MATERIAL SCIENCE AND TESTING LAB

B.Tech. (P&I) 3rd semester

OL+ OT + 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, Tata McGraw-Hill	2000
3	Suryanarayanan, A.V.K. "Testing of Metallic materials" TataMcGraw Hill	1993

3PIU10: FLUID MECHANICS LAB

B.Tech. (P&I) 3rd 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.

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8	Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.
9	Determination of Coefficient for minor losses in pipes.
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.

3PIU11: PROFESSIONAL SKILL WORKSHOP

B.Tech. (P&I) 3rd 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>Personality Assessment Skills: Personal SWOT Analysis activities, leveraging personal strengths, Self Evaluation, self discipline, self criticism, Mock Interviews</p> <p>Time Management Skills: Practice by game play and other learning methodology for achieving targets and setting priorities</p> <p>Conflict Management Skills: Learning negotiation and conflict resolution skills through simulation exercise</p> <p>Leadership Skills: Assertiveness, Innovation & Creativity, discussions on successful leaders and entrepreneurs</p> <p>Motivational Skills: Motivational Theories and their practical applications, Ability to motivate self and others</p> <p>Stress Management Skills: Practice different methods of Stress management, Introduction to Yoga & Pranayam, Use of prayer and Meditation, Effective use of music for relieving stress and enhancing concentration & consistency</p> <p>Group Dynamics: Group Discussion, Role plays, In-Basket exercises, Video samples of mock GD</p> <p>Behavioural Skills: Attitude and Altitude, Lateral Thinking, Psychometrics, Case study and Video samples</p>

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4PIU1: DESIGN OF MACHINE ELEMENTS – I

B.Tech. (P&I) 4th semester

3L+ 1T

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	<p>Design Criteria: Strength, Stiffness, aesthetics, ergonomics Design for Manufacturing: Design consideration for cast, forged and machined parts.</p> <p>Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications</p> <p>Design for Assembly: Introduction, Limits, fits and tolerances, Interchangeability, standardization.</p> <p>Materials: Selection of material from properties and economic aspects. Mechanical Properties and IS coding of various materials,</p>	7
II	<p>Design for Strength: Modes of failure, Allowable stresses, factor of safety.</p> <p>Stress concentration: causes and mitigation.</p>	4
	<p>Design of Members subjected to direct stress: Knuckle and cotter joints.</p>	5
III	<p>Design of Members in Bending: Levers and laminated springs.</p> <p>Design for stiffness: Introduction, Specific cases of beam design on the basis of maximum deflection.</p>	7
IV	<p>Design of Members in Torsion: Solid and hollow shafts. Shafts under combined loading. Sunk keys.</p>	5
	<p>Couplings: Design of muff coupling, flanged couplings: rigid and flexible</p>	3
V	<p>Design of Threaded fasteners: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading</p>	5
	<p>Power transmission: Belts and ropes, effect of centrifugal force and creep. Design of flat and Vee belts.</p>	4
TOTAL		40

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

4PIU2: WORK SYSTEM DESIGN AND ERGONOMICS

B.Tech. (P&I) 4th semester

3L+ 0T

CO1: Understand the concept of productivity & effectiveness.

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CO2: Learn about work measurement technics and method study.

CO3: Analyse work sampling and ancillary technics.

CO4: Learning of ergonomics practice Systems concepts.

UNIT	CONTENTS	CONTACT HOURS
I	Concept of Productivity, effectiveness and efficiency, work components of manufacturing time and work content, factors tending to reduce productivity, reducing work content and ineffective time.	3
	Work Study: Objectives of work study - work study procedure human factors in the application of work study-relationship between method study and work measurement.	5
II	Method Study: General principles - basic steps-criteria for selecting work-samples and techniques – data collection-critical evaluation-brain storming and creativity-development of new methods and installation principles of layout of material handling	4
	Principles of motion economy-work place layout-examples of method study in plants and offices. Work place and work environment design.	4
III	Work Measurement: Introduction to work measurement, purpose-use of work measurement-basic procedure-time study equipment's-selection of jobs to be studied-approach to workers-steps in making a time study-number of cycles to be studied.	5
	Performance rating and allowances: Rating-use of rating factor-allowances-personal allowance, fatigue allowance-compiling allowed time for a job - examples of time study-synthesis from standard data. Use of work measurement techniques	4
IV	Work sampling, Theory; determination of number of observations needed, confidence limits-area of application limitations-systematic work sampling and random work sampling.	5
	Ancillary techniques: Pre-determined Motion standards, MTM and work factor-design of work place, design of fixtures and equipment's, standard data, TMU formula, job evaluation and merit rating.	3
V	Ergonomics: The nature of Ergonomics; Ergonomics practice Systems concepts. Human body measurement (Anthropometry).	5
	Joints, bones, muscles. Layout of equipment. Seat design. Design of controls and compatibility.	3
TOTAL		40

TEXT BOOK	
Motion and Time Study and Measurement of Work, Ralph, M Barnes , John Wiley and Sons.	2001
REFERENCE BOOKS	
Name of Authors /Books /Publisher	Year of Pub.
Human Factors Engineering and Design, M.S.Saunders and E.J. McCormic, McGraw Hill.	1995
Introduction to Work Study, George Kanawaty, ILO.	2002
Industrial Engineering Handbook, Harold Bright Maynard, Kjell B. Zandin, McGraw-Hill.	1998
Work measurement and methods improvement, Lawrence S. Aft, Wiley-IEEE.	2002
“Niebel’s Methods, Standards, and Work Design”, Benjamin W. Niebel, Freivalds Andris, McGraw Hill Education (India).	2008
Motion and time study: improving productivity, Marvin Everett Mundel, Prentice-Hall.	2003

4PIU3: THEORY OF MACHINES

B.Tech. (P&I) 4th semester

3L+ 0T

CO1: Learn the basic concept of machine and different mechanism.

CO2: Understand laws of friction and its types.

CO3: Analyze the velocity and acceleration of different mechanisms.

CO4: Examine different gears and gear trains and its applications.

CO5: Learn about cams, gyroscope and balancing of masses.

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to mechanism: Basic concept of machines, links, kinematic pair, kinematic chain and mechanism. Inversions of kinematic chains: four bar chain mechanisms, quick return mechanisms, inversions of double slider crank mechanisms.	5
	Velocity and acceleration in mechanism: Velocity and acceleration polygons, relative velocity and instantaneous centre method	3
II	Friction devices: Types and laws of friction. Pivots and collars. Power screws such as lead screw of the lathe.	4
	Clutches: Single and multi-plate clutches. Brakes: Band, block and band and block brakes.	4
III	Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion. Rack and pinion, Spur, helical, basic introduction of bevel, worm and worm gears,.	6
	Gear Trains: Simple, compound and epicyclic gear trains.	3
IV	Cams: Type of cams; displacement, velocity and acceleration curves for different cam followers; consideration of pressure angle and wear.	4
	Gyroscope: Principles of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicles taking a turn, stabilization of ship.	4
V	Balancing: Balancing of rotating masses in same and different planes, balancing of reciprocating masses, swaying couple, hammer blow and tractive effort.	7
TOTAL		40

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

4PIU4: MACHINING SCIENCES

B.Tech. (P&I) 4th semester

3L+ 0T

CO1: Learn the concept of metal removal processes.

CO2: Analyse the mechanism of chip formation.

CO3: Understand various machining tools used in metal removal processes.

CO4: Classify different gear manufacturing techniques.

UNIT	CONTENTS	CONTACT HOURS
I	Classification of metal removal process and Classification of machine tools, Geometry of single point cutting tool and tool angles, tool nomenclature in ASA and ORS. Concept of orthogonal and oblique cutting.	5
II	Chip Formation, Mechanics of metal cutting, shear angle and its relevance, various theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. machinability, tool wear, tool life, Cutting fluids, Economics of machining, Measurement of cutting forces.	2
III	Lathe: Construction and cutting speed, feed, and depth of cut, machining time and power estimation. Capstan and turret lathe machines, tool layout. Shaper: Construction and working principle, Quick return mechanism.	4
	Milling: Introduction, types of milling machines, milling cutters, milling operations, dividing head, Indexing methods, machining time and power estimation and gear cutting.	4
IV	Gear hobbing, gear shaping. Gear finishing processes: shaving, grinding, lapping and shot blasting	3
	Drilling: - tool geometry of twist drills, types of drills, drilling machine construction, drilling time and force estimation	5
V	Grinding- Need and different methods of grinding, grinding wheel designation and selection, Dressing and truing, Types of grinding machines, Grinding process. Honing, lapping, super finishing, polishing and buffing processes.	4

TEXT BOOK		
1	Lal G.K., Introduction to Machining Science, New Age international Publishers.	2007
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub.
1	Rao.P.N., Manufacturing Technology, Vol. 1,2 and 3, Tata McGraw Hill	2013
2	Ghosh, A., & Mallik, A. K.. Manufacturing Science: East West Press Private Limited.	1986
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

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4PIU5: INDUSTRIAL MANAGEMENT

B.Tech. (P&I) 4th semester

3L+ 0T

CO1 Understand the evolutionary development of management thought and general principles of management.

CO2 Study management concepts and tools for successful functioning of organization.

CO3 Visualize the role of motivation in streamlining an organization.

CO4 Apply group decision making approaches for continuous improvement

UNIT	CONTENTS	CONTACT HOURS
I	Management: Definition including conceptual analysis, functions. Evolution of management thought, scientific management, contributions of Taylor, Gilbert, Gantt, Elton Mayo, Henry Fayol and others.	5
	Management process & systems approach to Management, functions of managers. Levels of management, Administration & Mnmgt. Decision making.	3
II	Forms of ownership: Proprietorship, partnership, joint stock company, private and public limited companies, Joint Stock Companies: Co-operative Society, choice of business forms and state undertakings. Multinational corporations.	4
	Management Planning: Managerial planning, Type of plans, steps in planning; mission, objectives, strategies, policies, procedures, rules and programs. Managing by objectives, strategic planning process, SWOT analysis.	4
III	Organizing: Meaning of organizing and organization, formal and informal organization, span of management, process of organizing. Organizational structure: Line organization, functional organization, matrix organization, strategic business units. Line/Staff concepts, empowerment, and decentralization, delegation of authority.	5
	Effective organizing and organizational culture. Staffing: overview, factors affecting staffing, systems approach, job design, selection, Performance appraisal, rewards. Career strategy, managerial training. Managing change.	4
IV	Human factors in managing Motivation : Theory X, Theory Y, Maslow's hierarchy of needs, Hertzberg's hygiene theory, porter and Lawler model, equity theory, Reinforcement theory, McClelland's theory behavioral model.	5
	Motivational techniques, job enrichment. Leadership: traits, approaches situational, contingency, path goal approach, transactional and transformational leadership.	3
V	Group decision making: Reasons for using Committees and groups, successful operation of committees and groups, working in teams. Communication: purpose, process of communication, communication flow in the organization, barriers to communication, Improvement of communication; role of electronic media in communication.	5
	Controlling: Basic control process, feed forward and feedback control, performance measures and control, requirement of effective control, use of Information Technology for control.	3

TEXT BOOK		
1	Essentials of Managements an Introduction, Koontz, Tata McGraw-Hill, New Delhi.	2002
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub.
1	Fundamentals of Managements, Robbins, Pearson Education	1995
2	Works Organisation and Management, Basu and Sahu, IBH	2005
3	Industrial Organisation and Management, Bethel, Atwater, Smith & Stachmax, McGraw Hill	2010
4	Principles of Industrial Organization, Kimbal and Kimbal, McGraw Hill	2008
5	Principles of Industrial Management, Leon Pratt Alford, Henry Russell Beatty, Revised Edition, Ronald Press Co.	2001

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6	Works Organisation & Mgt, SK Basu, K. C. Sahu, N. K. Datta , Oxford & IBH.	1992
7	Management, Griffin, John Wiley and Sons.	2002
8	Management: Tasks, Responsibilities & Practices, Drucker P. F., Allied Pub.	1995
8	Raju, Industrial Engg and Management, Cengage learning	2015

4PIU6: ADVANCED ENGINEERING MATHEMATICS -2

B.Tech. (P&I) 4th 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.

UNIT	CONTENTS	CONTACT HOURS
	Complex Analysis: Differentiability and Analytic functions, Cauchy-Riemann equations (Cartesian and Polar forms), Harmonic functions. Conformal mapping.	9
	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.	8
	Special Functions: 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.	8
	Statistics & Probability: 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.	9

TEXT BOOK		
SN	Name of Authors /Books /Publisher	Year of Pub.
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.	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Advanced Engineering Mathematics, Irvin Kreyszig, Wiley, India.	
2	Advanced Engineering Mathematics, M. Greenberg, Pearson Education,	
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, I	
6	Complex Variables and Applications, J.W. Brown & R.V. Churchill, MHI	
7	Probability and Statistics, Murray Spiegel, John Schiller, R. AluSrinivasan, McGraw Hill Education, India.	
8	Engineering Mathematics, Paras Ram, CBS Publisher, India.	

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4PIU7: PRODUCTION PRACTICE - II

B.Tech. (P&I) 4th 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	To cut multi-start Square/Metric threads on lathe machine. 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

4PIU8: PRODUCTION ENGINEERING DRAWING

B.Tech. (P&I) 4th semester

OL + OT + 3P

CO1: Review of sectioning and BIS standards for various machine elements.

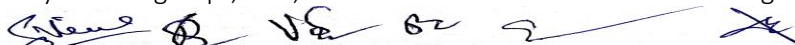
CO2: Practice assembly drawing with sectioning.

CO3: Practice part drawing from assembly.

CO4: Practice of drawings in software like AutoCAD/ProE etc.

CO5: Learn the free hand sketching of various parts of machine element.

SN	CONTENTS
	Review of sectioning, Review of BIS Standard (SP 46), Fasteners – screws, bolts and nuts, riveted joints, pins, locking devices, welded joints, pipe joints, unions and valves. Assemblies involving machine elements like shafts, couplings, bearing, pulleys, gears, belts, brackets. Tool drawings including jigs and fixtures. Engine mechanisms-assembly and disassembly. Production drawings - limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Layout drawings. Schematics, process and instrumentation diagrams, piping drawings. Structural drawings - examples for reading and interpretation. Computer aided design and use of software packages for engineering drawings
	Assembly Drawing with sectioning and bill of materials Universal Coupling, Forming punch and die, Jigs for inspecting shaft etc.(1 drawing sheet of any assembly) Lathe tail stock, shaper tool head, steam stop valve, feed check-valve, swivel machine vice etc (1 drawing sheet of any assembly)
	Detailed part drawings from assembly drawing indicating fits, tolerances and surface finish symbols by referring BIS codes (1 drawing sheet) Check-valve, Junction Valve etc.
	Computer Aided Drafting (4 drawings) Introduction, input, output devices, introduction to software like AutoCAD/ProE/ Creo/Solidworks, basic commands and development of 2D and 3D drawings of simple parts



	Free Hand Sketches: Connecting rod, crank shaft, Pipes and Pipe fittings, machine arbor and cutter, universal dividing head, jigs and fixtures, Step less drive, sliding gear box, safety valve, three way stop valve, blow-off cock, Swivel bearing, Turret Tool Post, drill-press vice, screw jack
TEXT BOOK	
1	Laxminarayan and M.L. Mathur, Machine Drawing, Jain Brothers
REFERENCE BOOKS	
SN	Name of Authors /Books /Publisher
1	Gill P S, Machine Drawing, Kataria & Sons
2	Basudeb Bhattacharya, Machine Drawing, Oxford University Press
4	Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS
5	Siddeshwar N., P Kannaiah, VVS Shastry, Machine Drawing, Tata McGraw Hill

4PIU9: THEORY OF MACHINES LAB.

B.Tech. (P&I) 4th semester

OL + OT + 2P

- CO1 Perform the experiments using pen, paper
 CO2 Develop the charts using the collected data
 CO3 Analyse the experiment data for improvement
 CO4 Suggest the improved practices for better productivity

SN	NAME OF EXPERIMENT
1	To study inversions of four bar chain and slider crank mechanism and their practical applications.
2	To study Steering Mechanisms: Davis and Ackerman.
3	Study of quick return mechanism and its practical applications.
4	Study of inversion of Double slider chain: Oldham Coupling, Scotch Yoke and Elliptical Trammel.
5	Study of various cam-follower arrangements. To plot displacement v/s angle of rotation curve for various cams
6	To determine co-efficient of friction using two roller oscillating arrangement.
7	Study of various types of dynamometers, Brakes and Clutches.
8	Study of differential gear box.
9	To verify the torque relation for gyroscope.
10	To perform wheel balancing. To perform static and dynamic balancing on balancing set up.
11	Study of a lathe gear box, sliding mesh automobile gear box, planetary gear box.

4PIU10: WORK SYSTEM DESIGN LAB

B.Tech. (P&I) 4th semester

OL + OT + 2P

- CO1 Perform the experiments using pen, paper
 CO2 Develop the charts using the collected data
 CO3 Analyse the experiment data for improvement
 CO4 Suggest the improved practices for better productivity

SN	LABORATORY WORK
1	Rating: To obtain practice in rating operators' performance in Card Dealing and Walking.
2	Man Machine Chart a) Prepare man machine chart for drilling two holes in a plate 10 mm thick on a radial drilling machine.

	b) To determine standard time for drilling a hole in mild steel workpiece by stopwatch method.
3	Two handed Process Chart a) To draw two handed process chart for bulb holder assembly and to suggest a satisfactory layout. b) To find out standard time for assembly.
4	Left - Hand and Right - Hand Operation Chart a) To make left hand and right hand operation chart for bolts and washer assembly. b) Draw work place layout using principles of motion economy.
5	Pin Board Experiment
6	To practice various Graphic tools for method study
	To study with reference to the bulb holder assembly operation the following aspects : (i) Learning effect (ii) Sequence of operation (iii) Preparation of 2-H process chart and computing cycle time.
7	To determine the normal working area, max. working area, height for a normal man (i) for the assembly of pins in a box (ii) For the assembly of Nuts, bolts and washers.
8	Work sampling Practice
9	MTM practice
10	To study the operator's performance under different working conditions (light, temperature, sound, atmosphere etc.)

4PIU11: BUSINESS COMMUNICATION LAB

B.Tech. (P&I) 4th semester

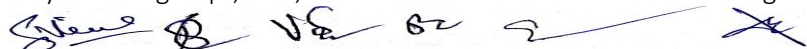
OL + OT + 2P

- 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 need to read the following book and make presentation in class, carry out activities and exercises keeping the content in focus. “You Can Win” by Shiv Kherra.
	Reference Books:

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| <ol style="list-style-type: none">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. |
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5PIU1: THERMAL ENGINEERING

B.Tech. (P&I) 5th semester

3L + 1T

CO1: Study the different modes of heat transfer.

CO2: Solve problems related to conduction, convection and radiation.

CO3: Design the heat exchangers for given size and inlet conditions.

CO4: Analyse various refrigeration and air conditioning systems.

UNIT	CONTENTS	CONTACT HOURS
I	Heat Transfer: Introduction, Fourier's law of conduction, Newton Rikhman equation, Stefan Boltzman law, Overall heat transfer coefficient.	2
	Conduction: Three dimensional heat flow equation-cartesian coordinates. One dimensional steady state conduction without heat generation, One dimensional flow through a plane wall, composite wall and tube, thick spherical shell, Critical insulation, Heat flow through fins.	6
II	Convection: Dimensional analysis of forced and free convection, empirical relations.	5
	Radiation: Introduction, Absorption, reflection and transmission, Monochromatic, total emissive power, view factor	3
III	Heat exchanger: Types of Heat Exchanger, LMTD equation for parallel and counter flow Heat Exchanger and its applications. Effectiveness - NTU Method	8
IV	Refrigeration: Air refrigeration system, vapour compression and vapour absorption system, steam refrigeration	4
	Refrigerants, Refrigeration equipments, Reciprocating Air Compressor.	4
V	Air Conditioning: Properties of moist air, Psychrometric chart and its use, Elementary psychrometric processes. Comfort Air Conditioning.	8
	TOTAL	40

TEXT BOOK

1 J.P. Halman, Heat Transfer, Mc Graw Hill

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Incropera and Dewitt, Fundamental of Heat and Mass transfer, John Wiley	2007
2	Cengel, Heat and Mass transfer, Mc Graw Hill	2011
3	M.Thirumaleshwar, Fundamental of Heat and Mass Transfer, Pearson Education	2006
4	Ozisik, Heat and Mass Transfer, Mc Graw Hill	2009
5	C.P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill.	2008

5PIU2: QUALITY CONTROL AND RELIABILITY ENGINEERING

B.Tech. (P&I) 5th 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.

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	8
TOTAL		40

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
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

5PIU3: DESIGN OF MACHINE ELEMENTS- II

B.Tech. (P&I) 5th semester

3L + 1T

CO 1 To account the static and dynamic loading conditions in different materials.

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- 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	Fatigue Considerations in Design: 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	Design of IC Engine components: 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	Design of gear teeth: 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	Design of Sliding and Journal Bearing: Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium.	4
	Selection of anti-friction bearings for different loads and load cycles, Mounting of the bearings, Method of lubrication.	4
TOTAL		40

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.	

5PIU4: MEASUREMENT & METROLOGY

B.Tech. (P&I) 5th 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	Concept of measurement: General concept of measurement, Need for measurement, Generalized measuring system, Units, Standards, Sensitivity, Readability, Range of accuracy, Precision, Accuracy Vs precision, Uncertainty.	4

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	Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Calibration, Interchangeability.	3
II	Linear and angular measurements: Linear measuring instruments: Vernier caliper, Micrometer, Slip gauges, Optical flat, Application of limit gauges;	3
	Comparators:- Mechanical comparators, Electrical 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	Form measurement: Introduction, Screw thread measurement, Thread gauges, Measurement of gears: Gear errors, Spur gear measurement, Parkinson gear tester.	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	Machine tool metrology: Coordinate measuring machine (CMM):- Types of CMM, Features of CMM, Computer based inspection, Computer aided inspection using robots.	5
V	Measurement of force: Accelerometer, Load cells. Torque measurement: Torque measurement using strain gauges, Torque measurement using torsion bars,	4
	Measurement of power: Mechanical dynamometers, Measurement of flow: Variable area meters – rotameter, Hot wire anemometer, Pitot tube.	4
	Temperature measurement: Thermocouples (Thermo electric effects), Thermistors, Pyrometers	4
	TOTAL	40

TEXT BOOK		
1	G.K. Vijayaraghavan & R. Rajappan, Engineering Metrology and Measurements, A.R.S. Publications, Chennai, Fourth Edition June	2009
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	
2	Dimensional Metrology . Khare & Vajpayee, Oxford & IBH	
3	Engineering Metrology, Jain R.K., Khanna Publishers	
4	Metrology & Precision Engineering , Scarr, McGraw Hill	
5	Handbook of Industrial Metrology, ASTM	

5PIU5: PRINCIPLES OF MACHINE TOOLS

B.Tech. (P&I) 5th semester

3L + 0T

CO1: Understand the concept of machining and machine tools.

CO2: Analyse different machine drives.

CO3: Design of different machine tool structures.

CO4: Learn kinematics and operations of various machine tools.

UNIT	CONTENTS	CONTACT HOURS
I	Machine tools: Concept and definition of machining and machine tools. Concept of producing geometrical surfaces by generatrix and directrix.	5
	Type of Machine tools, General requirements of machine tool design, Working and auxiliary motions in machine tools, Parameter defining working motion of machine tool.	3

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II	Machine drives: Mechanical transmission, Hydraulic transmission, Electrical circuits.	2
	Stepped regulation of speed: Design of speed box. Design of machine tool structures, Basic principles of design for strength, Basic principles of design for rigidity.	2
	Introduction to design of lathe beds	4
III	Introduction to guides and slideways: Types of slideways, Design of slideways, Shapes of slideways, Application of slideway Profiles and their combination, Material of slideways, Type of connecting sections and their applications, Clearance adjustment in slides. Anti-friction guideways.	8
IV	Machine tool spindles and spindle bearings, Kinematic systems and operations of lathes, Kinematic systems and operations of drilling machine, Kinematic systems and operations of milling machine.	8
V	Construction, working principle and applications of shaping, planing and slotting machines	4
	Alignment & Acceptance test of lathe, milling, drilling machines	4
TOTAL		40

TEXT BOOK		
1	Machine tool design by N K Mehta	2007
2	Principle of machine tools by G C Sen & Bhattacharya	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Rao P.N., Manufacturing Technology, Vol. 1,2 and 3, Tata McGraw Hill	2013
2	Ghosh, A., & Mallik, A. K.. Manufacturing Science: East West Press Private Limited.	1986
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

5PIU6.1: CNC MACHINES AND PROGRAMMING

B.Tech. (P&I) 5th 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.

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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
	TOTAL	40

TEXT BOOK		
1	Krar S. and Gill A., CNC: Technology and Programming, McGraw Hill	1990
REFERENCE BOOKS		
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

5PIU6.2: MANAGEMENT INFORMATION SYSTEM

B.Tech. (P&I) 5th 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

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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
TOTAL		40

TEXT BOOK		
1	Information systems for Modern Management, G.R.Murdick, Prentice Hall of India	
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	

5PIU6.3: STATISTICS FOR DECISION MAKING

B.Tech. (P&I) 5th semester

3L + 0T

- CO1 Understand the concepts of statistics
CO2 Collect and arrange the data for better analysis
CO3 Analyse the data for decision making
CO4 Finding relationship between the various variables

UNIT	CONTENTS	CONTACT HOURS
I	Introduction - Statistical Terminology: Descriptive statistics or exploratory data analysis, inferential statistics, population, sample, variable, parameter, statistic, random sample.	3
	Collecting Data: Historical data, types of studies (comparative, descriptive or noncomparative, observational, experimental), sample surveys, sampling and nonsampling errors, bias, representative sample, judgment sampling, quota sampling, simple random samples, sampling rate, sampling frame, stratified random sampling, multistage cluster sampling, probability-proportional-to-size sampling, systematic sampling.	4
II	Summarizing and Exploring Data: Variable types (categorical, qualitative, nominal, ordinal, numerical, continuous, discrete, interval, ratio), summarizing categorical data (frequency table, bar chart, Pareto chart, pie chart), summarizing numerical data (mean, median), skewness, outliers, measures of dispersion (quantiles, range, variance, standard deviation, interquartile range, coefficient of variation) standardized z-scores, histogram, bivariate numerical data (scatter plot, simple correlation coefficient, sample covariance), straight line regression, summarizing time-series data, data smoothing, forecasting techniques.	4

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	Basic Concepts of Inference: Estimation, hypothesis testing, point estimation, confidence interval estimation, estimator, estimate, bias and variance of estimator, mean square error, precision and standard error, confidence level and limits, null and alternative hypothesis, type I and II error, probabilities of type I and II error, acceptance sampling, simple and composite hypothesis, P-value, one-sided and two -sided tests.	4
III	Inference for Single Samples: Inference for the mean (large samples), confidence intervals for the mean, test for the mean, sample size determination for the z-interval, one-sided and two -sided z-test, inference for the mean (small samples), t distribution.	4
	Inference for Two Samples: Independent sample design, matched pair design, pros and cons of each design, side by side box plots, comparing means of two populations, large sample confidence interval for the difference of two means, large sample test of hypothesis for the difference of two means, inference for small samples (confidence intervals and tests of hypothesis).	4
IV	Inference for Proportions and Count Data: Large sample confidence interval for proportion, sample size determination for a confidence interval for proportion,	3
	Large sample hypothesis test on proportion, comparing two proportions in the independent sample design (confidence interval and test of hypothesis), chi-square statistic	4
V	Simple Linear Regression and Correlation: Dependent and independent variables, probability model for simple linear regression, least squares fit, goodness of fit of the LS line, sums of squares, analysis of variance, prediction of future observation, confidence and prediction intervals,	4
	Multiple Linear Regression: Probability model for multiple linear regression, least squares fit, sums of squares. Use Excel, R, and MATLAB® in the class.	4
	TOTAL	40

TEXT BOOK		
1	Ajit Tamhane and Dorothy Dunlop "Statistics and Data Analysis: From Elementary to Intermediate" Prentice Hall	1999
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub.
1	Richard Levin, David S. Rubin, Statistics for Managements, PHI	1988
2	J. K. Sharma, Statistics for Management, Pearson Education India	2001

5PIU6.4: RENEWABLE ENERGY SYSTEMS

B.Tech. (P&I) 5th semester

3L + 0T

UNIT	CONTENTS	CONTACT HOURS
I	Global and National scenarios, Form and characteristics of renewable energy sources. Solar Energy: 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
	Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication, Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes	3

II	Wind Energy: Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS-classification, characteristics, applications.	3
III	Ocean Energy: 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.	4
IV	Other Sources: 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.	5
V	Fuel Cells: Thermodynamics and electrochemical principles, Basic design, types, applications. Hydrogen Energy: Economics of hydrogen, Production methods.	5
	TOTAL	40

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

SPIU7: THERMAL ENGINEERING LAB

B.Tech. (P&I) 5th semester

OL + OT +3P

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.

SN	NAME OF EXPERIMENT
1	Comparative study of a) Four stroke diesel and petrol engines. b) Two stroke petrol and diesel engines
2	Studies of fuel supply systems of diesel and petrol engines.
3	Study of cooling, lubrication and ignition system in diesel and petrol engines.
4	To study various types of Boilers and to study Boiler mounting and accessories.
5	To study various types of Dynamometers.
6	To study Multi Stage Air Compressors.
7	To find the BHP, Thermal efficiency of four stroke diesel engine.
8	Study of Brakes, Clutches, and Transmission System.
9	To prepare a comparison sheet of various automobiles (4 Wheeler and 2 Wheeler).
10	Study of parallel flow and counter flow heat exchanger.
11	Load test on Petrol Engine and Diesel engine.
12	Determination of conductivity of insulating powder.
13	Determination of effectiveness of parallel and counter flow heat exchanger.

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5PIU8: MACHINE TOOL DESIGN SESSIONAL

B.Tech. (P&I) 5th semester

OL + OT +3P

CO1: Analyse working and auxiliary motions in machine tools.

CO2: Understand the design criterion for machine tool structure.

CO3: Learn about application and sketching of various machine tools mechanism.

CO4: Understand the speed & feed rate regulation, stepped regulation of speed.

CO5: Design a four / six speed Gear Box, lathe bed and guide ways.

CO6: Calculate power requirements and selection of motor for metal cutting machine tool spindles.

SN	SESSIONAL WORK
1	Functional requirements of machine tools.
2	Working and auxiliary motions in machine tools.
3	Design criterion for machine tool structure, Static & dynamic stiffness.
4	Function & important requirements of spindle unit.
5	Importance of machine tool compliance with respect to machine tool accuracy.
6	Application and sketching of Slider-crank mechanism, Cam mechanism, Rack & pinion mechanism, Nut & screw mechanism, Ratchet gear mechanism, Geneva mechanism, Reversing mechanism, Differential mechanism, Norton mechanism, Mender's mechanism.
7	Aim of speed & feed rate regulation, stepped regulation of speed.
8	G.P. series is used in stepped regulation of speed.
9	Design a four / six speed Gear Box.
10	Design of Lathe bed. (including Torque analysis of lathe bed, bending of lathe bed, designing for torsional rigidity, use of reinforcing stiffener in lathe bed)
11	Analysis of force under headstock, tail stock and saddle.
12	Design of Guide ways / Slide ways.
13	Estimation of power requirements and selection of motor for metal cutting machine tool spindles.

5PIU9: METROLOGY LAB

B.Tech. (P&I) 5th semester

OL + OT + 2P

CO1: Study various measuring tools like dial gauge, vernier caliper etc.

CO2: Measurement of angle using bevel protector and sine bar.

CO3: Measurement of gap using slip gauges.

CO4: Evaluation and inspection of surface roughness, flatness and defects.

CO5: Practice hardness tester for rubber and plastics.

SN	NAME OF EXPERIMENT
1	Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges.
2	Measurement of angle and width of a V-groove by using bevel protector..
3	To measure a gap by using slip gauges
4	Measurement of angle by using sine bar.
5	Study and use of surface roughness instrument (Taylor Hobson make) Inspection of various elements of screw thread by Tool makers microscope and optical projector.
6	Measurement of gear tooth thickness by using gear tooth vernier caliper.
7	To check accuracy of gear profile with the help of profile projector.
8	To determine the effective diameter of external thread by using three-wire method.
9	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
10	To plot the composite errors of a given set of gears using composite gear tester.
11	Measurement of coating thickness on electroplated part and paint coating on steel and non-ferrous material using coating thickness gauge.
12	Study and use of hardness tester for rubber and plastics.

13	To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface.
14	To compare & access the method of small-bore measurement with the aid of spheres.

SPIU10: QUALITY CONTROL LAB

B.Tech. (P&I) 5th semester

OL + OT + 2P

- CO1 Perform the experiments for different type of problems
 CO2 Develop the charts for finding the cause of variation
 CO3 Analyse the experiment data and eliminate the source of variation
 CO4 Understand the nature of data by plotting curves for various distributions

SN	NAME OF EXPERIMENT
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.

SPIU11: PROFESSIONAL ETHICS AND DISASTER MANAGEMENT

B.Tech. (P&I) 5th 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
1	Human values: 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.

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2	Professional ethics: 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	Disaster management: 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. Man made Disasters: 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	1995
2	Engineering Ethics: Concepts and cases by Charles E. Harris, Jr., Michael S. Pritchard, Michael J. Rabins. CENGAGE Learning, Delhi	2007
3	Controlling Technology: Ethics and Responsible Engineers by Stephen H Unger. John Willey and Sons.	2002
4	Ethical Issues in Engineering, by Deborah Johnson. Prentice Hall	2011
5	Human Values in the engineering Profession, Moniograph by A N Tripathi. Published by IIM Calcutta.	2015
6	Towards Basics of Natural Disaster Reduction by Prof. D.K. Sinha. Researchco Book Center, Delhi.	2009
7	Understanding Earthquake Disasters by Amita Sinvhal. Tata McGraw Hill, New Delhi.	2012

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6PIU1: TOOL ENGINEERING

B.Tech. (P&I) 6th semester

3L+1T

CO1: Learn about materials properties of tool.

CO2: Design different types of cutting tools

CO3: Understand the principles of Jig and fixtures.

CO4: Design of various dies and press used in manufacturing.

UNIT	CONTENTS	CONTACT HOURS
I	Introduction, properties of tool material, types of tool material,	5
	Basic requirement of tool material and general consideration in tool design.	3
II	Design of material-cutting tool: Single point tools, basic principles of multiple point tools, Linear-Travel tools (Broach),	4
	Axial Feed Rotary Tools (Drill), Milling Cutters.	3
III	Introduction to press, Press accessories, Die design fundamentals, Strip layout	4
	Blanking and piercing Dies, Combination Dies (compound & progressive die).	4
IV	Design of Bending Dies	3
	Design of Drawing and Deep drawing dies.	5
V	Introduction to Jig & Fixtures, usefulness, Principles of Jig & Fixtures design, Principle of location, Locating and Clamping devices.	4
	Basic construction principle, Drilling jigs, Brief introduction about Milling fixtures, Grinding fixtures, Broaching and Lathe fixtures.	5
	TOTAL	40

TEXT BOOK		
1	Rao, P.N. "Manufacturing Technology" Vol. I, Tata McGraw Hill Ltd	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Tool design by Donldson	2009
2	Tool design by ASTME	2004
3	Metal Cutting Theory and Cutting Tool Design, Arshinov & Acherken, MTR Publishers	2001
4	Machine Tool Design, Acherken, MIR Publishers	1992
5	Principles of Machine Tools, Sen & Bhattacharya, New Central Book Agency	2001
6	Principles of Metal Cutting, Shaw,M.C., Oxford & IBH	1991
7	Fundamentals of Tool Engineering Design, Basu, Mukhopadhyay & Mishra, Oxford & IBH	1996

6PIU2: OPERATIONS RESEARCH

B.Tech. (P&I) 6th 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 analyze engineering and managerial problems

UNIT	CONTENTS	CONTACT HOURS
I	Overview of Operations Research	1
	Linear Programming: Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis.	4
	Transportation Model and Assignment Model including travelling salesman problem.	4
II	Integer Linear Programming: Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming.	5
	Replacement Models: Capital equipment replacement with time, group replacement of items subjected to total failure.	3
III	Queuing Theory: 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
	Competitive Situations and Solutions: 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
	Deterministic Inventory control models: 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	Probabilistic Inventory control models: Instantaneous demand without setup cost and with setup cost, Continuous demand without setup cost	4
	Simulation: 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
TOTAL		40

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.	2002
2	Operations Research, Taha H.A., Pearson Education	2012
3	Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali, Wiley India.	2003
4	Principles of Operations Research, Wagner H.M., Prentice Hall of India.	2001
5	Operations Research, Gupta and Heera, S. Chand Publications.	2008

6PIU3: MICRO AND NANO MANUFACTURING**B.Tech. (P&I) 6th semester****3L+0T**

CO1: Understand the various machining operations on micro and nano scale.

CO2: Learn and developed understanding of micro and nano manufacturing tools.

CO3: Analyze the different surface damages during micro and nano manufacturing processes.

CO4: Apply the knowledge of micro and nano manufacturing processes in manufacturing industries.

UNIT	CONTENTS	CONTACT HOURS
I	Nanoscale Cutting:- Introduction, Material representation and microstructure, Atomic interaction, Nanometric machining	4
	Meso-micromachining:- Introduction, size effects in micromachining, mechanism for large plastic flow, origin of the size effect, Meso-machining processes. Burr formation in micromachining operations.	4
II	Microturning:- Characteristic features and applications, Microturning tools and tooling systems, Machine tools for microturning	3
	Microdrilling: Characteristic features and applications, Microdrills and tooling systems, Machine tools for microdrilling Micromilling:- Characteristic features and applications, Micromills and tooling systems, Machine tools for micromilling,	3
III	Microgrinding and Ultra-precision Processes: Introduction, Micro and nanogrinding, Nanogrinding apparatus, Nanogrinding procedures, Nanogrinding tools, Preparation of nanogrinding wheels, Bonding systems, Vitrified bonding	4
	Non-Conventional Processes: Laser Micromachining:- Introduction, Fundamentals of lasers, Stimulated emission, Types of lasers, Laser microfabrication, Nanosecond pulse microfabrication, Shielding gas, Effects of nanosecond pulsed microfabrication, Picosecond pulse microfabrication, Femtosecond pulse microfabrication, Laser nanofabrication.	4
IV	Evaluation of Subsurface Damage in Nano and Micromachining: Introduction, Destructive evaluation technologies, Cross-sectional microscopy, Preferential etching, Angle lapping/angle polishing, X-ray diffraction, Micro-Raman spectroscopy.	4
		4
V	Applications of Nano and Micromachining in Industry: Introduction, Typical machining methods, Diamond turning, Shaper/planner machining, Applications in optical manufacturing, Aspheric lens, Fresnel lens, Microstructured components, Semiconductor wafer production.	4
		5
	TOTAL	39

TEXT BOOK		
1	Micro and Nano manufacturing by Marks J. Jackson springer	2008
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	J. Paulo Davim, Mark J. Jackson, Nano and Micromachining ISTE Ltd John Wiley & Sons, Inc.	2009

6PIU4: TOTAL QUALITY MANAGEMENT**B.Tech. (P&I) 6th semester****3L+0T**

CO1: Understand the concept of TQM.

CO2: Compare the different theories of continuous process improvement and customer satisfaction.

CO3: Analyze different methods to achieve the quality in whole systems.

CO4: Describe importance of quality management, six sigma, bench marking systems etc.

CO5: Apply the knowledge of TQM in service and manufacturing industries.

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to TQM: Definition, Basic approach, Guru's of TQM, TQM framework, benefits.	2
	Leadership: Characteristics of Quality Leadership, Leadership Concepts, The 7 Habits of Highly Effective People, The Deming Philosophy, The Role of TQM Leaders Strategic Planning Communications, Decision Making.	3
	Customer Satisfaction: Introduction, Customer Perception of Quality, Service Quality, Translating Needs into Requirements, Customer Retention.	3
II	Continuous Process Improvement: Introduction, Process, The Juran Trilogy, Improvement Strategies, Types of Problems PDSA Cycle, Problem-Solving Method, DMAIC, Kaizen, Reengineering, six sigma.	3
	Supplier Partnership: Principles of Customer/Supplier Relationship Partnering, Sourcing Supplier, Selection, Supplier Certification Supplier Rating, Relationship Development.	2
	Performance Measures: Basic Concepts, Strategy, performance measure presentation, Cost of Quality, Malcolm Baldrige and Rajiv Gandhi National Quality Award, Balanced Score Card	3
III	Lean Enterprise: Historical Review, Lean Fundamentals, Value Stream Map, Implementing Lean, Benefits.	3
	Six Sigma: Historical Review, Statistical Aspects, Improvement Methodology, Organizational Structure Benefits.	3
	Benchmarking: Benchmarking Defined, Reasons to Benchmark, Process, deciding what to benchmark, Pitfalls and Criticisms.	2
IV	Quality Management Systems: Benefits of ISO Registration, ISO Series of Standards, ISO 9001 Requirements, Implementation, Documentation,	2
	Environmental Management Systems: ISO 14000 Series Standards, Concepts of ISO 14001, ISO 14001, Requirements, Benefits, Integrating QMS and EMS. Other EMS Systems,	2
	Quality Function Deployment: The QFD Team, QFD Process.	2
	Total Productive Maintenance: The Plan, Learning the New Philosophy, Promoting the Philosophy, Training, Improvement Needs, Goal,	2
V	Management Tools: Forced Field Analysis, Nominal Group Technique, Affinity Diagram, Interrelationship Digraph, Tree Diagram, Matrix Diagram, Process Decision Program Chart, Activity Network Diagram	2
	Experimental Design: Introduction, Basic Statistics, Hypothesis, t Test F Test. One Factor at a Time Orthogonal Design, Point and Interval Estimate, Two Factors Full Factorials. Fractional Factorials.	3
	Taguchi's Quality Engineering: Introduction, Loss Function, Orthogonal Arrays, Signal-to-Noise Ratio, Parameter Design,	3
	TOTAL	40

TEXT BOOK		
1	D. H. Besterfield, G. H Besterfield, Hemant Urdhwareshe, Total Quality Management: Revised Third Edition, Pearson Higher Education	2013
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year Pub.
1	Total Quality Management: text with cases, John S Oakland, Butterworth-Heinemann	2003
2	Total Quality Management for Engineers, Zaire, M., Wood Head Publishing	1991

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3	Total Quality Control, Feigenbaum. Armand V., McGraw Hill	1991
4	The Management and Control of Quality,(5th Edition), James R.Evans and William M.Lidsay, South-Western (Thomson Learning)	2002

6PIU5: FACILITY PLANNING

B.Tech. (P&I) 6th semester

3L+1T

- CO1: Understand the concepts of facility planning
CO2: Determine the suitable facility locations using various methods
CO3: Understand and solve the facility layout and line balancing problems
CO4: Describe the various material handling systems

UNIT	CONTENTS	CONTACT HOURS
I	Definition of facilities planning, significance and objectives of facilities planning. Process of facilities planning. Strategic facilities planning.	5
	Product selection, Review of various types of manufacturing processes and Process selection.	3
II	Facility Location: Need for location decisions, location factors, location analysis: Qualitative methods: subjective, equal weight, variable weight, factor point rating and composite measure method.	4
	Quantitative methods: location breakeven analysis, median model, gravity model, Brown and Gibson method, single facility location models, minmax location problem, Location allocation models, Bridgeman's Dimensional Analysis.	4
III	Facility Layout: Importance and function, objectives and advantages of good layout, types of plant layout problems. Basic layout types: Product, Process, Group and fixed position layout. Plant layout factors, Layout procedure, Systematic layout planning procedure, Flow and activity analysis, Process charts, flow diagram, Travel chart, activity relationship chart, and Relationship diagram. Evaluation and implementation of layout. Industrial buildings, influence of building on layout.	4
	Computer aided layout: CRAFT, CORELAP, COFAD, ALDEP, PLANET.	4
IV	Production and assembly line balancing - various operational research techniques for balancing of assembly line and fabrication line.	5
	Material Handling: Principles of material handling, materials handling system design. Systematic handling analysis, Unit loads. Computer Aided Material Handling.	3
V	Material Handling Equipment: Conveyors, monorail, hoists and Cranes; automated storage and retrieval systems (AS/RS) , Industrial trucks, Containers and supports, Auxiliary and other equipments	5
	Receiving and shipping, storage and warehousing; Equipment planning, layout planning.	3
TOTAL		40

TEXT BOOK		
1	Facilities Planning, Tomphins James A & White John A, John Wiley & Sons	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.

1	Facility Layout & Location, Francis R.C. & White J.A. Prentice Hall.	2002
2	Material Handling, Immer, McGraw Hill	2009
3	Practical Plant Layout, Muther , McGraw Hill	1998
4	Plant Layout & Design , Immer , McGraw Hill	2004

6PIU6.1: DATA ANALYTICS

B.Tech. (P&I) 6th semester

3L+0T

CO1: Understand the concepts of models

CO2: Finding relationship between the various variables and covariance

CO3: Analyse the problems using factor analysis

CO4: Solve the problems using ARIMA model and decision tree analysis

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity.	4
II	Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise- Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).	3
III	Logistic regression: Regression with binary dependent variable - Simple Discriminant Analysis- Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).	4
IV	Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).	4
V	Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) - Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.	4
TOTAL		39

TEXT BOOK

1	Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. "Multivariate data analysis", (7th edition). Pearson India.	2015
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REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Tabachnick, B. G., & Fidell, L. S., "Using multivariate statistics", (5th edition). Pearson Prentice Hall	2001
2	Gujarati, D. N. , "Basic econometrics", Tata McGraw-Hill Education.	2012
3	Malhotra, N. K., " Marketing research: An applied orientation", 5/e. Pearson Education India.	2008
4	Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. " Applied multiple regression/correlation analysis for the behavioral sciences", Routledge..	2013
5	Han, J., Kamber, M., & Pei, J. "Data mining: concepts and techniques: concepts and techniques", Elsevier.	2011

6PIU6.2: COMPUTER AIDED DESIGN AND GRAPHICS

B.Tech. (P&I) 6th 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.

UNIT	CONTENTS	CONTACT HOURS
I	Overview of Computer Graphics: 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.	5
	Parametric representation of plane curves: line, circle, ellipse, parabola and hyperbola.	4
II	Parametric representation of Space Curves: Cubic spline curve, Bezier Curve and B Spline Curves. Blending of Curves.	4
	Parametric representation of Surfaces: Hermite Bicubic surfaces, Bezier surfaces and Bspline surfaces.	4
III	Solid Representation: B-rep. and CSG. Comparison between three types of models.	7
IV	Two and Three Dimensional Transformation of Geometric Models: Translation, Scaling Reflection, Rotation and Shearing, Homogeneous Representation, Combined Transformation.	4
	Projection of Geometric models: Parallel and Perspective Projection.	4
V	Clipping: Point clipping, Line clipping, Cohen- Sutherland algorithm etc., Viewing transformation.	4
	Hidden line and surface removal: Techniques and Algorithms. Shading and Rendering.	4
TOTAL		40

TEXT BOOK		
1	Zeid and Sivasubramanian, CAD/CAM: Theory and Practice, Tata McGraw Hill	
2	Rogers and Adams, Mathematical Elements for Computer Graphics, Tata McGraw Hill	
REFERENCE BOOKS		
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

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6PIU6.3: MANAGERIAL ACCOUNTING, FINANCE & ECONOMICS

B.Tech. (P&I) 6th semester

3L+0T

CO1: Understand concept of engineering economics, decision making and time value of money.

CO2: Learn methods of comparison of alternatives and annual equivalent methods

CO3: Analyse replacement studies, methods of computing depreciation, cost accountancy and financial accountancy.

CO4: Compute elements of cost, techniques of cost control.

CO5: Understand budget, inflation, finance, break-even charts and relationships.

UNIT	CONTENTS	CONTACT HOURS
I	Concept and scope of Engineering Economics. Problem Solving and decision making. Time Value of Money: Interest formulae and their applications.	3
	Cash Flow Diagrams. Single and multiple payment cash flows.	4
II	Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram).	5
	Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.	4
III	Replacement studies: current salvage value of defender, replacement due to deterioration and obsolescence. Depreciation meaning and methods of computing depreciation-Straight line method of depreciation, declining balance method of depreciation, Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation.	4
	Cost and Costs Control: Costs and Cost Accountancy: Meaning of cost and cost Accountancy (C.A.) Financial Accountancy (F.A.) comparison between C.A. and F.A.	
IV	Elements of cost Direct cost and indirect cost, variable costs and fixed cost calculation of Product cost, Cost control-Techniques of cost control.	4
	Budgets- Meaning Kinds, Advantages, Budgetary control. Inflation: Causes of inflation, consequences of inflation, measuring inflation, leasing/buying decisions. Break-Even analysis, linear break-even analysis, Break-Even charts and relationships, Non-linear break-even analysis.	3
V	Finance & Financial Statements: Introduction Needs of Finance, Kinds of Capital Sources of fixed capital shares-ordinary and Preference Shares. Borrow capital. Surplus profits: Sources of Working capital, Management of working capital, Financial Institutions.	4
	Financial Statement (i) Profit & Loss Statement (ii) Balance Sheet (B.S.) Financial ratios-current ratio, Liquidity ratio, Profits investment ratio, equity ratio and Inventory turn-over ratio. Management and Financial ratio, Money conversion cycle in the Business.	
	TOTAL	40

TEXT BOOK		
1	Engineering Economics, Riggs Bedworth, Tata McGraw Hill, New Delhi	
REFERENCE BOOKS		
SN	Name of Authors / Books / Publisher	Year of Pub.
1	Engineering Economics and Costing, Sasmita Mishra, Prentice Hall of India	

(Handwritten signatures and marks)

2	Financial Planning Management and Control, Prasanna Chandra, Tata McGraw-Hill.	
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6PIU6.4: DESIGN AND MANUFACTURING OF PLASTIC PRODUCTS

3L+0T

B.Tech. (P&I) 6th semester

CO1: Learn about different plastic materials and their properties.

CO2: Understand Injection Molding Process and its applications.

CO3: Evaluate nominal wall thickness and their insulation characteristics.

CO4: Examine general types of assembly systems, various weldings and fasteners.

CO5: Understand machining, finishing and decorating techniques of plastics.

UNIT	CONTENTS	CONTACT HOURS
I	Plastics Materials: An Overview, Classification, Thermoplastics, Thermosets, Crystalline, Amorphous, and Liquid, Additives, Reinforcements, and Fillers, Physical Properties and Terminology.	5
	Mechanical Properties, Thermal Properties, Electrical Properties, Environmental Considerations, Structural Analysis	3
II	Design Considerations for Injection-Molded Parts: Injection Molding Process, Design Strategy, Efficient and Functional Design, Material Selection,	2
	Nominal Wall Thickness, Normal Ranges of Wall Thickness, Structural Requirements of the Nominal Wall,	2
	Insulation Characteristics of the Nominal Wall, Impact Response of the Nominal Wall, Draft, Structural Reinforcement, Ribs, Other Geometric Reinforcement, Bosses, Coring, Fillets and Radii, Undercuts	4
III	Polymer processing techniques such as extrusion, compression and transfer moulding.	4
	Injection moulding, blow moulding, thermoforming, rotational moulding, calendaring.	4
IV	Assembly: General Types of Assembly Systems, Molded-In Assembly Systems, Snap-Fit Assembly, Molded-In Threads, Press-Fits, Chemical Bonding Systems, Solvent Welding, Adhesive Bonding, Thermal Welding Methods, Ultrasonic Welding, Vibration Welding,	4
	Spin Welding, Radio Frequency (RF) Welding, Electromagnetic or Induction Welding, Assembly with Fasteners, Bolted Assembly, Threaded Metal Inserts, Self-Tapping Screws, Riveted Assembly, Sheet Metal Nuts, Specialty Plastic Fasteners	4
V	Machining of Plastics: Drilling and Reaming, Thread Tapping, Sawing, Milling, Turning, Grinding and Routing	4
	Finishing and Decorating of Plastics: Painting, Vacuum Metallizing and Sputter Plating, Electroplating, Flame Spraying/Arc Spraying, Hot Stamping	4
	TOTAL	40

TEXT BOOK

1	Design and Manufacture of Plastic Parts, R.L.E. Brown, John Wiley and Sons, New York	1980
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REFERENCE BOOKS

SN	Name of Authors / Books / Publisher	Year of Pub.
1	Designing with Plastics, Gerhard, Hanser Verlag	
2	Handbook of Plastics Joining: a practical guide, PDL handbook series, Plastics Design Library, William Andrew	

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3	Modern Plastics Handbook, McGraw Hill handbooks, Modern plastics series, Charles A. Harper, McGraw-Hill Professional	1997
4	Industrial Plastics: theory and applications, Erik Lokensgard and Terry L. Richardson, 4th Edition, Cengage Learning	2000

6PIU7: METAL CUTTING LAB.

OL+OT+2P

B.Tech. (P&I) 6th semester

At the end of course students will be able to

CO1:-Measurements of chip reduction co efficient, various forces on tool and power during orthogonal turning.

CO2:-Analyze thrust and torque during drilling.

CO3:- Evaluate chip tool interface temperature during turning using thermocouple technique.

CO4:- Study of variation of surface roughness with different speed and feed during plain milling operation on flat surface

CO5:- Making a job on capstan lathe, grinding machine, boring machine and EDM.

SN	NAME OF EXPERIMENT
1	Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
2	Forces measurements during orthogonal turning.
3	Estimation of Power required during orthogonal turning.
4	Torque and Thrust measurement during drilling.
5	Forces measurement during plain milling operation.
6	Measurement of Chip tool Interface temperature during turning using thermocouple technique.
7	Exercise involving cylindrical grinding on surface grinding machine.
8	Study the variation of surface roughness with different speed and feed during plain milling operation on flat surface.
9	Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
10	Engrave a profile on given workpiece using EDM machine.
11	Exercises for boring of cylindrical bores and machining of external surfaces coincident with internal bores on boring machine.

6PIU8: INDUSTRIAL ENGINEERING LAB-I

OL+OT+2P

B.Tech. (P&I) 6th semester

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	NAME OF EXPERIMENT	CONTACT HOURS
	Case Study on the following:	
1	Work Methods Design	
2	Location Planning	
3	Systematic Layout Planning	
4	Process Control Charts	
5	Productivity	
6	Project Management	
7	Materials Management	
8	Capacity Planning	

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6PIU9: OPERATIONS RESEARCH LAB.**B.Tech. (P&I) 6th semester****OL+OT+2P**

CO1: Solve linear programming, assignment and transportation problem using software.
 CO2: Solve integer programming, inventory and queuing theory using software.
 CO3: Solve simulation, replacement problems, decision tree and game theory using software and verify it with the analytical method.

SN	LABORATORY WORK/NAME OF EXPERIMENT
	Solve using software and verify with analytical methods
1	Linear programming problem
2	Assignment problem
3	Transportation problem
4	Integer programming problem
5	Queuing Problem
6	Inventory problem
7	Simulation Problem
8	Replacement Problem
9	Decision Tree
10	Game theory

6PIU10: STATISTICAL LAB.**B.Tech. (P&I) 6th semester****OL+OT+2P**

CO1: Solve problems on hypothesis testing using software.
 CO2: Solve problems on descriptive statistics using software.
 CO3: Solve problems on design of experiments using software.
 CO4: Analyse problems using ANOVA and ANCOVA in software.
 CO5: Solve problems on time series using software.

SN	LABORATORY WORK/NAME OF EXPERIMENT
	Solve using software and verify with analytical methods
1	Hypothesis Testing <ul style="list-style-type: none"> • Mean: One-Sample z-test, Two-sample z-test, One-Sample t-test, Two-Sample t-test, Paired t-test, Poisson test with Bonferroni, Dunn-Sidak adjustments • Variance: Single Variance, Equality of Two Variances, Equality of Several Variances • Correlation: Zero Correlation, Specific Correlation, Equality of Two Correlations • Proportion: Single Proportion, Equality of Two Proportions • Appropriate Quick Graphs • Resampling – Bootstrap, without replacement, Jackknife
2	Descriptive Statistics <ul style="list-style-type: none"> • Coefficient of variation, std err of mean • Adjustable confidence intervals of mean • Skewness, kurtosis, including standard errors
3	Design of Experiments <ul style="list-style-type: none"> • Complete and incomplete factorial designs • Latin square designs, 3-12 levels per factor • Box and Hunter 2-level incomplete designs • Taguchi designs

4	<p>ANOVA</p> <ul style="list-style-type: none"> • Designs: unbalanced, randomized block, complete block, fractional factorial, mixed model, nested, split plot, Latin square, crossover and change over, • ANCOVA • Means model for missing cells designs • Repeated measures: one-way, two or more factors, three or more factors • Options to test normality and homoscedasticity assumptions • Type I , II and III sums of squares
5	<p>Time Series</p> <ul style="list-style-type: none"> • Smoothing: LOWESS, moving average, running median, and exponential • Seasonal adjustment • Fourier and inverse Fourier transforms • Box-Jenkins ARIMA model • Specify autoregressive, difference and moving average parameters • Forecast and standard errors

6PIU11: CAPACITY BUILDING LAB

B.Tech. (P&I) 6th 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.

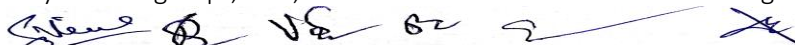
CO2: Practice maths, aptitude, reasoning, GK, Current Affairs, interview skills for different test conducted by various industries.

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.

Objectives: This course will focus on overall development and Personality of students by enhancing their communication skills, shaping their attitudes and behaviour and ultimately preparing them for corporate roles.

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.

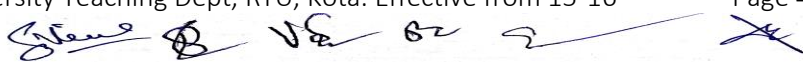
7PIU1: METAL FORMING PROCESSES

B.Tech. (P&I) 7th semester

Max. Marks: 150

UNIT	CONTENTS	CONTACT HOURS
I	FUNDAMENTALS OF METAL FORMING Classification of forming processes, Mechanics of metal working, Flow stress determination, Temperature in metal working, strain rate effects, metallurgical structures, deformation zone theory, hydrostatic pressure, residual stresses, Spring back	3
	Review of state of stress – Components of stress, behaviour of metal when subjected to stress, Introduction to stress tensor, principal stresses, Stress deviator, Mohr’s circle of stress (two dimension and three dimensions), Mohr’s circle of strain, von-mises, Tresca yield criteria.	5
II	FORGING: Classification, equipment, forging in plain strain, open-die forging, closed-die forging, calculation of forging loads in closed-die forging, forging defects, powder metallurgy forging, residual stresses in forging.	4
	ROLLING: Classification, Rolling mills, hot and cold rolling, rolling of bars and shapes, forces and geometrical relationships, simplified analysis of rolling load: rolling variables, Problems and defects in rolled products, theories of cold and hot rolling, torque and power.	4
III	EXTRUSION: Classification of extrusion processes, equipment, hot extrusion, deformation, lubrication and defects in extrusion, analysis of the extrusion process, cold extrusion and cold forming, hydrostatic extrusion, extrusion of tubing, influence of friction, extrusion force calculation, production of seamless pipe and tubing.	4
	DRAWING OF RODS, WIRES AND TUBES; Introduction, rod and wiredrawing, analysis of wiredrawing, tube-drawing processes, analysis of tube drawing, residual stresses in rod, wire, and tubes, defects, Tube drawing and sinking processes, Tube bending.	4
IV	SHEET METAL FORMING: Classification – conventional and HERF processes – presses – types and selection of Presses, forming limit criteria, Limiting Draw ratio - processes: Deep drawing,	3
	spinning, stretch forming, plate bending, Rubber pad forming, bulging, Explosion forming, electro hydraulic forming, Magnetic pulse forming.	5
V	RECENT ADVANCES: Super plastic forming – Electro forming – fine blanking – Hydro forming – Peen forming – LASER Forming –	4
	Micro forming - P/M forging – Isothermal forging – high speed hot forging – near net shape forming, high velocity extrusion – CAD and CAM in forming	4
	TOTAL	40

TEXT BOOK		
1	Rao, P.N. “Manufacturing Technology”, Vol 2, 3 TMH Ltd.,	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Nagpal G.R. “Metal forming processes”, Khanna publishers.	
2	Serope Kalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials” – Pearson Education	
3	Edward M. Mielenk, “Metal working science Engineering, McGraw Hill, Inc.,	
4	Metal Hand book Vol.14, “Forming and Forging”, Metal Park, Ohio, USA.	
5	Dieter G.E., “Mechanical Metallurgy”, McGraw Hill, Co., S.I.	



7PIU2: OPERATIONS PLANNING AND CONTROL

B.Tech. (P&I) 7th semester

Max. Marks: 150

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity	3
I	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.	4
II	Product and Service design, Process selection, Process types, Product and process matrix, Process analysis.	3
II	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.	2
III	Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning.	4
III	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	4
IV	Production Control: Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up. 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
IV	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
V	Project Management: Nature of projects, project life cycle, Work breakdown structure, PERT and CPM, Time-Cost trade-offs: Crashing. Resource allocation, leveling	5
TOTAL		40

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

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7PIU3: ADVANCED MANUFACTURING METHODS

B.Tech. (P&I) 7th semester

Max. Marks: 150

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

TEXT BOOK

1	Modern Machining Process, Pandey and Shan, Tata McGraw Hill	1980
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REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Advance Machining Process, Jain V.K., Allied Publishers Ltd.	2002
2	Non Traditional Manufacturing Process, Gary F. Bevedict, Marcel Dekker Inc New York.	1987
3	Non-Conventional Machining Process, Mishra P.K., Narosa Publishing House	2006
4	Non-Conventional Machining Process, J.A. McGeough	1988
5	Rapid Prototyping: principles and applications, Chee Kai Chua, Kah Fai Leong and Chu Sing Lim, 2nd Edition, World Scientific	2003
6	Rapid Prototyping: Theory and Practice, Ali Kamrani, Emad Abouel Nasr and Springer; 1 st Edition,	2006

7PIU4: COMPUTER INTEGRATED MANUFACTURING

B.Tech. (P&I) 7th semester

Max. Marks: 150

- CO1 Understand the effect of manufacturing automation strategies and derive production metrics.
- CO2 Analyze automated flowlines and assembly systems, and balance the line.
- CO3 Demonstrate automated material handling and storage systems for a typical production system.
- CO4 Develop CNC programs to manufacture industrial components.
- CO5 Explain CAPP systems for rotational and prismatic parts.

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to CIM: Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in	2

(Handwritten signatures and marks)

	manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background,	
	Introduction to manufacturing System, Classification of manufacturing system, overview of classification scheme, manufacturing progress functions.	3
II	Computer Aided Process Planning (CAPP): Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards.	8
III	Group Technology (GT): Introduction, part families, part classification and coding, coding system and machining cells. Introduction to Product data Management System (PDM)	4
	Computer Aided Production Management Systems (CAPM): Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, and computer process control.	5
IV	Computer Aided Quality Control (CAQ); Computer in quality control, Off-Line and On-Line Quality control, Automated inspection, contact inspection methods, Non contact inspection methods: optical and non optical computer aided testing. Overview of automatic identification methods.	5
	Flexible manufacturing systems (FMS). Types of FMS, Flexibility in manufacturing, FMS components, FMS applications and benefits.	4
V	Product Design and CAD/CAM in the production system: Introductory concepts Product design and CAD, CAM, CAD/CAM and CIM	4
	Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.	5
TOTAL		40
TEXT BOOK		
1	Mikell P. Groover, , Automation, Production Systems, and Computer-Integrated Manufacturing, 3rd ed., Pearson/Prentice Hall,	2008
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	James A. Rehg and Henry W. Kraebber, Computer-Integrated Manufacturing, 3rd ed., Pearson/Prentice Hall,	2005
2	Nanua Singh, Systems Approach to Computer-Integrated Design and Manufacturing, John Willey & Sons.	1996
3	Computer Aided Manufacturing, Chang, Wysk and Wang, Pearson Education	2008
4	CAD/CAM: Principles and Applications, P.N. Rao, McGraw Hill	2003
5	Computer Control of Manufacturing Systems, Y. Koren, McGraw Hill	2009
6	Computer aided Manufacturing, Rao, Tiwari and Kundra, Tata McGraw Hill.	2002
7	Computer Numerical Control: Machining and Turning Centres, Quesada and Jeyepoovan, Pearson Education	2007

7PIU5: MODELING AND SIMULATION

B.Tech. (P&I) 7th semester

Max. Marks: 150

- CO1: Understand the concept of system and environment.
CO2: Study of principles used in modelling and simulation.
CO3: Analyse various simulation technics.
CO4: Learn about system dynamics modelling.

(Handwritten signatures and marks)

CO5: Study of SIMULA, DYNAMO, STELLA, POWERSIM and Simulation softwares.

UNIT	CONTENTS	CONTACT HOURS
I	Physical modeling : 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	Computer system simulation: 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	Probability concepts in simulation: 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	System dynamics modelling: 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	Verification and validation: Design of simulation experiments, validation of experimental models, testing and analysis.	4
	Simulation languages comparison and selection, study of SIMULA, DYNAMO, STELLA, POWERSIM. Simulation softwares.	4
TOTAL		40

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

7PIU6.1: SUPPLY CHAIN MANAGEMENT

B.Tech. (P&I) 7th semester

Max. Marks: 150

Contents	Contact Hours
Introduction to Supply Chain Management: Supply chain – objectives – importance – decision phases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers – obstacles – framework – facilities – inventory – transportation – information – sourcing – pricing	7
Designing the supply chain Network: Designing the distribution network – role of distribution – factors influencing distribution – design options – e-business and its	4

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impact – distribution networks in practice design in the supply chain – role of network – factors affecting the network design decisions	
Designing and planning for transportation network: Role of transportation - modes and their performance – transportation infrastructure and policies - design options and their trade-offs – Tailored transportation.	4
Sourcing & pricing Sourcing – In-house or Outsource – 3rd and 4th PLs – supplier scoring and assessment, selection – design collaboration – procurement process – sourcing planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contract.	4
Dimensions of Logistics: Introduction, Nature and Concepts, Evolution; Supply Chain Management, Logistical Mission and Objectives; Components and Functions of Logistics Management; Integrated Logistics Management; Key Distribution-Related issues and Challenges and Strategic Logistics Management; Total Cost Analysis and Trade-off	3
Inventory Management: Introduction, Concept, types, Functions; Elements of Inventory Costs; Inventory Management under certainty, Managing Finished Products Inventory under Uncertainty, Strategic Inventory Management Tools and Techniques; Distribution Requirement Planning.	3
Supply Chain Integration: Introduction – push, pull and push–pull systems – push – based supply chains – pull – based supply chain – push-pull supply chain - identifying the appropriate supply chain strategy – implementing a push-pull strategy – demand – driven – strategies – the impact of the internet on supply chain	3
Strategies: distribution strategies – direct shipment – cross docking – trans shipment – centralized versus decentralized control – central versus local facilities.	
Decision-support systems for supply chain management: Introduction – the challenges of modeling – structure of decision support systems – input data – analytical tools – presentation tools – supply chain decision – support systems.	
	40

TEXT BOOK		
1	Donald J Bowersoy & David J Closs, Logistical Management- - Tata McGraw Hill	
2	R P Mohanty & S G Deshmukh, Supply Chain Management- Theories & Practice	
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Pub. Year
1	Sunil Chopra, Supply Chain Management--Pub: Peter Meindi	
2	Badi N V , Supply chain Management- - Pub : Vrindra Publications (P) Ltd. , Delhi	
3	Sunil Sharma , Supply Chain Management- Concept, Practice & Implementation -- Pub: Oxford Univ. Press	
4	Sople- Logistics Management-Pub.- Pearson edition-2013	
5	Desai K D – Six Sigma, Pub. Himalaya Publishing house	
6	Ray & Ruben- Stores Management, Pub. Himalaya Publishing House	

7PI6.2: MAINTENANCE MANAGEMENT

B.Tech. (P&I) 7th semester

Max. Marks: 150

UNIT	CONTENTS	CONTACT HOURS
I	Introduction -Fundamentals of Maintenance Engineering. Maintenance Engineering its importance in material & energy conservation, inventory control, productivity, safety, pollution control etc.	3

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	Safety Regulations, pollution problems, human reliability, total quality management (TQM), total productivity maintenance (TPM), environmental issues in maintenance, ISO 9000.	4
II	Maintenance Management - types of maintenance strategies, Planned and unplanned maintenance, breakdown, preventive & predictive maintenance. Their comparison, advantages & disadvantages. Limitations.	4
	Computer aided maintenance, maintenance scheduling, spare part management, inventory control, organisation of maintenance department.	4
III	Tribology in Maintenance, friction wear and lubrication, friction & wear mechanisms, prevention of wear, types of lubrication mechanisms, lubrication processes.	3
	Lubricants - types, general and special purpose, additives, testing of lubricants, degradation of lubricants, seal & packings.	3
	Repair methods for basic machine elements: Repair methods for beds, slideways, spindles, gears, lead screws and bearings–Failure analysis–Failures and their development–Logical fault location methods–Sequential fault location.	3
IV	Machine Health Monitoring - Condition based maintenance, signature analysis, oil analysis, vibration, noise and thermal signatures, on line & off line techniques,	4
	Instrumentation & equipment used in machine health monitoring. Instrumentation in maintenance, signal processing, data acquisition and analysis, application of intelligent systems, data base design.	4
V	Reliability, availability & maintainability (RAM) Analysis - Introduction to RAM failure mechanism, failure data analysis, failure distribution, reliability of repairable and non repairable systems.	4
	Improvement in reliability, reliability testing, reliability prediction, utilisation factor, system reliability by Monte Carlo Simulation Technique.	4
	TOTAL	40

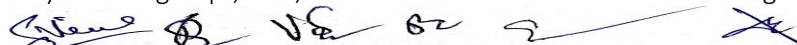
TEXT BOOK		
1	Anthony Kelly, Strategic Maintenance Planning, Butterworth-Heinemann	2006
2	R. C. Mishra, K. Pathak ,Maintenance Engineering and Management, PHI Learning Pvt. Ltd	2012
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill	1988
2	Maintenance & Spare parts Management Gopal Krishnan	
3	Srivastava S.K., “Industrial Maintenance Management”, S. Chand and Co	1981
4	Hand book of Condition Monitoring CNR Rao	
5	White E.N., “Maintenance Planning”, I Documentation, Gower Press	1979
6	Armstrong, “Condition Monitoring”, BSIRSA	1988
7	Davies, “Handbook of Condition Monitoring”, Chapman &Hall,	1996

7PIU6.3: RAPID PROTOTYPING

B.Tech. (P&I) 7th semester

Max. Marks: 150

Contents	Contact Hours
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Overview of Rapid Product Development (RPD). Product Development Cycle;	3
Definition of RPD; Components of RPD. Rapid Prototyping (RP);Principle of RP; Technologies and their classifications;	4
Selection of RP process; Issues in RP; Emerging trends.	4
Rapid Tooling (RT);Introduction to RT, Indirect RT process-Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Direct RT processes-Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting),	4
Emerging Trends in RT, Reverse Engineering: Geometric data acquisition,3D reconstruction, Applications and Case Studies, Engineering applications, Medical applications.	3
Processing Polyhedral Data: Polyhedral BRep modeling, STL format, Defects and repair of STL files,	3
Overview of the algorithms required for RP&T and Reverse Engineering-slicing, support generation, feature recognition etc.	3
TOTAL	40

TEXT BOOK		
1	C.K. Chua , K.F. Leong , C.S. Lim, Rapid Prototyping: Principles And Applications, World Scientific Publishing Co Pte Ltd; 3rd Revised	2008
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
2	Ali K. Kamrani , Emad Abouel Nasr, Rapid Prototyping: Theory And Practice (Manufacturing Systems Engineering Series) , Springer-Verlag New York Inc	2006
3	Stucker, David W. Rosen and Ian Gibson, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, And Direct Digital Manufacturing, Springer New York.	2014
4	Neil Hopkinson , Richard Hague , Philip Dickens, Rapid Manufacturing: An Industrial Revolution For The Digital Age 1st Edition, Wiley New York;	2005
5	Chee Kai Chua, Kah Fai Leong, 3d Printing And Additive Manufacturing: Principles And Applications , Fourth Edition Of Rapid Prototyping, World Scientific Publishing Company;	, 2014

7PIU6.4: ADVANCED WELDING TECHNOLOGY

B.Tech. (P&I) 7th semester

Max. Marks: 150

UNIT	CONTENTS	CONTACT HOURS
I	Welding: Introduction, Classification, Advantages and disadvantages of welding and Selection of power sources: Constant voltage and constant current power sources. Heat Transfer and associated losses. Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.	8
II	Solid state welding: Classification of solid state welding processes, advantages, and applications. Ultrasonic welding Process and Explosive Welding.	7
III	Friction welding: Friction welding process variables, welding of similar and dissimilar materials, Defective analysis of friction welded components, Friction welding of materials with inter layer. Friction stir welding: Processes parameters, tool geometry, welding of similar and dissimilar materials, Friction stir welding of Aluminum alloys and Magnesium alloys. Introduction of Hybrid FSW.	8

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IV	EBW and LBW: Electron Beam welding process parameters, atmospheric affect Defective analysis of Electron beam welds and Electron Beam welding dissimilar materials. Laser Beam welding process parameters, atmospheric affects in LBM and Laser Beam welding of steels.	8
V	Weldability: Weldability studies of cast iron and steel, Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and Aluminum. Micro & Macro structures in welding. Welding defects and inspection methods.	7
	TOTAL	40

TEXT BOOK		
1	Nadkarni S.V., <i>Modern Welding Technology</i> , Oxford IBH Publishers, 1996.	2009
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	D. L. Olson, T. A. Siewert, <i>Metal Hand Book, Vol 06, Welding, Brazing and Soldering</i> , ASM International Hand book Metals Park, Ohio USA, 2008.	2012
2	Howard B. Cary , Scott Helzer, <i>Modern Welding Technology Paperback</i> , Pearson Edu.	2004
3	K. S. Yadav, <i>Advanced Welding Technology</i> , Standard Book House	2018

7PIU7: METAL FORMING AND TOOL DESIGN LAB.

B.Tech. (P&I) 7th Semester

OL + OT + 3P

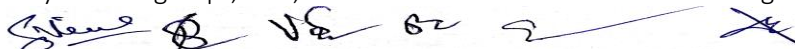
SN	NAME OF EXPERIMENT
	Perform any ten experiments from the list given below
1	Study of the effect of clearance and shear angle on the blanking and piercing operations
2	To determine the effect of percentage of reduction and the semi-cone angle of the die on the drawing load.
3	To find the effect of percentage of reduction and the die geometry on extruding force.
4	Experimental determination of wire drawing force for wire drawing operation.
5	Study of the drop forging operation (flowability, forging load etc by plasticine model.
6	To determine roll load in the sheet rolling process.
7	Students will be given at least one practical problem regarding the design and fabrication of Jigs & Fixture or Press tool.
8	Working drawings of the following:- Drilling Jigs (Box type, Leaf type, Indexing type, Trunion type etc.), Milling Fixtures, Grinding fixtures, Assembly and welding fixtures (for automobile components and frames etc.), Drawing Dies, Bending Dies, Compound Dies, Combination Dies & Progressive Dies.
9	Determination of true stress true strain relationship.
10	To mount die assembly on power press and produce the desired blanks.
11	To mount forming die assembly and to form a cup of M S Sheet.
12	Study of sheet gauges and sheet metal working machines and preparing a funnel using shear, circle cutting machine, ending rollers and spot wring machine.
13	Determine the drawing force component during wire drawing operation using wire drawing dynamometer.

7PIU8: CAM & INDUSTRIAL ENGINEERING LAB.

B.Tech. (P&I) 7th Semester

OL + OT + 3P

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

7PIU9: SIMULATION LAB.

B.Tech. (P&I) 7th Semester

OL + OT + 2P

CO1: Generate pseudo random numbers using different techniques.

CO2: Develop an analytical model for a given physical system.

CO3: Prepare a physical system using Monte – Carlo simulation model.

CO4: Develop an algorithm for selected simulated study and write a program in high level language.

CO5: Practice with simulation software ARENA.

SN	NAME OF EXPERIMENT
1	Generate Pseudo Random No. using different Techniques
2	Develop an Analytical Model for a given physical system
3	Develop a Monte-Carlo Simulation Model for a given physical system
4	Find a area of an irregular 2-D shape using Monte-Carlo Simulation
5	Find the effectiveness of simulation on a physical Stochastic System
6	Develop an algorithm for a selected Simulated Study and write the program in a high level language.
7	Modeling of manufacturing system using simulation software such as ARENA

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SPIUA1: NEW ENTERPRISE AND INNOVATION MANAGEMENT

B.Tech. (P&I) 8th semester

3L+1T

UNIT	CONTENTS	CONTACT HOURS
I	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.	8
II	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.	7
III	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.	8
IV	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.	8
V	Innovation Management: an introduction, organizational setups that facilitate innovations. Management of research and development. Strategic alliances and network. Incubators and Accelerators.	7
TOTAL		40

TEXT BOOK

1 Hisrich, Robert D., Michael Peters and Dean Shepherd, Entrepreneurship, Tata McGraw Hill, New Delhi.

REFERENCE BOOKS

Name of Authors /Books /Publisher

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.

(Handwritten signatures and marks)

SPIUA2: PRODUCT DEVELOPMENT AND LAUNCHING**B.Tech. (P&I) 8th semester****3L+0T**

CO1: Understand the process of product development.

CO2: To know the need and its economic existence.

CO3: To use the human engineering (ergonomics) in the product development process.

CO4: Knowledge about organizational structure and execution of product.

UNIT	CONTENTS	CONTACT HOURS
I	Importance of New Product: Definition-importance-Development Process, Importance of new product for growth of enterprise, Definition of product and new product,	2
	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,	3
	New product development process and organization, Generic product development process for Market Pull Products, Modification of this process for other types of products.	3
II	Need Analysis: Problem Formulation Establishing economic existence of need, Need Identification and Analysis, Engineering Statement of Problem, Establishing Target Specification.	8
III	Generation of Alternatives and Concept Selection: Concept generation- a creative process, Creativity, Road Elects to creative thinking-Fear of criticism and Psychological set,	4
	Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process, Concept feasibility and Concept Selection, Establishing Engineering Specification of Products.	4
IV	Preliminary and Detailed Design: Design Review Preliminary design-Identification of subsystems, Subsystem specifications, Compatibility, Detailed design of subsystems, component design,	6
	Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics.	2
V	Management of New Product: 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,	8
TOTAL		40

TEXT BOOK

1 | Product Design and Manufacturing, Chitale and Gupta. McGraw Hill.

REFERENCE BOOKS

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

SPIUA3: NON DESTRUCTIVE EVALUATION AND TESTING**B.Tech. (P&I) 8th semester****3L+0T**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction: An Overview, Factors influencing the Reliability of NDE, Defects in materials, Defects in composites. NDT methods used for evaluation of materials and composites.	3
	Visual Inspection: Basic Principle and Applications.	2
	Liquid Penetrant Testing: Principle, Procedure and Test Parameters, Materials, Limitations and Applications.	3
II	Radiographic Inspection: Principles of X – ray radiography, equipment, Absorption, Scattering, X-ray film processing, General radiographic procedures, Reading and Interpretation of Radiographs, Industrial radiographic practice, Limitations and Applications, Welding defects detection. Gamma ray radiography.	8
III	Ultrasonic Testing: Principle of wave propagation, Ultrasonic equipment, Variables affecting an ultrasound test, Basic methods: Pulse Echo and Through Transmission, Types of scanning.	5
	Applications of UT: Testing of products, Welding Inspection, Tube Inspection, Thickness Measurement, Elastic Constant Determination, Ultrasonic testing of composites.	3
IV	Magnetic Particle Inspection: Methods of generating magnetic field, Demagnetization of materials, Magnetic particle test: Principle, Test Equipment and Procedure, Interpretation and evaluation.	5
	Introduction to Acoustic Emission Testing and Thermography.	3
V	Eddy Current Testing: Principle of eddy current, Factors affecting eddy currents, Test system and test arrangement, Standardization and calibration, Application and effectiveness.	5
	Comparison and Selection of NDT Methods, Codes and Standards	3
TOTAL		40

TEXT BOOK

1	Baldev Raj, T. Jay Kumar, M. Thavasimuthu, Practical Non-Destructive Testing, Narosa.	
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REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Loius Cartz, Non Destructive Testing, ASM International	1995
2	J PRASAD, C G K NAIR, NDT & Evaluation Of Materials, TMH	2008
3	R. Halmshaw, Introduction to the Non-Destructive Testing of Welded Joints,	1997
4	American Metals Society, Non-Destructive Examination and Quality Control, Metals Hand Book, Vol.17, 9th Ed.	1989

SPIUA4: ENTERPRENEURSHIP LAB**B.Tech. (P&I) 8th Semester****0L + 0T + 3P**

SN	NAME OF EXPERIMENT
1	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"> • Prepare a feasibility report/business plan and make presentation in the class. • Prepare an assignment on at least three leading entrepreneurs • Visit a franchisee and prepare a report and/or make presentation in the class

SPIUA5: ADVANCE SOFTWARE LAB

B.Tech. (P&I) 8th Semester

OL + OT + 3P

SN	NAME OF EXPERIMENT
1	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).

