3PI1A: MECHANICS OF SOLIDS

B.Tech. (P&I) 3rd semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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
	Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications.	2
IV	**Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads.	4
	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**
5	Popov, E.P., Nagarajan, S., and Lu, Z. A., "Mechanics of Materials", 2nd Ed., Prentice-Hall of India	**2002**

3PI2A: MATERIAL SCIENCE AND ENGINEERING

Syllabus for B.Tech. (Production & Industrial) effective from 2012-2013, subject to approval of Academic Council, RTU Kota

Page 3

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 diagrams, 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 diagram 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 standards. Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_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 Engineering An Introduction, William D.Callister, John Wiley and Sons.	**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, Tata	**2008**

	McGraw-Hill Publications.	
3	Engineering Physical Metallurgy, Lakhtin Y., Mir Publisher.	
4	Introduction to Engineering materials Tata McGraw-Hill Publications.	2011
5	Engineering materials properties and selection Budinski and Budinski, PHI	2003

3PI3A: ENGINEERING THERMODYNAMICS

B.Tech. (P&I) 3rd semester Max. Marks: 100
3L+0T Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
I	**Basic Concepts and definitions of Thermodynamics**: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	2
	Zeroth and First Law of Thermodynamics: Zeroth 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
	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., Engineering Thermodynamics, Oxford University Press.	2011
2	Van G.J. Wylen and Sonntag R.E., Fundamental of Thermodynamics, John Wiley &Sons	2003

3	Cengel Y.A. and. Boles M.A, Thermodynamics-An Engineering Approach, McGraw Hill	**2011**
4	Jones J.B.&.Dugan R.E, Engineering Thermodynamics, Prentice Hall of India.	**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**

3PI4A: FOUNDRY AND WELDING TECHNOLOGY

B.Tech. (P&I) 3rd semester Max. Marks: 100
3L+0T Exam Hours: 3

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
	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, Electro-slag and electro-gas welding, ultrasonic welding, plasma arc welding, laser beam welding, friction welding, cold welding, hydrodynamic welding, under water welding.	3
	Welding of different materials like wrought iron, cast iron, carbon steel, tool steel, stainless steel, aluminum, pipe welding, Thermal cutting of metals, estimation of welding costs, 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	**4**

	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.	
	TOTAL	**40**

TEXT BOOK		
1	Rao.P.N., Manufacturing Technology, Vol. 1, Tata McGraw Hill	**2013**
REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of 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: Tata McGraw-Hill	**1999**
5	Heine, R.W., Loper, C.R., and Rosenthal, P.C., "Principles of Metal casting", Tata McGraw Hill.	**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.	

3PI5A: WORK SYSTEM DESIGN AND ERGONOMICS

B.Tech. (P&I) 3rd semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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	**5**

	work sampling and random work sampling.	
	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, musles. Layout of equipment. Seat design. Design of controls and compatibility.	3
	TOTAL	**40**

TEXT BOOK		
1	Motion and Time Study and Measurement of Work, Ralph, M Barnes , John Wiley and Sons.	**2001**

REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	Human Factors Engineering and Design, M.S.Saunders and E.J. McCormic, McGraw Hill.	**1995**
2	Introduction to Work Study, George Kanawaty, ILO.	**2002**
3	Industrial Engineering Handbook , Harold Bright Maynard, Kjell B. Zandin, McGraw-Hill.	**1998**
4	Work measurement and methods improvement, Lawrence S. Aft, Wiley-IEEE.	**2002**
5	"Niebel's Methods, Standards, and Work Design", Benjamin W. Niebel, Freivalds Andris, McGraw Hill Education (India).	**2008**
6	Motion and time study: improving productivity, Marvin Everett Mundel, Prentice-Hall.	**2003**

3PI6A: ADVANCED ENGINEERING MATHEMATICS

B.Tech. (P&I) 3rd semester   **Max. Marks: 100**
3L+1T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Fourier transform: Discrete and Fast Fourier transforms, Complex form of Fourier transform and its inverse, Fourier sine and cosine transform and their inversion. Properties of F-transform, Convolution theorem for F-transform, Parse Val's identity for F-transforms.	5
	Applications of Fourier transform: Applications of Fourier transform for the solution of partial differential equations having constant coefficients with special reference to heat equation and wave equation.	3
II	Laplace Transform: Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Differentiation and integration of transforms.	5
	Applications of Laplace Transform: Applications of Laplace Transform to the solution of ordinary and partial differential equations having constant coefficients with special reference to the wave and diffusion equations.	4
III	Probability: Basic Concepts of probability, Conditional Probability, Baye's Theorem.	4
	Random Variable and distributions: Discrete and continuous random variable, Moments, Expectation, Moment generating function, Binomial, Poisson and Normal distribution.	6
IV	Numerical Analysis –I: Finite differences, Difference operators: forward, Backward, central and average operators. Newton's forward and backward interpolation formula, Stirling's central difference formula Lagrange's interpolation formula for unequal interval.	6
V	Numerical Analysis –II: Numerical differentiation, Numerical integration trapezoidal rule, Simpson's one third and three eight rule. Numerical	7

	solution of ordinary differential equation of first order: Picard's method, Euler's, and modified Euler's, method, Milne's methods and Runga Kutta fourth order method.	
	TOTAL	**40**

TEXT BOOK		
1	Keyszig E., Advanced Engineering Mathematics, Wiley Eastern Publication	**2006**
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	**Year of Pub.**
1	Chandrika Prasad, Mathematics for Engineers, Prasad Mudralaya	
2	Jeffrey, Advanced Engineering Mathematics , ELSEVIER	**2001**
3	Grewal B. S., Higher engineering Mathematics, Khanna Publication, New Delhi	**2000**
4	Peter V. O. Neil, Advanced Engineering mathematics, Thomson Publication	**2011**
5	Gerald, C.F., and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley.	**1980**
6	Jain, M.K., Iyengar, S.R. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern.	**2004**
7	Kandasamy, P., Thilagavathy, K., and Gunavathy, S., Numerical Methods, S Chand and Company.	**1999**
8	J. Douglas Faires, Richard L. Burden, Numerical Methods, Cengage Learning.	**2013**
9	Chandrika Prasad, Mathematics for Engineers, Prasad Mudralaya	
10	Y. N.Gaur and C.L. Koul , Advanced Engineering Mathematics, Jaipur Publishing House, Jaipur.	**2003**

3PI7A: MATERIAL SCIENCE AND TESTING LAB.

B.Tech. (P&I) 3rd Semester   **Max. Marks: 75**
0L+0T+2P   **Exam Hours: 2**

SN	**NAME OF EXPERIMENT**	**CONTACT HOURS**
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 Metalic materials" TataMcGraw Hill	**1993**

3PI8A: BASIC MECHANICAL ENGINEERING LAB

B.Tech. (P&I) 3rd Semester		**Max. Marks: 75**
0L+0T+2P		**Exam Hours: 2**
SN	**LABORATORY WORK**	**CONTACT HOURS**
	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.	

3PI9A: PRODUCTION PRACTICE-I

B.Tech. (P&I) 3rd Semester		**Max. Marks: 75**
0L+0T+3P		**Exam Hours: 3**
SN	**NAME OF EXPERIMENT**	**CONTACT HOURS**
	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 aluminium.	
7	To perform moisture test and clay content test.	
8	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).	
9	To perform permeability test	
10	A.F.S. Sieve analysis test.	
	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).	

3PI10A: WORK SYSTEM DESIGN LAB.

B.Tech. (P&I) 3rd Semester		Max. Marks: 50
0L+0T+2P		Exam Hours: 2

SN	LABORATORY WORK	CONTACT HOURS
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.)	

3PI11A: COMMUNICATION SKILL WORKSHOP

B.Tech. (P&I) 3rd semester		Max. Marks: 75
0L+0T+2P		Exam Hours: 3

SN	CONTENTS	CONTACT HOURS
1	Ice Breaker Session -Introductions of the participants to each other	
2	Communicating Theory -one way and, two way, barrier, filters in communication.	
3	Body Language, Non Verbal interpretations	
4	Listening, Active Listening, Feed Back	
5 6	The hidden data of communication : Dealing with feelings; Assertiveness; Self confidence	
7	Working in teams : Team concept; Elements of team work; Formation of a team; Stages of the team formation; Effective team; Team Player styles	
8	Discussions and Decision: Characteristics of good GD; Structured GD; Strategies for making Group Decisions	
9	Presentations: Public Presentation Techniques and practice, Group presentations.	
10	Ethics and etiquette: Ethics; dealing with ethical dilemma; Dress, Dining etiquette; Email, communicating etiquettes	
11	Report making and presentation	

4PI1: METAL FORMING PROCESSES

B.Tech. (P&I) 4th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

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 road, 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. Mielink, "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. | |

4PI2A: FLUID ENGINEERING

B.Tech. (P&I) 4th Semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Basic concept relating to fluids**: Definitions-incompressible and compressible fluids. Density, Relative density, viscosity, Kinematic viscosity. Newtonian and Non Newtonian fluids, effect of temperature and pressure on viscosity. Ideal fluid, Compressibility and Elasticity of fluids and surface tension.	7
II	**Fluid Statics**: Pascal law, Manometers. Fluid Statics: Total pressure, centre of pressure, Problems on plane and Curved surface. Definition of Buoyancy, Centre of buoyancy. Metacentre and Metacentric height.	5
	Fluid Kinematics: Definitions, steady and unsteady flow, uniform and non uniform flow, one, two and three dimensional flow, Rotational and Irrorational flow, Streamline, path line and streak line. Continuity equation in Cartesian and polar coordinates, Circulation and vorticity, stream function, velocity potential, vortex flow.	4
III	**Fluid Dynamics**: Euler's equation of motion- Bernoulli's equation, application of Bernoulli's equation-Venturimeter, Orifice meter, pitot tube.	4
	Orifices, mouthpiece, notches and time of emptying tanks. Momentum equation -application of the momentum equation, Pipe bends curves vanes	4
IV	**Flow through pipes**: Reynolds experiment, Losses in pipes, Pipes in series and parallel.	4
	Dimensional Analysis: Bukingham – π theorem, Dimensionless numbers, Model similitude, Types of model, scale effect and model testing.	3
V	**Hydraulic Turbine**: Euler's Fundamental equation. Classification of turbine, Pelton wheel, Francis turbine Kaplan turbine, Velocity Triangles, Power and efficiency calculation, draft tube and cavitation, Specific speed.	4
	Centrifugal Pump: Classification of centrifugal pumps, velocity diagram, specific speed, head, power and efficiency. **Reciprocating Pump**: Indicator diagram, slip, effect of friction and acceleration, theory of air vessels. Hydraulic accumulator, intensifier, Hydraulic ram.	5
	TOTAL	40

TEXT BOOK		
1	Yunus A. Cengel and Cimbala, Fluid Mechanics, Tata McGrawHill,	**2006**
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Streeter V.L., K.W. Bedford and E.B.Wylie , Fluid Mechanics , Tata McGraw Hill	**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**

4PI3A: THEORY OF MACHINES

B.Tech. (P&IE) 4th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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.	3
	Clutches: Single and multi-plate clutches. **Brakes:** Band, block and band and block brakes.	3
	Power transmission: Belts and ropes, effect of centrifugal force and creep.	2
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.	2
IV	**Cams:** Type of cams; displacement, velocity and acceleration curves for different cam followers; consideration of pressure angle and wear.	4
	Governors: Simple, Porter, Proell, Hartnell and spring controlled governors, Governor effort, sensitivity and power stability, inertia effects.	4
V	**Balancing:** Balancing of rotating masses in same and different planes, balancing of reciprocating masses, swaying couple, hammer blow and tractive effort.	5
	Gyroscope: Principles of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicles taking a turn, stabilization of ship.	3
	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

4PI4A: DESIGN OF MACHINE ELEMENTS – I

UNIT	CONTENTS	CONTACT HOURS
I	**Materials**: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects.	3
	Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.	4
II	**Design for Strength**: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures.	4
	Design of Members subjected to direct stress: pin, cotter and keyed joints.	5
III	**Design of Members in Bending**: Beams, levers and laminated springs. **Design for stiffness of beam:** Use of maximum deflection formula for various end conditions for beam design	7
IV	**Design of Members in Torsion** **Shaft and Keys:** Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys.	5
	**Couplings*:* Design of muff coupling, flanged couplings: rigid and flexible	3
V	**Design of Threaded fasteners**: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading	4
	Power screws like lead screw, screw jack	2
	Design of members which are curved like crane hook, body of C-clamp, machine frame etc.	3
	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

4PI5A: MACHINING PROCESSES AND MACHINE TOOLS

UNIT	CONTENTS	CONTACT HOURS
I	Classification of metal removal process and Classification of machine tools: Generation and forming, Methods of generating surfaces, Geometry of single point cutting tool and tool angles, tool nomenclature in ASA and ORS. Concept of orthogonal and oblique cutting.	5
	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.	3

		Friction in metal cutting.	
II		Concept of machinability, tool wear, tool life, cutting tool materials, Cutting fluids, Economics of machining.	**2**
		Constructional features of centre lathe, cutting tools, different types of tools used in centre lathe, operation performed in a centre lathe, taper turning methods, thread cutting methods.	**2**
		cutting speed, feed, machining time and power estimation. Special purpose lathes: capstan and turret lathes, automatic lathes tooling layout.	**4**
III		Reciprocating machine tools- Shaper; construction and working principle, shaping time estimation, Planning machine, Broaching machine,	**4**
		Milling: Introduction, types of milling machines, milling cutters, milling operations, dividing head, Indexing methods, machining time and power estimation.	**4**
IV		Drilling: - tool geometry of twist drills, types of drills, drilling machine construction, drilling time and force estimation, Reaming, boring, tapping operation.	**3**
		Grinding- Need and different methods of grinding, grinding wheel designation and selection, Dressing and truing, Types of grinding machines, Grinding process, grinding time estimation. Honing, lapping, super finishing, polishing and buffing processes.	**5**
V		Gear Manufacturing Processes: hot rolling; stamping; powder metallurgy; extruding etc. Gear generating processes: gear hobbing, gear shaping. Gear finishing processes: shaving, grinding, lapping, shot blasting, phosphate coating, Gear testing.	**4**
		Machine tool testing: Introduction, measuring instruments used for testing, test procedures, acceptance tests for lathe, milling, drilling, grinding machine. Designing for machining: Introduction, general guidelines for design for machining/turning/hole making operation.	**4**
		TOTAL	**40**

	TEXT BOOK	
1	Lal G.K., Introduction to Machining Science, New Age international Publishers.	**2007**

	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	2006

	tools: Taylor and Francis.	
13	Milton C. Shaw, Metal Cutting Principles, CBS Publishers.	2005
14	Trent, E. M. Metal cutting: Butterworth Heinemann	2000

4PI6A: PRINCIPLES AND PRACTICES OF MANAGEMENT

B.Tech. (P&I) 4th Semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

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 and systems approach to Management, functions of managers. Levels of management, Administration and Management. 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, skills of manager. 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, expectancy, 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
		40

	TEXT BOOK	
1	Essentials of Managements an Introduction, Koontz, Tata McGraw-Hill, New Delhi.	2002
	REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**	**Year of 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 and 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
6	Works Organisation & Management, Sushil Kumar Basu, K. C. Sahu, N. K. Datta , Oxford & IBH.	1992
7	Management, Griffin, John Wiley and Sons.	2002
8	Management: Tasks, Responsibilities & Practices , Drucker Peter F., Allied Publishers.	1995

4PI7A: FLUID MECHANICS LAB

B.Tech. (P&I) 4th Semester **Max. Marks: 75**
0L+0T+2P **Exam Hours: 2**

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

4PI8A: THEORY OF MACHINES LAB

B.Tech. (P&I) 4th Semester **Max. Marks:50**
0L+0T+2P **Exam Hours: 2**

SN	NAME OF EXPERIMENT	CONTACT HOURS
1	To study inversions of four bar chain: Coupling Rod, Beam Engine	
2	To study Steering Mechanisms; Davis and Ackerman.	
3	Study of quick return mechanism and draw velocity and acceleration diagram.	
4	Study of inversion of Double slider chain Oldham Coupling, Scotch Yoke and Elliptical Trammel.	
5	Study of various cam-follower arrangements.	
6	To plot displacement v/s angle of rotation curve for various cams	
7	To determine co-efficient of friction using two roller oscillating arrangement.	
8	Study of various types of dynamometers, Brakes and Clutches.	
9	To determine moment of inertia of the given object using of Trifler suspension.	
10	Perform study of the following using Virtual Lab http://www.vlab.co.in/	
11	Position, velocity and acceleration analysis of Grashof four bar	

	mechanism	
12	Position, velocity and acceleration analysis of Slider Crank mechanism	

4PI9A: PRODUCTION PRACTICE-II

B.Tech. (P&I) 4th semester   **Max. Marks: 75**
0L+0T +3P   **Exam Hours: 3**

UNIT	NAME OF EXPERIMENT	CONTACT HOURS
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	

4PI10A: MACHINE DESIGN SESSIONAL-I

B.Tech. (P&I) 4th Semester   **Max. Marks: 75**
0L+0T+2P   **Exam Hours: 3**

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

TEXT BOOK	
1. Design Data Book, PSG College of Technology	

4PI11A: PRODUCTION ENGINEERING DRAWING

B.Tech. (P&I) 4th Semester   **Max. Marks: 75**
0L+0T+3P   **Exam Hours: 3**

SN	CONTENTS	CONTACT HOURS
	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**	**Year of Pub.**
1	Gill P S, Machine Drawing, Kataria & Sons	**2009**
2	Basudeb Bhattacharya, Machine Drawing, Oxford University Press	**2011**
3	Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company	**1998**
4	Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS	**1995**
5	Siddeshswar N., P Kannaiah, VVS Shastry, Machine Drawing,Tata McGraw Hill	

5PI1A: OPERATIONS RESEARCH

B.Tech. (P&I) 5th semester   **Max. Marks: 100**
3L+1T   **Exam Hours: 3**

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	4

	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	
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.	
2	Operations Research, Taha H.A., Pearson Education	
3	Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali, Wiley India.	
4	Principles of Operations Research, Wagner H.M., Prentice Hall of India.	
5	Operations Research, Gupta and Heera, S. Chand Publications.	
6	Operations Research, J K Sharma, Macmillan	2009

5PI2A: TOOL ENGINEERING

B.Tech. (P&I) 5th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

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	
2	Tool design by ASTME	
3	Metal Cutting Theory and Cutting Tool Design, Arshinov & Acherken, MTR Publishers	
4	Machine Tool Design, Acherken, MIR Publishers	
5	Principles of Machine Tools, Sen & Bhattacharya, New Central Book Agency	
6	Principles of Metal Cutting, Shaw,M.C., Oxford & IBH	
7	Fundamentals of Tool Engineering Design, Basu, Mukhopadhyay & Mishra, Oxford & IBH	

5PI3A: MEASUREMENT & METROLOGY

B.Tech. (P&I) 5th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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
	Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Comparison between systematic error and random error, Correction, Calibration, Interchangeability.	3
II	**Linear and angular measurements:** Linear measuring instruments: Vernier caliper, Micrometer, Slip gauges, Optical flat, Limit gauges:- Gauge design, Problems on gauge design, Application of limit gauges;	3
	Comparators:- Mechanical comparators, Electrical comparator, Optical comparator, Pneumatic comparator;	2
	Sine bar, Use of sine bar, Limitations of sine bars, Sources of error in sine bars, Bevel protractor, Applications of bevel protractor , Autocollimator, Angle dekkor	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	**Laser and advances in metrology:** Laser metrology, Laser telemetric system, Laser and led based distance measuring instruments, pattern formed in a laser, Principle of laser, Interferometry, Use of laser in interferometry, Laser interferometry.	3
	Machine tool metrology: Various geometrical checks on machine tool, Laser equipment for alignment testing, Machine tools tests, Alignment tests on lathe, milling machine, pillar type drilling machine, Acceptance tests for surface grinders, Coordinate measuring machine (CMM):-Types of CMM, Features of CMM, Computer based inspection, Computer aided inspection using robots.	5
V	**Measurement of power, flow and temperature related properties**	4

Measurement of force, Direct methods, Indirect methods:- Accelerometer, Load cells, Bourdon tube. **Torque measurement:** Prony brake, Torque measurement using strain gauges, Torque measurement using torsion bars, Measurement of power: Mechanical dynamometers, D.C. dynamometer, Eddy current or inductor dynamometers		
Measurement of flow: Orifice meter, Venturimeter, Flow nozzle, Variable area meters – rotameter, Hot wire anemometer, Pitot tube. Temperature measurement, Bimetallic strip, Calibration of temperature measuring devices, 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, ASTME	
6		

5PI4A: QUALITY CONTROL AND DESIGN OF EXPERIMENTS

B.Tech. (P&I) 5th Semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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.	4
	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, statistical aids in limits and tolerances.	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.	4
	Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma.	4

IV	Quality Assurance; Concept, advantages, field complaints, quality rating, quality audit, vendor quality rating (VQR), vendor rating (VR), manufacturing planning for quality, Quality function deployment (QFD).	
	Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ. Introduction to Quality systems like ISO 9000 and ISO 14000	4
V	Design of experiments: Strategy of experimentation; Basic principles, Guidelines for designing experiments. Simple Comparative Experiments: Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Paired comparison Designs, Inferences about the Variances of Normal Distributions.	4
	Introduction to Taguchi Method of Design Of Experiments, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments.	4
		40

TEXT BOOK		
1	Fundamentals of Quality Control and Improvement, Amitava Mitra, 2nd Edition,Prentice Hall.	1998

REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Quality Planning & Analysis, Juran J.M. & Gryna F.M. 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	Introduction to Statistical Quality Control, Douglas C. Montgomery, 2nd Edition, Wiley.	1991
5	Design and Analysis of Experiments, 5th Edition, Douglas C. Montgomery, Wiley-India.	2007
6		

5PI5A: SOCIOLOGY AND ELEMENTS OF ECONOMICS FOR ENGINEERS

B.Tech. (P&I) 5th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to sociological concepts-structure, system, organization, social institutions, Culture social stratification (caste, class, gender, power).State & civil society.	4
	Social change in contemporary India: Modernization and globalization, Secularism and communalism, Nature of development,	4
II	Processes of social exclusion and inclusion, Changing nature of work and organization.	4
	Political economy of Indian society. Industrial, Urban, Agrarian and Tribal society; Caste, Class, Ethnicity and Gender; Ecology and Environment.	5
III	Basic Principles and Methodology of Economics. Demand/Supply – elasticity –. Theory of the Firm and Market Structure.	4
	Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.	4

IV	Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank – Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets.	4
	Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve	4
V	Indian economy Brief overview of post independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization.	4
	Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.	4
		40

TEXT BOOK		
1	Mankiw Gregory N., Principles of Economics, Thompson Asia	2002
REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	Giddens, A, Sociology, Polity, 6th edn.	2009
2	Haralambos M, RM Heald, M Holborn, Sociology, Collins	2000
3	Xaxa, V, State, Society and Tribes Pearson	2008
4	Chandoke, Neera & Praveen Priyadarshi , Contemporary India: Economy, Society and Politics, Pearson	2009
5	Mohanty, M, Class, Caste & Gender- Volume 5, Sage	2004
6	Ramaswamy, E.A. and Ramaswamy,U., Industry and Labour, OU Press	1981
7	Bhowmik, S (ed.) Street Vendors in the Global Urban Economy, Routledge	2010
8	Rao, M.S.A. (ed.) Urban Sociology, Orient Longmans	1974
9	V. Mote, S. Paul, G. Gupta, Managerial Economics, Tata McGraw Hill	2004
10	Misra, S.K. and Puri , Indian Economy, Himalaya	2009
11	Pareek Saroj , Textbook of Business Economics, Sunrise Publishers	2003

5PI6.1A: COMPUTER AIDED DESIGN AND GRAPHICS

B.Tech. (P&I) 5th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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.	4

	Shading and Rendering.	
	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**

5PI6.2A: I.C. ENGINES AND AUTOMOBILE ENGINEERING

B.Tech. (P&I) 5th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction of Internal and external combustion engine and their comparison, four stroke cycle S.I. and C.I. engine, two stroke engine, comparison of four stroke and two stroke engines, comparison of S.I. and C.I. engine.	**4**
	Classification of I.C. Engine, Valve timing diagram for S.I. and C.I. engines, effect of valve timing and engine speed on volumetric efficiency, reasons for ignition and injection advance, dual fuel.	**4**
II	**Combustion:** Determination of stoichiometric air fuel ratio, fuel-air and exhaust gas analysis for a given combustion process. Combustion in S.I. and C.I. engines.	**4**
	Detonation, Pre-ignition , Knocking, Antiknock rating of fuels Octane number, critical compression ratio, HUCR, performance number, Cetane number.	**4**
III	**Carburetor:** Properties of air-petrol mixtures, mixture requirement, simple carburetor, limitation of simple carburetor, modern carburetor, Main metering system, Idling system, Economizer system, acceleration pump and cold starting system. Nozzle lip, venturi depression, calculation of fuel jet and venturi throat dia for given air fuel ratio. Petrol Injection system, electronic fuel injection, advantage and disadvantage of petrol injection.	**4**
	Injection System: Requirement, type, fuel pump, type of fuel injector, type of nozzle, atomization, spray penetration and spray direction, multiple point fuel injection system.	
IV	**Ignition System:** Battery and magneto ignition system and their comparative study, spark plug heat range, electronic ignition system, firing order, Ignition timing, centrifugal and vacuum ignition advance.	**4**
	Introduction to Cooling System and Lubrication System
Testing and Performance: Performance parameters, measurements of brake power, indicated power, friction power, fuel and air consumption, exhaust gas calorimeter, calculation of various performance parameter, heat balance sheet. Performance characteristics for S.I. and C.I. Engine with load and speed.	**4**
V	Gear boxes, Sliding mesh, constant mesh, synchromesh and epicyclic	

	gear boxes, Automatic transmission sytem; Hydraulic torque converter; overdrive, propeller shaft, universal joints, front wheel drive, differential; Rear axle drives.	4
	Steering system, steering gear boxes, Steering linkages, steering mechanism, under and over steering. Steering Geometry, effect of camber, caster, king pin inclination, toe in and toe out;	4
	TOTAL	**40**

TEXT BOOK		
1	R P Sharma ,A Course in Automobile Engineering,Dhanpat Rai & Sons	
REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	R K Rajpoot,A Text book of Automobile Engineering,Laxmi Publications	2007
2	Jornsen Reimpell, Helmut Stoll,The Automotive Chassis: Engineering Principles,Jurgen Betzler (P) Ltd,	2001
3	Kirpal Singh, Automobile Engineering, Standard Publishers, Vol1 & 2	2003
4	P S Gill,A Text book of Automobile Engineering,KATSON Books VOL 1&2	2010

5PI6.3A: STATISTICS FOR DECISION MAKING

B.Tech. (P&I) 5th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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) s tandardized 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
	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	Year of Pub.
1	Richard Ivor Levin, David S. Rubin, Statistics for Managements, Prentice Hall International	1988
2	J. K. Sharma, Statistics for Management, Pearson Education India	

5PI7A: METAL CUTTING LAB.

B.Tech. (P&I) 5th Semester   Max. Marks: 100
0L+0T+2P   Exam Hours: 2

SN	NAME OF EXPERIMENT	CONTACT HOURS
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.	

5PI8A: QC AND OR LAB.

B.Tech. (P&I) 5th Semester   Max. Marks: 100

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

5PI9A: METAL FORMING AND TOOL DESIGN LAB.

B.Tech. (P&I) 5th Semester   **Max. Marks: 100**
0L+0T+3P   **Exam Hours: 3**

SN	NAME OF EXPERIMENT	CONTACT HOURS
	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.	

5PI10A: PROFESSIONAL ETHICS AND DISASTER MANAGEMENT

B.Tech. (P&I) 5th Semester   **Max. Marks: 50**
0L+0T+3P   **Exam Hours: 3**

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

6PI1A: DESIGN OF MACHINE ELEMENTS- II

B.Tech. (P&I) 6th Semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

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.	

6PI2A: ADVANCED MANUFACTURING METHODS

B.Tech. (P&I) 6th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

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
	Abrasive finishing processes: AFM, MAF (for Plain and cylindrical surfaces).	4
II	**Mechanical advanced machining process**: Introduction, Mechanics of	5

	metal removal, process principle, Advantages, disadvantages and applications of AJM,USM,WJC.	
III	**Thermo electric advanced machining process**: Introduction, Principle, process parameters, advantages, disadvantages and applications about EDM, EDG,	4
	LBM, PAM, EBM	6
IV	**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
V	Overview of Rapid Product Development (RPD): Product Development Cycle; Definition of RPD; Components of RPD, Classification and advantages of Rapid Prototyping.	2
	Rapid prototyping process: Solid Ground Curing (SGC), Laminated Object Manufacturing (LOM), Selective Laser Sintering (SLS);	3
	Rapid Tooling (RT): Direct RT processes-Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (QuickCast, Full Mold Casting); Emerging Trends in RT.	3
	Introduction to Reverse Engineering. Software for RPD	2
	TOTAL	**40**

	TEXT BOOK	
1	Modern Machining Process, Pandey and Shan, Tata McGraw Hill	**1980**
	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; 1st Edition,	2006

6PI3A: MECHATRONICS

B.Tech. (P&I) 6th Semester　　　　　　　　　　　　　　**Max. Marks: 100**
3L+0T　　　　　　　　　　　　　　　　　　　　　　　　**Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Introduction:** Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines.	5
	MEMS: Basics of Micro- and Nanotechnology, microprocessor-based controllers and Microelectronics	3
II	**Introduction to Sensors:** Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors,	4
	Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication.	4
III	**Systems and Controls:** The Role of Controls in Mechatronics, Role of Modelling in Mechatronics Design, Signals and Systems: Continuous- and Discrete-time Signals, Z-Transforms and Digital Systems, Continuous- and Discrete-time State-space Models.	5

UNIT	CONTENTS	CONTACT HOURS
	Advanced Control Systems: Digital Signal Processing for Mechatronics Applications, Control System Design, Adaptive and Nonlinear Control Design, Neural Networks and Fuzzy Systems, Design Optimization of Mechatronics Systems.	3
IV	**Data Acquisition and related Instrumentation:** Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to Analog (D/A) conversation, Signal Conditioning.	4
	Real time Instrumentation: Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging.	4
V	**Design of Mechatronics systems:** Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators, Mobile robots and manipulator arms, Sorting and packaging systems in production lines, Computer Numerically Control (CNC) production machines, Aeroplanes and helicopters, Tank fluid level and temperature control systems.	8
	TOTAL	**40**

TEXT BOOK

1	Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education	**2011**

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Pub.
1	Mechatronics, HMT Hand Book, Tata McGraw Hill	**2000**
2	Alciatore and Histand, "Introduction to Mechatronics and Measurement Systems", Tata McGraw Hill	**2011**
3	Smaili and Mrad, "Mechatronics: Integrated Technologies for Intelligent Machines", Oxford	**2008**
4	Mahalik N.P., "Mechatronics: Principles, Concepts and applications", Tata McGraw Hill.	**2003**

6PI4A: OPERATIONS PLANNING AND CONTROL

B.Tech. (P&I) 6th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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
	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
	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
	Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning	4

	capacity requirements, Introduction to ERP	
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
	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
	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
5		

6PI5A: THERMAL ENGINEERING

B.Tech. (P&I) 6th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

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

6PI6.1A: INDUSTRIAL ECONOMICS

B.Tech. (P&I) 6th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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	
2	Financial Planning Management and Control, Prasanna Chandra, Tata McGraw-Hill.	

6PI6.2A: NON DESTRUCTIVE EVALUATION AND TESTING

B.Tech. (P&I) 6th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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 Accostic 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.	
	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, Tata McGraw Hill	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

6PI6.3A: PACKAGING MATERIALS AND TECHNOLOGY

B.Tech. (P&I) 6th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Fundamentals of Packaging**: Definition, functions of packaging, types and selection of package, Packaging hazards, interaction of package and contents, materials and machine interface, Environmental and recycling considerations - life cycle assessment	4
	Package Design - Fundamentals, factors influencing design, stages in package development, graphic design, Structural design – simulation softwares	4
II	**Packaging Materials** : Major Plastic packaging materials viz. Polyolefins, Polystyrene, Polyvinylchloride, Polyesters, Polyamides (Nylons), Polycarbonate and newer materials such as High Nitrile Polymers, Polyethylene Napthalate (PEN), Nanomaterials,	4
	Biodegradable materials – properties and applications, recycling; Wood, Paper, Textile, Glass, Metals -Tin, Steel, aluminum, Labelling materials, Cushioning Materials – properties and areas of application.	4
III	**Conversion Technology**:Extrusion – Blown film, cast film, sheet, multilayer film & sheet, Lamination, Injection moulding, Blow moulding, Thermoforming; Cartoning Machinery, Bottling, Can former, Form Fill and Seal machines, Corrugated box manufacturing machineries,	5
	Drums – types of drums, moulded pulp containers, Closures, Application of Robotics in packaging. Surface treatment for printing, Printing processes – offset, flexo, gravure and pad printing	3
IV	**Speciality Packaging**: Aerosol packaging, Shrink and Stretch wrapping, Blister packaging, Anti-static packaging, Aseptic packaging, Active packaging, Modified Atmospheric Packaging,	5
	Ovenable package; Cosmetic packaging, Hardware packaging, Textile packaging, Food packaging; Child resistant and Health care packaging, Export packaging, Lidding, RFID in packaging.	3
V	**Testing:** Package Testing – Drop test, Impact test, Vibration Test, Stacking and Compression test, Packaging Materials Testing: Mechanical – Tensile, tear burst, impact, compression test, Elongation, barrier properties - WVTR test, Adhesion test, Optical – Gloss, haze and clarity;	5
	Chemical Resistance test – solvents and chemicals, solubility test, burning test, solvent retention; Hardness and corrosion test for metals; Clarity and brittleness test for glass.	3
	TOTAL	40

	TEXT BOOK	
1	Aaron L.Brody & Kenneth S.Marsh, "Encyclopedia of Packaging Technology",John Wiley Interscience Publication	1997
	REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	F.A. Paine, "Fundamentals of Packaging", Brookside Press Ltd., London	**1990**
2	A.S.Athayle, "Plastics in Flexible Packaging", Multi-tech Publishing Co.,	**1992**
3	Mark J.Kirwar, "Paper and Paperboard Packaging Technology", Blackwell Publishing	**2005**
4	"Handbook of Package Design Research", Water stem Wiley Intrascience,	**1981**
5	Paine, "Packaging Development", PIRA International.	**1990**

6PI7A: MACHINE DESIGN SESSIONAL-II

B.Tech. (P&I) 6th Semester Max. Marks: 125
0L+0T+3P Exam Hours: 3

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

6PI8A: THERMAL ENGINEERING LAB

B.Tech. (P&I) 6th Semester Max. Marks: 100
0L+0T+3P Exam Hours: 3

SN	NAME OF EXPERIMENT	CONTACT HOURS
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.	

6PI9A: MECHATRONICS LAB

B.Tech. (P&I) 6th Semester Max. Marks:100
0L+0T+3P Exam Hours: 3

SN	SESSIONAL WORK	CONTACT HOURS
1	Study the following devices (a) Analog & digital multimeter (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations)	
2	Displacement Measurement using Capacitive & inductive Pick –ups.	
3	Study of Speed Measurement System: (a) Magnetic Pick-up (b) Stroboscope	
4	Study of Load Measurement System Load Cell	
5	Measurement of temperature using thermocouple, thermistor and RTD	
6	Measurement of displacement using POT, LVDT & Capacitive transducer	
7	Torque measurement using torque measuring devices	
8	Strain Measurement using strain gauge	

SN	NAME OF EXPERIMENT	CONTACT HOURS
9	Frequency to Voltage Converter and vice versa	
10	Position and velocity measurement using encoders	
11	Study on the application of data acquisition system for industrial purposes	
12	Speed control of DC motor using PLC.	
13	Study of Load Measurement System Load Cell	

6PI10A: METROLOGY LAB.

B.Tech. (P&I) 6th Semester   Max. Marks: 50
0L+0T+2P   Exam Hours: 3

SN	NAME OF EXPERIMENT	CONTACT HOURS
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.	

7PI1A: RELIABILITY, MAINTAINABILITY AND AVAILABILITY.

B.Tech. (P&I) 7th semester   Max. Marks: 100
3L+1T   Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
I	**Reliability**: Definition, reliability function Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate curve. Bathtub curve, Conditional Reliability, guarantee period etc, ,	7
II	**Constant Failure rate model:** Exponential Reliability function, Failure Modes, CFR model, memorylessness.	5
	System reliability: Series, parallel, mixed & complex configuration; Reliability improvement.	3
III	**Design for reliability**- Reliabiity specifications and system Measurements, System Effectiveness, redundancy, Classification of Redundancy. failure mode and effect analysis(FMEA)	4
	Analysis of Failure data: Data collection and empirical methods, static life estimation.	4

IV	**Maintainability**- Analysis of Downtime, repair time distribution, stochastic point processes,	4
	Design for Maintainability, Maintenance requirements, Maintenance concepts and procedures, Component reliability and Maintainability.	4
V	**Availability:** Concept and definition, Exponential Availability model, Static life estimation.	4
	Reliability testing: Product testing, Reliability life testing, test time calculations, Burn in testing.	4
		40

TEXT BOOK		
1	Reliability & Maintainability engineering, Ebling Charles E., Mcgraw Hill	2000

REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	Year of Pub.
1	Maintainability Principles and Practices, B.S. Blanchand,McGraw Hill	2003
2	Maintenance Management, A.S. Carder, McGraw Hill Book Company	2012
3	Reliability Engineering, , L.S. Srinath, Affiliated East West Press	2008
4	Reliability engineering, theory and practice, Alessandro Birolini, Springer, 2007	
5	Maintainability, Maintenance and Reliability for engineers, Balbir S. Dhillon, CRC Press, 2006	2011
6	Practical Reliability Engineering, Patrick D. T. O'Connor, David Newton, Richard and Bromley, John Wiley and Sons, 2002.	2003

7PI2A: DESIGN AND MANUFACTURING OF PLASTIC PRODUCTS

B.Tech. (P&I) 7th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Plastics Materials: An Overview, Classification, Thermoplastics, Thermosets, Crystalline, Amorphous, and Liquid, Crystalline Polymers, Copolymers, Alloys, Elastomers, 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	4

	Metal Nuts, Specialty Plastic Fasteners	
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**

	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	
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**

7PI3A: CNC MACHINES AND PROGRAMMING

B.Tech. (P&I) 7th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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	1983

	Hill.	
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

7PI4A MICRO AND NANO MANUFACTURING

B.Tech. (P&I) 7th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Nanoscale Cutting:- Introduction, Material representation and microstructure, Atomic interaction; Nonomachining:- Introduction, Nanometric machining, Theoretical basis of machining;	4
	Meso-micromcahining:- Introduction, size effects in micromachining, mechanism for large plastic flow, origin of the size effect, Meso-machining processes. Product quality in micromachining, 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	**Diamond Tools in Micromachining:** Introduction, Diamond technology, Hot Filament CVD (HFCVD), Preparation of substrate, Selection of substrate material, Pre-treatment of substrate, Modified HFCVD process.	4
	Deposition on complex substrates, Diamond deposition on metallic (molybdenum) wire, Deposition on WC-Co microtools, Diamond deposition on tungsten carbide, (WC-Co) microtool, Performance of diamond-coated microtool	4
V	**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
	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.	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

7PI5A: FACILITIES PLANNING

B.Tech. (P&I) 7th Semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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.	
2	Material Handling, Immer, McGraw Hill	
3	Practical Plant Layout, Muther , McGraw Hill	

| 4 | Plant Layout & Design , Immer , McGraw Hill | |

7PI6.1A: PRODUCTION OF AUTOMOTIVE COMPONENTS

B.Tech. (P&I) 7th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Casting of engine block - conventional and expendable pattern. Casting for cylinder heads	4
	Forging of crank shaft, connecting rod and gudgeon pins.	4
II	Casting of piston, upset forging of valves, piston ring manufacturing & Engine bearing manufacturing.	4
	Manufacturing of friction plates, Manufacture of composite friction lining	4
III	Casting of gear box casing, precision forging of gears	4
	Continuous casting of propeller shaft, Forging of rear axles, Casting of rear axle casing, wheels, brake drum.	4
IV	Tyre manufacturing.	3
	Thermoforming, hydro forming & press forming, welding of body	5
V	Injection moulding of instrument panel.	2
	Metal/polymer/metal panels, Adhesives and sealants	2
	Leaf spring manufacturing. Chemical Vapour Deposition and Physical Vapour Deposition.Spraying, plating and painting in paint booth	4
	TOTAL	**40**

TEXT BOOK		
1	Kalpakjian, "Manufacturing Engineering and Technology", Pearson Education'	2005

REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Heldt P M, "High Speed Combustion Engines", Oxford IBH publishing Co.,Calcutta.	1996
2	Degarmo E P, "Materials and process in Manufacturing", Macmillan Publishing Co.	1997
3	Philip F Ostwald and Jairo Munuz, "Manufacturing Processes and Systems", John Wiley & Sons, New York.	1998

7PI6.2A: ROBOTICS

B.Tech. (P&I) 7th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Introduction to Robotics:** Evolution of Robots and Robotics, Laws of Robotics, What is and What is not a Robot, Progressive Advancement in Robots.	3
	Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, Programming Robots, The Future Prospects, Notations.	5
II	**Robot End Effectors:** Classification of end effectors, drive system for	4

		grippers, Mechanical, Magnetic, Vaccum, Adhesive grippers, Hooks, Scoops, Miscellaneous devices, Gripper force analysis and Design, Active and Passive Gripeers	
		Coordinate Frames, Mapping and Transforms: Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices.	4
III		**Symbolic Modeling of Robots:** Direct Kinematic Model, Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modeling of the Manipulator,	3
		Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation Matrix. Introduction to Inverse Kinematic model, Solvability of Inverse Kinematics model, Solution techniques.	5
IV		**Robotic Sensors:** The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Choosing the right sensors	3
		Robotic vision: Introduction to Robotic Vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Image Representation and Image Processing	5
V		**Robot Applications:** Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-Industrial Applications.	4
		Robot Programming: Robot languages, Classification of Robot language, Computer control and robot software, VAL system and language	4
		TOTAL	40

TEXT BOOK		
1	Mittal R.K., Nagarath, I.K., Robotics and Control, Tata Mc Graw Hill,	**2007**
REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	Deb S.R., Robotics Technology and Flexible Automation, Tata McGraw Hill	**2010**
2	Ghoshal, A., Robotics Fundamental Concepts and Analysis, Oxford University Press	**2010**
3	Craig JJ, Introduction to Robotics, Mechanics and Control, Addison-Wesley, 2nd Ed.	**2004**
4	Fu, K.S., Gonzales, R.C. and Lee, C.S.G., Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill	**1987**
5	Groover, M. P., Wiess, M., Nagel, R. N. and Odery, N. G. Industrial Robotics- Technology, Programming and Applications, McGraw Hill Inc. Singapore	**2000**
9		

7PI6.3A: FINITE ELEMENT METHODS

B.Tech. (P&I) 7th semester **Max. Marks: 100**
3L+0T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to FEM and its applicability, Review of :Matrix algebra, Gauss elimination method, Uniqueness of solution, Banded symmetric matrix and bandwidth.	4

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

TEXT BOOK		
1	Seshu P.,"Text Book of Finite Element Analysis", Prentice Hall India	**2003**
REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	Dixit, U. S., "Finite Element Methods for Engineers" Cengage Learning	2003
2	Finite Element Procedure in Engineering Analysis, Bathe K.J., Prentice Hall India.	2001
3	An Introduction to the Finite Element Method, Reddy J.N., Tata McGraw-Hill, New Delhi	1993
4	Concepts & Applications of Finite Element Analysis, Cook and Plesha, Willey India New Delhi.	2007
5	Introduction to Finite Elements in Engineering, Chandupatla and Belegundu, Prentice Hall India.	1999

7PI7: MACHINE TOOL DESIGN SESSIONAL

B.Tech. (P&I) 7th Semester　　　　　　　　　　　　　　**Max. Marks: 100**
0L+0T+3P　　　　　　　　　　　　　　　　　　　　　　**Exam Hours: 3**

SN	SESSIONAL WORK	CONTACT HOURS
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 steeped 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.	

7PI8A: SOLID MODELING AND COMPUTER GRAPHICS LAB

B.Tech. (P&I) 7th Semester Max. Marks: 100
0L+0T+3P Exam Hours: 3

SN	LABORATORY WORK/NAME OF EXPERIMENT	CONTACT HOURS
1	Introduction and different features of the CAD Software.	
2	2-D Drafting.	
3	3-D Modeling.	
4	3-D Advanced Modeling.	
5	Assembly modeling.	
6	Feature Modification and Manipulation	
7	Detailing.	
8	Sheet Metal Operations.	
9	Surface Modeling	
10	One Dimensional problems of Finite Element Method Note: (These exercises may be performed by any of the following Advanced CAD Software such as Pro E /Unigraphics/ AotoCAD Inventor)	

8PI1A: COMPUTER INTEGRATED MANUFACTURING

B.Tech. (P&I) 8th semester Max. Marks: 100
3L+0T Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
I	**Introduction to CIM:** Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background,	2
	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, 2005, Computer-Integrated Manufacturing, 3rd ed., Pearson/Prentice Hall,	
2	Nanua Singh, 1996, Systems Approach to Computer-Integrated Design and Manufacturing, John Willey & Sons.	
3	Computer Aided Manufacturing, Chang, Wysk and Wang, Pearson Education	
4	CAD/CAM: Principles and Applications, P.N. Rao, McGraw Hill	
5	Computer Control of Manufacturing Systems,Y. Koren, McGraw Hill	
6	Computer aided Manufacturing, Rao, Tiwari and Kundra, Tata McGraw Hill.	
7	Computer Numerical Control: Machining and Turning Centres, Quesada and Jeyepoovan, Pearson Education	

8PI2A: LAWS FOR ENGINEERS

B.Tech. (P&I) 8th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	Constitutional Law: The Preamble; Fundamental Rights; Directive principles of State policy; Fundamental Duties; Emergency provisions – kinds, legal requirements and legal effects.	5
I	**General Principles of Contract under Indian Contract Act, 1872:** General principles of contract – Sec. 1 to 75 of Indian Contract Act and including Government as contracting party, Kinds of government contracts and dispute settlement, Standard form contracts; nature, advantages, unilateral character, principles of protection against possibility of exploitation, judicial approach to such contracts, exemption clauses, clash between two standard form contracts.	4
II	**Introduction to Human Rights:** Theoretical foundation, Historical development of human rights; Human Rights in Indian tradition and Western tradition; Covenant on Civil & Political Rights 1966 including Optional Protocol – I (Individual Complaint Mechanism) & Optional Protocol – II (Abolition of Death Penalty); Covenant on Economic, Social and Cultural Rights 1966 including Optional Protocol – I (2002);	4

	Enforcement of Human Rights in India including Supreme Court, High Courts, Statutory Commissions – NHRC, NCW, NCM, NC-SC/ST etc.		**4**
	Labour Laws: Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen"s Compensation Act, 1923.		**3**
	Right to Information Act, 2005: Evolution and concept; Practice and procedures; Official Secret Act, 1923; Indian Evidence Act, 1872; Information Technology – legislation and procedures, Cyber crimes – issues and investigations.		**3**
	Law relating to Intellectual property: Introduction–meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; International instruments on IP – Berne convention, Rome convention, TRIPS, Paris convention and international organizations relating IPRs, WTO etc;		**4**
III	Law relating to Copyright in India, Meaning of copyright – literary, dramatics and musical works, sound records and cinematographic films, computer programs, Ownership of copyrights, Criteria of infringement, Piracy in Internet – Remedies and procedures in India;		**1**
	Law relating to Trademarks under Trademark Act, 1999 including Rationale of protection of trademarks as Commercial aspect and Consumer rights, Trademarks, registration, procedures, Distinction between trademark and property mark, Doctrine of deceptive similarity, Passing off an infringement and remedies;		**2**
IV	Law relating to Patents under Patents Act, 1970, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent –application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies.		**3**
	Corporate Law: Meaning of corporation; Law relating to companies, public and private (Companies Act, 1956) general provisions; Law and multinational companies – International norms for control, FEMA 1999, Corporate liability, civil and criminal.		**4**
	Election provisions under Indian Constitution (Art.324–329): Representation of Peoples Act and Prevention of Corruption Act, 1988; Superintendence, directions and control of elections to be vested in Election Commission; Election to the house of people and to the legislative assemblies of States to be on the basis of adult suffrage. Candidate electoral rights.		**3**
V	**Constitutional Law***:* The Preamble; Fundamental Rights; Directive principles of State policy; Fundamental Duties; Emergency provisions – kinds, legal requirements and legal effects.		**5**
	General Principles of Contract under Indian Contract Act, 1872: General principles of contract – Sec. 1 to 75 of Indian Contract Act and including Government as contracting party, Kinds of government contracts and dispute settlement, Standard form contracts; nature, advantages, unilateral character, principles of protection against possibility of exploitation, judicial approach to such contracts, exemption clauses, clash between two standard form contracts.		**4**
		TOTAL	**40**

SN	REFERENCE BOOKS	
	Name of Authors /Books /Publisher	**Year of Pub.**
1	D.D. Basu, Shorter Constitution of India, Prentice Hall of India	1996
2	M.P. Jain, Indian Constitutional Law, Wadhwa & Co.	2005
3	S.K. Awasthi & R.P. Kataria, Law relating to Protection of Human Rights,	2006

	Orient Publishing	
4	S.K. Kapur, Human Rights under International Law and Indian Law, Central Law Agency	2001
5	Avtarsingh, Law of Contract, Eastern Book Co	2002
6	Wadhera , Intellectual Property Rights, Universal Law Publishing Co	2004
7	T. Ramappa, Intellectual Property Rights Law in India, Asia Law House	2010
8	O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers	

8PI3A: TOTAL QUALITY MANAGEMENT

B.Tech. (P&I) 8th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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, Quality Council, Core Values, Concepts, and Framework, Quality Statements, Strategic Planning Communications, Decision Making.	**3**
	Customer Satisfaction: Introduction, Customer Perception of Quality, Feedback, Using Customer Complaints, 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, Sector-specific Standards, ISO 9001 Requirements, Implementation, Documentation, Writing the Documents, Internal Audits, Registration.	**2**
	Environmental Management Systems: ISO 14000 Series Standards, Concepts of ISO 14001, ISO 14001, Requirements, Benefits, Integrating QMS and EMS. Other EMS Systems, Relationship to Health and Safety	**2**
	Quality Function Deployment: The QFD Team, Benefits, the voice of the Customer, Organization of Information, House of Quality, Building a House of Quality, QFD Process.	**2**
	Total Productive Maintenance: The Plan, Learning the New Philosophy, Promoting the Philosophy, Training, Improvement Needs, Goal, Developing Plans, Autonomous Work Groups	**2**
V	Management Tools: Forced Field Analysis, Nominal Group Technique, Affinity Diagram, Interrelationship Digraph, Tree Diagram, Matrix Diagram, Prioritization Matrices, 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	**3**

	Estimate, Two Factors Full Factorials. Fractional Factorials.	
	Taguchi's Quality Engineering: Introduction, Loss Function, Orthogonal Arrays, Signal-to-Noise Ratio, Parameter Design, Tolerance Design, Case study	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 of 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 Ltd.	1991
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
5		

8PI4.1A: MODELING AND SIMULATION

B.Tech. (P&I) 8th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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	

8PI4.2A: MANAGEMENT INFORMATION SYSTEM

B.Tech. (P&I) 8th semester   **Max. Marks: 100**
3L+0T   **Exam Hours: 3**

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

8PI4.3A: PRODUCT DEVELOPMENT/DESIGN AND LAUNCHING
B.Tech. (P&I) 8th semester   **Max. Marks: 100**

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,	5
	Project Planning: Project Task matrix, estimation of time and resources, project scheduling.	3
	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

8PI5A: CAM LAB.

B.Tech. (P&I) 8th Semester   **Max. Marks: 75**
0L+0T+2P   **Exam Hours: 2**

SN	NAME OF EXPERIMENT	CONTACT HOURS
1	To prepare part programming for plain turning operation.	
2	To prepare part programming for turning operation in absolute mode.	
3	To prepare part program in inch mode for plain turning operation.	

4	To prepare part program for taper turning operation.	
5	To prepare part program for turning operations using turning cycle.	
6	To prepare part program for threading operation.	
7	To prepare part program for slot milling operation.	
8	To prepare part program for gear cutting operation.	
9	To prepare part program for gear cutting using mill cycle.	
10	To prepare part program for drilling operation.	
11	To prepare part program for multiple drilling operation in Z-axis.	
12	To prepare part program for multiple drilling in X-axis.	
13	To prepare part program for multiple drilling in X and Z axis using drilling cycle.	

8PI6A: SIMULATION LAB.

B.Tech. (P&I) 8th Semester   **Max. Marks: 100**
0L+0T+3P   **Exam Hours: 3**

SN	NAME OF EXPERIMENT	CONTACT HOURS
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	

8PI7A: INDUSTRIAL ENGINEERING LAB-II

B.Tech. (P&I) 8th Semester   **Max. Marks: 75**
0L+0T+2P   **Exam Hours: 2**

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	