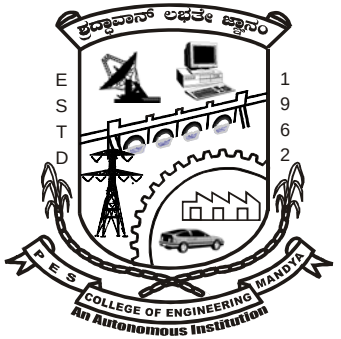
Syllabus

VI Semester B.E. Program
Mechanical Engineering



P.E.S. College of Engineering
Mandya - 571 401. Karnataka
(An Autonomous Institution under VTU Belgaum)

Grant -in- Aid Institution
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P.E.S. COLLEGE OF ENGINEERING, MANDYA

(An Autonomous Institution under VTU)

SCHEME OF TEACHING AND EXAMINATION

VI Semester B.E Mechanical Engineering

Sl No.	Course Code	Course Title	Teaching Dept.	Credit Pattern L : T : P	Total Credits	Total Hours/ Week	Examination Marks			Exam Duration in hours
							CIE	SEE	Total	
1	P08ME61	Design of Machine Elements-II	Mechanical	4:0:0	4	4	50	50	100	
2	P08ME62	Mechanical Vibrations	Mechanical	4:0:0	4	4	50	50	100	
3	P08ME63	Heat & Mass Transfer	Mechanical	4:0:0	4	4	50	50	100	
4	P08ME64	Management & Enterpreneurship	Mechanical	3:0:0	3	4	50	50	100	
5	P08ME65	CAD/CAM	Mechanical	4:0:0	4	4	50	50	100	
6	P08ME66	Elective-I	Mechanical	4:0:0	4	4	50	50	100	
7	P08MEL67	CAM Laboratory	Mechanical	0:0:3	1.5	3	50	50	100	
8	P08MEL68	Heat & Mass Transfer Laboratory	Mechanical	0:0:3	1.5	---	50	50	100	
				Total	26	27	400	400	800	

Elective -1

Sl No.	Course Code	Course Title
1	P08ME61Y	Composite Material
2	P08ME62Y	Statistical Quality Control
3	P08ME63Y	Cryogenics
4	P08ME64Y	Theory of Elasticity
5	P08ME65Y	Project Management
6	P08ME66Y	Non Traditional Machining

DESIGN OF MACHINE ELEMENTS - II

Course Code: P08ME61 **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT - 1

BENDING STRESSES IN CURVED BEAMS: Introduction, Analysis of stresses in curved beams, streses in beams of standard cross sections. 05 Hours

UNIT - 2

CYLINDERS&CYLINDER HEADS: Introduction, thick cylindrical shells subjected to internal pressure, Lame's Equations, Clavarino's equations, Birnie's equations, Barlow's equations, compound cylinders, stresses due to different types of fits, cylinder heads and cover plates. 07 Hours

UNIT - 3

SPRINGS : Introduction, types of springs, terminology, stresses and deflection in helical coil springs of circular and non-circular cross sections, springs under fluctuating loads, concentric springs. Leaf Springs, stresses in leaf springs, equalized stresses, length of spring leaves. 08 Hours

UNIT - 4

CLUTCHES& BRAKES: Introduction, types of clutches, design of Clutches (single plate, multi plate and cone clutches). Brakes, energy absorbed by a brake, heat dissipated during braking, single block brakes, simple band brakes. 07 Hours

PART - B

UNIT - 5

SPUR & HELICAL GEARS: Introduction, spur gears, standard proportions of gear systems, stresses in gear tooth, Lewis equation and form factor, design for strength, dynamic load and wear load. Helical Gears: definitions, formative number of teeth, design based on strength, dynamic and wear loads. 06 Hours

UNIT - 6

BEVEL AND WORM GEARS: Bevel Gears: terminology, formative number of teeth, design based on strength, dynamic and wear loads. Worm Gears: terminology, design based on strength, dynamic, wear loads and efficiency of worm gear drives. 06 Hours

UNIT - 7:

SLIDING AND ROLLING CONTACT BEARINGS: : Introduction, principle of hydro dynamic lubrication, assumptions in hydrodynamic lubrication

bearing characteristic number and modulus, Sommerfeld number,coefficient of friction, power loss, heat Generated and heat dissipated, design of journal bearings. Rolling contact bearings: types of bearings, static equivalent load, dynamic load rating, bearing life, selection of ball and roller bearings. 06 Hours

UNIT - 8

BELTS, ROPES AND CHAIN DRIVES: Introduction,design of flat belts. V-belts:design & selection of V-belts.Rope drives: advantages, classification and designation of rope drives, selection of rope drives.Chain drives:Types, power rating, design & selection of chain drives. 07 Hours

DESIGN DATA HAND BOOKS :

1. Design Data Hand Book by K. Mahadevan and K.Balaveera Reddy, CBS Publication.
2. Design Data Hand Book – K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. P.S.G.Design Data Hand Book- PSG College of Tech Coimbature

TEXT BOOKS :

1. A text book of Machine Design: R.S. Khurmi and J.K. Gupta, S.Chand & co.
2. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

REFERENCE BOOKS:

1. Machine Design: Robert L. Norton, Pearson Education Asia, 2001.
2. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
3. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S. K. Somani, Tata McGraw Hill Publishing Company Ltd.
4. Maleev & Hartman's Machine Design, Grover O.P., CBS Publishers.
5. Design of Machine Elements: M. F. Spotts, T. E. Shoup, L. E. Hornberger, adopted by S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
6. Design of Machine Elements - 2 - J.B.K. Das, Sapna book house.

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

MECHANICAL VIBRATIONS

Course Code: P08ME62 **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT - 1

UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS : Introduction, basic concepts of vibration, Simple harmonic motion, types of vibration, parts of vibrating system, Single degree of freedom systems, determination of natural frequency using Newton's law and energy methods. 06 Hours

UNIT - 2

DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, types of damping, free vibrations with viscous damping, under damped, over damped and critically damped systems, logarithmic decrement, viscous dampers. 07 Hours

UNIT – 3

FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS WITH HARMONIC EXCITATION: Introduction, forced vibration with constant harmonic excitation, steady state vibrations, forced vibration with rotating and reciprocating unbalance, forced vibrations due to excitation of the support, energy dissipated by damping, vibration isolation and transmissibility. 08 Hours

UNIT – 4

VIBRATION MEASURING INSTRUMENTS: Introduction, Vibrometer, velocity pick-up, accelerometer.

WHIRLING OF SHAFTS: Introduction, critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping. 06 Hours

PART - B

UNIT - 5

SYSTEMS WITH TWO DEGREES OF FREEDOM: Introduction, undamped systems, principle and normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions, combined rectilinear and angular modes, undamped forced vibrations with harmonic excitation, undamped dynamic vibration absorber. 08 Hours

UNIT - 6

MULTI DEGREE FREEDOM SYSTEMS-I: Introduction, Influence coefficients (stiffness and flexibility coefficients), Maxwell's reciprocal theorem, determination of natural frequencies, Rayleigh's method, Dunkerley's method. 06 Hours

UNIT - 7

MULTI DEGREE FREEDOM SYSTEMS-II: Introduction, orthogonality principle, matrix iteration method, Stodola's method, Holzer's method. 06 Hours

UNIT - 8

CONTINUOUS SYSTEMS: Introduction, vibration of string, longitudinal vibration of bars, Torsional vibration of circular shaft, lateral/transverse vibration of beams. Fourier series and harmonic analysis (analytical method) 5 Hours

TEXT BOOKS :

1. Mechanical vibrations : G.K. Grover, Nem Chand & brothers, Roorkee.
2. Mechanical Vibrations : V.P. Singh, Dhanpat Rai & Company Pvt. Ltd.

REFERENCE BOOKS :

1. Mechanical Vibrations : S.S. Rao, Pearson Education Inc, 4th Edition, 2003.
2. Mechanical Vibrations : S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. Theory & Practice of Mechanical vibrations : J.S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. Elements of Vibrations Analysis : Leonanrd Meirovitch, Tata McGraw Hill, Special Indian edition, 2007.
5. Mechanical Vibrations : Austin H Church, John Wiley & Sons.

SCHEME FOR END SEMESTER EXAMINATION :

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

HEAT AND MASS TRANSFER

Course Code: P08ME63 **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT - 1

INTRODUCTORY CONCEPTS AND DEFINITIONS: Modes of heat transfer; Basic laws governing conduction, convection and radiation heat transfer. Conduction-Basic Equations: Derivation of general form heat conduction equation in rectangular coordinates, heat conduction equation in cylindrical and Spherical coordinates (no derivation). Boundary conditions of conduction problems.Numerical Probelm. 6 Hours

UNIT - 2

ONE DIMENSIONAL STEADY STATE CONDUCTION : Steady state conduction in slab, cylinder, sphere and composite medium without heat generation : overall heat transfer coefficient, critical thickness of insulation, conduction in fins,fin efficiency: conduction in solids with variable thermal conductivity, Steady state conduction with heat generation in slab.Numerical Probelm. 8 Hours

UNIT - 3

ONE DIMENSIONAL TRANSIENT CONDUCTION : lumped system analysis, Transient conduction in slab, long cylinder and sphere: use of transient temperature charts.semi-infinite solids. Numerical Probelm.6 Hours

UNIT - 4

CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS: Flow over a body: velocity boundary layer: critical Reynolds number, general expression for drag coefficient and drag force, thermal boundary layer, heat transfer coefficient, relation between drag coefficient and heat transfer coefficient, flow inside a duct, hydro dynamically developed flow, friction factor and pressure drop.

FREE OR NATURAL CONVECTION : Application of dimensional analysis significance of Grashoff number; free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinder . Numerical Probelm. 6 Hours

PART - B

UNIT - 5

FORCED CONVECTION: Application of dimensional analysis for forced convection problems. Significance of Reynolds, Prandtl and Nusselt numbers. Flow over a flat plate, over a cylinder and across a tube bundle.Numerical Probelm. 06 Hours

UNIT - 6

HEAT EXCHANGERS: Classification of heat exchangersoverall heat tranfer coefficient, fouling and fouling factor; LMTD, effectiveness- NTU methods of analysis of heat exchangers.Numerical Probelms. 06Hours

UNIT - 7

CONDENSATION AND BOILING: Types of condensation (discussion only) Nusselt's theoryfor laminar condensation on a vertical flat surface:use of correlationon vertical flat surfaces, horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling correlations.Numerical Probelm. Mass tranfer definition and terms used in mass transfer analysis, Ficks First law of diffusion (No Numerical) 07 Hours

UNIT - 8

RADIATION HEAT TRANSFER: Definitions, Stefan-Boltzman law, Kirchoff 's law Plank's law and Wein's displacement law' radiation between two parallel black surfaces, gray surfaces, radiation shield, Lambert's law; view factor algebra; Hottel's cross string formula.Numerical Probelm. 07 Hours

TEXT BOOKS :

1. Heat Transfer- A Basic approach by M Necati Ozisik Mc-Graw Hill International ed 1988
2. Principles of Heat Transfer by Kreith Thomas learning 2001.

REFERENCE BOOKS :

1.Heat transfers a practical approaches by Yunus A Cengel Tata Mc-Graw Hill 2002.
2.Heat Transfer by sucec, Jaico Book house 2002.
3.Heat & Mass Transfer by Rajuputh
4.Heat & Mass Transfer by P.K. Nag Tata Mc-Graw Hill 2002
5.Fundamentals of Engg. Heat & Mass Transfer by R.C.Sachdeva
6.Heat Transfer by J.P. Holman

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2questions from part A and 2 questions from part B.

MANAGEMENT & ENTREPRENEURSHIP

Course Code: P08ME64 **Total hours : 40**
Credits : 3 **Hours per week : 04**

PART – A

UNIT –1

MANAGEMENT : Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management – Management as a science, art or profession – Management & Administration – Role of Management, Levels of Management, Development of Management Thought – early management approaches – Modern management approaches. 07 Hours

UNIT – 2

PLANNING: Nature, importance and purpose of planning process objectives Types of plans (Meaning only) -Decision making - Importance of planning steps in planning & planning premises – Hierarchy of plans. 06 Hours

UNIT – 3

ORGANISING AND STAFFING : Nature and purpose of organization principles of organization –Types of organization – Departmentation – Committees – Centralization V/s Decentralization of authority and responsibility – Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing – Process of Selection & Recruitment (in brief). 06 Hours

UNIT – 4

DIRECTING & CONTROLLING : Meaning and nature of directing Leadership styles, MotivationTheories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Co-ordination. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief). 07 Hours

PART – B

UNIT – 5

ENTREPRENEUR : Meaning of Entrepreneur, Evolution of Concept, Functions of Entrepreneur, Types of Entrepreneur, Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic development entrepreneurship in india, entrepreneurship - its barriers 06 Hours

UNIT – 6

SMALL SCALE INDUSTRY : Definition; Characteristics; Need and rationale: Objectives, Scope, role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI –Government policy towards SSI, Different Policies of SSI., Government Support on SSI., during 5 year plans. Impact of Liberalization, Privatisation, Globalization on SSI. Effect of WTO / GATT Supporting Agencies of Government for SSI Meaning.Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only). 07 Hours

UNIT – 7

INSTITUTIONAL SUPPORT : Different Schemes, TECKSOK, KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI, NSIC, SIDBI, KSFC. 06 Hours

UNIT – 8

PREPARATION OF PROJECT : Meaning of Project, Project Identification, Project Selection, Project Report, Need and significance of Report,Contents, formulation, Guidelines by Planning Commission for Project Report, Network Analysis, Errors of Project Report, Project Appraisal.

Identification of Business Opportunities : Market Feasibility Study: Tech nical Feasibility Study, Financial Feasibility Study & Social Feasibility Study. 07 Hours

TEXT BOOKS :

1. Principles of Management – P.C. Tripathi, P.N. Reddy, Tata McGraw Hill,
2. Dynamics of Entrepreneurial Development & Management – Vasant Desai – Himalaya Publishing House
3. Entrepreneurship Development – Small Business Enterprises – Poornima M. Charantimath – Pearson Education – 2005(2 & 4)
4. Management & Enterpereship - NVR Naidu & T Krishna Rao, IK Int.-2008

REFERENCE BOOKS :

1. Management Fundamentals – Concepts, Application, Skill Development – Robert Lusier – Thomson
2. Entrepreneurship Development – SS Khanka – S Chand & Co.
3. Management – Stephen Robbins – Pearson Education / PHI – 17th Edition, 2003.

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

CAD / CAM

Course Code: P08ME65 **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT – 1

INTRODUCTION : Role of computers in design and manufacturing, Product cycle in conventional and computerized manufacturing environment, introduction to CAD and CAM, advantages and limitations of CAD/CAM
05 Hours

UNIT – 2

HARDWARE FOR CAD : Display Units – CRT, DVST, DBR, Raster scan their image generation techniques, TFT, LCD, Plasma Etc. types. Input devices – Mouse, Joystick, Digitizer, Tablet, & Etc. Output devices – pen plotters, laser printer, color laser printer, Electrostatic printer 07 Hours

UNIT – 3

COMPUTER GRAPHICS: Software configuration of a graphics system, functions of graphics software. Graphic primitives, 2-D transformation , homogeneous transformation, concatenation, problems on transformations, Geometric modeling – wire frame, surface & solid modeling. 07 Hours

Unit – 4

GEOMETRIC MODELING TECHNIQUES: Introduction Drawing interchange files – DXF, IGES and STEP, representation of curves and surfaces, cubic splines, Bezier curves, B-splines and nurbs, Bicubic polynomial surface patches, Bezier bicubic surface patches, cubic B-spline surfaces.
07 Hours

PART – B

UNIT – 5

NUMERICAL CONTROL (NC) : Basic components of NC Systems , NC procedure, NC co-ordinate system , open loop & closed loop system (position controlled NC) NC motion control system, application of NC, Advantage & limitations of NC. 06 Hours

UNIT – 6

CNC MACHINE TOOLS: Functions of CNC, CNC machining centers, CNC turning centers, high speed CNC machine tools. 04 Hours

UNIT – 7

CNC TOOLING : Turning tool geometry, milling tooling system, tool representation, ATC, work holding devices. 04 Hours

UNIT – 8

CNC PROGRAMMING: Part program fundamentals, ISO Codes, simple programming exercises in drilling, turning and milling using ISO codes.
12 Hours

TEXT BOOKS :

1.Computer Aided Design/Computer Aided Manufacturing Principles and application by P.N. Rao, Tata McGraw Hill. 2002.
2.Computer Aided Design/Computer Aided Manufacturing by Groover Tata McGraw Hill. 2003.

REFERENCES BOOKS :

1. Introduction to the Design and Analysis of Algorithms - S.E. Goodman, S.T.Headetmiemi, McGraw Hill Book Company - 1988.
2. Principles of interactive Computer Graphics by Newman and Sproull, Tata McGraw Hill, 1995.
3. NC Machine programming and software Design - Chno-Hwachang, Michel.A.Melkanoff, Prentice Hall, 1989.
4. Numetical control and CAM, Pressman RS and Williams JE, Johnwiley. 2000.
5. Computer Graphics by Steven Harrington, McGraw Hill Book Co.2001.
6. CAD-CAM- Ibrahim Zeid. Tat McGraw Hill, 1999.
7. CAD/ CAM by chris McMahon & Jimmie Browne - Pearson education Asia 2001.
8. Computer Aided Manufacturing by P.N. Rao, N.K. Tewari and T.K. Kundra Tata McGraw Hill 1999.
9. Introduction to FEM, T Chandra patta Ashok D Bebgundu.2002.

SCHEME FOR END SEMESTER EXAMINATION :

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

CAM LABORATORY

Course Code: P08MEL67 **Total hours : 42**
Credits : 3 **Hours per week : 04**

PART – A

1. Modeling of simple machine parts and generating machine codes for CNC production using standard CAM packages.
2. Simulation of Turning, Drilling, Milling / Cutting operations on a Computer using CAM packages
3. 3 typical simulations to be carried out using simulation packages like Master – CAM, or any equivalent software 21 Hours

PART – B

1. Writing of manual part programming using ISO codes for machining simple machine parts. Use tool radius componsation. Canned cycles, Macros Etc.
2. Machining of simple parts on CNC Lathe/ Milling Machines. 15 Hours

PART – C

(Only for demo/ Viva voce)

1. FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with adding unloading arm and ASRS to be carried out on simple components.
2. Demo of Robot Programming : Using Teach pendent & offline Programming to perform pick and place, stacking of objects, 2 pragrams.

06 Hours

Scheme for Examination :

One Question from Part A	-	25 Marks (05 Write up +20)
One Question from Part B	-	15 Marks (05 Write up +10)
Viva-Voce	-	10 Marks
Total		**50 Marks**

HEAT & MASS TRANSFER LABORATORY

Course Code: P08MEL68 **Total hours : 42**
Credits : 3 **Hours per week : 04**

PART – A

1. Determination of thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.
5. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.
6. Determination of Emissivity of a Surface.
7. Determination of thermal conductivity of liquid. 21 Hours

PART –B

8. Determination of Stefan Boltzman Constant.
9. Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers.
10. Performance Test on a Vapour Compression Refrigeration.
11. Performance Test on a Vapour Compression Air – Conditioner
12. Experiment on Transient Conduction Heat Transfer 21 Hours

Scheme for Examination :

One Question from Part A	-	20 Marks (05 Write up +15)
One Question from Part B	-	20 Marks (05 Write up +15)
Viva-Voce	-	10 Marks
Total		**50 Marks**

ELECTIVE - I
COMPOSITE MATERIALS

Course Code: P08ME61Y **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART - A
UNIT - 1

INTRODUCTION TO COMPOSITE MATERIALS: Introduction, definitions, constituents of composites, classification of composites – based on matrix phase, based on reinforcement phase, commonly used matrix and reinforcement materials, manufacturing of glass fiber, boron fiber, carbon fiber, polyethylene fiber and aramid fibers. SiC whisker production starting from rice hulls. 06 Hours

UNIT – 2

POLYMER MATRIX COMPOSITES (PMC): Introduction, polymers, glass transition temperature, thermoplastics and thermosets, common polymeric matrix materials, processing of PMCs, hand lay up, spray up technique, filament winding, pultrusion, pressure bag moulding, sheet molding compound process, mechanical properties, applications and recycling of PMCs. 07 Hours

UNIT – 3

METAL MATRIX COMPOSITES (MMC): Introduction, types of MMCs, important metal matrices, processing of MMCs, casting, liquid infiltration, squeeze casting, spray forming, diffusion bonding, in situprocess. Interfaces in MMCs – interfacial bonding. Mechanical properties, applications and recycling of MMCs. 07 Hours

UNIT – 4

CERAMIC MATRIX COMPOSITES (CMC): Introduction, processing of CMCs, cold pressing and sintering, hot pressing,slurry impregnation process, reaction bonding, melt infiltration process, directed oxidation process, in situ chemical reaction techniques – chemical vapour deposition and chemical vapour impregnation, mechanical properties and applications of CMCs. 06 Hours

PART –B
UNIT – 5

MICROMECHANICS OF COMPOSITES: Introduction, density, mechanical properties, prediction of elastic constants – isostrain and isostress conditions, micromechanical approach, transverse stresses, thermal properties, thermal expansion coefficients of composites, thermal conductivity of composites. 06 Hours

UNIT -6

POWDER METALLURGY-I: Introduction, advantages and limitations, characteristics and testing of powders – chemical composition, particle size, size measurement technique, sieving method, microscopic method, sedimentation method, sedimentation and decantation method, elutriation method, Fisher sub sieve sizer, particle shape, specific surface, apparent density,tap density, flow rate, pressing properties, green density, green strength, sintered density, porosity. 07 Hours

UNIT – 7

POWDER METALLURGY-II: POWDER MANUFACTURE – introduction, mechanical processes, machining, crushing, milling, atomization process, chemical processes, electrodeposition process. POWDER CONDITIONING – ntroduction, preliminary heat treatment, blending or mixing process. 06 Hours

UNIT – 8

POWDER METALLURGY-III: POWDER COMPACTION – introduction, pressureless shaping technique, slip casting, slurry casting, die compaction, isostatic pressing, explosive forming, powder rolling or roll compacting, powder extrusion. SINTERING – introduction, stages of sintering, mechanisms of sintering, liquid phase sintering, hot isostatic pressing. 07 Hours

TEXT BOOKS :

1. Composite materials - Science and Engineering, 2nd edition, K.K. Chawla, Springer, 1998.
2. Powder metallurgy by A.K.Sinha, Dhanpat Rai publications.

REFERENCE BOOKS :

1. Composite materials hand book by Meing Schwaitz, Mc Graw Hill book Company.
2. Mechanics of Composite Materials by Robert M. Jones,
3. Fiber reinforced composites by P.K.Mallik, Marcel Dekker,Inc.,USA.
4. Metal matrix composites by Minoru Taya and Richard J. Arsenault, Pergamon press.

SCHEME FOR END SEMESTER EXAMINATION :

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

STATISTICAL QUALITY CONTROL

Course Code: P08ME62Y **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART - A

UNIT – 1

INTRODUCTION : Basic concepts of quality, Meaning and definition of quality, quality control, objectives of quality control, Quality Characteristics, Quality Costs, Quality of Design, Quality of conformance, Concepts in quality management, quality measurement, trouble shooting, diagnostic techniques, System approach to quality management. 08 Hours

UNIT – 2

BASIC STATISTICAL CONCEPTS: Concept of variation and its types, Variables and Attributes., Frequency distribution and its graphical representation (Frequency Polgon, Histrogram, and Ogive), Central tendency and Measures of dispersion (Mean, Median, Mode, Range, and Standard deviation), Numerical Problems 06 Hours

UNIT – 3

PROBABILITY AND PROBABILITY DISTRIBUTIONS: Theory of Probability Types of Probability distributions : Hypergeometric, Bi-nomial, Poisson and Normal distributions, Numerical Problems 06 Hours

UNIT – 4

CONTROL CHARTS FOR VARIABLES : Theory and definition of control chart, control charts for X – bar and R charts, Type I and Type II errors, Numerical Problems 06 Hours

PART – B

UNIT – 5

PROCESS CAPABILITY : Methods of calculating process capability, Natural Tolerance limits, process capability index C_P, $C_{pk.}$ Numerical problems. 05 Hours

UNIT – 6

CONTROL CHARTS FOR ATTRIBUTES: Control charts for defects and defectives –p, np,c, and u charts and their applications, Numerical Problems. 07 Hours

UNIT – 7

ACCEPTANCE SAMPLING: Basis concepts, Sampling by attributes, single, double and multiple sampling plans, use of sampling table, Sequential sampling plan, construction and use of Operating Characteristic curves, Numerical problems 06 Hours

UNIT – 8

FAILURE STATISTICS AND RELIABILITY : Failure density, Failure rate, Mean Failure rate, Mean time to failure, Mean time between failure, maintai nability,Availability, Concepts and meaning of reliability, Reliability prediction, Bath tub curve, component and system reliability, redundancy and its uses, interaction between reliability and maintenance, Numerical Problems. 08 Hours

TEXT BOOKS :

1. Statistical Quality Control, E.L. Grant and R.S. Leavenworth,Tata Mc Graw –Hill publishing Co. Ltd. New Delhi.
2. Concepts in Reliability Engineering, L.S. Srinath.

REFERENCE BOOKS :

1. Statistical Quality Control, R.C.Gupta, Khanna Publishers, Delhi
2. Statistical Quality Control, manohar Maharajan, Dhanpat Rai and Sons, New Delhi.
3. Statistical Process Control and Quality Improvement, Gerald M.Smith, Pearson Prentice Hall
4. Statistical Quality Control for Manufacturing Managers, W.S.Messina, Wiley and Sons, Inc., New York.
5. Introduction to statistical Quality Control, Montgomery Douglas C., John wiley and Sons, Inc., Hoboken.
6. Quality Planning & Analysis – Juran Banks, TataMcGraw Hill
7. Principles of Quality Control, Jerry Banks, Wiley & Sons, Inc.New York.
8. Introduction to Reliability and Quality**,** Thomson. R.
9. Reliability Engineering – E. Balaguruswamy, TataMCGrawHill.

SCHEME FOR END SEMESTER EXAMINATION :

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

CRYOGENICS

Course Code: P08ME63Y **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT - 1

INTRODUCTION TO CRYOGENIC SYSTEMS: Applications Areas of Cryogenic Engineering Low temperature properties of engineering materials – Mechanical properties Thermal properties Electrical properties. Introduction The Thermodynamically Ideal system Production of low temperatures – Joule Thompson Effect Adiabatic expansion. 06 Hours.

UNIT - 2

GAS LIQUEFACTION SYSTEMS: Liquefaction systems for Air Simple Linde – Hampson System Claude System Heylndt System Dual pressure Claude. Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon Critical components of liquefaction systems. 07 Hours.

UNIT - 3

GAS CYCLE CRYOGENIC REFRIGERATION SYSTEMS : Classification of Cryo coolers Stirling cycle cryo – refrigerators Ideal cycle – working principle Schmidt's analysis of Stirling cycle Various configurations of Stirling cycle refrigerators Integral piston Stirling cryo-cooler Free displacer split type Stirling Cryo coolers Gifford Mcmahon Cryo-refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators. 06 Hours

UNIT - 4

GAS SEPARATION AND GAS PURIFICATION SYSTEMS: Thermodynamic ideal separation system, Properties of mixtures, Principles of gas separation, Linde single column air separation. Linde double column air separation, Argon and Neon separation systems. Adsorption Process, PSA systems. 07 Hours

PART - B

UNIT - 5

ULTRA LOW TEMPERATURE CRYO – REFRIGERATORS: Magneto Caloric Refrigerator ^{3}He-^{4}He Dilution refrigerator. Pomeranchuk cooling. Measurement systems for low temperatures, Temperature measurement at low temperatures Resistance thermometers Thermocouples Thermistors Gas Thermometry. Liquid level sensors. 06 Hours

UNIT - 6

VACUUM TECHNOLOGY: Fundamental principles. Production of high vacuum, Mechanical vacuum pumps, Diffusion pumps, Cryo-pumping Measurement of high vacuum level. Cryogenic Insulation: Heat transfer due to conduction Evacuated porous insulation Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation. 07 Hours.

UNIT - 7

CRYOGENIC FLUID STORAGE AND TRANSFER SYSTEMS: Design of cryogenic fluid storage vessels, Inner vessel, Outer Insulation Suspension system, Fill and drain lines. Cryogenic fluid transfer, External pressurization, Self pressurization, Transfer pump. 07 Hours

UNIT - 8

APPLICATION OF CRYOGENIC SYSTEMS : Cryogenic application for food preservation – Instant Quick Freezing techniques 11.2 Super conductive devices, Cryogenic applications for space technology. 06 Hours

TEXT BOOKS :

1. Cryogenic Systems – Randall Barron – Oxford Press, 1985
2. Cryogenic Engineering – Thomas M. Flynn, Marcel Dekker, Inc N.Y. Basal 1997.

REFERENCE BOOKS :

1.Cryogenic Process Engineering: Klaus D. Timmerhaus &Thomas M. Flynn,Plenum Press, New York & London 1989.

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

THEORY OF ELASTICITY

Course Code: P08ME64Y **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT - 1

DEFINITION AND NOTATION: Stress, stress at a point, equilibrium equations, principal stresses, Mohr's diagram, maximum shear stress, boundary conditions. 06 Hours

UNIT - 2

STRAIN AT A POINT: Compatibility equations, principal strains, Generalised Hooke's law, methods of solution of elasticity problems – plane stress- plane strain problems. 08 Hours

UNIT - 3

TWO DIMENSIONAL PROBLEMS: Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure. 07 Hours

UNIT - 4

GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATE: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration. 06 Hours

PART – B

UNIT - 5

STRESSES IN AN INFINITE PLATE: (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders. 06 Hours

UNIT - 6

TORSION OF CIRCULAR, ELLIPTICAL AND TRIANGULAR BARS :
Membrane analogy, torsion of thin open sections and thin tubes. 06 Hours

UNIT - 7

THERMAL STRESSES: Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs and in long circular cylinder, sphere. 07 Hours

UNIT - 8

UNIQUENESS THEOREM: Principle of super position, reciprocal theorem, saint venant principle. 06 Hours

TEXT BOOKS :

1. Advanced Mechanics of solids, L. S. Srinath, Tata Mc. Graw Hill, 2003
2. Theory of Elasticity : S. P. Timoshenko and J. N Gordier, Mc. Graw Hill International, 3rd edition, 1972

REFERENCES BOOKS :

1. Theory of Elasticity: Dr. Sadhu Singh, Khanna Publications, 1988
2. Elasticity, Theory, Applications & Numericals: Martin H Sadd, Elsevier. 2005
3. Applied Elasticity, Seetharamu & Govindaraju, Interline Publishing
4. Applied Elasticity, C.T. WANG Sc. D. Mc. Graw Hill Book Co. 1953

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

PROJECT MANAGEMENT

Course Code: P08ME65Y **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT - 1

CONCEPTS OF PROJECT MANAGEMENT: Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management. 05 Hours

UNIT - 2

PROJECT PLANNING AND ESTIMATING: Feasibility report, phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability. 07 Hours

UNIT - 3

ORGANIZING AND STAFFING: The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution, controls, tendering and selection of contractors. 07 Hours

UNIT - 4

PROJECT SCHEDULING: Project implementation scheduling, different scheduling techniques bar (GANTT) charts, Bar charts for combined activities. Project evaluation and Review Techniques, PERT, planning. Simple Numerical Problems. 07 Hours

PART - B

UNIT - 5

CO-ORDINATION AND CONTROL: Project direction communication in a project, Role of MIS in project control, performance control, schedule control, cost Control Examples. 07 Hours

UNIT - 6

PERFORMANCE MEASURES IN PROJECT MANAGEMENT: Performance indicators, Performance improvement for the CM & DM companies for better project management. 07 Hours

UNIT - 7

CLOSING OF PROJECT: Types of project termination, strategic implications, project in trouble, termination strategies, evaluation of termination possibilities 06 Hours

UNIT - 8

PROJECT INVENTORY MANAGEMENT: nature of project inventory, supply and transportation of materials. 06 Hours

TEXT BOOKS:

1. Project Management a System approach to Planning Scheduling & Controlling, Harold Kerzner, CBS Publishers and Distributors.2002
2. Project Managemen t: Beningston Lawrence- Mc-Graw hill 1970

REFERENCE BOOKS :

1. Project Management with PERT and CPM, Moder Josep and Phillips cerel R., 2nd edition, New York V AN Nostrand, Reinhold- 1976.
2. Project planning, Scheduling & control, James P. Lewis, Meo Publishing company. 2001
3. Project Management, Bhavesh M Patel, Vikas Publishing House, ISBN 81-259-0777-7 2002

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

NON – TRADITIONAL MACHINING

Course Code: P08ME66Y **Total hours : 52**
Credits : 4 **Hours per week : 04**

PART – A

UNIT 1

INTRODUCTION: History, Classification, comparison between conventional and Non-conventional machining process selection. 03 Hours

UNIT - 2

ULTRA SONIC MACHINE(USM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM. 08 Hours

UNIT - 3

ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas,work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining**:** Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery. 09 Hours

UNIT - 4

ELECTROCHEMICAL MACHINING (ECM): Introduction , study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations. 06 Hours

PART - B

UNIT - 5

CHEMICAL MACHINING (CHM) : Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process

characteristics of CHM: ;material removal rate accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM. 06 Hours

UNIT - 6

ELECTRICAL DISCHARGE MACHINING (EDM): introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode , machining time. Flushing pressure flushing suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy surface finish, Heat affected Zone. Machine tool selection, Application EDM accessories / applications, electrical discharge grinding, Traveling wire EDM. 08 Hours

UNIT - 7

PLASMA ARC MACHINING (PAM): Introduction, equipment nonthermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations. 05 Hours

UNIT - 8

LASER BEAM MACHINING (LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations. **Electron Beam Machining (EBM):** Principles, equipment, operations, applications, advantages and imitation of EBM. 07 Hours

TEXT BOOKS:

1. Modern machining process, by PANDEY AND SHAN, TATA McGraw Hill 2000
2. New technology by BHATTACHARAYA 2000

REFERENCE BOOKS:

1. Production Technology, by HMT TATA McGraw Hill. 2001
2. Modern Machining Process by ADITYA. 2002
3. Non-Conventional Machining by P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
4. Metals Handbook: Machining(Hardcover) volume 16 by Joseph R. Davis (Editor), American Society of Metals (ASM)

SCHEME FOR END SEMESTER EXAMINATION:

One question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.