### M. E. – Production Engineering [Manufacturing and Automation] 2013

#### Semester I

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#### Semester II

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Elective I
- Reliability & Failure Analysis
- Materials Technology
- Manufacturing Management
- Advanced Mechatronics

Elective II
- Advanced Machine Tool Design
- Plastics Processing
- Supply Chain Management
- Product Life Cycle Management

Elective III (Open Elective)
- Optimization Techniques
- Engineering Economics & costing
- Occupational Health and Industrial Acts
- Energy Management
- Intellectual Property Rights
Teaching Scheme
Lectures: 4 hrs/week
Credits – 4

Examination Scheme
In semester: 50
End semester: 50

1. COMPLEX VARIABLES
Analytical functions, conformal mapping, bilinear transformations, complex integration, Cauchy’s integral theorem and formula, Taylor’s and Laurent’s series, Cauchy’s residue theorem, Applications to Dirichlet’s and Neumann’s problems.

2. CALCULUS OF VARIATIONS
Introduction, Variational notation, Euler’s first order condition with extension to several independent variables, constraints and Lagrange’s multipliers, Hamilton’s principle, Lagrange’s equation in generalized co-ordinates, sturm-Liouville’s equation with orthogonal character of the solution for different values of physical problems involving differential equations expressed as Variational problems Galerkin’s and Raleigh- Ritz method.

3. NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS
Difference equations and their types, Solutions of difference equations, finite difference equivalence of solutions of Elliptic Parabolic and hyperbolic equations. Applications to Laplace, Poisson and Cauchy’s equations.

4. SPECIAL FUNCTIONS
Differential Equations and its solutions in series, Bessel’s and Legendre’s differential equations and their series solutions, properties of Bessel's functions and Legendre’s polynomials, generating functions, recurrence relations, Fourier Bessel expansion of function and its applications to boundary value problems.

5. MATHEMATICAL MODELLING
Proportionality Models, fitting models to data, creating simulations, dimensional analysis, probabilistic modeling, optimization (discrete and continuous models), multivariate random number generation, bootstrapping, Monte Carlo simulation, efficiency improvement techniques, simulation output analysis.

6. STATISTICS AND PROBABILITY
Random variables, various distributions, sampling theory, Chi- square test, t-tests, elementary Stochastic process’s, Markov-chain, Markov process, reliability testing. Control chart.

References
2. Spiegel, Complex Variables, Schaum’s Series. ISBN: 0070602301
1. AUTOMATION USING HYDRAULIC SYSTEMS
Hydraulic fluid, fluid mechanics, design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. and their selection. Practical case studies on hydraulic circuit design and performance analysis. Servo valves, hydraulic servo actuators, electro hydraulic servo-valves, proportional valves and their applications, Modeling and Simulation of Electro-hydraulic Servo systems.

2. AUTOMATION USING PNEUMATIC SYSTEMS

3. CONTROL TECHNOLOGIES IN AUTOMATION

4. AUTOMATED WORK PIECE HANDLING
Working principles and techniques, job orienting and feeding devices. Transfer mechanisms, automated feed cut of components, performance analysis. Types of automated handling systems including AGV and its various guiding technologies, applications.

5. INTRODUCTION TO ROBOT TECHNOLOGY
Robot classification, robot elements, Robot co-ordinate systems, Position, path and speed control systems, robot programming for foundry, presswork, and machining. Collisions free motion planning.

6. MODELING AND SIMULATION FOR MANUFACTURING PLANT AUTOMATION
Introduction/ need for system Modeling, Building Mathematical Model of a manufacturing plant, Modern Tools- Use of Fuzzy decision making and Artificial Neural Networks in manufacturing automation, AI in manufacturing systems
REFERENCES
511103
Advanced Manufacturing Processes 2013

Teaching Scheme
Lectures: 4 hrs/week
Credits – 4

Examination Scheme
In semester: 50
End semester: 50

1. PRINCIPLES OF CASTING
Principles of Casting – metals and their alloys, Mechanism of melting and solidification, grain growth and structure, shrinkage defects. Mold filling – fluidity and turbulence, filling under gravity and pressure; filling defects; gating design, Injection Molding, Simulation of Mold filling and Solidification.

2. FUNDAMENTALS OF FUSION WELDING
Fundamentals of fusion welding processes – analysis of heat source, types of metal transfer, weld pool characteristics, solidification mechanisms in fusion zone, heat affected zone characteristics, types of weld joint, distortion and residual stresses, weld defects, destructive and non-destructive testing of welds.

3. NON CONVENTIONAL MACHINING PROCESSES
Introduction and need of Non-conventional machining processes- Principle, Theory of material removal, process parameters, advantages, limitations and applications of Ultrasonic machining, Electro discharge machining, Laser beam machining and Electro chemical machining.
Special processes: Micro and Nano machining, molecular dynamic analysis, dry-electro discharge machining, electro discharge chemical machining, vacuum coating, Ballistic machining, unit head machining, hot machining.

4. ADVANCES IN MATERIAL FORMING
Macroscopic plasticity and yield criteria, plastic instability, strain rate and temperature, slab analysis, upper bound analysis, slip line field theory, plastic anisotropy, and numerical analysis of material forming processes.

5. SHEET METAL FORMING
Formability, bending, cupping, redrawing, ironing, complex stamping, metal spinning, stretch forming, fine blanking, high speed blanking.

6. NON CONVENTIONAL FORMING PROCESSES
High energy rate forming, electromagnetic forming, explosive forming, high speed hot forging, high velocity extrusion, high speed forming machines, peen forming, study of various process parameters.
REFERENCES
1. INTRODUCTION
Nature and objectives of research. Methods of Research: historical, descriptive and experimental, research process, research approaches, criteria for good research, problems faced by researchers.

2. RESEARCH DESIGN
Meaning of research design, need of research design, features of good design, different research designs, basic principles of experimental designs, design of experiments.

3. DATA COLLECTION
Types of data, methods and techniques of data collection, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection, pilot study and pretest of tools, choice of data collection methods.

4. PROCESSING AND ANALYSIS OF DATA

5. DECISION MAKING TECHNIQUES
Multi-attribute decision making techniques: Analytical Hierarchy Process (AHP), TOPSIS, Data Envelope Analysis (DEA), graph theory and matrix approach.
Multi-objective decision making techniques: Simulated annealing, Genetic algorithms.

6. INTERPRETATION AND REPORT WRITING:
Techniques of interpretation, precautions in interpretation, significance of report writing, different steps in report writing, layout of research report, mechanics of writing research report.

REFERENCES
1. INTRODUCTION
Basic Probability-concept and various distributions, Concept of Reliability and analysis of various configurations of assemblies and sub-assemblies. Series, Parallel and other grouping. System reliability, Set theory, optimal Cut Set and Tie Set, 'stardelta' method, matrix method etc.

2. PRODUCT FAILURE THEORY
System reliability determination through 'Event Tree' analysis and Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA). R.P.N, Graph theory, etc.

3. RELIABILITY PREDICTION MODELS
Series and parallel systems - RBD approach - Standby systems - m/n configuration -Application of Baye's theorem - cut and tie set method - Markov analysis. Optimal allocation of component reliability to achieve maximum system reliability - various techniques and methods such as Proportional, Conditional, Agree, Arinc, etc.

4. RELIABILITY EVALUATION
Concept of loading roughness, probability in design including evaluation of safety margin. Reliability of Engineering Design; Mean, Median & K statistics for Reliability evaluation (non parametric, Short Sample).

5. RELIABILITY MANAGEMENT
Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.

6. CASE STUDIES
Diagnostic maintenance through ferrography, Vibration Signature, SOAP and other programme. Case studies done in Indian perspectives using Short Sample, nonparametric reliability

References
1. Gupta AK, “Reliability engineering and tero-technology”, Macmillan India Ltd, Delhi
1. ELASTIC AND PLASTIC BEHAVIOUR
Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, Yield stress; shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviours - Super plasticity - Deformation of non crystalline material.

2. FRACTURE BEHAVIOR
Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms – Ductile- brittle transition in steel, High temperature fracture, creep: Larson-Miller parameter, Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

3. SELECTION OF MATERIALS
Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing, Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

4. MODERN METALLIC MATERIALS
Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallics, Ni and Ti aluminides,Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials, bio-materials.

5. NON METALLIC MATERIALS
Plastics, rubber, foams, adhesives and coatings - Structure, properties and applications of engineering polymers - Advanced structural ceramics, WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN and diamond - properties, processing and applications.

6. COMPOSITE MATERIALS
Reinforced fibers, Particle strengthened and laminar composites-- production techniques of each type, Production of fibers, properties mechanics of composites, manufacturing of metal matrix, Ceramic matrix composite, Carbon-Carbon composite- properties and testing of composite material, areas of application.
REFERENCES:
511105 C
Manufacturing Management ELECTIVE I 2013

Teaching Scheme
Lectures: 5 hrs/week
Credits – 4

Examination Scheme
In semester: 50
End semester: 50

1. SCOPE OF MANUFACTURING MANAGEMENT
History and development of Manufacturing Management - Contribution of various pioneers,
overview of manufacturing systems, Manufacturing Management - Nature, Scope, Importance
and Functions, Its relationship with other functions

2. PRODUCTION PLANNING & CONTROL
Functions of Production Planning & Control (PPC), Scheduling – Graphical and analytical
techniques, Master Production Schedule, line balancing, Documentation - Production Work
Order. Introduction to PERT/CPM, Network Crashing

3. ADVANCED TOPICS IN PRODUCTION MANAGEMENT
Concept of world-class manufacturing, Total quality management, manufacturing challenges of
information age, JIT, lean and agile manufacturing, reconfigurable manufacturing, green
production, computerized production management system, simulation of manufacturing systems

4. QUALITY MANAGEMENT
Foundations of quality management, Fundamentals of statistical studies, Tools and methods of
analytic studies, stabilizing and improving a process with control charts, Process capability and
improvement studies, inspection policy, Fork Model for Quality Management, Current thinking
about statistical practice

5. MANUFACTURING STRATEGY
Need for manufacturing strategy (MS) and concept of MS, Structured strategy formulation,
Focus of MS decisions relating to capability, flexibility, product variety, inventory, supplier
relationships, manufacturable design. Role of Quality in the framework of MS-TQM, SPC, 6-
sigma. Interface of marketing and manufacturing, financial aspects, Performance measurement in
MS, Ingredients for a world-class manufacturing strategy, Contemporary cases from Indian
manufacturing

6. GROUP DYNAMICS AND TEAM WORKING
Theories of Group Formation - Formal and Informal Groups, their interaction – Importance of
teams - Formation of teams - Team Work. Conflict Management - Traditional vis-à-vis Modern
view of conflict - Stress management, Conflict Process - Strategies for encouraging constructive
conflict - Strategies for resolving destructive conflict.

REFERENCES

Page 16 of 51
1. INTRODUCTION

2. SENSORS AND TRANSDUCERS
Introduction - Performance Terminology - Displacement, Position and Proximity -Velocity and Motion – Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.

3. MICROPROCESSORS IN MECHATRONICS

4. PROCESS CONTROL COMPUTER SYSTEMS
Minis, micros, classification by hardware features and software facilities, performance evaluation techniques. Characteristics of Digital Processors: Organization, instruction set, characteristics for process control, input/output arrangements, addressing techniques, memory systems.

5. PROGRAMMABLE LOGIC CONTROLLERS
Introduction - Basic structure - Input / Output processing - Programming –Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

6. DESIGN AND MECHATRONICS (MECHATRONIC PRODUCT DESIGN)
Designing - Possible design solutions - Case studies of Mechatronics systems.

REFERENCES
511106
Lab Practice I 2013
Teaching Scheme
Practical: 4 hrs/week
Credits – 4

Examination Scheme
Oral: 50 Marks
TW: 50 Marks

Each student has to prepare a report based on *any eight* of the following laboratory work:

1. Analysis of regenerative circuit.
2. Study of meter in and meter out circuit
3. Practical case study on evaluation of alternative hydraulic circuit design
4. Study of effect of process parameters for any non-traditional machining process
5. Experimental analysis of any one of the metal forming processes
6. Experimental analysis of casting process.
7. Industrial case study on design of experiment
8. Industrial case study on multi-attribute decision making
9. Numerical solution of a partial differential equation by using different methods
10. Manufacturing application of T test and Chi-square test.

511107
Computer Integrated Manufacturing

Teaching Scheme
Lectures: 4 hrs/week
Credits-4

Examination Scheme
In semester: 50
End semester: 50

1. COMPUTER AIDED DESIGN
Introduction to CAD, Display technologies, Graphic Standards, 2D and 3D Geometric transformations, analytic and synthetic curves (cubic and Bezier curves), analytic and synthetic surfaces (cubic, bilinear, and Bezier curves), solid modeling techniques, visual realism, computer animation, mechanical assembly, mass property calculations.

2. COMPUTER AIDED MANUFACTURING
Features of NC/CNC/DNC systems and its role in computer integrated manufacturing, CNC part programming, computer aided process planning, manual part programming with APT, NC program generation from CAD models, tool path generation and verification, standard controllers, digital manufacturing.

3. COMPUTER AIDED ENGINEERING ANALYSIS
Introduction to finite element analysis, need for finite element analysis in CAD/CAM system, Steps in finite element analysis, second order differential equation in one dimension applications such as discrete systems, heat transfer, fluid mechanics, plane trusses.

4. CIM DATABASE AND DATABASE MANAGEMENT SYSTEM
Database requirements of CIM, database management, Database management system (DBMS), DBMS architecture, product data management (PDM) and its advantages.

5. COMPUTER AIDED SHOP FLOOR CONTROL
Computer aided production planning and control, computer aided material requirement planning, factory data collection system, computer process monitoring, computer aided quality control. Fundamental of Networking

6. FLEXIBLE MANUFACTURING SYSTEMS (FMS)

REFERENCES
511108
Tool & Die Design –2013

Teaching Scheme

Lectures: 4 hrs/week
Credits – 4

Examination Scheme

In semester: 50
End semester: 50

1. CUTTING TOOL DESIGN
Fundamentals of Cutting tools design, cutting tools and their principal elements, Tool geometry, system of nomenclatures and their interrelations, setting for the grinding of various basic cutting tool (turning, drilling, milling)

2. ANALYSES AND DESIGN OF JIGS AND FIXTURE
Principles of jig and fixture design, Dual cylinder location, diamond pin analysis, V-block analysis, design principles of centralizers, various mechanisms and design of equalizers, analysis for optimum number of clamping forces required and calculation of their magnitudes, concept of modular fixtures, design of fixtures for NC/CNC machines, computer applications in fixture design and analysis.

3. DESIGN OF PRESS TOOLS
Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts. Computer applications in press tool design.

4. DESIGN OF FORGING DIES
Grain flow considerations, parting line selection, draft, design problems involving ribs, bosses and fillets. Flash and flash control, determination of number of impressions required and their sequence, design steps and analysis of forging dies, detail calculations, shrinkage, cavity shapes, heat transfer considerations, cooling and ejection systems, automation in forging operations, computer aided design and analysis.

5. DESIGN OF INJECTION MOLDS
Principles of melt processing, product considerations, determination of economical number of cavities, temperature control of injection molds, calculation of mold opening force and ejection force. Detail design of cooling system, ejection system and gating system. Moldability features, mold flow analysis.

6. DIE CASTING DIE DESIGN
Metals for die casting, specific details of die construction, casting ejectors, side cores, loose die pieces, slides, types of cores, directional solidification, types of feeders, die venting, water cooling, design aspects of die casting dies, defects.
REFERENCES
4. ASTEM: “Fundamentals of Tool Design”
11. Hiram Kenneth Barton, Lucy Clare Barton “Die casting die design”, Machinery Publication Co.
511109
Advanced Joining Processes -2013

Lectures: 4 hrs/week         In semester: 50
Credits – 4         End semester: 50

1. INTRODUCTION

2. ADVANCED WELDING TECHNIQUES
Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

3. WELD DESIGN

4. METAL TRANSFER AND MELTING RATE
Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

5. THERMAL AND METALLURGICAL CONSIDERATION:

6. WELDING OF PLASTICS AND COMPOSITES
Principle of welding plastics, common weldable plastics, welding joint design, surface preparation, plastic welding processes, principle of operation, equipment required, Advantages, Applications.

REFERENCES:
511110 A  
Advanced Machine Tool Design- Elective-II 2013

Teaching Scheme       Examination Scheme
Lectures: 5 hrs/week       In semester: 50
Credits – 4              End semester: 50

1. INTRODUCTION

2. DESIGN OF STRUCTURAL COMPONENTS
Design of Machine tool spindle and bearings, Design of power Screws – Static deformation of various machine tool structures - thin walled box structures with open and compliant cross sections - correction coefficients - design of beds, columns, tables and supports. Dynamics of cutting forces - tool chatter - design of sideways.

3. DESIGN OF DRIVES
Design considerations of electrical, mechanical and Hydraulic drives in machine tool, stepped and step-less arrangements and systems. Design of control mechanisms - selection of standard components – Dynamic measurement of forces and vibrations in machine tools - Stability against chatter - use of vibration dampers.

4. DESIGN OF CNC MACHINE TOOL
CNC machine - block diagram showing memory, CPO, I/O, post processor, etc. Machining center, Auto tool changers, uses of Composites in machine tool. DNC and Local Area Network, machines with Adaptive Control. Design of slides with reinforced PTEE, Ball screw all design, methods of calculation of load, Reliability based design. Static and dynamic rigidity and stability analysis.

5. TESTING OF MACHINE TOOLS

6. ERGONOMICS APPLIED TO MACHINE TOOL
Concepts of aesthetics and ergonomics applied to machine tools, Latest trends in Machine Tool Design, Introduction to CAD and Finite Element Method used in machine tool design.
REFERENCES:


1. PLASTIC MATERIALS
Classification of plastic materials, their physical and mechanical properties, selection of plastics for various applications, advantages and limitations of using plastics.

2. MELT PROCESSING TECHNIQUES
Polymer processing techniques such as extrusion, compression and transfer moulding, Injection moulding, blow moulding, thermoforming, rotational moulding, calendaring, Bag moulding reaction moulding. Effect of time, temperature and pressure on plastic processing.

3. CONSTRUCTIONAL FEATURES OF MOLD
constructional features of core and cavity plates, mold size and strength, cavity material, and fabrication, mold placement, constructional features and layout of runners and gates.

4. PRODUCT DESIGN OF MOLDED PRODUCTS
Various considerations such as wall thickness, fillets and radii, ribs, under, cuts, drafts, holes, threads, inserts parting lines, etc. surface treatment mould design for avoiding warpage. Standards for tolerances on molded articles.

5. DESIGN OF MOLDS FOR PLASTIC PROCESSING
Methodical mold design, determination of economical number of cavities, melt rheology, temperature control of injection molds, calculation of mold opening force and ejection force. Detail design of cooling system, ejection system and gating system. Moulding thermoplastics, thermosets, expandable polysterene, foamed engineering plastics, molds for reaction injection molding.

6. COMPUTER APPLICATIONS IN PLASTIC MOLDING
Use of various software for mold flow analysis, optimum gate location and defect analysis, design of component for balanced flow, optimization of process parameters of plastic molding.

REFERENCES
511110 C
Supply Chain Management – Elective II 2013

Teaching Scheme
Examination Scheme
Lectures: 5 hrs/week In semester: 50
Credits – 5 End semester: 50

1. INTRODUCTION
Objectives of Supply Chain Management (SCM), key components of supply chain i.e. sourcing, distribution strategy, customer service strategy; supply chain. Management as Integrated logistics, generic activities, architecture of supply chain, future potential of SCM.

2. SUPPLY CHAIN STRATEGIES
Evaluation of supply chain strategies, supply chain performance measures, vendor management, JIT, Link to supply chain, evaluation of SCM strategies, customer focus in SCM, inventory and logistics management, vendor management, Just-in-Time (JIT). Supply chain design considerations.

3. LOGISTIC MANAGEMENT
Logistical operation, integration, network design, logistical performance cycle, customer service global logistic, logistical resources, logistic planning.

4. WAREHOUSE AND TRANSPORT MANAGEMENT
Concept of strategic storage, warehouse functionality, warehouse operating principles, developing warehouse resources, material handling and packaging in warehouse, transportation management, transport functionality and principles, transport infrastructure, transport economics and pricing, transport decision making.

5. INVENTORY MANAGEMENT
Cost associated with inventory decisions, selective control, economic order quantity, safety stock and service level, P and Q system, probabilistic models.

6. Recent Trends in SCM
Tierisation of supplies, Reverse logistics, JIT II, Milk Round System (MRS), bar coding, Hub and Spoke Concept and other latest concepts. IT – enabled supply chain: Electronic data interchange, enterprise resource planning (ERP), Application of IT, Scope of emerging distributed cooperative tele-manufacturing over internet.

REFERENCES
511110 D
Product Life Cycle Management-Elective II- 2013

Teaching Scheme
Lectures: 5 hrs/week
Credits – 4

Examination Scheme
In semester: 50
End semester: 50

1. INTRODUCTION TO PLM
Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning.

PLM Strategies: Industrial strategies, strategy elements, its identification, selection and implementation, make – to - stock, assemble-to order, make- to order strategy, change management for PLM, Strategies for recovery at end of life, recycling.

Product Data Management (PDM): PDM systems and importance, reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

2. PRODUCT DESIGN
Engineering design, Industrial design, Generic product design process, Types of products, Product planning, Identify customer needs, product specifications, concept generation, concept selection, concept testing, prototyping, and product cost analysis.

3. APPROACHES FOR PRODUCT DESIGN
Mass customization, Kano model, Kansei engineering, conjoint analysis, Product architecture, Modular product architecture, product line design, product configuration, and concurrent engineering.

4. NEW PRODUCT DEVELOPMENT
Structuring new product development, need and importance of NPD Voice of customers(VoC), Methods of VoCs, Quality function deployment, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, product family, product mix, market entry decision, Market segmentation, launching and tracking new product program, concept of redesign of product, product development economics.

5. DESIGN FOR ‘X’
Design for manufacturing, Design for assembly, design for reliability, design for serviceability(maintainability),design for environment, design for safety, design for aesthetics, design guidelines for various casting process, injection molding, turning ,milling grinding, sheet metal working processes.

6. TECHNOLOGY FORECASTING
Future mapping, S-curve, invoking rates of technological change, methods of technology forecasting such as relevance trees, morphological methods and mission flow diagram, product design and process selection, product system-level design, product cannibalization and
petrification, use of academic research in product design, combining forecast of different technologies, human factors in product design, modeling and simulation in product design.

REFERENCES
511111

Lab Practice II

Teaching Scheme
Practical: 4 hrs/week
Credits – 5

Examination Scheme 2013
In semester: 50
End semester: 50

Each student has to prepare a report based on following laboratory work.

1. Computer programming 3D transformations
2. Computer programming for synthetic curves/surfaces.
3. CNC part programming and machining
4. Simulation of manufacturing system
6. Industrial applications for design and analysis of Jigs and fixture/Press Tools/Forging dies/Injection molds
7. Study of temperature distribution due to heat flow in welding
8. Determination of angular distortion in butt welded joints.

511112

Seminar I 2013

Teaching Scheme
Practical: 4 hrs/week
Credits – 4

Examination Scheme
TW: 50 Marks
Oral: 50 Marks

Each student is required to deliver a Seminar on state of the art topic of his/her choice relevant to any area of Production Engineering and submit it in the form of short report.

611101
Advanced Robotics –2013

Teaching Scheme
Lectures: 4 hrs/week
Credits – 4

Examination Scheme
In semester: 50
End semester: 50

1. INTRODUCTION

2. TRANSFORMATIONS AND KINEMATICS

3. CONTROLS AND END EFFECTORS

4. ROBOT PROGRAMMING
Methods - Languages -Computer control and Robot Software - VAL system and Language.

5. SENSORY DEVICES

6. DESIGN OF MECHANISMS AND MANIPULATORS
Classification of closed- and open-loop kinematic systems, Definition of mechanisms and manipulators, Kinematic constraints, Degree of freedom (DOF) and Mobility; DH parameters, Coordinate transformations, Matrix methods; Structural analysis and synthesis of mechanisms; Forward kinematics of robot manipulators with examples; Inverse kinematics; Jacobian and singularity; Alternative design solutions of mechanisms and manipulators.

REFERENCES:
SURFACE ENGINEERING – 2013

Teaching Scheme
Lectures: 4 hrs/week
Credits: 4

Examination Scheme
End semester: 50

1. INTRODUCTION OF SURFACE DEPENDENT PROPERTIES

Introduction to various corrosion prevention methods. Classification and scope of surface modification techniques in metals, ceramics, polymers and composites. Tailoring of surfaces of advanced materials. Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, reflectivity, emissivity, etc.; common surface initiated engineering failures; mechanism of surface degradation; importance and necessity of surface engineering.

2 VARIOUS SURFACE CLEANING PROCESSES

Classification and Selection of Cleaning processes. Acid and Alkaline Salt bath, Ultrasonic, Mechanical cleaning, Pickling and descaling, etc. Process details, applications & Environmental concern of each method, Electrochemistry and electro-deposition; electro less deposition Process details. Scope and application of conventionally deposited materials like Copper Nickel etc.

3 COATINGS


4. OTHER SURFACE ENGINEERING PROCESSES


5. TESTING & CHARACTERIZATION OF COATINGS

Control properties, response properties; surface geometry characterization Techniques(conventional and recent trends); coating thickness measurements – laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement, conventional methods and recent developments; Quality assurance of coating process.

6. RECENT TRENDS IN SURFACE ENGINEERING
Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale, simulation of actual application environment in tribometer. High temperature coatings, Wear resistant coatings Use of Laser in Surface Engineering, Environmental protection issues.

REFERENCES
611103 A
Optimization Techniques - Elective III 2013

Teaching Scheme        Examination Scheme
Lectures: 5 hrs/week        In semester: 50
Credits – 5               End semester: 50

1. INTRODUCTION TO OPTIMIZATION
Statement of an optimization problem, classification. Introduction to optimization techniques, Engineering Applications

2. SINGLE VARIABLE OPTIMIZATION
Fabbonci search methods, golden section search methods, gradient based methods, Newton-Raphson method, secant method.

3. MULTI-VARIABLE OPTIMIZATION
Direct search methods: Evolutionary optimization method, Powell’s conjugate direction method.
Gradient based methods: Steepest descent method, Newton’s method.

4. CONSTRAINED OPTIMIZATION
Constraint handling methods, method of feasible directions, generalized reduced gradient method, gradient projection method.

5. SPECIALIZED ALGORITHMS: Integer programming, geometric programming.

6. NON-TRADITIONAL OPTIMIZATION ALGORITHMS
Genetic algorithms (GA) - working principle, Differences and Similarities between GA’s and traditional methods, GA’s for constrained optimization. Simulated Annealing (SA) approach – introduction only.

References
611103 B

Engineering Economics and costing-Elective III 2013

Teaching Scheme
Lectures: 5 hrs/week
Duration: 3 hours

Examination Scheme
Theory: 100 Marks
Credits – 4

1. INTRODUCTION TO ECONOMICS

2. FINANCIAL MANAGEMENT
Responsibilities and functions of financial management, financial analysis, ratio analysis, leverage analysis, budgeting and budgetary control, sources of finance for fixed and working capital.

3. INVESTMENT APPRAISAL METHODS
Types of investment appraisal methods – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, make or buy decisions, Examples in all the methods, risk analysis.

4. REPLACEMENT AND MAINTENANCE ANALYSIS
Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

5. DEPRECIATION ANALYSIS

6. COSTING, COST CONTROL AND COST REDUCTION
Process costing: Elements of production cost in process costing, methods of process costing, principles of process costing.
Marginal costing: Features of marginal costing, significance of marginal costing, break even point, P/V ratio.
Standard costing and variance analysis: Direct material variances, direct labor variances, overhead variances, sales variances.

Cost control and cost reduction, Techniques of cost control, cost reduction, areas of application.

References:

611103 C

OCCUPATIONAL HEALTH & INDUSTRIAL SAFETY (ELECTIVE III) 2013

Teaching Scheme                                           Examination Scheme
Lectures: 5 hrs/week                                      In semester: 50
Credits – 4                                               End semester: 50

1. INDUSTRIAL SAFETY:

SAFETY EDUCATION AND TRAINING:

2. SAFEGUARDING OF MACHINES:

MANUAL HANDLING AND STORAGE OF MATERIALS:

3. MECHANICAL HANDLING OF MATERIALS
Lifting machinery: Safety aspects in design and construction, testing, use and care, signaling, inspection and maintenance Safety in design and construction, operation, Inspection and maintenance of power trucks and tractors, Lifts and hoists, lifting tackles, and loose gears, conveyors. Safety features, safe working load, destructive and non-destructive testing, inspection and maintenance of lifting tackles. The competent persons, duties and responsibilities under the various legislations.

WORKING AT HEIGHTS
High incidence of serious accidents in working at heights. Types of operations. Safety features associated with design. Construction and use of stairways, runs, ramps, gangways, floors, ladders of different types, scaffolds of different types including Boatswain’s chair and safety belts. Working on roofs, other safety requirements while working at heights. Prevention of fall of persons. Potential tripping and slipping hazards.
4. SAFETY AT WORK PLACE:-
Work place design: Concept of workplace and its design. Improving safety and productivity through work place design control measures. Technical and engineering control measures. Control measures against human error


5. OCCUPATIONAL HEALTH

6. PERSONAL PROTECTIVE EQUIPMENTS

REFERENCES
1. Heinrich H.W ‘Industrial Accident Prevention’ Mc Graw-Hill,
5. 1979 Glossary of terms relating to wire ropes, IS 2363
6. 1977 Steel wire ropes for general engineering purposes, IS 2266
7.1964 Wire rope slings and sling legs, IS 2762
8. 1977 Steel wire suspension ropes for lifts, elevators and hoists, IS 2365
9. 1967 Code of practice for the selection, installation and maintenance of wire ropes IS 3973
13. Model Code of Safety Regulation for Industrial Establishments (ILO)
Teaching Scheme
Lectures: 5 hrs/week
Credits – 4

Examination Scheme
In semester: 50
End semester: 50

1. ENERGY SCENARIO
Global primary energy reserves and consumption pattern, Indian energy scenario, sector wise energy consumption, energy needs of growing economy, energy pricing in India, energy security importance of energy conservation and introduction of energy conservation act 2001.

2. ENERGY ECONOMICS AND ENERGY AUDIT
Energy economics: Simple payback period, time value of money, return on investment, net present value and internal rate of return. Energy Audit: Methodology, analysis and reporting, portable and online instruments required for energy audit, sankey diagram and specific energy consumption.

3. THERMAL SYSTEMS
Boiler efficiency calculations by direct and indirect method, various losses, steam distribution and steam traps, energy conservation opportunities in boiler. Efficiency calculation of oil fired furnace, heat losses and energy conservation opportunities in furnace. Thermal insulation, types of insulation, economic thickness of insulation.

4. ELECTRICAL SYSTEMS
Demand control, billing structure, power factor improvement, benefits and ways of improving PF, load scheduling, electric motors, losses and efficiency, energy efficient motor, speed control methods of motor, Lighting: illumination level, fixtures, timers, energy efficient illumination.

5. ENERGY CONSERVATION
Energy conservation in: Compressed air systems, refrigeration and air conditioning systems, pumps, fans, D. G. set and cooling tower.

6. COGENERATION AND WASTE HEAT RECOVERY
Cogeneration: Concept, technical options, classification of cogeneration system i.e. topping and bottoming cycle, selection criteria, applications. Waste Heat Recovery: Introduction, classification and applications, benefits, waste heat recovery equipments i. e. recuperator, regenerator, economizer, heat wheel, heat pipe, thermo-compressor, heat pump.

REFERENCES
1. Guide books 1, 2 and 3, Bureau of Energy Efficiency.
7. W. C. Turner, editor: The efficient use of energy (Butterworths)
Teaching Scheme
Lectures: 3 hrs./week
Duration: 3 hours

Examination Scheme
Theory: 100 Marks
Credits – 3

1. INTRODUCTION TO IPR

2. PATENTS AND COPYRIGHTS

3. INTERNATIONAL SCENARIO

4. NATIONAL INTELLECTUAL PROPERTY POLICY

5. CASE STUDIES
Case Studies on – Patents (Basmati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

6. NEW DEVELOPMENTS IN IPR
New Developments in IPR, Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Softwares etc.

References:
### 611104  
**Seminar II**

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
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</thead>
<tbody>
<tr>
<td>Practical: 4 hrs/week</td>
<td>Term Work: 50 Marks</td>
</tr>
<tr>
<td>Credits – 4</td>
<td>Oral: 50 Marks</td>
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</tbody>
</table>

Each student is required to review the literature related to proposed dissertation work to be done. He/she is required to deliver the seminar and submit it in the form of short report.

### 611105  
**Project Stage I 2013**

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
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<tbody>
<tr>
<td>Practical: 4 hrs/week</td>
<td>Term Work: 50</td>
</tr>
<tr>
<td>Credits – 5</td>
<td>Oral: 50 Marks</td>
</tr>
</tbody>
</table>

Student has to submit a report based upon the following:
- Objective of the Project
- Progress Achieved
- Difficulties encountered
- Experimental set up preparation
- Methodology and data analysis
- Future plan of action
611106 Seminar III

Teaching Scheme
Practical: 5 hrs/week
Credits – 5

Examination Scheme
Term Work: 50
Oral: 50 Marks

Each student is required deliver a seminar based on proposed dissertation work to be done and submit it in the form of short report. The report should include analytical treatment and mathematical formulation of the problem identified for the dissertation work.

611107 Project Stage II

Teaching Scheme
Practical: 20 hrs/week
Credits – 20

Examination Scheme
Term Work: 150
Oral: 50 Marks

Student has to submit a report based upon the following:
1. Objectives of work
2. Review of literature
3. Development of methodology
4. Experimental and numerical analysis.
5. Results obtained.
6. Comparison of results with previous work done