EVALUATION SCHEME & SYLLABUS
For

B. Tech. 3rd Year
Manufacturing Technology

ON CBCS
[Effective from session 2018-19]
## V SEMESTER

<table>
<thead>
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<th>Sl No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Deptt.</th>
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**Department Elective Course – I**

1. RMT051 Advance Casting Process.
2. RMT052 Plastic material and Manufacturing
3. RME-055: Advance Manufacturing science.
4. RMT053 Plant Layout and Design
DESIGN OF MACHINE ELEMENTS

UNIT I

Introduction
Design requirements of machine elements, Principles of mechanical design, Modes of failures and Factor of Safety. Systematic design process, Aesthetic and Ergonomic considerations in design, Use of standards in design, Manufacturing consideration in design, Selection of preferred sizes, Indian Standards designation, Designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

UNIT II

Design for Static and Fluctuating Loads
Cyclic stresses, Fatigue and endurance limit, Notch sensitivity, Stress concentration. Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

Shafts, Keys and Couplings
Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads. Types of keys, splines, Selection of keys, Strength of keys, Design of rigid and flexible couplings.

UNIT III

Design of Mechanical Drives
Introduction to power transmission and drives. Classification of gears, Terminology, Gear tooth proportions, Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Failure of gear tooth, Design considerations, AGMA and Indian standards, Beam strength and wear strength of gear tooth, Design of spur and helical gears.

UNIT IV

Mechanical Springs
Classification of springs, Material for helical springs, End connections for compression and tension helical springs, Design of helical springs subjected to static and fatigue loading.

Power Screws
Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack.

UNIT V

Basic of Finite Element Method, Variational calculus, Integral formulation, variational methods: Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions.


Note: Design data book is allowed in the examination

Text Books:
2. Design of Machine Elements, Sharma and Purohit, PHI.
MANUFACTURING SCIENCE & TECHNOLOGY-II

UNIT- I

Introduction: Classification of machine tools based on application and production rate: General purpose and Special purpose machines, Classification based on types of machine tools and the processes.


UNIT- II

Machine Tools

Lathe: Principle, construction, types, operations of Turret/capstan, semi/Automatic, NC, CNC and DNC lathe, major difference between CNC lathe and conventional lathe. Driving mechanisms, apron mechanism, thread cutting mechanism and calculations, features of half-nut engagement – disengagement, indexing dial mechanism.

Reciprocating Type Machine Tools: Shaper, Planer and Slotter: Constructional features, basic mechanism, kinematics and related calculations.

UNIT- III

Milling: Principle, construction, types, operations. Milling cutters, work-holding devices, up & down milling. Max chip thickness and power required. Simple, compound and differential indexing and
machining time calculations.

Introduction to machining centers.

**Drilling Machines:** Principle, construction, types, operations feed mechanism, work and tool – holding devices. Estimation of drilling time. Geometry of twist drills, Boring, reaming tool

**UNIT -IV**

**Grinding Machines:** Different types of grinding machines: cylindrical, surface and centre-less grinding machines, basic constructional features and mechanisms, different grinding operations, grinding wheel specification.

**Super finishing:** Honing, lapping, polishing and abrasive flow machining.

**Gear Manufacturing Machines:** Gear forming, gear generation, gear shaping and gear hobbing.

**UNIT-V**

**Introduction to Unconventional Machining:** Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM, AJM, WJM. Introduction to Hybrid machining processes

**Reference Books:**

10. Manufacturing Science (5th edition), Serope Kalpakjian, Steven R Schmid, PEARSON.
12. Manufacturing processes, J P Kaushish, PHI.
13. Materials and Processes in Manufacturing by JT Black and Ronald

**ADVANCED WELDING TECHNOLOGY**

**Unit-I**


**Unit-II**
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.

**Unit-III**

Advanced welding Techniques (continued): Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding / Metallising, Hard facing.

**Unit-IV**


**Books**

1. Welding Hand Book

**DESIGN AND SIMULATION LAB**

1. Design & Modeling of Cotter joint.
2. Design & Modeling of Knuckle joint
3. Design & Modeling of riveted joint applied to boiler joints.
4. Study of a FEA package and modeling stress analysis of
   a. Bars of constant cross section area, tapered cross section area and stepped bar
   b. Trusses,
   c. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc
5. Mini Project: Will take up problems from real life applications and optimize using modeling and analysis software

Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme or through software tools. This assignment should be done in groups, which will be submitted at the end of the semester.

**Text Books:**

2. Design of Machine Elements, Sharma and Purohit, PHI.
MANUFACTURING SCIENCE & TECHNOLOGY –II LAB

NOTE: Minimum eight experiments out of the following along-with study of the machines processes

1. Preparation of three specimen on lathe machine involving Plain turning, Taper turning, step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and eccentric turning.
2. Cutting of V Groove/ dovetail / Rectangular groove using a shaper.
4. Tool grinding (specified tool geometry) using tool grinding machine.
5. Finishing of a surface on surface-grinding machine.
6. Drilling holes on drilling machine and study of twist-drill.
7. Study of different types of tools and its angles & materials.
8. Experiment on tool wear and tool life.
9. Experiment on jigs/Fixtures and its uses
10. Experiment on unconventional machining.
Minimum 8 experiments out of the following

1. Making of welded joints using conventional welding processes - arc welding
3. Making of at least one joint using TIG welding techniques
4. Making of at least one joint using MIG welding techniques.
5. Testing of welded joints as per BIS
6. Microstructure study of welded joints
7. Inspection of welded joints by dye penetration ultrasonic method.
8. Study of different techniques used for inspection of welds
9. Study of HAZ of welded joint
Department Elective Course – I

1. Advance Casting Process.
2. Plastic material and Manufacturing
3. Advance Manufacturing systems
4. Engineering Plastics, Parmar, Khanna Book Publishing Co., Delhi
5. Plant Layout and Design
6. Lean Manufacturing

ADVANCE CASTING PROCESS

UNIT-I

Production of Moulds and Cores : Mould production - equipment for moulding, moulding technique - pattern utilisation, hand and machine compaction, machine moulding, mould drying and hardening. Cores and core making - core boxes, compaction, core hardening, closing of moulds. UNIT-II

Melting and Pouring : Melting Practice : Classification of melting furnaces, brief description of construction and operation of various furnaces - cupola and its design, electric arc furnaces, electric induction furnaces. Melting charge, melting conditions, melting losses, special melt treatment, melt quality control and recent development in metal melting. Pouring : Metal temperature, pouring equipment and techniques.

UNIT-III


UNIT-IV

Solidification of Castings : Crystallization and development of cast structure - Nucleation, Growth and dendrite growth, independent nucleation, eutectic freezing, paratactic relations, structure of castings - significance and practical control cast structure, grain shape and orientation, grain size, refinement and modification of cast structure. Concept of progressive and directional solidification, solidification time and derivation of Chvorinov’s equation influence of mould characteristics and cast metal. Properties on solidification, process numerical methods for heat flow analysis.

UNIT-V

Feeding of Castings : Feeding characteristics of alloys, geometric influences on solidification. Methods of the feeding of castings - cost and concept of yield, orientations, gating technique, casting temperature and pouring speed, design and location of feeder heads. Aids to feeder head efficiency, junction of feeder head and casting, use of padding, chills and insulators.
REFERENCE:
Beeley P.R., “Foundry Technology” (Buttersworth) Heine and Rosenthal, “Principles of Metal Cutting” (TMH) “
Engineering Plastics, Parmar, Khanna Book Publishing Co., Delhi
Metal Casting” ASME Handbook P.C.Mukherji,
“Metal Casting Technology”

PLASTIC MATERIALS & MANUFACTURING
Unit –I

Structure of Plastics : Molecules –Crystallinity – Effect of Crystallinity on properties – cross linked plastics – Determination of Molecular weight – Effect of Molecular weight on processing and properties – Molecular weight distribution. Linear, branched and cross linked structures in polymers. Flexibility and movement of macromolecules. Glass transition temperature (Tg). Relationship

Unit-II

Plastic Materials Sources of raw materials, general purpose plastics, engineering plastics and thermosets plastics, thermo setting and elastomers general high performance plastics, properties of plastics materials, alloys and blending. Properties and applications of polyethylene, polypropylene ABC PVC, nylons, poly acetates, polycarbonates, phenol formaldehyde, melamine formaldehyde.

Unit-III

Plastics Manufacturing Processes Basic concepts of injection moulding, process variables, blow moulding, compression moulding Extrusion process and their process variables and rotational moulding.

Unit-IV

Basic concept of mould design Selection of proper mould design, single, multi cavity semiautomatic and automatic moulds cooling system, injection and feeding system. Design of product features i.e wall thickness rib bosses, radii and draft.

Unit-V

Plastic Material Testing Importance of testing, standard and specifications, national, international standards, test specimen preparation, preconditioning and test atmosphere. Introduction to Mechanical testing, thermal testing, Electrical & Optical testing.

Books and References:
1. Hand book of plastics material and technology
2. Back plastics product design
3. Engineering Plastics, Parmar, Khanna Book Publishing Co., Delhi
4. Mathur AB & Bhardwaj IS, Testing and evaluation of plastics
5. Strong A Brent, Plastics materials and processing.
ADVANCED MANUFACTURING SYSTEMS

UNIT-I

Fundamental of Manufacturing and Automation: Manufacturing operations and automation strategies; Hard and soft automation. Transfer systems, automated flow lines, feeders, assembly and line balancing.

Fundamental of Computer Aided Manufacturing:

Introduction to CAD/CAM. N.C. Machine Tools; P, L and C type; CNC, DNC, Adaptive control. Manual part programming through simple examples; computer assisted part programming.

UNIT-II

AUTOMATED STORAGE AND MATERIALS HANDLING SYSTEMS: Automated materials handling (including AGV), storage and retrieval systems; Robots and its applications in manufacturing.

PROCESS PLANNING: Introduction to process planning (PP), Computer aided process planning (CAPP); scheduling; sequencing of manufacturing operations.

UNIT-III

GROUP TECHNOLOGY (GT):

Introduction to coding and classification; Benefits of GT.

PRODUCTION ECONOMICS: Kinds of costs, evaluation of capital investments, capital budgeting, break-even-analysis, make-buy decisions, evaluation of alternatives, discounted cash flow, equivalent comparison methods, depreciation.

UNIT-IV

MATERIALS MANAGEMENT: Purchasing, distribution and inventory control, Inventory concepts; Material requirement planning; Just in time.

QUALITY MANAGEMENT: Economics of quality assurance; Quality control; Process control, Control charts and acceptance sampling, concept of total quality management

INTRODUCTION TO CONCURRENT ENGINEERING AND AGILE MANUFACTURING

UNIT-V

FMS and CIMS: Flexible manufacturing systems (FMS); FMS work stations; FMS planning and applications. Computer integrated manufacturing systems (CIMS); net work and data bases for manufacturing system. Simulation of manufacturing systems.

Spoken Tutorial (MOOCs):

Spoken Tutorial MOOC, 'Course on QCAD', IIT Bombay (http://spoken-tutorial.org/)
REFERENCE BOOKS:

1. Automation, Production Systems, & CIM by Grover; Prentice Hall
2. CAD CAM by C. McMahon and J. Browne; published by Addison-Wesley. 25
4. Agile Manufacturing by A. Gunsekaran; Elsevier.
6. CAD/CAM by Grover and Zimmersl Prentice Hall.
PLANT LAYOUT AND DESIGN

UNIT-I
Introduction: Meaning of plant layout, design-importance and scope. Planning for plant design.

Plant Location: Levels of location problems, factors influencing location of a plant, theories of plant location.

UNIT_II

UNIT-III

UNIT-IV
Materials Handling: Principles, Classification of Material handling systems, product flow, and material handling equipments. Characteristics of different types of handling - conveyor’s, cranes, trolleys and forklifts.

UNIT-V
Employee Facilities: Services, working conditions, influence of organisation and incentives.
Plant Services and Industrial Layout: Electrical, water, sewage, compressed air and gases, steam and heating, and communication facilities. Hazards and prevention - prevention against noise, air and water pollution. Environment management plan.

REFERENCE:
2. James Apple, “Plant Layout and Materials Handling”
4. Richard Muther “Plant Engineering Handbook” McG
LEAN MANUFACTURING

Unit I

Unit II

Unit III

Unit IV

Unit V
Text Books:

References:
### VI SEMESTER

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**Department Elective Course –2**

1. RMT061: Product design and development.
2. RMT062: Manufacturing Strategies
4. RMT063: Operation Research.
PNEUMATICS AND HYDRAULICS

UNIT I

UNIT II
(Fluid Power Elements) 8 Pressure control valves, flow control valves, directional control valves – working principle and construction, special type valves, servo valves, Cartridge valves Actuation methods, Shock absorbers – Accumulator – Symbol for fluid power elements.

UNIT III

UNIT IV
Pneumatic Systems Pneumatic fundamentals Filter, regulator, lubricator, air motors, air cylinders, pneumatic valves, Basic Pneumatic circuits – Hydro Pneumatic Systems – air- oil cylinder, air – oil reservoir, air – oil intensifier and simple circuits.

UNIT V

References:
1. A Fluid Power with applications Antony Esposito
2. B. Pneumatic Systems – Principles and Maintenance Mazumdar S. R
4. Oil Hydraulics Systems – Principles and Maintenance Mazumdar S. R
5. D. Industrial Hydraulics John Pipenger & Tyler Hicks
6. E. Fluid Power Chandashekhara P. K.
7. A.K. Babu, Automobile Mechanics, Khanna Publishing House
8. F. Automobile Engineering Vol. I Kripal Singh
SIMULATION MODELING AND ANALYSIS

Unit I
Introduction to Simulation: Simulation, advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study.

Unit II

Unit III
Introduction to Probability distributions: Weibull, Triangular, Erlang and Gamma distributions and their applications (No analytical treatment)
Random Variate Generation:
Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and lognormal Distributions
Convolution Method – Erlang distribution Acceptance and Rejection technique – Poisson and Gamma distributions

Unit IV
Input Modeling: List of steps involved in input modeling – no analytical treatment Selecting input models without data, Multivariate and time series input models – Covariance and correlation, multivariate input models, time series input models.
Verification and Validation of Simulation Model: Model Building, Verification and validation, Verification of simulation models, Calibration and Validation of Models, Naylor and Finger’s validation process.

Unit V
Output analysis for a single model: types of simulations, stochastic nature of output data, Output analysis of terminating simulations, Output analysis of steady state simulations
Optimization via simulation: What does “optimization via simulation” mean? Why is optimization so difficult? Basic GA and TS.

Text books:

Reference:
PRODUCTION PLANNING & CONTROL

Unit-I


Unit-II


Unit-III

Production and Inventory Control: Progress control through records and charts. Types of inventories, Inventory Classification. Inventory Control under constraints Economic lot (batch) size. Trends in purchasing and store keeping, JIT production MRP II, comparison of Push & Pull systems, ERP, CAPPC.

Unit-IV

Productivity: Importance, Productivity patterns, productivity measurements & ratios, improvement-maintenance process. 3 Human Factors & Ergonomics: Human abilities, Training & motivation safety programs, workplace design & working conditions.

Books:
1. Elements of Production Planning & Control –Eilon
2. Production Planning & Control – Jain and Agarwal
List of experiments

2. Study of symbols used in single and double acting hydraulic & pneumatic cylinders.
4. Study of constructional detail and performance characteristics of rotary pumps.
5. Determination of viscosity index of hydraulic fluids by using redwood viscometer.
6. Study and operation of solenoid valves and relay timers.
7. To operate a single acting cylinder using 3/2 push button valves on an electro pneumatic kit.
8. To operate a single acting cylinder using 3/2 push button valves on an electro pneumatic kit.
9. To operate a 5/2 pilot operated valve by using double acting cylinder on an electro pneumatic kit.
SIMULATION MODELING AND ANALYSIS LAB

1. Introduction to Simulation Packages and selection.
2. Understanding the Simulation Package
3. Identifying probability distributions for given data
4. Building simulation models for manufacturing operations (Electronic assembly – With Basic templates)
5. Building simulation models for manufacturing operations (Electronic assembly – With Common templates)
6. Building simulation models for manufacturing operations with transport System
7. Building simulation models for manufacturing operations with layout
8. Building simulation models for manufacturing operations with layout and transport System
9. Building simulation Models for Banking service (Bank teller problem)
10. Building simulation Models for Mortgage application problem
11. Building simulation Models for food processing problem
12. Building simulation Models for Post office animation
13. Statistical Analysis of Simulation models (input analysis)
14. Statistical Analysis of Simulation models (output analysis)
15. Simulation model for foundry exercise.

Text books:

Reference:
ENTERPRISE RESOURCE PLANNING LAB

Note: A minimum of 12 exercises are to be conducted

2. Generating Bill of Materials for Various Engineering Designs
3. Creating Item Master for various Engineering Designs
4. Conduction of vendor Evaluation exercise
5. Basic Statistical Analysis
6. Creating Purchase order for Items
7. Creating Work order for Items
8. Perform inventory transaction
9. Creating quotation process for Items
10. Creating Dispatch Instruction for Items
11. Creating Payment reconciliation.
12. MRP II Generating of Various reports for confirmed orders
13. Basic statistical analysis
14. Analyse of existing capacity and defining routes optimizing the resources along routes.
15. Optimization problems using OR packages (two exercises only).
16. Scheduling of activities

Suggested Software Packages

1. Statistical Packages : SYSTAT / MINITAB / SPSS and such others
2. ERP Packages: SIXTH SENSE / RAMCO / MAARSMAN / CIMAS / UNISOFT / OPTIMIZER 10.6 and such others.
3. Preactor – Scheduling Software OR Packages : Lindo / Lingo / STORM / such others

REFRIGERATION & AIR CONDITIONING Lab

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Study of different types of expansion devices used in refrigeration system.
3. Study of different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. Experiment on air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency, PV diagram and effect of intercooling.
14. Experiment on Desert coolers.
1. Product Design and Development.
2. Manufacturing Strategies
4. Tool Engineering.
5. Operation Research.

PRODUCT DESIGN AND DEVELOPMENT

Unit-I

Introduction to Product Design:
Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.

UNIT II

Morphology of Design:

UNIT III

Transformations

UNIT IV

Reliability

UNIT V

Product Appraisal
Information and literature search, patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting.

Recommended Books:
2. Product design and Development-Karl Ulrich-PHI
3. 2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
4. 3. The Art of Thought – Grohem Walls – Bruce & Co., New York
MANUFACTURING STRATEGIES

UNIT I

UNIT II
Benchmarking:

UNIT III
Concepts and Modeling:
Generation of concepts, information gathering and brain storming, directed search, morphological analysis, combining solutions. Decision making, estimation of technical feasibility, concept selection process, selection charts, measurement theory, numerical concept scoring, design evaluation scheme, concept embodiment, geometry and layout, system modeling, modeling of product metrics, selection of model by performance specifications, physical prototyping, informal and formal models.

UNIT IV
Design materials & human factors in product design
Material properties, metals, plastics, rubber, woods & factors considered while designing for metals, plastics, rubber, woods etc, Anthropometry factors, physiological factors, psychology factors, anatomy factors.
Economic factors influencing design, product value, safety, reliability & environmental considerations, economic analysis, break even analysis, profit & competitiveness, economic of a new product design.

UNIT V
Value engineering in product design
Introduction, historical perspective, nature & measurement of value, importance of value, value analysis job plan, creativity, steps for solving & value analysis, value analysis tests Principal stress trajectories( force flow lines), balanced design, criteria & objective of design, material toughness, resilience, designing for uniform strength.

UNIT VI
Modern Approaches to Product Design
TEXT BOOKS:


REFERENCE BOOKS:

MACHINE VISION & IMAGE PROCESSING

UNIT-I

Introduction Digital image representation; fundamental steps in image processing; elements of digital image processing systems: image acquisition, storage, processing and display. 2. Digital Image Fundamentals : Structure of the human eye; image formation; brightness adaptation and discrimination; a simple image model; uniform and non-uniform sampling and quantization; some basic relationships between pixels; neighbors of a pixel; connectivity; Labeling. Distance measures; imaging geometry.

UNIT-II

Image Enhancement in the spatial domain 4L Basic gray level transformations-histogram processing-Enhancement using arithmetic/logic operations-Basics of spatial filtering-comparison between smoothing and sharpening spatial filters.

UNIT-III

Image Enhancement in the frequency domain 4L 1D Fourier transform-2D Fourier transform and its Inverse-Smoothing & sharpening frequency domain filters (Ideal, Butterworth, Gaussian)-homomorphic filtering.

Image compression 4L Fundamentals-Image compression, Error-free compression: Huffman coding, block coding, constant area coding, variable length coding; bit-plane coding; lossless predictive coding.

UNIT-IV

Machine Vision 12L Introduction, definition, human visual system. Active vision system, increasing of machine vision. Machine vision components, hardware’s and algorithms, image function and characteristics, image formation & image sensing frequency space analysis, Fourier transform, convolution algorithms, image gaussian, image enhancement, image analysis and segmentation data reduction, feature extraction, edge detection, image recognition and decisions, m/c learning, image processing, machine vision edges detection, application in the area such as inspection part identification, industrial robot control, mobile robot application. Industrial MVs in production and services, structure of industrial m/c vision, generic standards, rules of thumb, image formation, illumination, optics, interfacing machine vision system. Vision system calibration.

UNIT-V

2D & 3D vision 6L 16 Competing technologies, principle, CCD, Videcon and other cameras, data capture. Triangulation geometry, resolution, passive and active 3-D stereo imaging, data processing

References:

2. Introduction to AI and Expert Systems by D.W.Patterson, Prentice Hall.
TOOL ENGINEERING

Unit I

General Considerations:

Tool classification, Tool materials, properties & applications, Tooling economics General design considerations, Safety aspects.

Unit II

Design of Metal Cutting Tools:


Multipoint cutting tool: Design of drills, reamers, milling cutters, broach & gear cutting tools.

Unit III

Design Of Metal Working Tools:

Design of press working tools, shearing, piercing, blanking, dies, compound die design, progressive dies, bending, forming drawing dies. Tooling for Forging-Design principles for forging dies, Drop forging, upset forging. Design principles and practice for rolling, Roll pass Design.

Unit IV


Unit V

Design Of Gauges And Inspection Features: Design of gauges for tolerance for dimensions and form inspection.

Dies And Mould Design For Plastics & Rubber Parts: Compression moulding, transfer moulding, blow moulding.

Suggested Books:

1. Fundamentals of Tool Design Wilson ASTME
2. Tooling for production parron
3. Tool Design Donaldson T.M.H.
5. Die Design Hand Book by ASTME/ McGraw Hill
6. Metal cutting & Cutting Tool Design Archinov MIR Publishers Moscow
7. Introduction to Jig and Tool Design M. H. A. Kempster FLBS
OPERATIONS RESEARCH

Unit-I
Introduction: Definition and scope of OR, Techniques and tools, model formulation, general methods for solution, Classification of Optimization problems, Optimization techniques

Unit-II
Transportation & Assignment problems. Transportation and Assignment models, Traveling salesman problems.

Unit-III
Decision theory: Decision under various conditions.
Game Theory: Minimax criterion and optimal strategy Two Person Zero sum game, Solution with / without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Linear Programming
Sequencing: Basic assumption, n Jobs through two / three machines, 2 Jobs on m machines.

Unit-IV
Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy
Simulations: Use, advantages & limitations, Monte-carlo simulation, Application to queuing, inventory & other problems.

Unit-V
Queuing models: Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration
Project Management: Basic concept, Rules for drawing the network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

Text Books
Operations Research by : Wagner
Operations Research by : Taha
Introduction to Management Science by: Hiller & Hiller
Operations Research by : Wayne L. Winston