



*Text Book:*

1. *Handy A.Taha, " Operation, Research-An Introduction ", Prentice Hall of India, 1997.*

*References:*

1. *P.K.Guptha and Man-Mohan, " Problems in operations Research-Sultan chand & Sons ", 1994.*
2. *MONKS J.G - " Operations Management theroy and Practice ", McGraw Hill, 1992.*
3. *Ravindran, Philips and Solberg, " Operations Research Principles and Practice ", John Wiley & Sons, Singapore, 1992.*
4. *J.K.Sharma, " Operations Research - Theory and Applications ", Macmillan India Ltd, 1997.*

**1. PRODUCT DEVELOPMENT CONCEPTS 10**

Fundamentals of Mechanical Design-Selection of materials-Factor of Safety-Codes and Standards-economics of Design-Reliability-Safety and product liability-Product Development-Stages-Sequential and concurrent engineering.

**2. STATIC AND VARIABLE STRESS ANALYSIS 10**

Static Strength-Failure theories-Stress Concentration-Fatigue Strength-S/N Diagram-Low cycle-High cycle fatigue--Endurance limit-Modifying Factors-Fluctuating Stresses-Stresses due to combined loading.

**3. DESIGN OF MECHANICAL ELEMENTS 8**

Shafts-Design for static loads-Bending, torsion and axial loads-Reversed bending and steady torsion-Soderberg and Goodman Approach-Design of couplings-Muff flange, bushed pin types-Design of closely coiled helical springs.

**4. DESIGN OF TRANSMISSION ELEMENTS 10**

Design of gears-Spur, helical, bevel and worm gears-Belt drives-Flat belts and V belts-Selection and Specification-Design of Journal Bearings-Selection and specification of Rolling Contact Bearings.

**5. RECENT ADVANCES 7**

Synthesis design of Multistage speed reducers-Design of a typical special purpose machine-Design of Geneva mechanism-Ratchet and pawl mechanism-Software Implementation in Design-CAD-Product Modelling Concepts.

**Total No of periods: 45**

*Text book:*

*1. Joseph Edward Shigley, " Mechanical Engineering Design ", 5/e, McGraw Hill, 1989.*

*References:*

- 1. Spotts, " Design of Machine Elements ", 7/e, 1997, Prentice Hall.*
- 2. Robert L.Norton, " Machine Design An Integrated Approach ", 1997, Prentice Hall.*
- 3. Wilson, " Computer Integrated Machine Design ", 1996, Prentice Hall.*
- 4. Joesph E. Shigley, " Standard Handbook of Machine Design ", McGraw Hill 1996.*

**1. GENERAL CONCEPTS OF MEASUREMENT 5**

Definition-Standards of measurement-Errors in measurement-Accuracy, precision etc-calibration of instruments, selection and care of instruments.

**2. LINEAR AND ANGULAR MEASUREMENTS 10**

Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges-comparators, various types-principle and applications-limits, fits and tolerance-design of gauges-interferometry applications-angular measuring instruments-bevel protector, levels, clinometers-sine bar , angle dekkor-alignment telescope, autocollimator.

**3. MEASUREMENT OF FORM ERRORS, SURFACE ROUGHNESS AND MEASURING MACHINES 10**

Straightness, flatness, alignment errors-surface texture-various measuring instruments-runout and concentricity-tool makers microscope-metroscope.

**4. MEASUREMENT OF SCREW THREADS AND GEARS 10**

Various elements of threads-2 wire and 3 wire methods-gears elements -various errors and measurements.

**5. COMPUTER AIDED AND LASER METROLOGY 10**

Coordinate measuring machine-LASER micrometer-LASER interferometer-Noncontact and in-process inspection , vision system.

**Total No of periods: 45**

*Text book:*

*1. I.C.GUPTA, " A Text Book of Engineering metrology ", Dhanpat Rai and Sons, 1996.*

*References:*

- 1. R.K.JAIN and S.C.GUPTA, " Engineering metrology ", Dhanpat Rai and Sons, 1996.*
- 2. G.N.GALYER F.W and C.R.SHOTBOLT, " Metrology for Engineers ", ELBS Edn 1990.*
- 3. " ASTE Handbook of Industries Metrology ", Prentice Hall of India Led., 1992.*
- 4. CIRP Annals*
- 5. Manuals of CMM and LASER Interfermeter.*

**1. THEORY OF METAL FORMING 10**

Metallurgical aspects of metal forming-slip-twinning-mechanics of plastic deformation-effects of temperature, strain rate-microstructure and friction in metal forming-yield criteria and their significance-classification of metal forming processes.

**2. FORGING AND ROLLING PROCESSES 14**

Principle-classification-equipment, tooling-processes, parameters and calculation of forces during forging and rolling processes-Ring compression tests-Post forming heat treatment-Defects(cause and remedy)-applications.

**3. EXTRUSION AND DRAWING PROCESSES 14**

Classification of extrusion processes-tool,equipment and principle of these processes-influence of friction-Extrusion force calculation-Defects and analysis-Rod/wire drawing-tool, equipment and principle of processes-defects-Tube drawing and sinking processes-Mannessmann processes of seamless pipe manufacturing.

**4. SHEET METALFORMING PROCESSES 14**

Classification-conventional and HERF processes-Presses-types and selection of presses-formability of sheet metals-Principle, process parameters, equipment and application of the following processes; Deep drawing, spinning, stretch forming, plate bending, pressbrake forming-Explosive forming, electro hydraulic forming, magnetic pulse forming.

**5. RECENT ADVANCES 8**

Superplastic forming-electro forming-fine blanking, P/M forging-Isothermal forging-high speed, hot forging-high velocity extrusion.

**Total No of periods: 60**

*Text book:*

1. Narayanasamy. R, " *Metalworking Technology* ", Prentice Hall (1997).

*References:*

1. Dieter, " *Mechanical metallurgy* ", Revised Edition 1992.
2. Nagpal. G.R., " *Metal forming processes* ", Khanna Publishers, Delhi, 1998.
3. George E. " *Dieter-Engineering Design (A materials and processing Approach)* ", McGraw Hill-Edition II-Univ. of Maryland - 1991.
4. SEROPE KALPAKJIAN, " *Manufacturing engineering and Technology* ", Edition III - addision - Wesley Publishing Co., 1995.
5. William F. Hosford & Robert M. Caddel, " *Metal forming* ", (Mechanics & Metallurgy), Prentice Hall Publishing Co., 1990.
6. Sinha and Prasad, " *Theory of metal forming and metal cutting* ", Dhanpat Rai Pub (p) Ltd. 1999.
7. Rao P.N, " *Manufacturing Technology* ", TMH Ltd., 1998. (Revised Edition).

**1. PATTERNS AND PATTERN MAKING 8**

Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern, materials colour coding and storing of patterns

**2. MOULDING 10**

Moulding methods and processes-materials, equipment, moulding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making.

Design considerations in casting, gating and Riserling - directional solidification in castings.

**3. CASTING PROCESSES 15**

Sand castings-pressure die casting-permanent mould casting-centrifugal casting-precision investment, casting-shell moulding-Co2 moulding, continuous casting-squeeze casting-electroslag casting Feting and finishing-defects in Castings.

**4. MELTING, POURING AND TESTING 7**

Foundry remelting furnaces-selection of furnace-crucibles oil fired furnaces-electric furnaces-cupola, calculation of cupola charges-Hot blast, cupola-Degassification-inoculation-pouring equipment-Inspection of castings.

**5. MODERNISATION AND MECHANISATION IN FOUNDRYSHOP 5**

Need-Areas for mechanisation-Typical layout-sand reclamation techniques-material handling, pollution control in Foundry, Computers in casting process.

**Total No of periods: 45**

*Text book:*

*1. Banga T.R., and Agarwal R.L., " Foundry Engineering ", Khanna Publishers, 1992.*

*References:*

- 1. Taylor H.F Flemings M.C & Wulff J. " Foudry Engineering ", Wiley Eastern Limited, 1993.*
- 2. Gupta R.B., " Foundry Engineering ", Satyaprakashan, 1989.*
- 3. Lal, Mand Khanna O.P A " Text Book of Foundry Technology ", Dhanpat Rai and Sons, 1986.*
- 4. Lindberg R.a " Processes and Materials of Manufacture ", Prentice Hall of India (p) Ltd.*
- 5. Jain P.L " Principles of Foundry Technology ", Tata McGraw Hill Publishing company Ltd., 1995.*
- 6. " ASM Metals Hand Book on casting ", 1992.*

<b>1. BASIC JOINING PROCESSES</b>	<b>9</b>
Types of welding-gas welding-arc welding-shielded metal arc welding, GTAW,GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermit welding-soldering, brazing and braze welding.	
<b>2. DESIGN OF WELDMENTS</b>	<b>9</b>
Welding symbols-Positions of welding-joint and groove design-weld stress-calculations-design of weld size-estimation of weld dilution, heat input, preheat, and post heat temperature-computer applications in weld design.	
<b>3. SPECIAL WELDING PROCESSES</b>	<b>9</b>
Electron beam and Laser beam welding-plasma arc welding-stud welding-friction welding-explosive welding-ultrasonic welding-underwater welding-roll bonding-diffusion bonding-cold welding-welding of plastics, dissimilar metal.	
<b>4. WELDING EQUIPMENTS AND AUTOMATION</b>	<b>9</b>
Gas welding equipments-welding power sources and characteristics-safety aspects in welding-automation of welding,seam tracking, vision and arc sensing-welding robots.	
<b>5. WELDMENT TESTING AND METALLURGY</b>	<b>9</b>
Defects in welding-causes and remedies-destructive testing methods - NDT of weldments - testing of pipe, plate, boiler, drum, tank-case studies-weld thermal cycle-residual stresses-distortion-relieving of stresses-weldability of cast iron, steel, stainless steel, aluminium alloys-effect of gases in welding-fatigue failure in weldments.	
<b>Total No of periods:</b>	<b>45</b>

*References:*

1. *Parmer R.S. " Welding processes & technology ", Khanna Publishers, 1994.*
2. *Little, " Welding technology ", Tata McGraw Hill, 1992.*
3. *Lancaster J.F., " Metallurgy of welding ", George allen and Unwin, 1991.*
4. *Metals Hand Book, Vol 6, 8th edition, ASM, 1971.*
5. *AWS welding handbook, vol 1 to 4 AWS.*

1. A brief revision of the following concepts, in not less than 3 hours of lectures is recommended as a curtain raiser to the courses: Interchangeability-Basic size-tolerance-allowance-fit-surface texture parameters - Tolerance build - up - Geometric tolerance.
2. Detailed part drawings and assembly drawings (with suitable tolerancing, machining symbols, standard specification of fit).
  1. Lathe Tailstock
  2. Machine Vice
  3. Four Jaw Chuck of Lathe.
  4. Square Turret tool holder for Lathe.
  5. Swivel bearing
  6. Hydraulic/pneumatic power cylinder assembly
  7. Mechanical fly press
  8. Petrol engine connecting rod assembly
  9. Injection moulding Die assembly for plastic products.
  10. Blue print reading (at least 5 industrial drawings)
3. Computer Aided Drawing of simple members consisting of at least three components-practice of component and assembly drawings.

**Total No of periods: 60**

*Text book:*

1. Narayana K.L., Kannaiah P., and Venkata Reddy. K., " Production Drawing ", New Age International Ltd, Delhi 1996.

*References:*

1. Nagpal G.R. " Machine Drawing ", Khanna Publishers, New Delhi, 1994.
2. Bhat N.D., " Machine Drawing ", Chartotar Publishing House, Anand, 2000.

- 1. Estimation of accuracy of instruments -vernier and micrometer.
- 2. Calibration of dial gauge, micrometer and vernier.
- 3. Measurement of angels using sine bar, bevel protractors, spirit level.
- 4. Measurement of gear tooth thickness by various methods including profile projector.
- 5. Measurement of effective diameter, pitch and helix angle of screw threads.
- 6. Surface roughness measurement .
- 7. Measurement of runout and concentricity.
- 8. Measurement of internal and external angles, bores, concavity, convexity using standard balls, rollers,height gauge and depth micrometer.
- 9. Measurement using vision system.
- 10. Study of co-ordinate measuring machine.
- 11. study of digital measuring instruments.
- 12. Measurement of Straightness and Flatness.

**Total No of periods: 45**

**1. FINANCE FUNCTION AND FINANCIAL ACCOUNTING 9**

The finance function - Indian financial system-financial planning-cost of capital-operating and financial leverages-financial statements-Income statement-Balance sheet.

**2. CAPITAL BUDGETING AND WORKING CAPITAL MANAGEMENT 11**

Different techniques of capital budgeting and investment analysis-concept of present value-sources of long term finance-cash management-Receivables management-sources of short term finance.

**3. INVENTORY MANAGEMENT 10**

Purpose of inventories-costs related to inventories-basic EOQ model-variations in EOQ model-Finite Production-Stock out-Quantity discounts-Lot size under constraints-MRP inventory accounting.

**4. COST ESTIMATION AND COST ACCOUNTING 12**

Importance and aims of cost estimation and costing-determination of materials cost, labour cost, cost of a product-overhead expenses-Depreciation-methods-profit planning-analysis-cost-volume relationship-breakeven analysis.

**5. RECENT ADVANCES 3**

Just In Time(JIT) system-MRP II-credit rating-leasing-Hire Purchasing-venture capital-SEBI

**Total No of periods: 45**

*Text Book:*

1. *Prasanna Chandra, " Financial Management - Theory and Practice ", Tata McGraw Hill, 1998.*

*References:*

1. *James C.Vanhorne, John M Wachowilz, " Fundamentals of Financial Management ", Prentice Hall of India, 1996.*
2. *T.R. Banga and S.C Sharma, " Mechanical Estimating and costing ", Khanna Publishers, 1993.*
3. *Monks J.G. - " Operations Management theory and practice ", McGraw Hill, 1992.*
4. *I.M.Pandey, " Financial Management ", Vikas Publishing House, 1995.*

**1. TOOL NOMENCLATURE 10**

Single point tool-significance of the various angles provided and nose radius-American, German CIRP and orthogonal system of tool nomenclature, conversion of rake angles from American to German and vice versa-Nomenclature of drills, milling cutters and broaches-Need for chip breakers.

**2. MECHANICS OF METAL CUTTING 10**

Mechanisms of formation of chips-types of chips and the conditions conducive for the formation of each type-built-up edge, its effects orthogonal Vs oblique cutting-Merchant's circle diagram-Force and Velocity relationship, shear plane angle, Energy considerations in matching-Ernst Merchant's theory of shear angle relationship-original assumption and modifications made.

**3. FORCES IN MACHINING 8**

Forces in turning, drilling, milling and grinding, conventional Vs climb milling-mean and maximum cross sectional areas of chip in milling-specific cutting pressure-specific horse power-requirements of tool dynamometers-construction and principle of operation of tool dynamometers for turning, drilling and milling.

**4. THERMAL ASPECTS IN MACHINING 8**

Sources of heat generation in machining-temperature measurement techniques in machining, Functions of cutting fluid-characteristics of cutting fluid-types free machining steel-o.p additives-application of cutting fluids.

**5. TOOL MATERIALS, TOOL WEAR AND TOOL LIFE 9**

Requirements of tool materials-advances in tool materials-HSS, PM, HSS, coated HSS, carbides and coated carbides, ceramic, cold pressed, hotpressed, ceramic composites, CBN, Diamond properties, advantages and limitations-ISO-specifications for inserts and tool holders Tool wear, type mechanisms, tool life, machinability, economics of machining, chatter in machining.

**Total No of periods: 45**

*Text book:*

1. *Juneja B.L and Sekhon G.S., " Fundamentals of Metal cutting and Machine Tools ", New Age International (P) Ltd., 1995.*

*References:*

1. *Shaw M.C., " Metal cutting principles ", Oxford, Clarendon Press, 1984.*
2. *Bhattacharya A. " Metal Cutting Theory and Practice ", New Central Book Agency (p) Ltd., Calcutta, 1984.*
3. *Venkatesh V.C and Chandrasekaran. H " Experimental Techniques in Metal Cutting ", Prentice Hall of India, 1982.*
4. *Xing Sheng Li & Low.I.M., Editors, " Advanced ceramic tools for machining Applications ", I TRANSTECH PUBLICATIONS, 1994.*
5. *Kuppuswamy. G. " Principles of Metal Cutting ", Universites Press, 1996.*

**1. LOCATION AND CLAMPING DEVICES IN JIGS & FIXTURES 10**

Principles of Jigs and fixtures-Design concepts-method-different types of locating devices-clamps-drill bushes and bush retainers-Elements of fixtures.

**2. DESIGN OF ELEMENTS OF JIGS AND FIXTURES 12**

Design concepts of turn over, Builtup, box, latch, Indexing and solid-types of jigs, Fixtures for different operations like milling, grinding, turning, Welding-modular fixtures.

**3. PRESS WORKING OPERATION AND FORMING DIES 11**

Blanking, Piercing, Bending, forming-drawing-lancing, notching-Design features of extrusion, wire drawing and forging dies.

**4. ELEMENTS OF DIE 12**

Design concepts of the following elements of progressive and combination dies: Die block -die shoe, Bolster plate-punch-punch plate-punch holder-guide pins and bushes-strippers-knockouts-stops-pilots-Selection of standard die sets -strip layout and development.

**5. DESIGN AND DRAWING OF DIES, JIGS AND FIXTURES 30**

Progressive die, Compound die-Bending and drawing dies, Drill jigs-milling fixtures, welding fixtures.

**Total No of periods: 75**

*Text Book:*

1. *Donaldson, G.H. Lecain, Goold V.V., " Tool design ", TMH Edition, 1976.*

*References:*

1. *" Handbook of Metal forming ", Kurt Lunge McGraw Hill, Pub Co., 1985.*
2. *Paquin, " Die design fundamentals ", Industrial Press Inc, New York, 1979.*
3. *ASTME, " Fundamentals of tool Design ", Prentice-Hall, 1974*
4. *Kemster M.H.A, " Introduction to Jigs and tool design ", ELBS EDN, 1976.*

**LIST OF EXPERIMENTS IN METAL CUTTING**

1. Study of influence of cutting parameters on surface roughness in turning
2. Tool life study on a single point turning tool.
3. Measurement of cutting forces in turning using lathe tool dynamometer.
4. Measurement of shear plane angle using chip-thickness ratio criteria.
5. a) Acceptance test on RAM type milling machine as per ISI test chart & Measurement single point tool angles.

**LIST OF EXPERIMENTS IN METAL FORMING**

1. Forming Limit diagrams for sheet metals using Ericcson cupping tester.
2. Ring compression test to estimate coefficient of friction for different lubricants, using Hydraulic Press.
3. Macro and Micro forming on sheet metals in waterhammer forming.
4. Flow curves for engineering materials at constant cross head speed, in UTM.
5. Experimental determination of strain rate sensitivity index of superplastic metals, using UTM.

**Total No of periods: 60**

- 1. Two dimensional geometry creation and modification using standard drafting package.
- 2. Detailing and documentation of a typical production drawing.
- 3. Attributes and Data extraction from a drawing
- 4. Creation of Simple Solid Models using CSG and B-Rep Approach.
- 5. Surface Modelling types.
- 6. Interfacing a programming language with a typical drafting package.
- 7. Interfacing database package with typical drafting package.
- 8. Object Modeling and Mesh generation using simple elements.
- 9. Analysis of typical machine elements.
- 10. Kinematic Analysis of simple mechanisms.
- 11. Software project consisting of development of algorithms and programs in the field of manufacturing applications.

**Total No of periods: 60**

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**1. 45**

The students in batches have to do detailed design and prepare production drawing in any two of the following areas :

1. Jigs and Fixture Design
2. Die Design
3. Automation using hydraulic, pneumatic, electrical, electronic and mechanical devices.

**2.**

The students may make use of computer for their design project.

**3.**

The evaluation of these projects should be done by a committee of faculty members nominated by the Head of the Department.

**4.**

There should be a minimum of three reviews and percentage of marks for each review may be decided by the committee.

**Total No of periods: 45**





*Text Books:*

1. *G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997*
2. *J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersey, 1996.*

*References:*

1. *S. K. Dhameja, Environmental Engineering and Management, S. K. Kataria and Sons, New Delhi, 1999.*
2. *State of India's Environment - A Citizen's Report, Centre for Science and Environment and Others, 1999*
3. *Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.*

**1. ENGINEERING ETHICS 9**

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - professions and professionalism - professional ideals and virtues - theories about right action - self-interest-customs and religion - uses of ethical theories

**2. ENGINEERING AS SOCIAL EXPERIMENTATION 9**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics-a balanced outlook on law-the challenger case study

**3. ENGINEER'S RESPONSIBILITY FOR SAFETY 9**

Safety and risk - assessment of safety and risk - risk benefit analysis-reducing risk-the three mile island and Chernobyl case studies.

**4. RESPONSIBILITIES AND RIGHTS 9**

Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - intellectual property rights (IPR)-discrimination.

**5. GLOBAL ISSUES 9**

Multinational corporations - environmental ethics-computer ethics-weapons development-engineers as managers-consulting engineers-engineers as expert witnesses and advisors-moral leadership-sample code of conduct.

**Total No of periods: 45**

*Text Book:*

1. *Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York 1996.*

*References :*

1. *Charles D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.*

2. *Laura Schlesinger, "How Could You Do That: The Abdication of Character, Courage, and Conscience", Harper Collins, New York, 1996.*

3. *Stephen Carter, "Integrity", Basic Books, New York, 1996.*

4. *Tom Rusk, "The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life", Viking, New York, 1993*

**1. WORK STUDY AND ERGONOMICS 10**

Method study-definition-objectives-motion economy principles-tools and techniques-applications work measurement-purpose-use-procedure-tools and techniques-standard time-Ergonomics-Principles-applications.

**2. PROCESS PLANNING AND AGGREGATE PLANNING 11**

Aims of process planning-information needed-steps to prepare the detailed work sheets for manufacturing a given component-process selection-Breakeven analysis-Aggregate planning-strategies-costs-Methods-Make or buydecisions-scheduling-priority rules for sheduling.

**3. COST ESTIMATION OF MANUFACTURED JOBS 10**

Cost estimation to find out labour and total costs for simple machining works such as turning, drilling, shaping planning, milling, grinding, cast, welded and forged components.

**4. PLANT LAYOUT, MATERIAL HANDLING AND VALUE ENGINEERING 11**

Plant layout-definition-objectives-principles-factors influencing layout-types of layout-selection of layout-tools and techniques -materials handling-principles -types and selection of materials handlingequipments-plant location-Value analysis and engineering-types of value-techniques.

**5. RECENT ADVANCES 3**

Manufacturing Systems Design(MSD)-Business Process Reengineering (BPR)-World Class Manufacturing(WCM)-Manufacturing Information Systems-Systems analysis and Design Principles.

**Total No of periods: 45**

*Text book:*

*1. K.K AHUJA - " Production and Operations Management ", Prentice Hall of India, 1995.*

*References:*

- 1. S.N.Chary, " Production and Operations Management ", Tata McGraw Hill, 1994.*
- 2. Adam & Ebert - " Production and Operations Management ", Prentice Hall of India, 1995.*
- 3. Banga T.R., and Sharma S.C. " Mechanical Estimation and costing ", Khanna Publishers, 1993.*
- 4. Laurence Miles - " Techniques of valueanalysis and Engineering ", Tata McGraw Hill, 1990.*

**1. STATISTICS & QUALITY 8**

Sampling Theory and testing of Hypothesis-Population and Sample -influence of sample size-Random sampling -confidence intervals-Choice of sample size for estimation. Testing of hypothesis for large and small samples- testing of hypothesis for mean, difference between means-F distribution-C-distribution-Goodness of fit-design of experiments.

**2. STATISTICAL PROCESS CONTROL 10**

Variation in processes-Factors-Process capability-Analysis of process capability-control-charts-variables- Attributes-Establishing and interpreting control charts-X,R, ,chart for variables-defects-P chart and U chart- Control charts for Defectives and quality rating.

**3. ACCEPTANCE SAMPLING 10**

Lot-by-lot sampling-types-probability of acceptance in single, double, multiple sampling techniques-O.C.curves- producer's Risk and consumer's Risk AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD-uses of standard sampling plans.

**4. LIFE TESTING-RELIABILITY-SYSTEM APPROACH 10**

Life testing-objective-classification-failure characteristics-failure data analysis-mean time to failure- maintainability and availability-reliability-system reliability-series and parallel systems-system reliability in terms of probability of failure-MTBF-Acceptance sampling based on reliability test-OC curves.

**5. QUALITY AND RELIABILITY 7**

Reliability improvement-techniques-use of pareto analysis-Design for reliability-Redundancy-standby redundancy-failsafe systems-optimization in reliability-product Design-product Analysis-Product Development- product life

**6. TUTORIALS 15**

**Total No of periods: 60**

*Text Books:*

1. *Besterfield D.H., " Quality Control ", Prentice Hall (1993) (Revised Edn).*
2. *Sharma S.C., " Inspection Quality Control and Reliability ", Khanna Publishers, New Delhi (1998).*

*References:*

1. *John Bank, " The Essence of Total Quality Management ", Prentice Hall of India (p) Ltd., New Delhi (1995).*
2. *Danny Samson, " Manufacturing & Operations strategy ", Prentice Hall, New York (1991).*
3. *Ganapathy.K, Subramaniam. B., Narayana. " V-Quality Circle concepts and implementation - QCFI ", Secundrabad 919940.*
4. *Tapan P. Bagchi ISO9000, " concepts, methods and implementataion ", Wheeler Publisher, Allahabad (1994).*
5. *Connor, P.D.T.O., " Practical Reliability Engineering ", John Wiley (1993).*
6. *Green A.E., and Bourne A.J. " Reliability, Technology ", Wiley Interscience, 1991.*
7. *Kollavic " Creating Quality ", McGraw Hill, New York, 1995.*

**1. FUNDAMENTALS OF MANUFACTURING, AUTOMATION AND CIM 7**

Modelling-automated modelling systems-Production economics - Nature role and development of CIM-Architecture-computers in CIM-simulation software.

**2. CONTROL SYSTEMS 8**

Process model formulation-control actions-optimal control structure model of a manufacturing process-steady state optimal control-adoptive control-sequence control and programmable controllers-computer process control-The computer process interface-interface hardware-direct digital control.

**3. MANUFACTURING SYSTEMS 10**

Group technology-part families-parts classification and coding-Production Flow analysis-cellular manufacturing-cell design-benefits MRP I and II -computer aided quality control.

**4. PROCESS PLANNING 10**

Process planning and concurrent engineering-logical design of a process plans election of machining processes, tools-workpiece holders etc-sequencing of operations-geometric interpretation of technical drawings-dimensioning and tolerancing-selection of detailed method of production-computer aided process planning (CAPP) - files management, variant approach, generative approach / development and trends.

**5. FLEXIBLE MANUFACTURING SYSTEMS 10**

Architecture-workstations-material handling and storage systems-computer controlled machines-automated work flow-automated assembly systems-dead locks in automated manufacturing systems -PETRINET models-applications-development of software for FMS integration.

**Total No of periods: 45**

*Text Book:*

1. *Micell P. Groover, " Automation, Production System and computer intergrated manufacturing ", Prentice - Hall of India Pvt Ltd., 1995.*

*References:*

1. *N.Viswanadham and Y. Narahari, " Performance Modelling of automated Manufacturing Systems ", Prentice-Hall of India Pvt Ltd., 1994.*
2. *P.Radhakrishnan and S.Subramanian, " CAD/CAM/CIM ", Wiley Eastern Limited, 1994.*
3. *GIDEON HALEVI and ROLAND D.WEILL, " Principles of process planning ", Chapman Hall, 1995.*
4. *P.GU and D.H NORRIE, " Intelligent Manufacturing Planning ", Chapman and Hall, 1995.*
5. *ANDREW KUSIK, " Intelligent Manufacturing Systems ", Prentice Hall of India Ltd., 1990.*

**LIST OF EXPERIMENTS**

1. A study of different control systems and I.S and FANUC codes.
2. CNC Miller-programming exercise involving linear polation, circular interpolation and repeat cycle.
3. CNC Miller-programming excersise involving mirror image, tool setting, job setting and editing of tools.
4. CNC Miller-programming exercise involving canned cycles.
5. CNC lathe-programming exercise for a simple component involving linear and circular-interpolation.
6. CNC lathe programming making use of subroutine and Do LOOP.
7. CNC lathe programming on hmt lathe in sinumeric system.
- 8.CNC programming on a retrofitted lathe.
- 9.CAM software in CNC tutor, Master CAM.
- 10.Generative machining in IDEAS.

**Total No of periods: 45**

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**1. 45**

Comprehension test will be conducted with two written tests during the semester and one viva-voce examination at the end of the semester in all the subjects during their courses of study. The written test will consist of questions of multiple choice, objective type, fill in the blanks, true or false and short answer type questions.

**2.**

Students of 2 or 3 in a group will be given a Specific topic in manufacturing engineering to write and present a seminar;

**3.**

Students of 2 or 3 in a group will be given a general topic like total quality management, getting ISO 9000 certification, feasibility study on starting some specific project etc and a term paper has to be submitted in a prescribed format.

**Total No of periods: 45**

**1.**

1. The students have to undergo practical industrial training for six weeks ( during vacation at the end of VI semester) in recognised industrial establishments.

**2.**

At the end of the training they have to submit a report with following information :

1. Profile of the Industry
2. Product range
3. Organisation structure
4. Plant layout
5. Processes/Machines/Equipment/devices
6. Personnel welfare schemes
7. Details of the training undergo
8. Projects undertaken during the training, if any
9. Learning points.

**3.**

End Semester examination will be a Viva-Voce Examination.

**Total No of periods:**



**1. INTRODUCTION 9**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

**2. TQM PRINCIPLES 9**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

**3. STATISTICAL PROCESS CONTROL (SPC) 9**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

**4. TQM TOOLS 9**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

**5. QUALITY SYSTEMS 9**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

**TEXT BOOK:**

1. Dale H.Besterfield, et al., Total Quality Management, Pearson Education Asia, 1999. (Indian reprint 2002).

**REFERENCES:**

1. James R.Evans & William M.Lindsay, The Management and Control of Quality, (5<sup>th</sup> Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. “Total Quality Management, McGraw-Hill, 1991.
3. Oakland.J.S. “Total Quality Management Butterworth – Heinemann Ltd., Oxford. 1989.
4. Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International 1996.
5. Zeiri. “Total Quality Management for Engineers Wood Head Publishers, 1991.

**PR438 Project Work**

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**1. 180**

The students in batches(not exceeding three in batch) have to take up a project in the area of manufacturing engineering.

**2.**

Each batch is guided by a faculty member. The students have to select a suitable problem, design, prepare the drawings, produce components, assemble and commission the project.

**3.**

The students have to prepare and present a detailed project report at the end of the VIII Semester.

**Total No of periods: 180**