

KALASALINGAM UNIVERSITY

Anand Nagar, Krishnankoil - 626 190
Srivilliputhur Taluk, Virudhunagar District, Tamil Nadu, India



CURRICULUM AND SYLLABUS 2007-2008

M. TECH
(CAD / CAM)

Courses Offered by

**CENTRE FOR AUTOMOTIVE SYSTEMS AND INDUSTRIAL ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING
KALASALINGAM UNIVERSITY**

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**RWTH, AACHEN UNIVERSITY OF TECHNOLOGY
GERMANY**

KALASALINGAM UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
CURRICULUM FOR M.Tech (CAD / CAM)

SEMESTER – I

Code No.	Course Title	L	T	P	C
THEORY					
MAT5009	Applied Mathematics	3	0	0	3
MEC5001	Computer Application in Design	3	0	0	3
MEC5002	Finite Element Analysis	3	0	0	3
MEC5003	Design of Hydraulics and Pneumatics systems	3	0	0	3
MEC5004	Rapid Prototyping and Tooling	3	0	0	3
MECxxx	Elective I	3	0	0	3
PRACTICAL					
MEC5081	CAD Laboratory	0	0	3	2
Total		18	0	3	20

SEMESTER – II

Code No.	Course Title	L	T	P	C
THEORY					
MEC5005	Industrial Robotics and Expert System	3	0	0	3
MEC5006	Integrated Mechanical Design	3	0	0	3
MEC5007	Product Design and Development Strategies	3	0	0	3
MEC5008	Integrated Manufacturing Systems	3	0	0	3
MEC5009	Flexible Manufacturing Systems	3	0	0	3
MECxxx	Elective II	3	0	0	3
PRACTICAL					
MEC5082	CAM Laboratory	0	0	3	2
Total		18	0	3	20

SEMESTER – III

Code No.	Course Title	L	T	P	C
THEORY					
MECxxx	Elective III	3	0	0	3
MECxxx	Elective IV	3	0	0	3
MECxxx	Elective V	3	0	0	3
PRACTICAL					
MEC6098	Project Work – Phase I	0	0	18	6
Total		9	0	18	15

SEMESTER – IV

Code No.	Course Title	L	T	P	C
PRACTICAL					
MEC6099	Project Work Phase II	0	0	36	12

Total Credit = 67

LIST OF ELECTIVES**M.Tech (CAD / CAM)**

Course Code	Course Title	L	T	P	C
MEC5011	Mechatronics in Manufacturing Systems	3	0	0	3
MEC5012	Computer Aided Process Planning	3	0	0	3
MEC5013	Data Communication in CAD/CAM	3	0	0	3
MEC5014	Performance Modelling and Analysis of Manufacturing System	3	0	0	3
MEC5015	Tribology in Design	3	0	0	3
MEC5016	Advanced Machine Tool Design	3	0	0	3
MEC5017	Industrial Safety Management	3	0	0	3
MEC5018	Design for Manufacture and Assembly	3	0	0	3
MEC5019	Computational Fluid Dynamics	3	0	0	3
MEC6001	Design of Material Handling Equipments	3	0	0	3
MEC6002	Total Quality Management	3	0	0	3
MEC6003	Tero Engineering	3	0	0	3
MEC6004	Maintenance Management	3	0	0	3
MEC6005	Research Methodology	3	0	0	3
MEC6006	Quality Engineering	3	0	0	3
MEC6007	Precision Manufacturing Technology	3	0	0	3
MEC6008	Value Engineering	3	0	0	3
MEC6009	Supply Chain Management	3	0	0	3
MEC6010	Metrology and Non Destructive Testing	3	0	0	3
MEC6011	Advanced Strength of Materials	3	0	0	3
MEC6012	Applied Materials Technology	3	0	0	3
MEC6013	Advanced Mechanisms Design and Simulation	3	0	0	3

Semester – I

MAT5009	APPLIED MATHEMATICS	L	T	P	C
		3	0	0	3

(Common for M.Tech (CAD/CAM), M.Tech (Energy) and M.Tech (ASE))

ONE-DIMENSIONAL WAVE EQUATION

Laplace transform methods for one dimensional wave equation - displacements in a string - longitudinal vibration of an elastic bar - Fourier transformation methods for one - dimensional heat conduction problems in infinite and semi-infinite rod.

LAPLACE EQUATION

Laplace equation - properties of harmonic functions - Fourier transformation methods for Laplace equation - solutions for Poisson equation by Fourier transform method.

VARIATION AND ITS DERIVATIVES

Variation and its properties - Euler's equation - functional dependent on first and higher order derivatives - functionals dependent on functions of several independent variables - some applications - direct methods - Ritz and Kantorovich methods.

SOLUTION OF LAPLACE EQUATION

Solution of Laplace's and Poisson equation on a rectangular region by Liebmann's method - Diffusion equation by the explicit and Crank Nicolson - implicit methods - Stability and Convergence criterion - solution of wave equation by explicit scheme.

SCHWARZ - CHRISTOFFEL TRANSFORMATION

The Schwarz - Christoffel transformation - Transformation of boundaries in parametric form - Physical applications - Application to fluid flow - Application to heat flow.

Text Book

1. Sneddon, I. N., Elements of partial differential equations, McGraw-Hill, 1986.

References

1. Spiegel, M. R., Theory and problems of complex variables with an introduction to conformal mapping and its applications, Schaum's outline series, McGraw-Hill Book Co., 1987.
2. Sankara Rao, k., Introduction to partial differential equations, Prentice-Hall of India, New Delhi, 1995.
3. Elsgolts, L., Differential equation and calculus of variations, Mir Publishers, Moscow, 1966.

MEC5001	COMPUTER APPLICATION IN DESIGN	L	T	P	C
		3	0	0	3

INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS

Output primitives (points, lines, curves Etc.), 2-D transformation (Translation, scaling, rotators) windowing, and view ports clipping transformation.

INTRODUCTION TO CAD SOFTWARE

Writing interactive programs to solve design problems and production of drawings, using any languages like Auto LISP/C/FORTRAN etc., creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts).

VISUAL REALISM

Hiddenline - surface and solid removal algorithms - shading – coloring - introduction to parametric and variational geometry based on softwares and their principles creation of prismatic and lofted parts using these packages.

ASSEMBLY OF PARTS

Assembly of parts, tolerance analysis mass property calculations, mechanism simulation.

SOLID MODELLING

Rapid prototyping, data exchange, documentation, customizing solid modelling system.

Text Book

1. William M. Neumann and Robert F. Sproul Principle of Computer Graphics, McGraw Hill Book Co. Singapore, 1989.

References

1. Donald Hearn and M. Pauline Baker, Computer Graphics, Prentice Hall, Inc., 1992.
2. Mikell, P. Groover and Emory, Zimmers W. Jr., CAD/CAM Computer - Aided Design and Manufacturing, Prentice Hall, Inc., 1995.
3. Ibrahim Zeid, CAD/CAM - Theory and Practice, McGraw Hill, International Edition, 1998.

MEC5002	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

(Common for M.Tech (CAD/CAM) and M.Tech (Energy Engineering))

INTRODUCTION

Historical background, weighted residual methods - basic concept of FEM variational formulation of boundary value problems - Ritz method - finite element modelling - element equation - linear and quadratic shape functions - bar, beam, elements - application to heat transfer.

HEAT TRANSFER AND FLUIDMECHANICS

Basic boundary value problems in 2 dimensions - triangular, quadrilateral, higher order elements - Poissons and laplaces equation - weak formulation - element matrices and vectors - application to solid mechanics, heat transfer, fluid mechanics.

ISO-PARAMETRIC ELEMENT

Natural co-ordinate systems - lagrangian interpolation polynomials - isoparametric, elements - formulation numerical integration – one dimensional - two dimensional triangular elements - rectangular elements - illustrative examples.

PLANE STRESS AND STRAIN

Introduction to theory of elasticity - plane stress - plane strain and axisymmetric formulation - principle of virtual work - element matrices using energy approach.

STRUCTURAL DYNAMICS APPLICATIONS

Dynamic analysis - equation of motions - mass matrices - free vibration analysis - natural frequencies of longitudinal - transverse and torsional vibration introduction to transient field problem - non linear analysis - uses of softwares - h and p elements - special element formulation.

Text Book

1. Reddy, J. N., An Introduction to the Finite Element Method, McGraw Hill, International Edition,1993

References

1. Segerlind, L. J., Applied Finite Element Analysis, John Wiley, 1984.
2. Rao, S. S, Finite Element Method in Engineering, Pergamon Press, 1989.
3. Chandrupatla and Belagundu, Finite Element in Engineering, Prentice Hall of India Private Ltd, 1997.
4. Cook,Robert, Davis, et.al, Concept and Applications of Finite Element Analysis, Wiley, John and Sons,1999.
5. George, R. Buchaman, Schaum's Outline of Finite Element Analysis, McGraw Hill Company, 1994.

MEC5003	DESIGN OF HYDRAULICS AND PNEUMATICS SYSTEMS	L	T	P	C
		3	0	0	3

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS

Hydraulic power generators - selection and specification of pumps, pump characteristics - linear and rotary actuators - selection, specification and characteristics - pressure - direction and flow control valves - relief valves, non return and safety valves - actuation systems.

HYDRAULIC CIRCUITS

Reciprocation- quick return- sequencing- synchronizing circuits - accumulator circuits - Industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, forklift, earth mover circuits - design and selection of components - safety and emergency mandrels.

PNEUMATIC SYSTEM AND CIRCUITS

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

SPECIAL CIRCUITS IN PNEUMATICS

Pneumatic equipments - selection of components - design calculations - application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, low cost automation - robotic circuits.

Text Book

1. Antony Esposito, Fluid power with Applications, Prentice Hall, 1980.

References

1. Dudleyt, A. Pease and John, J. Pippenger, Basic Fluid Power, Prentice Hall, 1987.
2. Andrew Parr, Hydraulic and Pneumatics, (HB), Jaico Publishing House, 1999.
3. Bolton, W. Pneumatic and Hydraulic Systems, Butterworth Heineman, 1997.

MEC5004	RAPID PROTOTYPING AND TOOLING	L	T	P	C
		3	0	0	3

BASICS FOR RPT

Introduction - need for time compression in product development, product development – conceptual design – development – detail design – prototype – tooling.

CLASSIFICATION OF RPT PROCESSES

Classification of RP systems, stereo lithography systems – principle – process parameters – process details – machine details, applications - Direct Metal Laser Sintering (DMLS) system – principle – process parameters – process details – machine details, applications.

RPT PROCESSES

Fusion deposition modeling – principle – process parameters – process details – machine details, applications - laminated object manufacturing – principle – process parameters – process details – machine details, applications.

ADVANCES IN RPT

Solid ground curing – principle – process parameters – process details – machine details, applications. 3-dimensional printers – principle – process parameters – process details – machine details, applications, and other concept modelers like thermo jet printers, sander's model maker, JP system 5, object Quadra system.

RAPID TOOLING

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) – principle - introduction to rapid tooling – direct and indirect method, software for RP – STL files, magics, mimics - application of rapid prototyping in medical field.

Text Book

1. Donald, E. Lacourse, Handbook of Solid Modeling, McGraw Hill Inc., New York, 1995.

References

1. Chowiah, M. P., Agile Manufacturing, International Conference on agile Manufacturing, Bangalore, Feb. 22-24, 1996, Tata McGraw Hill Pub. Co., Ltd., New Delhi, 1996.
2. Marshall Burns Automated Fabrication, Improving Productivity in Manufacturing, PTR Prentice Hall, Englewood Cliffs, New Delhi, 1993.
3. Rapid Automated Prototyping, An Introduction, Industrial Press Inc., New York.
4. Paul F. Jacobs, Rapid Prototyping and Manufacturing Fundamentals of Stereo Lithography, I Edition, Society of Manufacturing Engineers, Dearborn, Michigan, 1992.

MEC5081	CAD LABORATORY	L	T	P	C
		3	0	0	3

Exercises in Modeling and Analysis of Mechanical Components and assembly using Parametric and feature based Packages like PRO-E / SOLIDE WORKS /CATIA / NX / ANSYS / NASTRAN etc.

Equipments for CAD Laboratory

1. CAD Workstations : 10 Nos
2. CAD, 3D Modeling Software with assembly, Mechanism simulation and drafting modules : 10 Nos

SEMESTER – II

MEC5005	INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS	L	T	P	C
		3	0	0	3

INTRODUCTION AND ROBOT KINEMATICS

Definition need and scope of industrial robots – robot anatomy – work volume – precision movement – end effectors – sensors - robot kinematics – direct and inverse kinematics – robot trajectories – control of robot manipulators – robot dynamics – methods for orientation and location of objects.

ROBOT DRIVES AND CONTROL

Controlling the robot motion – position and velocity sensing devices – design of drive systems – hydraulic and pneumatic drives – linear and rotary actuators and control valves – electro hydraulic servo valves, electric drives – motors – designing of end effectors – vacuum, magnetic and air operated grippers.

ROBOT SENSORS

Transducers and sensors – sensors in robot – tactile sensor – proximity and range sensors – sensing joint forces – robotic vision system – image gripping – image processing and analysis – image segmentation – pattern recognition – training of vision system.

ROBOT CELL DESIGN AND APPLICATION

Robot work cell design and control – safety in robotics – robot cell layouts – multiple robots and machine interference – robot cycle time analysis - industrial application of robots.

ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPORT SYSTEMS

Methods of robot programming – characteristics of task level languages lead through programming methods – motion interpolation - artificial intelligence – basics – goals of artificial intelligence – AI techniques – problem representation in AI – problem reduction and solution techniques - application of AI and KBES in robots.

Text Book

1. K. S. Fu, R. C. Gonzalez and C.S.G. Lee, Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, 1987.

References

1. Yoram Koren, Robotics for Engineers, McGraw-Hill, 1987.
2. Kozyrey, Yu., Industrial Robots, MIR Publishers Moscow, 1985.
3. Richard, D. Klafter, Thomas, A. Chmielewski, Michael Negin, Robotics Engineering – An Integrated Approach, Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S. R., Robotics Technology and Flexible Automation, Tata McGraw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, McGraw-Hill, Int. 1986.
6. Timothy Jordanides et.al, Expert Systems and Robotics, Springer –Verlag, New York, May 1991.

MEC5006	INTEGRATED MECHANICAL DESIGN	L	T	P	C
		3	0	0	3

DESIGN CONCEPTS

Phases of design - standardization and interchangeability of machine elements - tolerances for process and function, individual and group tolerances - selection of fits for different design situations, design for assembly and modular constructions - concepts of integration.

SHAFTING

Analysis and design of shafts for different applications - preparation of production drawings integrated design of shaft, bearing and casing - design for rigidity.

GEARS

Principles of gear tooth action - gear tooth failure modes - stresses and loads - component design of spur, helical, bevel and worm gears - design for sub assembly - integrated design of speed reducers and multi speed gear boxes - application of software packages.

CLUTCHES

Design of automobile clutches – disc clutches – cone clutches.

BRAKES

Dynamic and thermal aspects of vehicle braking - integrated design of brakes for machine tools, automobiles and mechanical handling equipments.

Text Book

1. Juvinall, R L.C., Fundamentals of Machine Component Design, John Wiley, 1983.

References

1. Newcomb, T. P., and Spur, R.T., Automobile brakes and braking systems, Chapman and Hall, 2nd Edition, 1975.
2. Maitra G. M., Hand Book for Gear Design, Tata McGraw Hill, 1985.
3. Shigley, J. E., Mechanical Engineering Design, McGraw Hill, 1986.

MEC5007	PRODUCT DESIGN AND DEVELOPMENT STRATEGIES	L	T	P	C
		3	0	0	3

INTRODUCTION TO PRODUCT DESIGN

Nature and scope of product engineering - creative thinking and organizing for product innovation criteria for product success in life cycle of a product.

MODELING AND SIMULATION

Modeling and simulation - role of models in product design - mathematical modeling - similitude relations - weighted property index.

MATERIAL SELECTION

Problems of material selection-performance characteristics of materials - materials selection process - economics of materials - cost versus performance relations - weighted property index.

DESIGN CONSIDERATION

Functional and production design - form design-influence of mechanical loading and material on form design - design consideration of gray castings, malleable iron castings, aluminium castings, pressure die castings, plastic moulding, welded fabrications, forging and manufacture by machining methods.

TOLERANCE AND ANALYSIS

Influence of space, size, weight, etc., on form design, aesthetic and ergonomic considerations - dimensioning and tolerancing a product-functional production and inspection datum - tolerance analysis.

Text Book

1. Jones, J. C., Design Methods, John Wiley and Sons, 1980.

References

1. Dieter, G. E., Engineering Design, McGraw Hill, 1983.
2. Robert Matousek, Engineering Design, Blackie and Sons Ltd., 1963.
3. Niebel, B. W. and Draper, A. B., Product Design and Process Engineering, McGraw Hill, 1974.
4. Harry Peck, Designing for Manufacturing, Sir Issac Pitman and Sons Ltd., 1973.

MEC5008	INTEGRATED MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

BASICS OF MANUFACTURING SYSTEM

Objectives of a manufacturing system-identifying business opportunities and problems classification of production systems-linking manufacturing strategy and systems-analysis of manufacturing operations.

GROUP TECHNOLOGY

Part families-parts classification and coding, group technology machine cells-benefits of group technology - automatic identification system, barcode technology, automated data collection system.

PRODUCTION PLANNING AND CONTROL

Introduction - cost planning and control-inventory management - material requirements planning (MRP)-shop floor control - factory data collection system - process planning function CAPP - computer generated time standards.

COMPUTER MONITORING

Types of production monitoring systems-structure model of manufacturing process - process control strategies, direct digital control, supervisory computer control - computer in QC - contact inspection methods, non-contact inspection methods, computer-aided testing, integration of CAQC with CAD/CAM.

INTEGRATED MANUFACTURING SYSTEMS

Definition - application - features - types of manufacturing systems-machine tools - materials handling system-computer control system - DNC systems manufacturing cell - flexible manufacturing systems (FMS) - the FMS concept, transfer systems, head changing FMS, variable mission manufacturing system, CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits - rapid prototyping - artificial intelligence and expert system in CIM.

Text Book

1. Groover, M. P., Automation, Production System and CIM, Prentice-Hall of India, 1998.

References

1. David Bedworth, Computer Integrated Design and Manufacturing, McGraw Hill, New Delhi, 1998.
2. Yoram Koren, Computer Integrated Manufacturing Systems, McGraw Hill, 1983.
3. Ranky, Paul, G., Computer Integrated Manufacturing, Prentice Hall International 1986.
4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, Design rules for a CIM system, North Holland Amsterdam, 1985.

MEC5009	FLEXIBLE MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

INTRODUCTION TO FMS

Basic concepts, advantages, components and examples of FMS - distributed numerical control (DNC) - communication between DNC computer and MCU.

DATA PROCESSING

Distributed data processing in FMS - computer network protocols - interfacing of CAD and CAM - part programming in FMS tool data base - clamping devices and fixtures data base, tool management system part alignment and work mounting errors - surface description method for automated design and robotized assembly.

GROUP TECHNOLOGY

Part families-parts classification and coding, group technology machine cells-benefits of group technology - automatic identification system, barcode technology, automated data collection system

HANDLING SYSTEMS:

Material handling systems - ASRS - AGVs – features of industrial robots - robot cell design and control.

INTERFACING

Interfacing of computer - machine tool controllers and handling systems - communications standards - programmable logic controllers (PLC's) – interfacing - computer aided project planning - inventory control

Text Book:

1. Groover, M. P., Automation, Production System and CIM, Prentice-Hall of India, 1998.

References:

1. Paul Ranky., The design and operation of FMS, IFS publication. 1983.
2. Viswanathan, N and Nahari, Y, Performance modeling of automated manufacturing systems, Prentice Hall, 1992.

MEC5082	CAM LABORATORY	L	T	P	C
		3	0	0	3

- Practice in part programme and operation of a turning center
- Practice in part programme and operations of a machine center
- Tool planning and selection for machining center / turning center
- Programming using CAD softwares
- Practice in NC programming languages
- Simulation and machining using CNC / DNC machine tools
- Use of FEM packages
- Practice on computer aided measuring instruments
- Use of advanced CNC machining packages
- Diagnosis and trouble shooting in CNC machines

MEC5011	MECHATRONICS IN MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

INTRODUCTION TO MECHATRONICS

Introduction to mechatronics systems - mechatronics in production, measurement and control systems.

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.

MICROPROCESSOR IN PLANNING

Architecture - pin configuration - instruction set - programming of microprocessors using 8085 instructions - interfacing input and output devices - interfacing D/A converters and A/D converters - applications - temperature control - stepper motor control - traffic light controller.

PROGRAMMABLE LOGIC CONTROLLERS

Basic structure - input / output processing - programming - mnemonics timers - internal relays and counters - data handling - analog input / output - selection of PLC.

DESIGN OF MECHATRONICS

Traditional design and mechatronics design - possible design solutions - case studies of mechatronics systems.

Text Book

1. Michael B., Histan and David G., Alciatore, Introduction to Mechatronics and Measurement Systems, McGraw-Hill International Editions, 1999.

References

1. Bradley, D. A., Dawson, D, Buru, N. C. and Loader, AJ. Mechatronics, Chapman and Hall, 1993.
2. Ramesh. S, Gaonkar, Microprocessor Architecture, Programming and Applications, Wiley Eastern, 1998.
3. Lawrence, J., Kamm, Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics, Prentice-Hall, 2000.
4. Ghosh, P. K. and Sridhar, P. R., 0000 to 8085, Introduction to Microprocessors for Engineers and Scientists, Second Edition, Prentice Hall, 1995.

MEC5012	COMPUTER AIDED PROCESS PLANNING	L	T	P	C
		3	0	0	3

INTRODUCTION TO COMPUTER AIDED PROCESS PLANNING

The place of process planning in the manufacturing cycle - process planning and production planning - process planning and concurrent engineering – CAPP - group technology.

PART DESIGN REPRESENTATION

Design drafting - dimensioning, conventional tolerancing, geometric tolerancing CAD, input / output devices, topology, geometric transformation - perspective transformation - data structure - geometric modelling for process planning,

GROUP TECHNOLOGY

Part families - parts classification and coding, group technology machine cells - automatic identification system – barcode technology - the optiz system, the MICLASS system – benefits.

PROCESS ENGINEERING

Experienced - based planning - decision table and decision trees - process capability analysis - process planning variant process planning - generative approach - forward and backward planning.

COMPUTER AIDED PROCESS PLANNING SYSTEMS

Logical design of a process planning - implementation considerations - manufacturing system components, production volume, number of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

Text Book

1. Gideon Halevi and Roland D. Weill, Principles of Process Planning, A logical approach, Chapman and Hall, 1995.

References

1. Tien-Chien Chang, Richard A. Wysk, An Introduction to automated process planning systems, Prentice Hall, 1985.
2. Chang, T. C., An Expert Process Planning System, Prentice Hall, 1985.
3. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley and Sons, 1996.
4. Rao, Computer Aided Manufacturing , Tata McGraw Hill Publishing Co., 2000.

MEC5013	DATA COMMUNICATION IN CAD/CAM	L	T	P	C
		3	0	0	3

DIGITAL COMPUTERS AND MICROPROCESSOR

Block diagram - register transfer language, arithmetic, logic and shift micro operations - instruction code training and control instruction cycle - I/O and interrupt design of basic computer - machine language - assembly language, assembler - registers ALU and bus systems - timing and control signals - machine cycle and timing diagram - functional block diagrams of 8086 and modes of operation.

OPERATING SYSTEM AND ENVIRONMENTS

Types - functions - UNIX and WINDOWS NT- architecture, graphical user interfaces - compilers - analysis of the source program - the phases of a compiler - cosines of the compiler.

COMMUNICATION MODEL

Data communication and networking - protocols and architecture - data transmission concepts and terminology guided transmission media - wireless transmission - data encoding - asynchronous and synchronous communication - base band interface standards RS232C, RS449 interface.

COMPUTER NETWORKS

Network structure - network architecture - the OSI reference model services - network standardization - example - managing remote systems in network - network file systems - net working in manufacturing.

INTERNET

Internet services - protocols - mail based service - system and network requirements - internet tools.

Text Book

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1996.

References:

1. Gaonkar R.S., Microprocessor Architecture, Programming and Applications of 8085, Penram International, 1997.
2. Peterson J.L., Galvin P. and Silberschaz, A., Operating Systems Concepts, Addison Wesley, 1997.
3. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, Compilers Principles Techniques and Tools, Addison Wesley, 1986.
4. William Stallings, Data of Computer Communications, Prentice Hall of India, 1997.
5. Andrew S. Tanenbanum Computer Networks, Prentice Hall of India 3rd Edition, 1996.
6. Christian Crumlish, The ABC's of the Internet, BPB Publication, 1996.

MEC5014	PERFORMANCE MODELLING AND ANALYSIS OF MANUFACTURING SYSTEM	L	T	P	C
		3	0	0	3

MANUFACTURING SYSTEMS AND CONTROLS

Automated manufacturing systems - modelling, role of performance modelling, simulation models, analytical models - product cycle - manufacturing automation - economics of scale and scope - input/output model – plant configurations - performance measures - manufacturing lead time - work in process - machine utilization - flexibility - performability – quality - control systems - control system architecture - factory communications - local area networks - factory networks - open systems interconnection model.

MANUFACTURING PROCESS

Examples of stochastic processes - Poisson process discrete time Markov chain models - Definition and notation - Sojourn times in states - examples of DTMCs in manufacturing Chapman - Kolmogorov equation – steady-state analysis - continuous time Markov chain models - definitions and notation - sojourn times in states - examples of CTMCs in manufacturing - equations for CTMC evolution - Markov model of a transfer line- birth and death processes in manufacturing.

QUEING MODELS

Queues in manufacturing systems - performance measures, Little's result - steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns- analysis of a flexible machine center.

QUEING NETWORKS

QN models in manufacturing - Little's law in queuing networks, Tandem queue, an open queuing network with feed back, an open central server model for FMS, closed transfer line - closed server model Garden Newell networks.

PETRI NETS

Classical Petri Nets - Transition firing and reachability, representational power, properties manufacturing models - Stochastic Petri Nets, exponential timed Petri Nets, generalized Stochastic Petri Nets, modelling of KANBAN systems, manufacturing models.

Text Book:

1. Viswanadham, N and Narahari, Y. "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1994.

References:

1. Trivedi, K.S., Probability and Statistics with Reliability, Queuing and Computer Science Applications, Prentice Hall, New Jersey, 1982.
2. Gupta S.C., and Kapoor V.K., Fundamentals of Mathematical Statistics, 3rd Edition, Sultan Chand and Sons, New Delhi, 1988.

MEC5015	TRIBOLOGY IN DESIGN	L	T	P	C
		3	0	0	3

SURFACE, FRICTION AND WEAR

Topography of the surfaces - surface features, surface interaction - theory of friction - sliding and rolling friction, friction properties of metallic and non-metallic materials - friction in extreme conditions - wear, types of wear, mechanism of wear, wear resistance materials, surface treatment, surface modifications, surface coatings.

LUBRICATION THEORY

Lubricants and their physical properties lubricants standards - lubrication regimes - hydrodynamic lubrication Reynolds equation - thermal, inertia and turbulent effects - Elasto hydrodynamic and Plasto hydrodynamic and magneto hydrodynamic lubrication - hydro static lubrication - gas lubrication.

DESIGN OF FLUID FILM BEARINGS

Design and performance analysis of thrust and journal bearings - full, partial, fixed and pivoted journal bearings design - lubricant flow and delivery - power loss, heat and temperature rotating loads and dynamic loads in journal bearings - special bearings - hydrostatic bearing design.

ROLLING ELEMENT BEARING

Geometry and kinematics - materials and manufacturing processes - contact stresses - Hertzian stress equation - stresses and deflection - axial loads and rotational effects - bearing life capacity and variable loads - ISO standards - oil films and their effects - rolling bearings failures.

TRIBOLOGY MEASUREMENTS IN INSTRUMENTATION

Surface topography measurements - electron microscope and friction and wear measurements - laser method - instrumentation - international standards bearings performance measurements - bearing vibration measurement.

Text Book

1. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd. , UK,1981.

References

1. Hulling , J. (Editor), Principles of Tribology, Macmillan ,1984.
2. Williams J.A . Engineering Tribology, Oxford Univ. Press, 1994.
3. Neale M.J, "Tribology Hand Book, Butterworth Heinemann, 1995.

MEC5016	ADVANCED MACHINE TOOL DESIGN	L	T	P	C
		3	0	0	3

INTRODUCTION

Introduction to metal cutting machine tools, kinematics, basic principles of machine tool design, estimation of drive power.

DESIGN OF MACHINE TOOL SPINDLE AND FRAMES

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 SLIDEWAYS

Design of slideways - concepts of aesthetics and ergonomics applied to machine tools, latest trends in machine tool design.

DESIGN OF DRIVES AND CONTROL MECHANISMS

Design considerations of electrical, mechanical and hydraulic drives in machine tool, stepped and stepless arrangements and systems - design of control mechanisms - selection of standard components - dynamic measurement of forces and vibrations in machine tools - stability against chatter - vibration dampers.

TESTING AND STANDARDISATION

Acceptance tests and standardization of machine tools - machine tools reconditioning.

Text Book

1. Mehta, N.K., Machine Tool design, Tata McGraw Hill, 1989.

References

1. Koenisberger, F., Design Principles of Metal cutting Machine Tools, Pergamon Press, 1964.
2. Acherkan, N., Machine Tool Design, Vol.3 and 4, MIR Publishers, Moscow, 1968.
3. Sen, G. and Bhattacharya, A., Principles of Machine Tools, Vol.2, NCB, Calcutta, 1973.

MEC5017	INDUSTRIAL SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

BASICS OF INDUSTRIAL SAFETY MANAGEMENT

History, development of safety - evaluation of modern safety concepts - role of government, trade union and management - safety management functions - safety organization, safety department, safety committee – safety management techniques - job safety analysis, plant safety inspection, safety audit, safety sampling technique, safety survey - performance measurements and motivation - employee participation - safety and productivity.

OPERATIONAL SAFETY – I

Hot metal operation – boiler and pressure vessels, heat treatment shop, gas furnace operation, electroplating, hot bending pipes, safety in welding and cutting - cold metal operation - safety in machine shop, cold bending and chamfering of pipes, metal cutting, shot blasting, grinding, painting - power press and other machines.

OPERATIONAL SAFETY - II

Safety in layout design and material handling, dock safety, machine guarding - safety in use of electricity - management of toxic gases and chemicals - safety in chemical laboratories, ammonia printing - safety in sewage disposal and cleaning – industrial pollution - working at heights - Industrial fires and prevention - managing emergencies in industries - on-site and off-site emergencies, control of major industrial hazards

PROTECTING DEVICES AND ACCIDENT PREVENTION

Personal protective equipment - causes and cost of accidents - basic philosophy of accident prevention - accident prevention programmes - specific hazard control strategies-HAZOP - house keeping - safety education and training - first aid- fire fighting devices - accident reporting, investigations and statistics - industrial psychology in accident prevention.

LAWS RELATED TO SAFETY AND INDUSTRIAL HYGIENE

Safety and health standards - industrial hygiene and occupational disease prevention, welfare facilities - history of legislation's related to safety - safety provisions in the factory act - Workmen compensation act - environmental protection act - electricity act – OHSA.

Text Book

1. Lees, F.P., Loss Prevention in Process Industries, Butterworths, New Delhi, 1986.
2. Occupational Safety manual, BHEL, Trichy, 2002.

Reference

1. John V.Girmaldi and Rollin H.Simonds, Safety management, All India Travellers bookseller, New Delhi, 1989.
2. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
3. Heinrich H.W., Industrial Accident Prevention, McGraw-Hill, 1980.
4. Brown D.B., System Analysis and Design for Safety, Prentice Hall Inc., New Jersey, 1976.
5. Handbook of Occupational Health and Safety, NSC Chicago, 1982
6. Encyclopedia of Occupational Health and Safety, Vol. I and II, International Labour Organisation, Geneva, 1985.

MEC5018	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	C
		3	0	0	3

INTRODUCTION

Steps, basic rules, principles, guidelines - design for ease of assembly - design for standards - design for maintenance - recycling, minimum risk, evaluating embodiment design - design for minimum cost - DFM approach and processes - DFM guidelines, DFMEA, PFMEA.

PROCESS PARAMETERS

Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process cumulative effect of tolerances-sure fit law, normal law and truncated normal law. selective assembly - interchangeable part manufacture and selective assembly, deciding the number of groups- Model-I Group tolerances of mating parts equal - model II total and group tolerances of shaft equal control of axial ply- introducing secondary machining operations, laminated shims, examples.

DEGREES OF FREEDOM

Degrees of freedom, grouped datum systems- different types, two and three mutually perpendicular grouped datum planes; grouped datum system with spigot and recess, pin and hole; grouped datum system with spigot and recess pair and tongue- slot pair computation of translational and rotational accuracy, geometric analysis and applications.

CONVENTIONAL METHODS

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples - form design of castings and weldments - redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols.

DESIGN AND CASE STUDIES

Operation sequence for typical shaft type of components - preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples - design features to facilitate machining - datum features- functional and manufacturing - components design- machining considerations, redesign for manufacture, examples - case Studies - redesign to suit manufacture of typical drive - system example, design of experiments - value analysis and design rules to minimize cost of a product - computer aided DFMA, Poke Yoke principles.

Text Book

1. Harry Peck, Designing for Manufacture, Pitman Publications, 1983.

References

1. Matousek, Engineering Design- A Systematic Approach, Blackie and Son Ltd., London.

MEC5019	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

(Common for M.Tech (CAD/CAM) and M.Tech (Energy Engineering))

GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD

Classification, initial and boundary conditions, initial and boundary value problems - finite difference method, central, forward, backward difference, uniform and non-uniform grids, numerical errors, grid independence test.

CONDUCTION HEAT TRANSFER

Steady one-dimensional conduction, two and three dimensional steady state problems, transient one-dimensional problem, two-dimensional transient problems

INCOMPRESSIBLE FLUID FLOW

Governing equations, stream function – vorticity method, determination of pressure for viscous flow, simple procedure of Patankar and spalding, computation of boundary layer flow, finite difference approach.

CONVECTION HEAT TRANSFER AND FEM

Steady one-dimensional and two-dimensional convection – diffusion, unsteady one-dimensional convection – diffusion, unsteady two - dimensional convection – diffusion – introduction to finite element method – solution of steady heat conduction by fem – incompressible flow – simulation by FEM.

TURBULENCE MODELS

Algebraic models – one equation model, $K - \epsilon$ models, standard and high and low Reynolds number models, prediction of fluid flow and heat transfer using standard codes.

Text Book

1. Muralidhar, K., and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1995.

References

1. Ghoshdasdar, P.S., Computer Simulation of flow and heat transfer, Tata McGraw-Hill Publishing Company Ltd., 1998.
2. Subas, V. Patankar Numerical heat transfer fluid flow, Hemisphere Publishing Corporation, 1980.
3. Taylor, C and Hughes, J.B. Finite Element Programming of the Navier Stock Equation, Pineridge Press Limited, U.K., 1981.
4. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., Computational fluid Mechanics and Heat Transfer “ Hemisphere Publishing Corporation, Newyork, USA, 1984.
5. Fletcher, C.A.J. Computational Techniques for Fluid Dynamics 1” Fundamental and General Techniques, Springer – Verlag, 1987.
6. Fletcher, C.A.J. Computational Techniques for Fluid Dynamics 2, Specific Techniques for Different Flow Categories, Springer – Verlag, 1987.
7. Bose, T.X., Numerical Fluid Dynamics Narosa Publishing House, 1997.

MEC6001	DESIGN OF MATERIAL HANDLING EQUIPMENTS	L	T	P	C
		3	0	0	3

(Use of Approved Data Book is permitted)

MATERIAL HANDLING EQUIPMENTS

Types, selection and applications

DESIGN OF HOIST

Design of hoisting elements- welded and roller chains, hemp and wire ropes, design of ropes, pulleys, pulley systems, sprockets and drums, load handling attachments - design of forged hooks and eye hooks, crane grabs lifting magnets, grabbing attachments, design of arresting gear, brakes - shoe, band and cone types.

DRIVES OF HOISTING GEAR

Hand and power drives - travelling gear, rail traveling mechanism , cantilever and monorail cranes, slewing, jib and luffing gear, cogwheel drive, selecting the motor ratings.

CONVEYORS

Types - description - design and applications of belt conveyors, apron conveyors and escalators pneumatic conveyors, screw conveyors and vibratory conveyors.

ELEVATORS

Bucket elevator design - loading and bucket arrangements - cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - design of form lift trucks.

Text Book

1. Spivakovsy, A.O. and Dyachkov, V.K., L Conveying Machines, Volumes I and II, MIR Publishers, 1985.

References

1. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.

MEC6002	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

INTRODUCTION

Philosophy of TQM, customer focus, organisation, top management commitment, teamwork, quality philosophies of Deming, Crosby and Muller.

QUALITY PROCESS

QC tools, problem solving methodologies, new management tools, work habits, quality circles, bench marking, strategic quality planning.

QUALITY IMPROVEMENT PROCESS

Quality policy deployment, quality function deployment, standardization, designing for quality, manufacturing for quality.

ISO SYSTEMS

Need for ISO 9000 system, advantages, clauses of ISO 9000, Implementation of ISO 9000, quality costs, quality auditing, case studies.

IMPLEMENTATION OF TQM

Steps in KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, case studies.

Text Book

1. Rose., J.E. Total Quality Management, Kogan Page Ltd., 1993.

References

1. John Bank, The Essence of total quality management, PHI 1993.
2. Greg Bounds, Lyle Yorks et al, Beyond Total Quality Management, McGraw Hill, 1994.

MEC6003	TERO ENGINEERING	L	T	P	C
		3	0	0	3

RELIABILITY CONCEPT

Reliability function - failure rate - Mean Time Between Failures (MTBF) - Mean Time To Failure (MTTF) - a priori and a posteriori concept - mortality curve - useful life availability - maintainability - system effectiveness.

RELIABILITY DATA ANALYSIS

Time to failure distributions - exponential, normal, gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting.

RELIABILITY PREDICTION MODEL

Series and parallel systems - RBD approach - standby systems – M/N configuration - application of Baye's theorem - cut and tie set method - Markov analysis - FTA - limitations.

RELIABILITY MANAGEMENT

Reliability testing - reliability growth monitoring - non parametric methods - reliability and life cycle costs reliability allocation - replacement model.

RISK ASSESMENT

Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

Text Book

1. Modarres, Reliability and Risk analysis, Mara Dekker Inc., 1993.

References

1. John Davidson, The Reliability of Mechanical system, published by the Institution of Mechanical Engineers, London, 1988.
2. Smith C.O. Introduction to Reliability in Design, McGraw Hill, London, 1976.

MEC6004	MAINTENANCE MANAGEMENT	L	T	P	C
		3	0	0	3

BASICS

Maintenance functions - Tero technology - maintenance costs - organisation for maintenance - Japanese concept.

RELIABILITY ANALYSIS

Reliability function - useful life - repair time distribution - Weibull application - standby systems - maintainability and availability - RCM.

MAINTANANCE POLICIES

Maintenance types - Preventive maintenance - PM for functional characteristics and large scale systems - repair policy - PM and break down maintenance - Statistical applications - replacement models.

LOGISTICS

Spare parts control - overall/optimum availability - maintenance planning - priority rules maintenance staffing UMS - maintenance manual.

ADVANCED TECHNIQUES

Condition monitoring - WDM, SPM, vibration monitoring - maintenance information system - TPM - maximize equipment effectiveness.

Text Book

1. Edward Hartman, Maintenance Management, Productivity and Quality Publishing Pvt. Ltd., Madras, 1995.

References

1. Smith D.J. Reliability and Maintainability in perspective, Mac Millan Ltd., London, 1985.
2. Seiichi Nakagrma, Introduction to Total Productive Maintenance, Productivity press (India) Pvt. Ltd.,1993.

MEC6005	RESEARCH METHODOLOGY	L	T	P	C
		3	0	0	3

INTRODUCTION

Observation of research- motivation - types of research - approaches - significance - research methods versus methodology - research process - criteria of good research - formal science and empirical science - logic of scientific method - hypothetic deductive method - models - scientific attitude.

LOGICAL APPROACH

Logical approach - soft system approach - creative approach - development of creativity - group problem solving techniques for idea generation - approaches to management research problem - investigation of idea by an experienced researcher - pilot study.

EXPERIMENTAL RESEARCH

Experimental research- principles of experiment - laboratory experiments - experimental designs - quasi - experimental designs - action research - validity and reliability of experiments and quasi-experiments - sources of invalidity of experiments and quasi - experiments - choice of experimental design.

PROBLEM IDENTIFICATION

Exploration for problem identification - hypothesis generation - formulation of the problem -heuristics and simulation - heuristic optimization- simulation modeling - measurement design-primary types of measurement scales - errors in measurement- validity and reliability in measurement - qualitative research methods.

PRIMARY DATA COLLECTION METHODS

Primary data collection methods - sources of secondary data - non-sampling errors - validity and reliability of data collection procedures - data preparation- exploratory data analysis – statistical estimation - hypothesis testing - Univariate analysis - logic - identification of appropriate test- parametric tests - non-parametric tests - Bivariate analysis and hypothesis testing.

ANALYSIS OF EXPERIMENTS

Analysis of experiments data - analysis of single factor experiment - Latin square design randomized 2x2 factorial designs - multivariate analysis of data - dependence and interdependence analysis - pre-writing consideration - style and composition of the report - principles of thesis writing - format of reporting - briefing - rules for typing or word processing.

Text Book

1. Krishnaswamy, K.N. Appa Iyer Sivakumar. M.Mithran Management research methodology: Integration of principles, methods and techniques' Pearson education, Delhi, 2006.

References

1. Panneer selvam .R., Research methodology, PHI India ,2004.
2. Kothari.C.R., Research methodology,1990.

MEC6006	QUALITY ENGINEERING	L	T	P	C
		3	0	0	3

CONTROL CHARTS

Quality – Definition, need – variation – causes – control charts for variable \bar{X} , R and σ charts – control charts for attributes – p, np, c, u chart, CUSUM charts, Exponential Weighted Moving Average (EWMA) chart.

ANALYSIS OF PROCESS CONTROL AND MULTIVARIATE QUALITY CONTROL

Shift in process mean – probability of shift, ARL, process capability analysis, six sigma – Quality control for two independent variables, two dependent variables – Use of covariance matrix – Hotelling T control chart – Monitoring process variability.

ACCEPTANCE SAMPLING

Sampling plans – need, types – single sampling plan – OC curve – construction, interpretation, AOQL, ATI – double sampling plan – probability of acceptance, ASN, ATI, AOQL – multiple sampling plans – design of sampling plans – use of Dodge Romig tables, IS2500 Part I and II.

QUALITY MANAGEMENT

TPM – Overall equipment effectiveness, Failure mode effect analysis – Six sigma – Define Measure Analyse Improve Control (DMAIC) – Repeatability and Reproducibility, JIT – Kanban, Lean manufacturing.

SYSTEM CERTIFICATION

Need for a quality system, ISO – elements, implementation documentation, auditing, QS 9000 – certification for automobile industries – TS/16949 concepts ISO 14000 – environmental requirements, Benefits Software quality – CMM levels.

Text Book

1. Mahajan, Statistical Quality Control, Dhanpat Rai and Co (P) Ltd, Third Edition, 2002.

References

1. Douglas C. Montgomery, Introduction to Statistical Quality Control, John Wiley and Sons, Inc, Fifth Edition, 2004.
2. Eugene L. Grant Richard S., Leven Worth, Statistical Quality Control McGraw Hill, Seventh Edition, 1996.
3. Kannan SM, Jayabalan V, Total Quality Management, McGraw Hill. Seventh Edition, 1996.
4. Seiichi Nakajima, Introduction to TPM, RKR Publications, 2005.
5. Sharma DD, Total Quality Management, Sultan Chand and Sons, 2002.

MEC6007	PRECISION MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

BASICS

Introduction, history, development and need of micro-electro-mechanical systems - overview of MEMS technology - working principle of micro system thermo fluid engineering and micro system design.

ELECTRO PHYSICAL PROCESSES

Different electro - physical processes used for machining - dealing with MEMS materials - relevant non-conventional processes; IC fabrication processes used for MEMS; MEMS sensors and actuators

BULK MANUFACTURING

Bulk manufacturing - surface micro machining- LIGA process.

MECHANICAL PROCESSES

Mechanical process techniques and process models for micro-machining; Fabrication processes and design of the process sequences.

MICRO SYSTEM DESIGN

Micro system design introduction design considerations - process design - mechanical design - design of silicon die and micro fluidic cad applications capillary electrophoresis network system.

Text Book

1. Tai Ran Hsu MEMS and MICRO SYSTEMS Design and Manufacture, TMH, Delhi-2.

References

1. Vijay K Varadan, Micro Sensors, MEMS, and Smart Devices, John wiley and sons 2001.
2. Marc Madou, Fundamentals of micro Fabrication, CRC Press,1997.

MEC6008	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

BASICS

Overview of value analysis - product design - design process.

VALUE ANALYSIS

Value and value analysis - identification of its function/end use - importance in import substitution - techniques of value analysis - the information phase - the analytical phase - recommendation,

IMPLEMENTATION

Implementation - organisation structure - responsibilities of individual departments.

PRODUCT DESIGN

Product design, design process, design method, design considerations, cost evaluation, basic concept of value engineering, value engineering and quality, value engineering and productivity, value engineering phase, value engineering process, cost-value analysis.

DESIGN PROCESS

Problems and organization of design process and value engineering, methods in value engineering to improve the competitiveness of product/service.

Text Book

1. Lawrence, D.M., Techniques of Value Analysis and Engineering, McGraw Hill, 1988.

References

1. George. E.D. Engineering Design: a Material and Processing Approach, McGraw Hill, 1991.
2. Heller.D.E., Value Management, Value Engineering and Cost Reduction, Addison Wesley,1988.

MEC6009	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

BASICS

Building blocks of a supply chain network - business processes in supply chains - types of supply chains and examples – supply chain drivers.

SUPPLY CHAIN INVENTORY MANAGEMENT

Strategic, tactical, and operational decisions in supply chains - supply chain performance measures - supply chain inventory management – demand forecasting – impact of uncertainty of supply in safety inventory – managing safety inventory in multi echelon supply chains - bullwhip effect.

SOURCING DECISION IN SUPPLY CHAIN

Role of sourcing – in-house sourcing and outsourcing – third party logistics – supplier relation – procurement processes – risk management in sourcing.

TRANSPORTATION IN SUPPLY CHAIN

Role of transportation – modes – design option for a transportation network – trade off in transportation design.

SUPPLY CHAIN AUTOMATION

IT enabled supply chains – role of IT in forecasting, inventory management, procurement, transportation - customer relationship management - ERP and supply chains - supply chain automation and supply chain integration.

Text Book

1. Sunil Chopra and Peter Meindl. Supply Chain Management: Strategy, Planning, and Operation, Third Edition, Pearson Education, 2007.

References

1. N. Viswanadham and Y. Narahari. Performance Modeling of Automated manufacturing Systems. Prentice Hall of India, 1998.
2. R.B. Handfield and E.L. Nochols, Jr. Introduction to Supply Chain Management. Prentice Hall, 1999.

MEC6010	METROLOGY AND NON DESTRUCTIVE TESTING	L	T	P	C
		3	0	0	3

MEASUREMENT SYSTEMS

Tool maker's microscope - co-ordinate measuring machines - universal measuring machine - laser viewers for production profile checks - image shearing microscope - use of computers - machine vision technology, microprocessors in metrology.

STATISTICAL METHODS

Data presentation - statistical measures and tools - process capability - confidence and tolerance limits - control charts for variables and for fraction defectives - theory of probability - sampling - ABC standard - reliability and life testing.

LIQUID PENETRANT AND MAGNETIC PARTICLE TESTING

Characteristics of liquid penetrants - different washable systems - developers - applications - methods of production of magnetic fields - principles of operation of magnetic particle test - applications - advantages and limitations.

RADIOGRAPHY

Sources of ray - X-ray production - properties of X rays - film characteristics - exposure charts - contrasts operational characteristics of X ray equipment - applications.

ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - principles of acoustic emission techniques - advantages and limitations - instrumentation applications.

Text Book

1. Jain, R.K., Engineering Metrology, Khanna Publishers, 1997.

References

1. Barry Hull and Vernon John, Non Destructive Testing, MacMillan, 1988.
2. American Society for Metals, Metals Hand Book, Vol.II, 1976.
3. Progress in Acoustic Emission, Proceedings of 10th International Acoustic Emission Symposium, Japanese Society for NDI, 1990.

MEC6011	ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

ELASTICITY

Stress - strain relations and general equations of elasticity in Cartesian, polar and spherical coordinates differential equations of equilibrium-compatibility - boundary conditions - representation of three - dimensional stress of a tension generalized hook's law - St. Venant's principle - plane stress - Airy's stress function.

SHEAR CENTRE

Location of shear centre for various sections - shear flows - stresses and deflections in beams subjected to unsymmetrical loading - kern of a section.

CURVED FLEXIBLE MEMBERS

Circumference and radial stresses - deflections – curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks.

STRESS IN FLAT AND CIRCULAR PLATES

Stresses in circular and rectangular plates due to various types of loading and end conditions buckling of plates - Torsion of rectangular cross section - St. Venants theory - elastic membrane analogy, Prandtl's stress function, torsional stress in hollow thin walled tubes.

STRESS DUE TO ROTARY SECTIONS

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications.

Text Book

1. Seely and Smith, Advanced Mechanics of Materials, John Wiley International Edn, 1952.

References

1. Rimoahwnko, Strength of Materials, Van Nostrand.
2. Timoshenko and Goodier, LTheory of Elasticity, McGraw Hill.
3. Wang, Applied Elasticity, McGraw Hill.
4. Cas, Strength of Materials, Edward Arnold, London 1957.
5. Robert D. Cook, Warren C. Young, Advanced Mechanics of Materials, Mc-millan pub. Co., 1985.

MEC6012	APPLIED MATERIALS TECHNOLOGY	L	T	P	C
		3	0	0	3

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 solution strengthening, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening - effect of temperature, strain and strain rate on plastic behaviors - super plasticity - deformation of non-crystalline material.

FRACTURE BEHAVIOUR

Griffith 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.

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.

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.

NON METALLIC MATERIALS

Polymeric materials - formation of polymer structure - production techniques of fibers, 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.

Text Book

1. Thomas H.Courtney, Mechanical Behaviour of Materials, (2nd Edition), McGraw-Hill, 2000.

References

1. Charles J.A., Crane, F.A.A and Furness, J.A.G., Selection and use of Engineering Materials, (3rd Edition), Butterworth-Heinemann, 1977.
2. Flinn, R.A. and Trojan, P.K., Engineering Materials and their Applications , (4th Edition), Jaico, 1999.

3. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988.
4. Metals Hand Book, Vol.10, "Failure Analysis and Prevention, (10th Edition), 1994.

MEC6013	ADVANCED MECHANISMS DESIGN AND SIMULATION	3	0	0	3
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KINEMATICS

Review of fundamentals of kinematics - mobility analysis - formation of one D.O.F. multiloop kinematic chains, network formula - gross motion concepts.

POSITION ANALYSIS

Position analysis - Vectorloop equations for four bar, slider crank, inverted slider crank - geared five bar and six bar linkages - analytical method for velocity and acceleration analysis - four bar linkage jerk analysis - plane complex mechanism - fixed and moving centrodes, inflection points and inflection circle - Euler Savory equation, graphical constructions - cubic of stationary curvature.

SYNTHESIS

Type synthesis - number synthesis - associated linkage concept - dimensional synthesis - function generation, path generation, motion generation - graphical methods - cognate linkage coupler curve synthesis, design of six bar mechanisms algebraic methods - application of instant centre in linkage design - cam mechanism - determination of optimum size of cams.

STATIC AND INERTIA FORCE ANALYSIS

Static force analysis with friction - inertia force analysis - combined static and inertia force analysis - shaking force, Kinetostatic analysis - introduction to force and moment balancing of linkages.

KINEMATIC ANALYSIS

Kinematic analysis of spatial RSSR mechanism - Denavit - Hartenberg parameters - forward and inverse kinematics of robotic manipulators.

Text Book

1. Sandor G.N. and Erdman A.G., Advanced Mechanism Design Analysis and Synthesis, Prentice Hall, 1984.

References

1. Shigley, J.E., and Uicker, J.J., Theory of Machines and Mechanisms, McGraw Hill, 1995.
2. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, EWLP, Delhi, 1999.
3. Norton R.L., Design of Machinery, McGraw Hill, 1999.
4. Kenneth J. Waldron, Gary L. Kinzel, Kinematics, Dynamics and Design of Machinery, John Wiley-sons, 1999.