Syllabus

M.Tech in Mechanical Engineering

Specialization: Computer Integrated Manufacturing

M.Tech. Programme
Mechanical Engineering – Computer Integrated Manufacturing
Curriculum and Scheme of Examinations (2013 Admission)

SEMESTER I

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam hours	Marks			Remarks
					Internal Continuous Assessment	End Semester Exam	Total	
MCM1001	Advanced Mathematical Modeling	3	3	3	40	60	**100**	Of the 40 marks of internal Assessment, 25marks for test and 15 marks for assignment. End sem exam is Conducted by the University
MCC 1002	CAD/CAM	3	3	3	40	60	**100**	do
MCC 1003	Advanced Materials and Their Processing	3	3	3	40	60	**100**	do
MCC 1004	Finite Element Analysis in Manufacturing	3	3	3	40	60	**100**	do
MCC 1005	CNC Machine Tools	3	3	3	40	60	**100**	do
MCC 1006	Instrumentation and Control Systems	3	3	3	40	60	**100**	do
MCC 1101	CAD/CAM lab	1	2	-	100	-	**100**	No End Sem Examinations
MCC 1102	Seminar	2	2	-	100	-	**100**	do
	TOTAL	**21**	**22**		**440**	**360**	**800**	7 hours of Departmental assistance work

SEMESTER II

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam hours	Marks			Remarks
					Internal Continuous Assessment	End Semester Exam	Total	
MCC 2000	Research Methodology	2	2	3	40	**60**	**100**	Of the 40 marks of internal Assessment, 25marks for test and 15 marks for assignment.End Sem Exam is conducted by the Individual Institutions
MCC 2001	Computer Integrated Manufacturing Systems	3	3	3	40	**60**	**100**	Of the 40 marks of internal Assessment, 25marks for test and 15 marks for assignment. End sem exam is Conducted by the University
MCC 2002	Computer Aided Inspection	3	3	3	40	**60**	**100**	do
***	Stream Elective I	3	3	3	40	**60**	**100**	do
***	Stream Elective II	3	3	3	40	**60**	**100**	do
**	Department Elective	3	3	3	40	**60**	**100**	do
MCC 2101	CIM lab	1	2	-	100	-	**100**	No End Sem Examinations
MCC 2102	Thesis – Preliminary – Part I	2	2	-	100	-	**100**	do
MCC 2103	Seminar	2	2	-	100	-	**100**	do
	TOTAL	**22**	**23**	---	**540**	**360**	**900**	6 hours of Departmental assistance work

List of Stream Electives for Second Semester

STREAM ELECTIVE I		STREAM ELECTIVE II	
MCE 2001	Mechatronics System Design	MCE 2007	Rapid Prototyping, Tooling And Manufacture
MCE 2002	Design For Manufacture and Assembly	MCE 2008	Computer Aided Process Planning And Control
MCE 2003	Modeling And Simulation of Manufacturing Systems	MCE 2009	Advanced Finite Element Analysis
MCE 2004	Precision Engineering	MCE 2010	Integrated Product Design & Development
MCE 2005	Advanced Manufacturing Planning and Control	MCE 2011	System Dynamics
MCE 2006	Advanced Materials Removal Processes	MCE 2012	MEMS Modeling

List Of Department Electives For Second Semester**

1. **MCD 2001** Principles of Robotics And Applications
2. **MCD 2002** Computational Fluid Dynamics
3. **MCD 2003** Tool and Die Design
4. **MCD 2004** Information System For Manufacturing
5. **MCD 2005** Total Quality Management
6. **MCD 2006** Creative Engineering Design

SEMESTER III

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam hours	Marks			Remarks
					Continuous Assessment	End Semester Exam	Total	
***	Stream Elective III	3	3	3	40	60	**100**	Of the 40 marks of internal Assessment, 25marks for test and 15 marks for assignment End Sem Exam is conducted by the Individual Institutions
***	Stream Elective IV	3	3	3	40	60	**100**	do
**	Non-Dept. (Interdisciplinary) Elective	3	3	3	40	60	**100**	do
MCC 3101	Thesis – Preliminary – Part II	5	14	-	200	-	**200**	No End Sem Examinations
	TOTAL	**14**	**23**	-	**320**	**180**	**500**	5 hours of Departmental assistance work

List of Stream Electives for Third Semester

STREAM ELECTIVE III		**STREAM ELECTIVE IV**	
MCE 3001	Composite Material Technology	MCE 3005	Cellular Manufacturing Systems
MCE 3002	Statistical Process Control and Non Destructive Testing	MCE 3006	Lean Manufacturing
MCE 3003	Meshless Methods	MCE 3007	Six Sigma
MCE 3004	Hydraulics and Pneumatics	MCE 3008	Reliability Engineering and Total Productive Maintenance

List of Non- Department Electives** for Third Semester

1. **MCI 3001** Artificial Intelligence In Cim
2. **MCI 3002** Advanced Numerical techniques
3. **MCI 3003** Nanotechnology
4. **MCI 3004** Surface Engineering

SEMESTER IV

Code No	Subject Name	Credits	Hrs/week	Marks					Remarks
				Continuous Assessment		University Exam		Total	
				Guide	Evaluation Committee	Thesis Evaluation	Viva Voce		
MCC 4101	Thesis	12	21	150	150	200	100	600	8 hours of Departmental assistance work
	Total	**12**	**21**					**600**	

M.Tech in Mechanical Engineering

Specialization: Computer Integrated Manufacturing

SYLLABUS

SEMESTER I

MCM 1001 Applied Mathematical Modeling

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Make a mathematical model of a technical problem using ordinary or partial differential equations
Analyze the mathematical model using mathematical analysis
Implement a variety of problem-solving strategies.
Demonstrate the iterative techniques for the solution of linear algebraic systems
Demonstrate the concepts of numerical differentiation and integration
To study concepts and techniques in statistical methodology

Learning Outcomes

Apply problem-solving using techniques in differential equations and vector and tensor calculus in diverse situations in physics, engineering and other mathematical contexts.
Analyze the convergent properties of the iterative algorithms
Find the numerical approximation of the integrals
To design and conduct experiments, as well as to analyze and interpret data

Module 1

Vector and Tensor Analysis in Cartesian system, effect of rotation of coordinate systems. Review of ODEs; Laplace & Fourier methods, series solutions, and orthogonal polynomials. Sturm-Liouville problem. Review of 1st and 2nd order PDEs.

Module 2

Linear systems of algebraic equations. Gauss elimination, LU decomposition etc., Matrix inversion, ill-conditioned systems.
Numerical Eigen solution techniques (Power, Householder, QR methods etc.). Numerical solution of systems of nonlinear algebraic equations; Newton-Raphson method.
Numerical integration: Newton-Cotes methods, error estimates, Gaussian quadrature.

Module 3

Numerical solution of ODEs: Euler, Adams, Runge-Kutta methods, and predictor-corrector procedures; Solution of PDEs: finite difference techniques.
Probability and Statistics – Probability Distribution, conditional probability, moment generating functions, Baye’s Theorem.
Testing of hypothesis, Tests for sample mean, difference of means single proportion, goodness of fit, testing of attributes

References:

1. E. Kreyzig, Advanced Engineering Mathematics, New Age International, 1996.
2. D. S. Watkins, Fundamentals of Matrix Computations, John Wiley, 1992
3. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, 3rd Ed., New Age International, 1993
4. D.S. Chandrashekaraiah and L. Debnath, Continuum Mechanics, Academic Press, 1994.

5. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Computational Methods for Partial Differential Equations, New Age International, 1994
6. R. Courant and D. Hilbert, Methods of Mathematical Physics, Wiley, 1989.
7. P.V. O'Neil, Advanced Engineering Mathematics, Cengage Learning, 2007
8. G. B. Arfken, H. J. Weber and F.Harris, Mathematical Methods for Physicists, 5th Ed., Academic Press,

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCC 1002 CAD/CAM

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To produce knowledgeable users of CAD systems.
Understand the various CAD/CAM and CNC processes.
To study advanced features of CAM
To understand the associativity between design and manufacturing

Learning Outcomes

To synthesize and apply the concepts learnt
Describe various operation in numerical control system and part programming
Describe CNC machining and interfaces of CAM and CNC
Undertake, under supervision, laboratory experiments to design in CAD and to program in CAM for machining

Module 1

Computer Aided Design – Definition, Functional areas, CAD methodology, CAD System architecture. Interactive Computer Graphics: - 2D and 3D Display control facilities – Vector generation, Windowing Clipping Reflection, Zooming, panning and Perspective transformation, Brightness modification. Hidden line removal, Hidden surface removal and shading 2D and 3D transformation: - Translation, Scaling Rotation and Reflection- Projections parametric representation of Ellipse, Parabola, Hyperbola.

Module 2

CAD/CAM Data Exchange: Evaluation of data- exchange formats, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

Basic components of an NC system, classification, merits and demerits, applications, the cost of NC/CNC, dimensioning systems, axes designation, NC motion control, interpolation, part programming formats, manual part programming, NC words, codes cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, sub routines, do loop, mirroring features macro statements, application of NC to machine tools and other applications, NC coding systems (ISO and EIA)

Module 3

APT statements, programming, NC part programming using CAD/CAM, manual data input (MDI), engineering analysis of NC positioning systems, open loop and closed loop positioning systems, precision in NC positioning
Computer Numerical Control (CNC) and DNC: Features of CNC, Elements of CNC machines, the machine control unit for CNC, CNC software, direct numerical control, distributed numerical control
CAD – CAM Integration – Introduction, Identification of Cut boundaries and cutting tools, Cutter path and Cutter specification DATA (CLDATA).

References:

1. Ibrahim Zeid, CAD/CAM, " Theory and Practaice ", Tata McGraw-Hill Co. Ltd. New Delhi
2. David F.Rogers and Alan Adams.J, " Mathematical Elements for Computer Graphics ",McGraw-Hill Publishing Company International Edition,
3. William M.Newman, Robert F.Sproull, " Principles of Interactive Computer Graphics", McGraw-Hill International Book Company,
4. Groover M.P., Automation, " Production Systems and Computer Integrated Manufacturing" Prentice-Hall of India Pvt.Ltd., New Delhi,
5.Hans B. Kief and J. Frederick Waters "Computer Numerical Control" Glencae Macmillan/McGraw Hill
6. Steve Krar and Arthar Gill, "CNC Technology and Programming", McGraw Hill Pub. Company, New Delhi.
7. Nicholas John M. "Competitive Manufacturing Management" McGraw Hill International

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCC 1003: Advanced Materials and Their Processing

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

This course provides knowledge in the areas Of Metallurgy, chemical Properties, heat treatment, advanced materials and selection of materials for important applications.

Learning Outcomes

To impart knowledge at an advanced level in advanced materials and their processing

Module 1

Solid materials: Classification, Ceramics, composites and metal glasses, Super hard materials, Plastics. Magnetic alloys, Bearing alloys, Aluminium, Titanium and their alloys. Intermetallics, Ni and Ti aluminides . Alloying techniques-Thermal, mechanical and chemical methods, Power metallurgy techniques.

Module 2

Advanced metallic materials: Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel. Nanomaterials: Preparation of nano particles, synthesis, properties and applications of SiC, Alumina, Zirconia and nano crystalline materials,

Module3

Biomaterials, Superalloys, Smart materials, Shape memory alloys: Principle, types, applications. Advanced Composite Materials: Classification, Processing and Applications of GFRP and CFRP. Advanced structural ceramics: WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN and diamond: properties and applications.

References :

1. Flinn,P , Trojan,P,K., “Engineering Materials and Applications”, MIR Publications
2.Bhargava, A.K.,” Engineering Materials: Polymers, Ceramics and Composites” Prentice Hall of India
3.Balasubramaniam,R., “Callister's Materials science and Engineering” , Wiley - India
4.Kalpakjian.,”Manufacturing processes for Engineering Materials”, Wesley Publishing Co.
5. Bandyopadhyay ,A,K., “Nano Materials”, New Age International.
6. Rama Rao,P., “Advances in Materials and Their Applications”, Wiley Eastern

Structure of the Question paper

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MCC 1004 Finite Element Analysis in Manufacturing

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Develop comprehensive knowledge in the fundamental mathematical and physical basis of FEM.

Know how to do build FEM models of physical problems and apply appropriate constraints and boundary conditions along with external loads followed by an analysis.

Develop a complete FEM solution strategy for analysis of mechanical systems

Learning Outcomes

Students will be able to:

Explain the basic theoretical principles of the Finite Element method.
Employ industry-standard software for interactive FE model generation, analysis and the post-processing of results
Formulate the boundary conditions of a problem in a suitable form for correct analysis
Assess alternative strategies (of element type, mesh design, boundary condition definition etc.) for economical and accurate FE modeling of specific 2D, 3D and axisymmetric structural problems

Module 1

Introduction, historical background, general procedure, applications, advantages, Theory of elasticity, stress and equilibrium, strain displacement relationship, plane stress, plane strain and axi-symmetric approximation. Temperature effect.
Potential energy and equilibrium, principles of minimum potential energy. The Raleigh Ritz method, Gelarkin method, Saint – Venant's principle.
Solution of Algebraic equations, Banded and skyline solutions, Numerical Integration using Guass quadrant.

Module 2

Finite element modelling – Types of elements, Discretization. Shape functions – Types (linear and quadratic).
Boundary conditions, penalty and elimination approach, Multipoint constraints, local and global co-ordinates derivation of element equations on axial beam, bending beam elements, transformation matrices, assembly procedure. Global equations, load vector, properties of stiffness matrices.
2D problems with CST, Axi-symmetric solid subjected to axi-symmetric loading. Two – dimensional isoparametric elements.

Module 3

3D Problems in stress analysis Scalar field problems, Dynamic problems – Element mass matrices. Evaluation of Eigen value and Eigen vectors.

Introduction to finite element packages, capabilities and limitations. 2D and 3D finite element modelling, Mesh generation, triangular, quadrilateral, tetrahedron and hexahedron elements. Finite element modelling, mesh preparation, node and element numbering, applying boundary conditions and load. Specifying contact conditions. Plane strain, axi-symmetric and three dimensional analysis. Post processing.

Solving elemental manufacturing problems like upsetting, sheet bending, drawing, extrusion.

References:

1. Rao, S. S., The Finite Element Method in Engineering, 5th Edition, Elsevier 2011

2. Reddy, J.N. " An Introduction to the Finite Element Method ", McGraw-Hill, 1985.

3.Thirupathi R chamdrupatla, Belegundu,A.D., "Introduction to Finite Elements in Engineering ", PHI, 2006.

4. Bathe, K.J., " Finite Element Procedures in Engineering Analysis, PHI,2010.

5. Kobayashi, S, Soo-Ik-Oh and Altan, T, " Metal Forming and the Finite Element Methods ",Oxford University Press, 1989

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCC 1005 CNC Machine Tools

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

This course makes students understand the emergence and development of numerical control machine, characteristics and application areas, master basic knowledge of transmission of machine, numerical control machine tool working principle and composition, master CNC machinery structure and nc machining system technology and equipment, understand all kinds of typical numerically-controlled machine tool, in order to adapt to the needs of the development of the modern industry.

Learning Outcomes

The students will be able to:

Learn NC Programming (Manual and Computerised), Design and machine using CAD/CAM packages, Toolpaths Creations, Toolpath Verifications,Understand advanced features of CAD/CAM

Module 1

Development of CNC Technology (machines):- principles, features, advantages, economic benefits, applications, CNC,DNC concept.
Working principles of typical CNC lathes/turning centre, machining centre, CNC grinders, CNC press brakes, Laser cutting machines
Elements used to convert the rotary motion to a linear motion - Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion.
Linear motion guideways, magnetic slides, tool magazines, ATC, APC, chip conveyors, tool turrets. Tool holders, Work holding devices

Module 2

Torque transmission elements - gears, timing belts, flexible couplings, Bearings. Spindle bearings, Main Spindle design , Ball screw design and assembly principle, Lenear slide design and assembly
shunt motor, AC induction motor, Axis feed drives – stepper motor, servo motor, Encoder, Tachogenerators, semsors and other feed back device for CNC machiens
Open loop and closed loop systems, microprocessor based CNC systems, block diagram of a typical CNC system, standard and optional features of a CNC control system, comparison of different control systems.

Module 3

Part Programming of a CNC Lathe**:** Axes definition, machine and workpiece datum, turret datum, absolute and incremental programming, G and M functions, tool offset information, tool nose radius compensation, long turning cycle, facing

cycle, constant cutting velocity, threading cycle, peck drilling cycle, part programming examples.
Manual Part Programming of a Machining Centre**:** Co-ordinate systems, cutter diameter compensation, fixed cycles- drilling cycle, tapping cycle, boring cycle, part programming examples.

References:

1. Radhakrishnan P, "Computer Numerical Control (CNC) Machines", New Central Book Agency, 1992.
2. Yoram Koren, "Computer Control of Manufacturing Systems", Tata McGraw Hill Book Co., 2005.
3. David Gibbs and Thomas Crandall, *CNC Machining and Programming: An Introduction*, Industrial Press Inc., 2003.
4. THK (TSK) Ball Screws and Linear Motion Systems Manual, 1998.
5.Kirloskar DC Servo Motors Catalogue, 1995. Use Siemens or Fanuc servomotor manual
6. Programming Instruction Manuals of CNC Lathes and Machining Centres, 2001.
7. Korta, "Ball Screws" 1985..
8. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi,1998.
9. James Madison, " CNC Machining Hand Book ", Industrial Press Inc., 1996.
10. Sadasivan, T.A. and Sarathy, D, " Cutting Tools for Productive Machining ", Widia (India)Ltd., August 1999.
11. Peter Smid, " CNC Programming Hand Book ", Industrial Press Inc., 2000. Siemens or fanuc CNC programme manual

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCC 1006 Instrumentation and Control Systems

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives:

To provide knowledge on the fundamentals of measurement science and measuring instruments
To provide a knowledge on the basics of control system theory

Learning Outcomes

Students will be conversant with measurement techniques and the use of measuring instruments
Students will have working knowledge for dealing with problems involving control system fundamentals

Module1

Instrument classification, characteristics of instruments- static and dynamic, error analysis , systematic, and gross errors, statistical analysis. Different types of sensors and transducers ,resistance,inductance, capacitance, piezoelectric, thermoelectric, photoelectric, strain gauges.

Module2

Measurement of linear motion, velocity, acceleration, force, torque, strain, vibration, noise level, pressure,temperature, flow rate, humidity, Data acquisition systems , Virtual instrumentation, Condition monitoring.

Module3.

General theory of automatic control- significance of feedback effects in different physical systems- linear and non linear systems- lumped and distributed parameter systems, use of random input- output data in the determination of system characteristics. First and second order system with step, ramp and impulse response. Transfer functions. Criteria for stability, Routh- Hurwitz Criteria, Root locus Plot, Nyquist plot, control systems in NC/CNC machines.

References:

1. Doeblin E.O., Measurement Systems- Application and Design, McGraw hill
2. Bechwit, Marangoni & Lienhard.,Mechanical measurements , Pearson edu.
3. Considine D. M., Process Instruments and Control Handbook 4/e, McGraw Hill.
4. Jones B.E Butterworths., Instrument technology – Vol1,Scientific Pub., London.
5. Katsuhiko Ogata.,Modern control engineering , Prentice Hall Of India Pvt Ltd
6. Sahni,A,K., Mechanical and industrial measurements, Dhanpat Rai

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCC 1101 CAD/CAM LAB

Structure of the Course

Practical : 2 hrs/ Week Credits : 1
Internal Continuous Assessment : 100 Marks

Computer Aided Drafting , Geometric Modeling
Modeling and analysis using FEA software,
Manual and computer assisted part programming and Component manufacture in machining centre/CNC Lathe
Simulation of Machining using CAM software

MCC 1102 Seminar

Structure of the Course

Seminar : 2 hrs/ Week Credits : 2
Internal Continuous Assessment : 100 Marks

The student is expected to present a seminar in one of the current topics in Mechanical, Computer Integrated Manufacturing and related areas. The student will under take a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester.

Marks: Seminar Report Evaluation: 50
Seminar Presentation: 50

SEMESTER II

MCC2000: RESEARCH METHODOLOGY 2-0-0

Structure of the Course

Lecture: 2 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Academic research is a training to do an actual research. The objective of this course is to give an introduction to the methodology, methods and tools for doing a research work at academic level independently.

Learning Outcomes

Reading, understanding and interpreting the contents of a research paper published in a reputed journal in international level pertaining to the area of specialization.

Ability to summarize analyzes and interprets data. Ability to formulate and test hypothesis.

Module I

Introduction – meaning of research- objectives of research-motivation in research- types of research-research approaches – significance of research- research methods Vs methodology – criteria for good research

Defining research problem- what is a research problem- selecting the problem- necessity of defining the problem- literature review – importance of literature review in defining a problem- critical literature review – identifying gap areas from literature review

Module II

Research design–meaning of research design-need–features of good design- important concepts relating to research design- different types – developing a research plan

Method of data collection–collection of data- observation method- interview method- questionnaire method – processing and analyzing of data- processing options- types of analysis- interpretation of results

Module III

Report writing – types of report – research report , research proposal, technical paper- significance- different steps in the preparation – lay out, structure and language of typical reports- simple exercises - oral presentation – planning, preparation, practice- making presentation – answering questions- use of visual aids- quality and proper usage – importance of effective communication with illustrations

References

1. Coley SM &Scheinberg CA, 1990, Proposal Writing, Newbury- Sage Publications
2. LeedyPD, Practical Research-Planning and Design,4thedition, MW Mac Millan Publishing Co
3. Day Ra "How to write and Publish a scientific paper", Cambridge University Press 1989
4. Earl Babbie – The Practice of Social Research – Wordsworth Publishing Company – 1994.
5. Institute of Town Planners – India.
6. C.S. Yadav – City Planning – Administration & Participation
7. J.H. Ansari, Mahavir – ITPI Reading Material on Planning Techniques

Structure of the Question paper

For the End semester Examination There will be three questions from each module out of which two questions are to be answered by the students.

MCC 2001 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Emphasizes the integration of manufacturing enterprise using computer-integrated manufacturing (CIM) technologies. It employs CAD/CAM interface and other CIM sub-systems, database management, facility layout, Group technology, teamwork, and manufacturing operations.

Learning Outcomes

Develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.

Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.

Describe the integration of manufacturing activities into a complete system.

Module 1

Introduction to Manufacturing systems:CIM Technology,CIM models ,FMS Concepts-Definition of FMS – types– types of flexibility and performance measures,Different FMS layouts, advantages, disadvantages, components of FMS, manufacturing cell.

Group technology-classification and coding, production flow analysis, machine cell design-simple examples in design, FAS-Different methods.

Machining centres and turning centres,workpiece handling systems,loading and unloading-fixtures and pallets,head indexers

Module 2

Distributed numerical control: DNC system – communication between DNC computer and machine control unit – hierarchical processing of data in DNC system – features of DNC system.

Adaptive control in Machine control unit.

Automated material handling: Function - types – analysis of material handling equipments.Design of AGV systems.

Automated storage: Storage system performance – AS/RS – carousel storage system – WIP storage – interfacing handling storage with manufacturing,Analysis of AS/RS, Industrial robots.

Tool Management system-tool strategies-tool identification technologies and tool monitoring, Inspection stations-CMM and non contact inspection

Module 3

Networking concepts, LOSI, MAP,TOP,LAN,WAN,Communication interface,bus architecture, topologies ,protocols.

Manufacturing data base-Process planning, CAPP, ERP modules.

Development and implementation of FMS: Planning phases, scheduling – integration – system.
configuration – simulation – FMS project development steps.– hardware and software development.
Installation and implementation. Application and benefits of FMS, Quantitative analysis of FMS.

References:

1.Parrish D. J, "Flexible manufacturing", Butterworth – Heinemann Ltd, 1990
2. Groover M. P, "Automation, production systems and computer integrated manufacturing", Prentice Hall India (P) Ltd., 2002
3.Shivanand H. K., Benal M. M and Koti V, "Flexible manufacturing system", New AgeInternational (P) Limited. Publishers, 2006
4. Kusiak A., "Intelligent manufacturing systems", Prentice Hall, Englewood Cliffs, NJ,1990
5.Considine D. M. & Considine G. D, "Standard handbook of industrial automation",Chapman and Hall, London, 1986
6. Ranky P. G, "The design and operation of FMS", IFS Pub, U. K, 1998
7.Joseph Talavage & Hannam, "Flexible Manufacturing Systems in Practice", Marcel Dekker Inc.
8. Kant Vajpayee, "Principles of Computer Integrated Manufacturing",Prentice Hall of India.

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MCC 2002 COMPUTER AIDED INSPECTION

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objective:

To teach the basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries.

Expose to various modern metrological instruments and the procedure used to operate these instruments.

Learning Outcome:

To give a thorough knowledge of measurement and instrumentation of increasing importance in industry.

The student will be knowledgeable in various standards and proliferation of computerized and automated inspecting techniques.

Module 1

Laser Metrology – Types of lasers and features – Optics and its arrangements in laser metrology- Applications of lasers in calibration, measurements – Laser interferometry for form measurement, speckle measurements, Laser scanners. Errors in laser measurements.

Module 2

Co-ordinate measuring machine (CMM) – Contact type CMM – Configurations, parts and its features, types of probes, probe compensation. Non-Contact type CMM – Features, probes. Specifications.

Errors in CMM measurement – Calibration of CMM – measuring scales, accuracy – Moiré fringes – Applications of CMM for dimensional and form measurements.

Module 3

Machine Vision Metrology: Machine vision system – Methods for sensing objects, image processing, segmentation, pattern recognition. Filters in image processing and analysis. Image histogram and processing. Applications in metrology.

Reference:

1. Thomas. G. G., “Engineering Metrology”, Butterworth Pub.1974.
2. Ulrich-Rembold, Armbruster and Ulzmann., “Interface Technology for Computer Controlled Manufacturing Processes”, Marcel Dekker Pub. New York,1993
3. John A Bosch., “Co-ordinate Measuring Machines and Systems”, Marcel Dekker, Inc.1995
4. Fu S., Gonzalez R.C., Lee C.S.G., Robotics: Control, Sensing, Vision, and Intelligence. Tata MGH, New Delhi 1987.

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MCC 2101 CIM Lab

Structure of the Course

Practical : 2 hrs/ Week Credits : 1
Internal Continuous Assessment : 100 Marks

Practice on Computer Aided Measuring Instruments
Image Processing ,PLC Controllers
Exposure to advanced CAM Packages.
Study on robotics, programming.
Study on FMS- Practice on Rapid Prototyping

MCC 2102 Thesis – Preliminary – Part 1

Structure of the Course

Thesis: 2 hrs/ Week Credits : 2
Internal Continuous Assessment : 100 Marks

For the thesis- preliminary Part I the student is expected to start the preliminary background studies towards the Thesis by conducting a literature survey in the relevent field. He/ she should broadly identify the area of the thesis work, familiarize with the design and simulation tools required for the thesis work and plan the experimental platform, if any, required for the thesis work. The student should submit a detailed report of these activities at the end of the semester.

Evaluation of marks for the thesis preliminary part I
Evaluation of the thesis – preliminary work by the guide - 50 marks
Evaluation of the thesis – preliminary by the Evaluation Committee - 50 marks

MCC 2103 Seminar

Structure of the Course

Seminar : 2 hrs/ Week Credits : 2
Internal Continuous Assessment : 100 Marks

The student is expected to present a seminar in one of the current topics in Mechanical, Computer Integrated Manufacturing and related areas. The student will under take a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester.

Marks: Seminar Report Evaluation: 50
Seminar Presentation: 50

STREAM ELECTIVES

FOR

SECOND SEMESTER

STREAM ELECTIVE I
MCE 2001 MECHATRONICS SYSTEM DESIGN

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Introduce the students the main components of mechatronics system design and principles, namely modelling of physical system, sensing components, actuating devices, signal and control, real-time interface.
Provide the knowledge of basic system elements and actuation, various system models, basic digital principles and system design.
It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

Learning Outcomes

Apply mechatronic concepts to actual problems encountered in engineering practice.

Module I

Introduction to Mechatronics - Systems- Need for Mechatronics - Emerging area of Mechatronics - Classification of Mechatronics - Measurement Systems – Control Systems.
SENSORS AND TRANSDUCERS:Introduction - Performance Terminology – Potentiometers - LVDT – Capacitance, sensors - Strain gauges - Eddy current sensor - Hall effect sensor – Temperature,sensors - Light sensors - Selection of sensors - Signal processing.

Module II

Actuators – Mechanical - Electrical - Fluid Power - Piezoelectric – Magnetostrictive - Shape memory alloy - applications - selection of actuators.
PROGRAMMABLE LOGIC CONTROLLERS:Introduction - Basic structure - Input and output processing - Programming - Mnemonics- Timers, counters and internal relays - Data handling - Selection of PLC.

Module III

DESIGN AND MECHATRONICS CASE STUDIES:
Designing - Possible design solutions-Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Conveyor based material handling system - PC based CNC drilling machine – Mechatronics Control in automated Manufacturing – Data Acquisition Case studies.

References:

1. Bolton.W, “Mechatronics”, Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.

3. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company, 2007.
4. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006.
5. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and applicatlions” Tata McGraw-Hill Publishing Company Limited, 2003.
6. Michael B.Histand and Davis G.Alciatore,”Introduction to Mechatronics and Measurement systems”. McGraw Hill International edition, 1999.
7. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, “Mechatronics” Nelson Thornes

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2002 DESIGN FOR MANUFACTURE AND ASSEMBLY

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To provide students with the knowledge, methodologies, and practice to optimize the design of mechanical products for ease of assembly in manufacturing.
To analyze designs in terms of DFA and redesign to improve assembly.
To quantify and compare improvements in assembly resulting from design revisions.

Learning Outcomes

The student will be able :

To characterize and describe assembly, understand different assembly systems that are in use today.
Utilize effective analysis, brainstorming, and trade-off techniques for redesigning assemblies and subassemblies
To apply DFA principles to mechanical product design.
To design parts to facilitate assembly and to estimate rates of feeling and orientation of small parts.

Module 1

Tolerancing: Geometric tolerances for manufacture as per Indian Standards and ASME Y 14.5 standard, representation of surface finish. Limits and fits, tolerance chains and identification of functionally important dimensions for applications. Statistical tolerance indication in mechanical drawings, population parameter zone in the μ, σ plane defined using Cp, Cpk.
Tolerance stack up analysis: Dimensional chain analysis-equivalent tolerances method, equivalent standard tolerance grade method, equivalent influence method.

Selective assembly: Interchangeable part manufacture and selective assembly, deciding the number of groups, group tolerances of mating parts.

Module 2

True position theory: 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, zero true position tolerance, compound assembly
Automatic assembly: Transfer systems – Continuous and intermittent - Indexing mechanisms. Methods for feeding, orienting and escapement for various forms of parts. Case study: Vibratory feeder.
Design for Manufacture and Assembly (DFMA): DFMA as the tool for concurrent engineering, DFMA criteria for retaining components for redesign of a product.
Tools for total design: Quality function deployment (QFD), failure modes and effects analysis (FMEA). Computer-aided design for assembly using software.

Module 3

DFMA: General part design guidelines for manual assembly, development of systematic Design for Assembly (DFA) methodology, assembly efficiency, classification system for part handling, effect of various part features in handling and assembly. Typical case studies.

High speed automatic assembly: Part feeding and orienting. Part design for automated assembly- general principles and guidelines for mechanical assembly. Guidelines for robotic assembly. Case study: Assembly of printed circuit board

References:

1. Boothroyd G, Dewhurst P and Knight W, "Product Design for Manufacture and Assembly", Marcell Dekker, 1992.
2. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.
3. Matousek, "Engineering Design - A Systematic Approach", Blackie and Son Ltd., London, 1974.
4. Oliver R Wade, "Tolerance Control in Design and Manufacturing" Industrial Press Inc., New York, 1967.
5. Poli C, "Design for Manufacturing: A Structured Approach", Butterworth Heinemann.
6. Owen Molloy, Steven Tilley, Ernest A. Warman, "Design for Manufacturing and Assembly: Concepts, Architectures and Implementation", Springer, 1998

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2003 MODELING AND SIMULATION OF MANUFACTURING SYSTEMS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To understand the nature of discrete-event simulation and the types of simulation models
To understand the broad applicability of discrete-event simulation to solve complex manufacturing systems problems
To learn the essential steps of the simulation methodology
To gain insight into system behavior by measuring the performance characteristics of proposed new manufacturing system or the impact of proposed changes for existing manufacturing system

Learning Outcomes

Explain various methods of evaluating manufacturing system designs based on key performance measures.
Evaluate and interpret alternative system designs
Apply simulation modeling to an industrial problem, utilizing experimental design techniques.

Module 1

MANUFACTURING SYSTEMS AND MODELS: Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building.

FLOW SHOP SYSTEMS: Assembly lines - reliable serial systems - approaches to line balancing – COMSOAL, ranked positional weight heuristic, branch and bound technique (optimal solution) – sequencing mixed models – unpaced lines. transfer lines and general serial systems – paced lines without buffers, two stage paced lines with buffers, introduction to unpaced lines.

Module 2

FLEXIBLE MANUFACTURING SYSTEMS: System components – planning and control hierarchy – system design, system setup, scheduling and control – flexible assembly systems.

CELLULAR SYSTEMS: Group technology – coding schemes – assigning machines to groups – production flow analysis, binary ordering algorithm, single pass heuristic, similarity coefficients, graph partition - assigning parts to machines.

JOB SHOP SYSTEMS: Facility layout- systematic layout planning, quadratic assignments problem approach – VNZ heuristic, branch and bound method – graph theoretical approach – decomposition of large facilities – net aisle and department layout.

Module 3

SUPPORTING COMPONENTS: Machine setup and operation sequencing – task assignment, task sequencing, integrated assignment and sequencing. material handling systems – conveyor analysis, AGV systems. Warehousing – storage and retrieval systems, order picking.

GENERIC MODELING APPROACHES: Queuing models – notations, performance measures, m/m/1 queue, m/m/m queue, batch arrival queuing systems, queues with breakdowns – queuing networks – open and closed networks, central server model.
MODELING THROUGH PETRI NET: Basic definitions – classical petri nets – transformation firing and reachability, reachability graphs – representation schemes – timed Perti nets - modeling of manufacturing systems.

References:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993.
2. Viswanatham N and Narahari Y "Performance Modeling of Automated Manufacturing Systems", Prentice Hall Inc., 1992.
3. Mengchu Zhou, "Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach", World Scientific Publishing Company Pvt Ltd., 2000.
4. Jean Marie Proth and Xiaolan Xie, "Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley and Sons, New York, 1996.
5. Brandimarte P and Villa A, "Modeling Manufacturing Systems" Springer Verlag, Berlin, 1999.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2004 PRECISION ENGINEERING

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To expose the students about the concepts of micro and precision manufacturing, the various processes involved in it and, the metrology of the micro and precision manufactured components

Learning Outcomes

Students will be able to

Identify the distinguish elements of bulk micromachining and surface micromachining

Describe the micromachining processes required to fabricate various MEMS devices.

Module 1

ACCURACY: Concept of accuracy – accuracy of numeric control systems, acceptance test for machine tools.

FACTORS AFFECTING ACCURACY: Static stiffness and its influence on machining accuracy, inaccuracies due to thermal effects, influence of forced vibrations on accuracy, dimensional wear of cutting tools and its influence on accuracy.

Module 2

MICRO FINISHING PROCESS: Surface roughness, bearing area curves, surface texture measurement, methods of improving accuracy and surface finish, finish boring, finish grinding, precision cylindrical grinding, micro machining, precision micro drilling.
BULK MICRO MACHINING AND NANO TECHNOLOGY: Wet etching, isotropic etching, anisotropic etching, dry etching, physical etching, reactive ion etching, Nano Technology, nano-grating system, nano-lithography, fabrication of CCDS, nano processing of materials for super high density ICs, nano-mechanical parts.

Module 3

MICRO ELECTRO MECHANICAL SYSTEMS: Introduction to silicon processing, wafer cleaning, diffusion and ion implantation, oxidation, photolithography, photo resist, resist strip, electron beam and X-ray lithography, thin film deposition, evaporation, sputtering, molecular beam epitaxy, chemical vapour deposition, electro plating.

UNCONVENTIONAL MACHINING: EDM machining, electro mechanical grinding, electron beam machining, laser beam machining. micro EDM and its applications, micro machining with laser

References:

1. Murthy R L, "Precision Engineering in Manufacturing", New Age International Publishers, 1996.
2. Mark J Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002.

3. Niño Tanigudi, “Nanotechnology”, Oxford University Press, New York, 2003.
4. Davidson, “Handbook of Precision Engineering”, Vol. 1, 12, McMillan, 1972.
5. Jaeger R C, “Introduction to Micro Electronics Fabrication”, Addison Wesley, England, 1988.
6. Chang C V and Sze S M , “VLSI Technology”, Tata McGraw Hill, New Delhi, 2003.
7. Bhart Bhusshan, “Handbook of Nano Technology”, Springer Germany, 2004.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2005 ADVANCED MANUFACTURING PLANNING AND CONTROL

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To introduce the student to a broad array of topics that fall under the umbrella of manufacturing planning and control; this includes an exposure to the terminology,concepts, principles, etc. associated with the area.
To develop a basic understanding of traditional planning techniques used by tactical and operational managers in real world organizations.
To introduce students to new approaches for planning and control

Learning Outcomes

Students will be able to understand the production information systems objectives and functionality, able to understand how manufacturing, MPS, PRP tables are processed.

Module 1

Introduction to Manufacturing Systems Engineering: Process Planning, Logical design of process planning, Computer Aided Process Planning (CAPP), Computerisation of file management; Variant (Retrieval), Generative and demigenertaive approaches, General remarks on CAPP developments and trends.
Resource Planning & Production Control: Overview of production control, Forecasting, Master production schedule, Materials requirements planning, Evolution from MRP to MRP II, Evaluation of MRP approach, Order release, Shop floor control.

Module 2

Just in Time (JST) Production: Introduction- The spread of JIT movement, Some definitions of JIT, Core Japanese practices of JIT, Profit through cost reduction, Elimination of over production, Quality control, Quality assurance, Respect for humanity, Flexible work force, JIT production adapting to changing production quantities, Process layout for shortened lead times, Standardization of operation, automation.

Module 3

Toyota Production System (TPS): Philosophy of TPS, Basic frame work, Kanbans, Determining number of Kanbans inTPS
(a) Kanban number under constant quantity withdrawal system
(b) Constant cycle, Non-constant quantity withdrawal system
(c) Constant withdrawal cycle system for the supplier Kanban
Supplier Kanban and the sequence schedule for use by suppliers
(a) Later replenishment system by Kanban
(b) Sequence withdrawal system
Production smoothing in TPS, Production planning, Production smoothing, Adaptability to demand fluctuations, Sequencing method for the mixed model assembly line to realize smoothed production of goal.

References :

1. Halevi, G, Weill, R.D., Principles of Process Planning, Chapman and Hall
2. Yasuhiro Monden, Toyota production System-An IntegratedApproach to Just in Time, CRC Press
3. Chary,S,N.,Production and Operations Management, Tata McGraw Hill
4. Monks, J,G., Operations Management, McGraw Hill
5. Francis, R,L., Leon Franklin McGinnis., John A. White., Facility Layout and Location, Prentice Hall
6. Cheng, T,C., Podolsky, S., Just in Time Manufacturing, Springer
7. James P. Womack., Daniel T. Jones., Lean Thinking, Simon & Schuster

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2006 ADVANCED MATERIAL REMOVAL PROCESSES

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives : To understand metal cutting and cutting tool materials, special machining processes, unconventional machining processes, micro machining processes .

Learning Outcomes: To impart knowledge in various fields of advanced manufacturing technology

Module 1

Deformation of metals during machining – Mechanics of Orthogonal cutting – Thin Zone models – Thick Zone models – Shear angle relation ship – Oblique cutting – Friction in metal cutting – cutting fluids – Cutting temperature

Module II

Tool wear – Tool life and machinability – Economics of Machining – Development of tool Materials – tool / insert specifications – Abrasive process – Diamond Turning – Creep feed gracing – Honing –Lapping – super finishing – High Quality surfaces.

Module III

Ultrasonic machining – Thermal Metal removal process – ECM – Chemical machining , LBM, EDM, Wire Cut EDM – Micro machining.

Reference: -

1. E.J.A. Armarego & R.H. Brown ,The Machining of Metals ,Prentice Hall Inc.
2. A. Bhattacharyya ,Metal Cutting Theory Practice New Central Book Agency (p) Ltd, Calcutta.
3. M.C. Shaw ,Metal Cutting Principles ,CBS Publishers
4. Geoffry Boothroyd ,Fundamentals of Metal Machining and Machine Tools ,McGraw Hill
5. K.C. Jain & L.N. Agrawal ,Metal Cutting Science and Production Technology
6. V. Arshinov ,Metal Cutting Theory & Cutting Tool Design ,MIR Publishers.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

STREAM ELECTIVE II

MCE 2007 RAPID PROTOTYPING, TOOLING AND MANUFACTURE

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives :

Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

Learning Outcomes

Student should be able to:

Develop an understanding of the emerging technologies of rapid prototyping, rapid manufacturing and rapid tooling.

Develop a degree of competency in the evaluation of various rapid manufacturing and rapid tooling technologies and their application in modern manufacturing processes

Module 1

Introduction: Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling – Benefits - Applications.

Reverse Engineering And Cad Modeling: Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats – Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

Module 2

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, postbuild processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.

Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications.

Module 3

Powder Based Rapid Prototyping Systems:

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping(LENS):Processes, materials, products, advantages, limitations and applications.

Other Rapid Prototyping Technologies:

Three Dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications. Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing.

Reference:

1. Chua C.K., Leong, K.F., and Lim C.S Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2003.
2. Andreas Gebhardt, Rapid prototyping, Hanser Gardener Publications, 2003.
3. Liou W.Liou, Frank W.Liou, Rapid Prototyping and Engineering applications : A tool box for prototype development, CRC Press, 2007.
4. Ali K. Kamrani., Emad Abouel Nasr., Rapid Prototyping: Theory and practice, Springer, 2006.
5. Ali K. Kamrani, Emad Abouel Nasr, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, Rapid Tooling: Technologies and Industrial Applications, CRC press, 2000

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2008 COMPUTER AIDED PROCESS PLANNING AND CONTROL

Structure of the Course

Lecture : 3 hrs/ Week   Credits : 3

Internal Continuous Assessment : 40 Marks

End Semester Examination   : 60 Marks

Course Objectives

To develop an understanding of the underlying knowledge and related methods of Computer Aided Process Planning.

To equip the students with the skills required in carrying out the process planning (PP) function in a computer integrated manufacturing environment

Learning Outcomes

Students will be able to

Implement Manual and Computer Aided Process Planning systems based on process planning criteria, and implementation and economic considerations

Describe the process planning functions, the role of process planning in manufacturing, the characteristics of traditional and Computer Aided Process Planning (CAPP) systems, and the structure of typical CAPP systems

Module 1

Introduction: The place of process planning in the manufacturing cycle - process planning and production planning – process planning and concurrent engineering, capp, group Technology.

Design drafting - dimensioning - conventional tolerance - geometric tolerance – geometric modelling for process planning.

Module 2

Process engineering and process planning: GT coding - the optiz system - the MICLASS system. Experienced, based planning - decision table and decision trees - process capability analysis - process planning - variant process planning - generative approach – forward and backward planning, input format, AI**.**

Module 3

Computer aided process planning systems: Logical design of a process planning - implementation considerations – manufacturing system components, production volume, no. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

Intergrated process planning systems: Totally integrated process planning systems – an overview - modulus structure – data structure, operation - report generation, expert process planning.

References:

1. Gideon Halevi and Roland D. Weill, “Principles of process planning - a logical approach”, Chapman & Hall, 1995

2. Tien-Chien Chang, Richard A.Wysk, “An introduction to automated process planning systems”, Prentice Hall, 1985

3. Chang, T. C., “An expert process planning system”, Prentice Hall, 1985

4. Nanua Singh, “Systems approach to computer integrated design and manufacturing”, John Wiley & Sons, 1996

5. Rao, “Computer aided manufacturing”, Tata McGraw Hill, 2000

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2009 ADVANCED FINITE ELEMENT ANALYSIS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course objective

To introduce advanced topics in FEA.
Emphasizes are on the mathematical foundations of the method, numerical algorithms for software implementation, and analysis of problems with materials and geometric nonlinear behavior. The course aims to investigate practical problems in detail

Learning Outcome

To perform complete FE formulations for engineering analysis
To write codes for a finite element model
To use commercial FEA software to solve engineering problems
To apply finite element methods in design engineering components or systems

Module 1

Bending Of Plates And Shells : Review of Elasticity Equations-Bending of Plates and Shells-Finite Element Formulation of Plate and Shell Elements-Conforming and Non Conforming Elements - Co and C1 Continuity Elements-Application and Examples

Non-Linear Problems

Introduction-Iterative Techniques-Material non-Linearity-Elasto Plasticity-Plasticity-Visco plasticity-Geometric Non linearity-large displacement Formulation-Application in Metal Forming Process and contact problems

Module 2

Dynamic Problem

Direct Formulation - Free, Transient and Forced Response - Solution Procedures-Subspace Iterative Technique -Houbolt, Wilson, Newmark - Methods – Examples

Module 3

Fluid Mechanics And Heat Transfer

Governing Equations of Fluid Mechanics-Inviscid and Incompressible Flow-Potential Formulations-Slow Non- Newtonian Flow-Metal and Polymer Forming-Navier Stokes Equation-Steady and Transient Solutions.

Error Estimates And Adaptive Refinement

Error norms and Covergence rates- high refinement with adaptivity-Adaptive refinement

References:

1. Zeinkiewicz,O.C and Taylor,R.L., "The Finite element Method",Fourth Edition,Volumes 1 & 2, McGraw Hill International Edition,Physics services,1991
2. Cook R.D. "Concepts and Applications of Finite Element Analysis", John Wiley and Sons Inc., NewYork,1989
3. Bathe K.J..,"Finite Element Procedures in Engineering Analysis", Prentice Hall ,1990

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2010 INTEGRATED PRODUCT DESIGN AND DEVELOPMENT

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Become familiar with the IE techniques used in different stages of Product Lifecycle Management. To understand and to plan and implement the technical aspects of product development within a company

Learning Outcomes

The students should be able to know clearly the following;

Be able to get product specifications after discussions with the customers
Be able to get concepts from scratch and design a product using the specified procedures of product development.
Be able to cost for every stage of the product development, and look out for ways of minimizing them**.**

MODULE 1

Product Development Process And Organization
Introduction - Product Development in the changing global world- stages of product development – early design, detailed design, prototyping, manufacturing, servicing, discard /recycle
Product development organization – Concurrent engineering - Definition – CE Design Methodologies – CE organization – collaborative product development – Requirement definition- product requirement and definition

MODULE 2

Integration Of Product Development Phases
CAD/CAM data exchange – data exchange standards, IGES, STEP ISO – Product data management – Concept – function – 3 tire architecture- product structure – product process – configuration
Management – Engineering change management, Document management.
Product lifecycle – definition - Types of integration- file transfer, middle ware, and database

MODULE 3

Tools For Integration - IT enabled product development, Web based PDM architecture, CAD – PDM integration,
Integration approaches - feature based integration, Meta data based integration.
Internet Standards HTML,XML. Visualisation of CAD data, VRML

References

1. John W. Priest., Jose M. ,Product Development and design for manufacturing, Sanchez – Marcel Dekker Inc.
2. Karl T. Ulrich.,Steven D. Eppinger., Product Design and Development, 3rd Edition, McGRAW-Hill, 2003.
3. Rodger J. Burden., PDM: Product Data Management,2003

4. Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology", Wiley, John and Sons Inc., 1992.
5. Ibrahim Zeid., CAD/CAM Theory and Practice, McGraw-Hill,edition (1991)

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2011 SYSTEM DYNAMICS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To develop student's skills in analyzing dynamic systems through the application of transient response analysis

To develop the student's skills in proper modeling of mechanics to model mechanical, electrical and electromechanical systems

To introduce computational tools for the analysis of dynamic systems and the design and analysis of controllers

Learning Outcomes

Students will be able to create system equations for linear and rotary mechanical, electrical, hydraulic and thermal systems

Students should demonstrate mastery of first and second order system equations by, for example, forming transfer functions, relating the system's response to pole location, identifying time constants and natural frequencies, and producing the response to various inputs

Students will be able to compute, plot and understand the frequency response of a system

Module 1

Introduction – Dynamic system classification, Analysis and Design of Dynamic system, Mathematical modeling of Dynamic systems – Mechanical systems – Electrical systems, Electromechanical Systems – Fluid & Thermal system, Review of vibration of single degree, Two degree freedom systems, Review of matrix algebra and Laplace Transforms

Control systems – Introduction –,Control system configurations – Control system Terminology – Control system classes – Feedback systems – Analysis of Feedback Historical Developments of control systems – Control system analysis and Design Objectives.

Module 2

System Representation : Introduction – Block Diagrams – Block Diagrams Representation – Block Diagram Reduction – Signal flow graphs – Signal flow graph algebra – Mason's Gain formula – Zeros and Additional poles.
Performance Of Feedback Systems :Introduction – Properties of feedback – Transient response specifications – Controller types and actions

Module 3

Stability of control systems – Routh-Hurwitz criterion – Steady state error – Control system types.
Analysis Of Control Systems: Introduction – analysis of control systems – Root-Locus analysis – Bode analysis – Nyquist analysis - Nyquist stability criterion – Nichols chart analysis – Frequency Domain specifications.

References

1. Rao.V.Dukkipati, 'Engineering system Dynamics', Narosa Publishing House, 2004, New Delhi.
2. Benjamin C.Kuo, 'Automatic Control systems', Prentice-Hall of India Pvt. Ltd., 1995, New Delhi.
3. Thomson W.T., 'Theory of Vibration with Applications', CBS Publishers and Distributors, 1990,New Delhi.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 2012 MEMS MODELING

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To understand the basic physics (and multi-physics) governing the behavior and response of MEMS.

To understand the operation of a wide range of sensors and actuators appropriate for microscale systems encompassing different energy domains.

To study a complete microsystem manufacturing cycle including design, modeling and fabrication

Learning Outcomes

Students will be able to

Understand the micromachining techniques, including what they are, when to use them, and what needs to be considered when using them,Demonstrate proficiency in designing process sequences

Represent microsystems as generalized networks, suitable for design, analysis and simulation

Module 1

Introduction to Micro-Electro-Mechanical Systems, Applications and Materials, Advantages & Disadvantages of Micro-sensors, and micro-actuators.

Sensors and Actuators in Micro-domain : Concept of Sensors & Actuators, Sensing & Actuation Principles: Mechanical Sensing, Capacitive, Electrostatic, Electromagnetic, Piezo Resistive, Piezo Electric, Thin Films, Shape Memory Alloys , Comb Drive Actuation & Sensing. Micro-mechanisms, Air-Bag Sensors,Chemical Sensors,Sensors & Actuators for Automotive, Biomedical, Industrial applications , Design of sensor and actuator for few applications such as automobile accelerometer, bimetallic temperature sensor.

Module 2

Fabrication Methods

Microfabrication Methods (VLSI Techniques) , Positive and Negative Photoresists, Bulk Micromachining, Surface Micromachining, Etching (Isotropic and Anisotropic),Deposition techniques such as CVD (Chemical Vapor Deposition), Metallization Techniques.3D High Aspect Ratio Techniques : LIGA, AMANDA, Microstereolithography,IH-Process,X-Ray Techniques, Ion-beam Lithography etc.

Modelling and Simulation Techniques : Scaling Laws, Governing Equations, Modelling of Mechanical Structures via classical methods, Newtons Laws, Thermal Laws, Fluid Flow Analysis,Micro-mechanism modelling and analysis techniques : Lumped Parameter Modelling and Distributed Parameter Modelling

Module 3

Characterization Techniques,Topography Methods (Optical, Electrical and Mechanical Methods)Microscopy, STM (Scanning Tunneling Microscopes), SEM (Scanning Electron microscopes), SPM (Scanning Probe Microscopes), AFM (Atomic Force Microscopes)

Mechanical Structure Analysis

Deformation & Vibration Measurement Techniques (Piezo resistive and piezo electric),Interferometry Techniques, SPI (Speckle Pattern Interferometry), ESPI (Electronic Speckle Pattern Interferometry), Laser Techniques, Laser Doppler Vibrometers

Fluid, Thermal and Chemical Analysis

Thermal Analysis Techniques (Theoretical and Experimental), Fluid Flow Pattern Analysis, Electro-chemical Analysis, PIV Techniques, Spectroscopy

References:

1. Julian W. Garden, Vijay K. Varadan and Osama O. Awadelkarim "Microsensors MEMS and Smart devices", John Wiley and sons, Ltd.

2. Nadim Mulaf and Kirt Williams, "An Introduction to Microelectromechanical systems Engineering", Artech House.

3. Nicolae Lobontiu and Ephrahim Garcia, "Mechanics of Microelectromechanical systems", Kluwer Academic Publication.

4. Stanley Wolf and Richard Tauber, "Silicon Processing for the VLSI era Volume - 1 Technology", Lattice press.

5. Vijay K. Varadan, K.J.Vinoy and S. Gopalkrishnan, "Smart Material Systems and MEMS: Design and Development Methodologies", John Wiley and sons Ltd.

6. Bhushan, "Springer Handbook of Nanotechnology", Springer Inc.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

Department Electives

MCD 2001 PRINCIPLES OF ROBOTICS AND APPLICATIONS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objective :

To give the knowledge in Robot anatomy, end effectors, sensors, vision systems, kinematics, programming and the application of Artificial Intelligence in Robotics

Learning Outcome :

To provide advanced knowledge in the field of Industrial Robotics and the associated artificial intelligence

Module 1

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: basic concept and modals, controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system..

Motion Analysis And Control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

Module 2

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

Sensors: Desirable features, tactile, proximity and range sensors, uses sensors in robotics

Machine Vision, Functions, Sensing and Digitizing-imaging Devices

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations

Module 3

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements in function

Robot Application: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

Recent Trends In Robotics: Multi-axis robots, intelligent robots.

Reference Books:

1. Saeed B Niku.,Introduction to Robotics Analysis, Systems, Applications, PHI.
2. Moshen Shahinpoor., A Robot Engg text book, Harper and Row Publishers, NY.
3. Robert J Schilling., Fundamentals of Robotics – Analysis and Control, PHI.
4. Werner G Holzbook.,Robotic technology, Principles and practice, Van Nostrand Reinhold Co NY.

5. Richard D Klaffer., Thomas A Chmielewski., Michael Negin., Robotic Engineering – An Integrated Approach,PHI.
6. Mark W Spong., M Vidyasagar., Robot Dynamics and Control, Wiley India.
7. John J Craig., Introduction to Robotics, Mechanics and Control,Pearson Education.
8.Sisil Kumararawadu.,Modelling and Control of Vehicular and robotic systems,Narosa publishing house.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCD 2002 COMPUTATIONAL FLUID DYNAMICS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To introduce the basic principles in computational fluid dynamics
To develop methodologies which facilitate the application of the subject to practical problems

Learning Outcomes

Students will be able to

Build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes

Gain experience in the application of CFD analysis to real engineering designs.

Module 1

INTRODUCTION: Basics of fluid flow, derivation of the governing equations - conservation of mass, momentum and energy.

GRID GENERATION: Choice of grid, grid oriented velocity components, cartesian velocity components, staggered and collocated arrangements, adaptive grids.

DISCRETISATION: Finite difference method, forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods, stability analysis, error estimation.

Module 2

CFD TECHNIQUES: Mathematical classification of flow, hyperbolic, parabolic, elliptic and mixed flow types, Lax - Wendroff technique, MacCormack's technique, relaxation technique, artificial viscosity, ADI technique, pressure correction technique, SIMPLE algorithm, upwind schemes, flux vector splitting.

Module 3

FINITE VOLUME METHOD: Introduction, difference between FDM and FVM, approximation of surface integrals, approximation of volume integrals, interpolation practices, implementation of boundary conditions.

TURBULENCE MODELING: Turbulence energy equation- one-equation model, the k-ω model, the k- ε model.
APPLICATIONS**:** Fluid dynamics and heat transfer problems.

References:

1. Muralidhar K and Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, 2003.
2. Chung T J, "Computational Fluid Dynamics", Cambridge University Press, 2002.

3. Joel H Freziger and Milovan Peric, “Computational Methods for Fluid Dynamics”, Springer Publications, 1999.
4. John D Anderson, “Computational Fluid Dynamics – The Basics with Applications”, McGraw Hill, 1995.
5. Versteeg H K and Malalasekara W, “An Introduction to Computational Fluid Dynamics - The Finite Volume Method', Longman, 1995.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCD 2003 TOOL AND DIE DESIGN

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives:

This course provides knowledge in the areas of design of single point and multi point cutting tools, dies, jigs, fixtures and limit gauges and toll design for CNC machines.

Learning Outcome:

To impart in depth knowledge in various fields of tool engineering.

Module 1

Cutting Tool Design :Fundamentals of Cutting tools design, cutting tools and their principal elements, Tool geometry, system of nomenclatures and their interrelations, setting for the grinding of various basic cutting tool (turning, drilling, milling)
Analyses and Design of Jigs and Fixture : Principles of jig and fixture design, Dual cylinder location, diamond pin analysis, V-block analysis, design principles of centralizes, various mechanisms and design of equalizers, analysis for optimum number of clamping forces required and calculation of their magnitudes, concept of modular fixtures, design of fixtures for NC/CNC machines, computer applications in fixture design and analysis.

Module 2

Design of press tools: Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts. Computer applications in press tool design.
Design of forging dies: Grain flow considerations, parting line selection, draft, design problems involving ribs, bosses and fillets. Flash and flash control, determination of number of impressions required and their sequence, design steps and analysis of forging dies, detail calculations, shrinkage, cavity shapes, heat transfer considerations, cooling and ejection systems, automation in forging operations, computer aided design and analysis.

Module 3

Design of injection molds :Principles of melt processing, product considerations, determination of economical number of cavities, temperature control of injection molds, calculation of mold opening force and ejection force. Detail design of cooling system, ejection system and gating system. Mold ability features, mold flow analysis.
Die casting die design : Metals for die casting, specific details of die construction, casting ejectors, side cores, loose die pieces, slides, types of cores, directional solidification, types of feeders, die venting, water cooling, design aspects of die casting dies, defects.

References

1. Cole, C.B., “Tool Design”
2. Donaldson: “Tool Design”, Tata McGraw Hill.

3. ASTEM: “Fundamentals of Tool Design”
4. P.C.Sharma: “A Textbook of Production Engineering”., S.Chand Publication, N.Delhi
5. Ivana Suchy, “Handbook of Die Design”, 2nd edition McGraw Hill.
6. Ventatraman, “Design of Jigs, Fixtures and Press Tools”, Ascent Series Tata McGraw Hill.
7. Deshpande D. L., “Basic Tools”, 2nd edition University Press.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCD 2004 INFORMATION SYSTEM FOR MANUFACTURING

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The course provides students a fundamental understanding of management information systems concepts and their role in contemporary business.

To understand the various types of computer-based information systems used in organizations, when each is appropriate, the technology required to implement each system, and the types of system development approaches that should be used

Learning Outcomes

Understand the components and types of computer-based information systems.

Describe the role of information systems in decision making.

Develop an understanding of how various information systems work together to accomplish the information objectives of an organization

Module 1

Introduction: The evolution of order policies, from MRP to MRP II, the role of production organization, operations control. Data base terminologies – entities and attributes - data models, schema and subschema - data independence– ER diagram - trends in database.

Module 2

Designing database: Hierarchical model - network approach - relational data model - concepts, principles, keys, relational operations - functional dependence - normalization, types - query languages.

Module 3

Manufacturing consideration and Information system for manufacturing: The product and its structure, inventory and process flow - shop floor control - data structure and procedure - various model - the order scheduling module, input/ output analysis module the stock status database – the complete IOM database.

Parts oriented production information system - concepts and structure - computerized production scheduling, online production control systems, computer based production management system, computerized manufacturing information system - case study.

References:

1. Luca G. Sartori, “Manufacturing information systems”, Addison Wesley Publishing Company, 1988
2. Date. C. J., “An introduction to database systems”, Narosa Publishing House, 1997
3. Orlicky G., “Material requirements planning”, McGraw Hill, 1975
4. Kerr R., “Knowledge based manufacturing management”, Addison Wesley, 1991

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCD 2005 TOTAL QUALITY MANAGEMENT

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To teach the concept of Total Quality Management applied in different organizations, Quality and Quality Standards followed by such entities and the implications of applying the Statistical Process Control Techniques to measure Quality products and services.

Learning Outcomes

Adopt TQM as a fundamental business strategy
Communicate the importance of customer focused TQM

Module 1

FOUNDATIONS OF TQM: Understanding quality, quality, competitiveness and customers, building quality chains, managing quality, quality in all functions, models and frame works for total quality management, Early TQM frameworks – quality award models – the four Ps and three Cs of TQM - a new model for TQM.

LEADERSHIP AND COMMITMENT: The TQM approach – commitment and policy – creating or changing the culture – effective leadership – excellence in leadership.
DESIGN FOR QUALITY: Design, innovation and improvement – the design process – quality function deployment (QFD) – the house of quality – specifications and standards - design in the service sectors – failure mode effect and criticality analysis (FMECA) – The links between good design and managing the business.

PROCESS REDESIGN / ENGINEERING: Reengineering the organization - process for redesign - the redesign process – the people and the leaders.

Module 2

HUMAN RESOURCE MANAGEMENT: Introduction – strategic alignment of HRM policies – effective communication – employee empowerment and involvement – training and development – teams and team work – review, continuous improvement and conclusions – organizing people for quality – quality circles or kaizen teams.

COMMUNICATIONS, INNOVATION AND LEARNING: Communicating the quality strategy - communicating the quality message – communication, learning, education and training – a systematic approach to education and training for quality – turning educations and training into learning – the practicalities of sharing knowledge and learning.

Module 3

IMPLEMENTING TQM: TQM and the management of change – planning the implementation of TQM – sustained improvement.

QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEMS: Benefits of ISO registration - ISO 9000 series of standards – sector specific standards –ISO 9001 requirements – implementation – documentation – writing the documents – internal audits – registration - ISO 14000 series standards – concepts of ISO 14001 – requirements of ISO 14001 – benefits of EMS – integrating ISO 14000 with ISO 9000 – relationship between health and safety.

References:

1. Oakland J S, "Total Quality Management - Text with Cases", Butterworth – Heinemann – An Imprint of Elseiver, First Indian Print, 2005.
2. Besterfield D H et al, "Total Quality Management", Pearson Education Private Limited, 2004.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCD 2006 CREATIVE ENGINEEERING DESIGN

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To enhance critical thinking and design skills.
To introduce students a broad view of engineering analysis and design,
To reinforce the importance of mathematics and science in engineering design and analysis,
Offer experience in hands-on, creative engineering projects.

Learning Outcomes

Understand the design of systems, components, and processes to meet desired needs within realistic constraints.
Develop early abilities in identifying, formulating, and solving engineering problems

Module 1

Introduction: Example of different kinds of designs and designers, Good and bad designs, Design problems, Definition of Design, engineering design and design research, Importance.
Product life cycle, Morphology of design, Introduction to system design process, Stage models.
Introduction to Task Clarification: overall process and steps Methods for Data collection and collation including patent analysis.

Module 2

Methods for identification of requirements: Role Playing, Checklists, Solution neutral problem statements, Quantifying requirements and Assigning importance to requirements.
Linking Customer requirements to engineering requirements: Quality Function Deployment techniques.
Introduction to conceptual design: Identification of functions, Ideation, Simulation and Consolidation into solution proposals.

Module 3

Methods for Identification of functions - functional decomposition techniques, Methods for Ideation- Brainstorming, Synectics.
Methods for consolidation into solution proposals- Morphological charts, Morphological matrix, Methods for simulation: analytical, virtual and physical Simulations.
Methods for improvement of solution proposals- contradiction analysis, various other TRIZ techniques, Systematic evaluation of concepts: ordinal methods and cardinal methods.

References:

1. Pahl, G, and Beitz, W. Engineering Design: A Systematic Approach, 3rd Ed., Springer,
2. Cross, N. Engineering Design Methods: Strategies for Product Design (4th edition), John Wiley and Sons Ltd., Chichester

3. Roozenburg, N.F.M., Eekels, J. Product Design, Fundamentals and Methods, Wiley, Chichester.
4. Jones, J.C. Design Methods, 2nd Edition, John Wiley and Sons Ltd., Chichester

Structure of the Question paper

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SEMESTER III

MCC 3101Thesis Preliminary Part II

Structure of the Course

Thesis : 14 hrs/ Week Credits : 5

Internal Continuous Assessment : 200 Marks

The student has to continue the thesis work identified in the Second semester. The student has to present two seminars and submit an interim thesis report.

Evaluation of marks for the thesis preliminary part II

Evaluation of the thesis – preliminary work by the guide - 100 marks

Evaluation of the thesis – preliminary by the Evaluation Committee - 100 marks

Stream Electives Offered For Third Semester

STREAM ELECTIVE III

MCE 3001 COMPOSITE MATERIAL TECHNOLOGY

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To develop an understanding of the linear elastic analysis of composite materials.
To predict/interpret the behaviour and properties of composites as a function of their composition and manufacturing conditions
To provide an understanding of many important design, manufacture and performance issues of concern in current applications of composite materials

Learning Outcomes

Students will be able to

Suggest solutions for a wide variety of simple composite design/manufacture performance issues.
Analyze a laminated plate in bending, including finding laminate properties from lamina properties and find residual stresses from curing and moisture.
Predict the failure strength of a laminated composite plate.

Module 1

INTRODUCTION: Characteristics of composite materials, classification of composites, advantages, applications. Matrix and their role, principal types of fibre and matrix materials, basic principles of production of composite materials and products, advantages and limitations of different processes.

MICRO MECHANICAL BEHAVIOUR OF A LAMINA: Volume and mass fractions, evaluation of elastic moduli, strength of unidirectional lamina, multiaxial strength criteria, analysis of discontinuous fiber lamina.

Module 2

MACRO MECHANICAL BEHAVIOUR OF A LAMINA: Hooke's law for different types of materials, engineering constants for orthotropic materials. Stress, strain relations for plane stress in an orthotropic materials and in a lamina of arbitrary orientation, strength of an orthotropic lamina, basic strength theories, determinations of engineering constants, mechanics of materials approach.

MACRO MECHANICAL BEHAVIOUR OF A LAMINATE: Classical lamination theory, lamina stress, strain behaviour, resultant forces and moments in a laminate, types of laminates, strength and stiffness of laminates, interlaminar stresses in laminates.

Module 3

LAMINATED PLATES AND BEAMS: Types of laminated plates and beams, elementary mechanical behaviour, bending and buckling of laminated plates, forces and moments, stresses and deflections under different boundary conditions.

MANUFACTURE OF COMPOSITE COMPONENTS: Lay up and curing, open and closed mould processes, hand lay up techniques, bag moulding, filament winding, pultrusion, pulforming, thermoforming, injections moulding, blow moulding. Manufacture of metal matrix composites and ceramic matrix composites.

References:

1. Sanjay K Mazumdar, "Composites Manufacturing", CRC Press, 2003.
2. Autar K Kaw, "Mechanics of Composite Materials", CRC Press, 1997.
3. Matthews F L and Rawlings R D, "Composite Materials: Engineering and Science", Chapman and Hall, 1994.
4. Ronald F Gibson, "Principles of Composite Material Mechanics", McGraw Hill Book Co, 1994.
5. Agarwal B D and Broutman L J, "Analysis and Performance of Fibre Composites", John Wiley and Sons Inc, 1990.
6. Terry Richardson, "Composites - A Design Guide", Industrial Press Inc, 1987.
7. Robert M Jones, "Mechanics of Composite Materials", McGraw Hill Book Co, 1970.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 3002 STATISTICAL PROCESS CONTROL AND NON DESTRUCTIVE TESTING

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3

Internal Continuous Assessment : 40 Marks

End Semester Examination : 60 Marks

Course Objectives:

The students are expected to understand the general issues and applications of Statistical Process Control and Non Destructive Testing.

Learning Outcome:

To appreciate the students with the background, applications and current status of Statistical Process Control and Non Destructive Testing.

Module 1

STATISTICAL QUALITY CONTROL: Methods and Philosophy of Statistical Process Control - Control Charts for Variables and Attributes - Cumulative sum and Exponentially weighted moving average control charts - Others SPC Techniques – Process - Capability Analysis - Six sigma accuracy.

ACCEPTANCE SAMPLING: Acceptance Sampling Problem - Single Sampling Plans for attributes - double,multiple and sequential sampling, The Dodge - Roming sampling plans – Military standards.

Module 2

LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS:

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 d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

Module 3

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 – scanning electron microscope (SEM) – Transmission electron microscopy (TEM).

References:

1. Douglus C. Montgomery, " Introduction to Statistical Quality Control ", 2nd Edition, John Wileyand Sons, 1991.

2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.

3. Harvid Noori and Russel, " Production and Operations mangament – Total Quality and Responsiveness ", McGraw-Hill Inc, 1995.

4. Suresh Dalela and Saurabh, ISO 9000 "A Manual for Total Quality Management", S.Chand and Company Ltd., 1997.

5. John Bank, "The Essence of Total Quality Management", Prentice Hall of India Pvt.Ltd., 1995.

6. Grant E.L and Leavensworth, "Statistical Quality Control", McGraw-Hill, 1984.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 3003 MESHLESS METHODS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To learn the definitions and understand the key concepts of multivariate scattered data approximation with radial basis functions and moving least squares methods.
To learn direct and iterative algorithms to solve multivariate interpolation and least squares approximation problems.
To apply these methods to the solution of partial differential equations.

Learning Outcomes

Students will be able to

Learn meshfree method types, meshfree shape functions, weak form types
Have the ability to be able to solve problems by using meshfree methods
to solve a problem by writing a computer code containing meshfree method

Module 1

Introduction: Foundation of Physical Theories, Atomistic Modeling and Computation, PDE-Based Continuum Modeling and Computation.
Fundamental of Continuum Mechanics :Kinematics ,Basic Laws of Motion, Constitutive Theory, Thermoviscoelastic Solid and Special Cases
Overview on Meshless Methods and Their Applications: Approximation Function, Numerical Implementation,Applications

Module 2

Procedures of Meshless Methods:
Construction of the Approximation, Choice of Weight Function, Formulation of Meshless Analysis, Evaluation of the Integral, Treatment of Discontinuity, Treatment of Mirror Symmetry, H- and P-Refinements,
Meshless Analysis of Elastic Problems: Background Theory for Applications of Elastostatics, Meshless Analysis of Elastostatic Problems , General Dynamic Problems, Meshless Analysis of Elastodynamic Problems, Meshless Analysis of Multiphase Materials

Module 3

Meshless Analysis of Nonlocal Continua : Introduction to Nonlocal theory,The Framework of Nonlocal Theory ,Material Instability and Intrinsic Length , Nonlocal Constitutive Relations, Formulation of Nonlocal Meshless Method, Numerical Examples by Nonlocal Meshless Method.
Meshless Analysis of Plasticity : Constitutive Relations, Return Mapping Algorithm ,J2 Flow Theory.
Meshless Analysis of High-Speed Impact/Contact Problem, Incremental Plasticity and Slow Crack Growth Problem.

References:

1. G.R Liu, Meshfree Methods: Moving beyond the Finite element method, CRC press
2. Youping Chen, James D. Lee,and Azim Eskandarian,Meshless Methods in Solid Mechanics,Springer

3. Michael Griebel, Marc Alexander Schweitzer, Meshfree Methods for Partial Differential Equations, Springer

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 3004 HYDRAULIC AND PNEUMATICS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3

Internal Continuous Assessment : 40 Marks

End Semester Examination : 60 Marks

Course Objectives

To understand the basic components and functions of hydraulic and pneumatic systems, compare hydraulics and pneumatics to each other in terms of technical performance

Learning Outcomes

Upon completion, the students will demonstrate an understanding of Hydraulic and Pneumatic principles, equipment, Seals and industries, will be able to identify and describe the basic operation of Hydraulic / Pneumatic systems, the various equipment used in their operation, Hydraulic / Pneumatic terms as well as actuator Sealing Device design / material strengths and weaknesses,will be able to troubleshoot Hydraulic / Pneumatic equipment and Seals

Module I

Introduction to oil hydraulics and pneumatics, their advantages and limitations. ISO Symbols and standards in Oil Hydraulics and Pneumatics. Recent developments, applications Basic types and constructions of Hydraulic pumps and motors. Ideal pump and motor analysis. Practical pump and motor analysis. Performance curves and parameters.

Hydraulic control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves.

Module 2

Flapper valve analysis, Analysis of valve controlled and pump controlled motor. Electrohydraulic servo valves – specification, selection and use of servo valves.

Electro hydraulic servomechanisms – Electro hydraulic position control servos and velocity control servos. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Basic configurations of hydraulic power supplies – Bypass Regulated and Stroke Regulated Hydraulic Power Supplies. Heat generation and dissipation in hydraulic systems. Design and analysis of typical hydraulic circuits.

Module 3

Use of Displacement – Time and Travel-Step diagrams; Synchronization circuits and accumulator sizing. Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits.

Components of a pneumatic system; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits; Valves for logic functions; Time delay valve; Exhaust and supply air throttling; Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel dependent control and Time-dependent control, Combined Control, Program Control, Sequence Control, Electro-pneumatic control and air-hydraulic control. Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

References

1. Blackburn J F, G Reethof and J L Shearer, Fluid Power Control, New York : Technology Press of M I T and Wiley, 1960
2. Ernst W, Oil Hydraulic Power and its Industrial Applications 2 nd ed. New York, McGraw Hill, 1960
3. Lewis E E and H Stern, Design of Hydraulic Control Systems New York, McGraw-Hill
4. Morse A C, Electro hydraulic Servomechanism, New York, Mc Graw-Hill, 1963
5. Pippenger J J and R M Koff, Fluid Power Control, New York : McGraw-Hill, 1959
6. Ernest C. Fitch Jr., Fluid Power Control Systems, New York : McGraw Hill, 1966
7. Khaimovitch : Hydraulic and Pneumatic control of machine tools
8. Merrit : Hydraulic control systems
9. Thoma Jean U, Hydrostatic Power Transmission, Trade and Technical Press Surrey, England 1964.
10. lan Meneal, Hydraulic operation and control of Machine tools – Ronald Press
11. Stewart, Hydraulic and Pneumatic power for production – Industrial press.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

STREAM ELECTIVE IV

MCE 3005 CELLULAR MANUFACTURING SYSTEMS

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Courses Objective:

To understand the Concepts and applications of Cellular manufacturing systems,Traditional and non-traditional approaches of Problem solving, Performance measurement, Human and economical aspects of CMS.

Learning Outcome:

To impart knowledge on group technology, optimization algorithms, implementation of GT/CMS, Performance measurements and economical aspects of CMS.

Module 1

Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.
Problems in GT/CMS - Design of CMS - Models, traditional approaches and non traditional approaches -Genetic Algorithms, Simulated Annealing, Neural networks.

Module 2

Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.

Module 3

Performance Measurement And Control: Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.
Economics Of Gt/Cms: Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

References:

1. Askin, R.G. and Vakharia, A.J., G.T "Planning and Operation, in The automated factory-Hand Book: Technology and Management", Cleland.D.I. and Bidananda, B (Eds), TAB Books , NY, 1991.
2. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), "Planning, design and analysis of cellular manufacturing systems", Elsevier, 1995.
3. Burbidge, J.L. Group "Technology in Engineering Industry", Mechanical Engineering pub.London, 1979.
4. Irani, S.A. "Cellular Manufacturing Systems", Hand Book

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 3006 LEAN MANUFACTURING

Structure of the Course

Lecture: 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

Identify manufacturing system waste Understand the roles of employees and managers, supply chain issues, pre-automation, autonomation and automation as they apply to lean manufacturing

Learning Outcomes

Understand workplace organization and visual manufacturing tools
Understand and apply value stream mapping concepts
Understand the idea about pull production and maintenance system

Module 1

Lean manufacturing: Basics, principles & elements

Small-lot production: Lot-size basics; lot sizing; lot-size reduction; facilitating small lot size.

Setup-Time reduction: Setup reduction methodology; techniques for setup-reduction; setup reduction projects.

Pull production systems: Pull systems and push systems; conditions for pull production systems; how to achieve pull production; mechanisms for signal and control.

Module 2

Work cells and cellular manufacturing: Cell layout and capacity measures; design of workcells; worker assignment; implementation issues.

Scheduling for smooth flow: Production leveling; level scheduling in pull production; master production scheduling.

Synchronizing and balancing process: Synchronisation; bottleneck scheduling; balancing; adapting to schedule changes.

Module 3

Planning and control in pull production: Centralized planning and control system; decentralized planning and control system; adapting MRP-based production planning and control system to pull production

Maintaining and improving equipment: Equipment maintenance; equipment effectiveness; total productive maintenance.

References:

1. Harold J. Steudel and Paul Desruelle, “Manufacturing in the nineties – how to become a lean, world - class competitor”, Van Norstrand Reinhold, New York, 1992

2. John Nicholas, “Competitive manufacturing management - continuos improvement, lean production, and customer-focused qualities”, McGraw Hill International Edition, 1998
3. Ronald G. Askin & Jeffrey B. Goldberg, “Design and analysis of lean production systems”, John Wiley & Sons, 2003
4. Pascal Dennis, “Lean Production Simplified”, Productivity Press.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.

MCE 3007 SIX SIGMA

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To demonstrate a good understanding of the numerous techniques, tools and methodologies used in Six Sigma

To apply the principles of Six Sigma as used in Engineering and Asset Management

To appreciate the utilisation of Quality/Six Sigma /Lean throughout the total life cycle of the Manufacturing or Asset Management processes

To use Sigma Tools to eliminate waste in Production

Learning Outcomes

Students will be able to

Get knowledge and experience of the stages of Six Sigma - the structured DMAIC methodology

Lead and execute process-level improvement projects

Collect process data and develop process maps

Develop statistical hypotheses using simple statistical tools

Module 1

INTRODUCTION: Overview , six sigma defined – background – six sigma compared to total quality management – transactional vs. Manufacturing six sigma – common terms, foundations of lean six sigma – the four keys, five laws of lean six sigma.

PREPARATION PHASE: Organizational success factors – leadership, six sigma as strategic initiative, internal communication strategy and tactics, formal launch, organizational structure, six sigma training plan, project selection, assessing organizational readiness, pitfalls. work as a process – vertical functions and horizontal processes. Voice of customer – importance, collect voc data, critical to quality customer requirements. project management – challenges, culture, project management processes, team typing, team stages, characteristics of effective teams.

Module 2

DEFINE PHASE: DMAIC phases, overview, project charter – voice of the customer – high level process map– project team – case study.

MEASURE AND ANALYSE PHASES: Overview – types of measures – introduction to statistical methods – sampling plan – data collection – choosing statistical software – measure tools – process maps, pareto charts, cause and effect diagrams, histograms, control charts – six sigma measurements – cost of poor quality – measurement system analysis – process capability calculations. analyze – overview – process analysis – hypothesis testing – statistical tests and tables – tools for analyzing relationships among variables – survival analysis.

Module 3

IMPROVE AND CONTROL PHASE: Overview – process redesign – generating improvement alternatives – design of experiments – pilot experiments – cost/benefit analysis – implementation plan. control phase – overview – control plan – process scorecard – failure mode and effects analysis – SPC charts, final project report and documentation.

DESIGN FOR SIX SIGMA (DFSS): Overview – DFSS Tools – Quality Function Deployment (QFD), Theory of Inventive Problem Solving (TRIZ), Failure Modes and Effects Analysis (FMEA), Design of Experiments (DOE).

References:

1. Betsiharris Ehrlich, "Transactional Six Sigma and Lean Servicing", St. Lucia Press, 2002.
2. Jay Arthur, "Lean Six Sigma – Demystified", Tata McGraw Hill Companies Inc, 2007.
3. Michael L George, David T Rowlands, and Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
4. Kai Yang and Basem El,Haik, "Design for Six Sigma", McGraw Hill, New York, 2004.
5. Thomas Pyzdek, "Six Sigma Handbook: Complete Guide for Greenbelts, Blackbelts and Managers at All Levels", Tata McGraw Hill Companies Inc,2003.
6. Donald W Benbow and Kubiak T M, "Certified Six Sigma Black Belt Handbook", Pearson Education, 2007.

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students

MCE 3008 RELIABILITY ENGINEERING AND TOTAL PRODUCTIVE MAINTENANCE

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3

Internal Continuous Assessment : 40 Marks

End Semester Examination : 60 Marks

Course Objectives

To empower with the skills to manage a manufacturing system to achieve continuous system availability for production

To develop ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system

To equip with essential system diagnosis techniques so that you can identify and take appropriate actions on error symptoms and causes of failures

Learning Outcomes

Students will be able to

Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment

Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies

Manage the manufacturing organisation with highest possible availability

Module 1

INTRODUCTION: Definitions, stage gate approach, reliability mathematics, reliability models, parametric and catastrophic methods, reliability predictive modelling.

FAILURE MODES AND EFFECT ANALYSIS: Goal and vision, concepts and types of FMEA evaluations, fault tree model.

Module 2

EVALUATING PRODUCT RISK: Test design by failure modes and aging stresses. Aging due to cyclic force, Miner's rule.

CONCEPTS IN ACCELERATED TESTING: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.

Module 3

PRODUCT MAINTAINABILITY: Maintainability concepts and analysis measures of maintainability, design for serviceability, supportability and maintainability preventive maintenance scheduling.

INTRODUCTION TO SOFTWARE RELIABILITY: Definitions, waterfall lifecycle, techniques to improve software reliability, software reliability models.

References:

1. Naikan V N A, “Reliability Engineering and Life Testing”, PHI Learning Private Limited, 2009.
2. Prabhakar Murthy D N and Marvin Rausand, “Product Reliability”, Springer-Verlag London Limited, 2008.
3. Dana Crowe and Alec Feinberg, “Design for Reliability”, CRC Press, 2001.
4. John W Priest and Jose M Sanchez, “Product Development and Design for Manufacturing – A Collaborative Approach to Producibility and Reliability”, Second Edition, Marcel Dekker, 2001.
5. Michael Pecht, “Product Reliability, Maintainability and Supportability Handbook”, CRC Press, 1995.

Structure of the Question paper

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SEMESTER IV

MCC 4101 THESIS

Structure of the Course

Thesis : 21 hrs/ Week Credits : 12
Internal Continuous Assessment : 300 Marks
Thesis Evaluation + Viva-Voce : 300 Marks

The student has to continue the thesis work identified in the Second semester. There shall be two seminars (a mid term evaluation on the progress of the work and the pre submission seminar to assess the quality and quantum of the work). At least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation. The marks for the Thesis-Final may be proportionally distributed between external and internal evaluation as follows.

Distribution of marks allotted for the Thesis

Internal evaluation of the thesis work by the guide - 150 marks
Internal evaluation of the thesis by the evaluation committee - 150 marks
Final evaluation of the thesis work by internal and External examiners :
(Evaluation of Thesis :200 marks + Viva voce :100 marks) – 300 Marks