UNIVERSITY OF CALICUT
(Abstract)

Faculty of Engineering – Regulations, scheme & Syllabi of M.Tech Courses – implemented with effect from 2010 admn onwards - Orders Issued.

GENERAL AND ACADEMIC BRANCH - IV 'E' Section

GAIV/E1/AC / 03.07.2010 Dated, Calicut University.P.O., 27-08-2010.

Read:- 1) U.O. No. GAI/D4/4085/2003 dated, 21.11.2009.
2) Minutes of the meeting of the BOS in Engineering (PG) held on 10.12.2009 and 28.01.2010.
3) Minutes of the meeting of the faculty of Engineering held on 28.01.2010.
4) Minutes of the meeting of the Academic Council held on 03.07.2010.

ORDER

As per paper read 1st, Provisional affiliation was granted to start a new course in M.Tech Machine Design in Nehru College of Engineering & Research Centre, Pampady.

As per the paper read 2nd, the Board of Studies in Engineering (PG) framed, formulated and approved the syllabi of M.Tech in Machine design for 2010-2011. The Board of Studies also framed the revised M.Tech regulations, scheme and Syllabi of the following M.Tech Courses for the year 2010-2011.

1) Environmental Engineering
2) Production Engineering
3) Thermal Systems
4) Power Systems
5) Chemical Process Control
6) Embedded Systems

As per the paper read 3rd, the meeting of the faculty of Engineering approved the decision of the Board of Studies held on 10.12.2009 and 28.01.2010 and approved the revised M.Tech regulations and scheme and syllabi of the above M.Tech Courses.

The faculty also recommended the following in the revised regulations of M.Tech in the case of self financing colleges that there should be sufficient qualified faculty members and sufficient infrastructure in self financing colleges as recommended by All India Council for Technical Education.

As per paper read 4th, the meeting of the Academic Council held on 03.07.2010, approved the decisions of the Board of Studies held on 10.12.2009 and 28.01.2010 and the minutes of the faculty of Engineering held on 28.01.2010 for implementing the regulations and scheme and syllabi of the above M.Tech courses with effect from 2010 admission.

Contd…..2

Sanction has therefore been accorded for implementing the revised M.Tech regulations and Scheme & Syllabi of the following M.Tech Courses with effect from 2010 admission onwards.

1) Environmental Engineering
2) Production Engineering
3) Thermal Systems
4) Power Systems
5) Chemical Process Control
6) Embedded Systems
7) Machine design

Orders are issued accordingly, (regulations, scheme & Syllabi appended)

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UNIVERSITY OF CALICUT

M.Tech. DEGREE COURSE

PRODUCTION ENGINEERING
(MECHANICAL ENGINEERING)

Curricula, Scheme of Examinations and Syllabi
(with effect from 2010 admissions)

M.Tech. PRODUCTION ENGINEERING (MECHANICAL ENGINEERING)

SCHEME OF EXAMINATIONS

Semester - I

Code	Subject	Hours per week			Marks		Total Marks	Sem-end exam duration - Hrs	Credits
		L	T	P/D	Intl.	Sem-end			
MPE10 101	Applied Mathematics	3	1	-	100	100	200	3	4
MPE10 102	Advanced Welding and Casting Technology	3	1	-	100	100	200	3	4
MPE10 103	Design of Machine Tools	3	1	-	100	100	200	3	4
MPE10 104	Production and Operations Management	3	1	-	100	100	200	3	4
MPE10 105	Elective-1	3	1	-	100	100	200	3	4
MPE10 106(P)	*Production Engineering Laboratory*	-	-	2	100	-	100	3	2
MPE10 107(P)	*Seminar*	-	-	2	100	-	100	-	2
	Departmental Assistance	-	-	6	-	-	-	-	-
TOTAL		15	5	10			1200		24

Electives -I

MPE10 105(A) Advanced Metrology
MPE10 105(B) Composite Materials
MPE10 105(C) Mechatronics Product Design

Semester - II

Code	Subject	Hours per week			Marks		Total Marks	Sem-end exam duration - Hrs	Credits
		L	T	P/D	Intl.	Sem-end			
MPE10 201	Computer Integrated Manufacturing	3	1	-	100	100	200	3	4
MPE10 202	Modern Manufacturing Processes	3	1	-	100	100	200	3	4
MPE10 203	Plant Maintenance and Safety	3	1	-	100	100	200	3	4
MPE10 204	Elective-2	3	1	-	100	100	200	3	4
MPE10 205	Elective-3	3	1	-	100	100	200	3	4
MPE10 206(P)	*Seminar*	-	-	2	100	-	100	-	2
MPE10 207(P)	*Mini Project*	-	-	2	100	-	100	-	2
	Departmental Assistance		-	6	-	-	-	-	-
TOTAL		15	5	10			1200		24

Electives –II

MPE10 204 (A) Group Technologies and Flexible Manufacturing
MPE10 204(B) Management Information System
MPE10 204(C) Metal Forming

Electives –III

MPE10 205(A) Manufacturing Automation
MPE10 205(B) Quantitative Techniques for Managerial Decisions
MPE10 205(C) Rapid Prototyping

Semester - III

Code	Subject	Hours per week			Marks		Total Marks	Sem-end exam duration-Hrs	Credits
		L	T	P/D	Intl.	Sem-end			
MPE10 301	Elective-4	3	1	-	100	100	200	3	4
MPE10 302	Elective-5	3	1	-	100	100	200	3	4
MPE10 303(P)	*Industrial Training*	-	-	-	50	-	50	-	1
MPE10 304(P)	*Masters Research Project(Phase -I)*	-	-	22	Guide 150 / EC* 150	-	300	-	6
TOTAL		6	2	22	500		750		15

NB: The student has to undertake the departmental work assigned by HOD

*EC – Evaluation Committee

Electives –IV

MPE10 301(A) Advanced Finite Element Methods
MPE10 301(B) Computational Fluid Dynamics
MPE10 301(C) System Simulation and Modeling

Electives –V

MPE10 302(A) Industrial Energy Management
MPE10 302(B) Nanotechnology
MPE10 302(C) Optimization Techniques

Semester - IV

Code	Subject	Hours per week			Internal Marks		Sem-end exam.		Total Marks	Credits
		L	T	P/D	Guide	Evaluation committee	Extl. Guide	Viva-Voce		
MPE10 401(P)	*Masters Research Project (Phase -II)*	-	-	30	150	150	150	150	600	12
TOTAL				30	150	150	150	150	600	12

NB: The student has to undertake the departmental work assigned by HOD

PE10 101: APPLIED MATHEMATICS

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To enable to do statistical techniques in engineering problems and to provide necessary back ground in linear algebra and tensors needed for analyzing problems in mechanical engineering.*

Module 1 (15 Hrs.)

Probability distributions – Binomial, Poission, Hypergeometric, Uniform, Normal, Beta, Gamma, Weibull – Sampling distributions – Sampling distribution of the mean ,variance – Standard error – Determination of sample size – Chi square, Student's t, F distributions.

Correlation and regression – Partial and multiple correlations – Linear and curvilinear regressions.

Module II (15 Hrs.)

Statistical inferences – Point estimation – Interval estimation – Tests of hypothesis – Large and small sample tests – Tests for single mean, means of two samples, proportions, two variance, two observed correlation coefficients, regression coefficients and multiple correlation coefficients.

Design of Experiments – Analysis of variance - Completely randomized designs – Randomized block designs – Latin square designs.

Module III (12 Hrs.)

Vector Space and Linear Transformations – Vector space – Basis, Dimension, Subspace , The vector space R^3 - Inner product space – Orthonormal basis - Linear transformations – Matrix of a linear transformation, Rank and null space of linear transformations – Eigen values , Eigen vectors Space – Algebra of linear transformations and their equivalences.

Module IV (12 Hrs.)

Tensor Analysis – Generalized coordinate transformations – Contravarient and covariant tensor components - Contraction – Algebra of tensors – Symmetric and skew-symmetric tensors – Metric tensors – Christoffel symbols – Transformation of Christoffel symbols –Covariant differention of tensors – Riemann-Christoffel curvature tensor.

Reference

1. Miller & Freuned's , *Richard A Johnson,Probability and Statistics for Engineers*, Sixth Edittion , Pearson Education.
2. S.S.Sastry, *Advanced Engineering Mathematics*, PHI Private Limitted, Newdelhi, INDIA.
3. C.S.Jog, *Foundations and Applications of Mechanics*, Volume I Continuum Mechanics, Narosa Publications .
4. Kenneth Hoffman and Ray Kunze, *Linear Algebra*, PHI Private Limitted, Newdelhi, INDIA.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 102: ADVANCED WELDING AND CASTING TECHNOLOGY

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To understand the principles and operations of special and modern welding processes.*
To understand advanced metal casting procedures and the defects on the process.

Module 1: (14 Hrs.)

SPECIAL WELDING PROCESSES: Gas tungsten arc (TIG) welding, Gas metal arc (MIG)welding, submerged arc welding, electro slag welding processes, power sources and other characteristics for these individual processes, equipments and accessories, application and limitation of each process. Resistance welding processes-their principle-Types (spot, seam, projection, percussion, flash) - Equipments required for each application.

Module 2: (13 Hrs.)

MODERN WELDING PROCESSES: Electron beam welding, laser beam welding, Plasma arc welding, friction welding, explosive welding, ultrasonic welding, stud welding, under water welding, diffusion bonding, cold welding, welding of dissimilar metals - equipments and accessories, application and limitation of each process.

Module 3: (13 Hrs.)

SHELL MOULDING : Various Special Casting Techniques-Shell Moulding Machines, Pattern Equipment, Sands, Resins and other Materials used for Shell Moulding, application of Shell Moulding, advantages of Shell Moulding over other Methods of Moulding.
CENTRIFUGAL CASTING : Types of Centrifugal Casting Processes-calculation of Mould Rotary Speeds, Techniques, equipments and Production Processes, advantages and limitations of Centrifugal Casting Methods.

Module 4: (14 Hrs.)

INVESTMENT CASTING: Introduction, Pattern and Mould Materials used, Techniques and Production of Investment Moulds, Shaw Process, Full Mould Process, applications of Investment Casting Process.
DIE CASTING : Die Casting Machines- Gravity and Pressure Die Casting, Cold and Hot Chamber, Operation and Details, Die Materials, Metals Cast by Die Casting Method, Casting of Aluminium, Magnesium and Zinc Alloys, Compo, Rheo and Thixo Processes, advantages of Die Casting.
ORGANIC AND OTHER PROCESSES : Cold Box, Hot Box and No Bake Processes, Fluid Sand Process, V Process, Graphite Moulding Process, Magnetic Moulding, Impulse Moulding, High Pressure Moulding, Metal Injection Moulding.

Text Books :

1) Parmar, R.S., *Welding Processes And Technology*, 2nd edn. Khanna Pub., New Delhi, 2001
2) Srinivasan.N.K., *Welding Technology*, Khanna Publications, Delhi, 1995.
3) Nadkarni.S V, *Modern Arc Welding Technology*, Oxford & IBH, New Delhi, 1988.
4) Beeley, P. R., *Foundry Technology*, Butterworths, London, 1982
5) Clegg. A J., *Precision Casting Processes*, Pergamon Press, London, U.K, 1991.

References:

1) ASM Metals Handbook. Vol.6. *Welding Brazing & Soldering*, ASM International, Metals Park, Ohio, USA, 1993.
2) AWS Welding Handbooks, AWS, New York, 1995
3) Howard B Cary., *Modern Welding Technology*, 4th edn., Prentice Hall, New Jersey, USA, 1997.
4) Heine, Loper And Rosenthal, *Principles of Metal Casting*, Tata McGraw-Hill Publishing's Co., Ltd, New Delhi, 1995.
5) Dumond. T C, *Shell Moulding and Shell Moulded Castings*, Reinhold Publishing Corporation Inc. 1984.
6) Doehler.E.H, *Die Casting*, McGraw-Hill Book Co. New York, 1991.
7) Barton H K, *Die Casting Processes*, Odhams Press Ltd., 1985
8) ASM Metals Hand Book, *Casting,* Volume 15, ASM International, 10th Edition, 1991

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 103: DESIGN OF MACHINE TOOLS

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To make the students understand the concepts & broad principles of machine tool design, regulation of speed and speed regulation, design of machine tool structure, dynamics of machine tools.*

Module 1 (14 Hrs.)

Introduction: Developments of machine tools, types of machine tools surface, profiles and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc. General requirement of machine tool design. Machine tool design process. Tool wear, force
Machine Tools Drives: Classification of machine tool drives, group v/s individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc. Fundamentals of Kinematics structure of machine tools.

Module 2 (13 Hrs.)

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, developing gearing diagrams. Step less regulation of speed and feed in machine tool, speed and feed control.

Module 3 (14 Hrs.)

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design.

Design of guide ways and power screws: Basic guide way profiles, designing guide way for stiffness a wear resistance & hydrostatic and antifriction guide ways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings machine tools

Module 4 (13 Hrs.)

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools. Control Systems: Functions, requirements & types of machine tool controls, controls for speed & feed change. Automatic and manual Controls. Basics of numerical controls. Machine tool testing.

Text Books :

N.K. Mehta, *Machine Tools Design & Numerical Controls*, T.M.H. New Delhi.
S.K. Basu, *Design of Machine Tools*, Allied Publishers.
Bhattacharya A and Sen.G.C, *Principles of Machine Tools*, New Central Book Agency.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 104: PRODUCTION AND OPERATIONS MANAGEMENT

Teaching scheme: 3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives:

To understand the comprehensive thought of forecasting, facility location and layout, production planning and control, scheduling, inventory control and analysis, project planning and just-in-time production.

Module – 1 (13 Hrs.)

Product Manufacturing Function-Operations Concept of Production-Production as a Conversion Process-Productivity of Conversion Process-Objectives of Production Management-Component of Production Function-Short History of Production Management-Organization for Production-The Responsibilities of Production – Manager - Qualities of Production Manager - Production as a Co-ordination Function - Factors Influencing Choice of Manufacturing Methods-Classification of Manufacturing Methods-Selection of the Manufacturing Methods - Facilities (Plant) Location - Necessity of Location Decision - Factors Governing Plant Location - Economic Survey for the Site Selection - Urban Versus Rural Site - Sub-Urban Location - Typical Examples on Plant Location - Objectives of Good Plant Layout-Principles of Good Layout -Types of Layouts-Comparison between Product Layout & Process Layout-Cost Analysis of Basic Forms of Layout-Combination Layout-Factor Governing Plant Layout - Systematic Layout Procedure-Tools & Technique for Layout Analysis-Space Determination and Area Allocation-Evaluation of Layout Plans & Selection of Optimal Layout.

Module – 2 (14 Hrs.)

Production Planning & Production Control-Objectives of Production Planning & Control-Functions of Production Planning & Control Organization of Production Planning & Control Department-Work Order Preparation-Subsidiary Orders-Factors Influencing Material Planning-Techniques for Material Planning Bill of Materials-Material Requirement Planning - (MRP)-Past Consumption Analysis-Moving Average Method-Exponential Smoothing-Inventory Control-Other Operations Research Techniques-Inputs for Process Planning-Factors Influencing Process Planning-Steps in Process Planning-Route Sheets-Process Planning in Different Situations-Documents in Process Planning-Why Scheduling?-Inputs of Scheduling-Gantt Charts-Techniques of Scheduling-Functions of Dispatching-How Dispatching Function is Performed-Dispatching under Different Situations-Documents in Dispatching-Functions in Progressing-Documents in Progressing - Projects - Need for Systematic Approach-What is CPA?-What can CPA give?-Network Logic-Procedural Steps-Activity Identification-Activity Relationships-Network Construction-Node Labelling-Activity Time Estimation-Network Time Analysis-Activity Float Analysis-Probability Aspect of Project Planning-Cost Analysis & Crashing of Activities Project Scheduling-Project Monitoring-Computer Applications in Project Management Maintenance of the Plant-Introduction-Typical Causes of Plant Breakdown-Cost Associated with Eventual Breakdown Objectives of a Good Maintenance System Types of Maintenance-Elements of Good Maintenance System Preventive Maintenance-Corrective Maintenance-Organization for Maintenance.

Module – 3 (14 Hrs.)

Quality Management - I (Inspection & Quality Control) Introduction-Definition of Quality-J.M. Juan's View of Quality Historical Development of Quality Management-The Achievement of Quality-Quality Standards-Meaning of Quality Control-Three Basic Aspects of Quality Control-Inspection Versus Quality Control-Inspection Planning-How to Exercise Control over Quality-Quality Control of Purchased Material-Quality Control of Work Done at Home Plant-Organization for Inspection & Quality Control-Types of Inspection-Basis of Sampling Inspection-Defects & their Classification-Operating Characteristic Curve-Parameters of an OC Curve-Relationship between the Parameter-OC Curve of an Ideal Plan-OC Curve of a General Plan-Specifying an OC Curve-Types of Sampling Plans-Principles Underlying Process Control-Control Charts as Tool for Process Control-Types of Control Charts-Control Charts for Variables (X - R Charts)-Control Charts for Attributes (p, np & c Charts)

Module – 4 (13 Hrs.)

Work Study. I (Method Study)-What is Work Study?-Introduction to Method Study-Basic Procedure of Method Study-Work Study. II (Work Measurement)-Uses of Work Measurement Data-Techniques of Work Measurement-Time Study-Illustrative Examples on

Computation of Standard Time-Work Sampling-Procedure for Conducting Work Sampling Study-Setting Performance Standards with Work Sampling-Advantages & Disadvantages of Work Sampling over Time Study-Typical Examples on Work Sampling-Financial Incentives-Objective of an Incentive Scheme-Individual Versus Group Incentives-Prerequisite of Wage Incentive Plan-characteristics of Good Incentive Plan-Classification of Incentive Plans

References:

1. Francis and White – *Facility Layout and Location*, Prentice Hall Inc.
2. Samuel Elion - *Production Planning and Control*, Universal Book Corporation
3. Weist and Levy – *A Management guide to PERT AND CPM*, Prentice Hall Inc
4. D B James – *Operations Management- Design, Planning and control for Manufacturing and Services*, McGraw Hill,Inc. New Delhi.
5. Hillier and Liebermann - Introduction *to Operations Research*, Holden Day Inc.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 105(A): ADVANCED METROLOGY

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives:

To understand the working principles and operations of various measuring devices and its calibration.

Module - I (16 hours)

Elements of measurement, Statistical analysis of measurement results, Errors and uncertainties in measurement - computation of uncertainty in inputs and outputs. End, Line and wave length Standards of length, Airy & Bessel points, desirable features of end standards, calibration of end standards by interferometry - NPL Gauge length interferometer, calibration of line standard by micrometer microscope, Photoelectric microscope and moir fringe technique, measurement of large displacements using lasers, photoelectric autocollimator, Types of interchangeability.

Module – II (15 hours)

Limit Gauges: Taylor's principles of gauge design, limitations of ring & plug gauges, position and receiver gauges, types of limit gauges. Comparators: Multirange sigma comparator, optotest comparator, Eden-Rolt millionth comparator, Back pressure and free flow type pneumatic comparators, Differential back pressure gauge, Non contact and contact type pneumatic gauging elements, Air gauging with electronic sensors, Pre-process, in-process & post process gauging, Automatic inspection.

Module - III (14 hours)

Calibration: Calibration of Working Standards by Interferrometry, Application of interferometry, calibration of gauges by interference method, the gauge length interferometer, obliquity correction, the absolute length gauge interferometer. The Calibration of working standards by direct comparison in series: Different types of comparators such as the pneumatic, optical, electrical and electronic comparators, principle of amplification, magnification, sensitivity and response, the calibrations of end gauges in sets, ruling and calibration of standard scales.

Module-IV (15 hours)

Measuring Machines: Floating carriage diameter measuring machine, universal measuring machine (UMM), Matrix internal diameter measuring machine, Optical dividing head, Optical projector, CMM, Design principles of measuring machines. Management of Inspection and quality control: Communication of specifications, the nature of dimensions, selection of gauging equipment, kind of inspection, quality control Management.

References:

1. Tilher, *Metrology and Measuring Instruments*
2. Miller, *Dimensional Metrology*
3. R.K.Jain, *Engineering Metrology*
4. Michelon, Leno C. Harper & Brothers, *Industrial Inspection Methods*
5. The DoALL Co, Des Plaines Illinois *The Science of Precision Measurement*
6. The Industrial Press New York, Inspection *& Gauging*
7. ASTME, *Hand Book of Industrial Metrology*

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 105 (B): COMPOSITE MATERIALS

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To understand the principles of manufacture of composite materials, micro mechanical behaviour of composite materials and designs of composites.*

Module 1: (13 Hrs.)

Introduction, Classification, General Characteristics, Materials, Mechanical Behaviour, Basic technology of Laminated Fibre reinforced composite materials. Metal and Ceramic matrix composites. Manufacture of Composite Materials – Fundamentals. Processes – Bag moulding, Compression moulding, Petrusion, Filament winding. Processes for Thermoplastic composites.

Module 2: (14 Hrs.)

Macro Mechanical Behaviour of Lamina – Introduction, Anisotropic materials, Stiffness, Stress strain relations, Engineering Constants of composites, Properties of Orthotropic Laminae, Strength and properties of an orthotropic laminae. Bi axial strength of an Orthotropic lamina. Micro Mechanical behaviour of Lamina. Stiffness – Mechanics of materials approach and Elasticity approach. Comparison of approaches to stiffness. Strength Mechanics of Materials Approach.

Module 3: (14 Hrs.)

Laminates – Macro Mechanical Behaviour - Classical Laminate theory – Laminate stiffness, Special cases of Laminate stiffness. Theoretical versus Measured Laminate stiffness - Cross ply and Angle ply laminates. Strength of Laminates – Introduction - Croos ply and Angle ply. Inter laminar stresses – Classical Lamination theory, Elasticity Formulation, Elasticity solution results, Inter laminar stresses in cross ply laminates, Implication of inter laminar stresses, Free edge Delamination.
(Use of a suitable computer program / software for analysis is recommended in the 2 modules listed above)

Module 4: (13 Hrs.)

Design of Composites – Introduction to application in Structures, Material selection, Configuration selection, Design requirements and Failure criteria. Failure prediction in Unidirectional lamina Maximum stress Theory, Maximum strain Theory, Azzi-Tsai-Hill Theory. Failure prediction - unnotched laminates, notched laminates and delamination.

Text Books:

1. Robert M Jones, *Mechanics of Composite Materials*, 2nd edition, Published by Taylor and Francis Inc. Philadelphia.ISBN 1 – 56032 - 712 - X
2. P K Mallick, *Fiber Reinforced Composites*, Published by Marcel Dekker inc New york, ISBN 0 – 8247- 9031- 6
3. Mahmood Husein Datoo, *Mechanics of Fibrous Composites*, Elsevier Applied Science, ISBN 1-85166-600 – 1

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 105(C): MECHATRONICS PRODUCT DESIGN

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives:

To understand the principles of traditional and mechatronics design, programmable logic controllers, microprocessors in mechatronics and their applications and design of mechatronics system elements.

Module - I (16 hours)

Introduction to Mechatronics systems and components. Mechatronics in Products -Traditional design and Mechatronics Design. Principles of basic electronics - Digital logic, Number system logic gates, Sequence logic flip flop system - JK flip flop - D-flip flop. Signal conditioning processes, various types of amplifiers, low pass and high pass filters. Software and hardware principles and tools to build mechatronics systems.

Module - II (14 hours)

Programmable Logic Controllers: Introduction - Basic structure - Input / Output processing 0Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC. Sensors for condition monitoring, Mechatronics control in Automated manufacturing, Artificial Intelligence and Fuzzy Logic applications in Mechatronics, Micro Sensors

Module - III (15 hours)

Microprocessors in mechatronics and their applications - Architecture - Pin configuration Instruction set - Programming of Microprocessors using 8085 instructions. Microcontroller. Integrated circuits- Principles of Electronic system communication- Interfacing. AD and DA converters, input and output devices. Applications - Temperature control, Stepper motor control, Traffic light controller.

Module – IV (15 hours)

Importance of product design in industry. Principal requirements of good product design. Factors and considerations affecting product design. Ergonomic factor in product design. Product design methodology and techniques. Basic elements and concepts of visual design. Design and selection of Mechatronics system elements - line encoders and revolvers, stepper and servomotors, ball screws, solenoids, line actuators and controllers with application to CNC machines, robots, consumer electronics products etc. Design of a mechatronics product using available CAD software packages.

References:

1. W. Bolton, *Mechatronics*, Pearson Education, Low Price Edition.
2. Michael B.Histand and David G. Alciatore, *Introduction to Mechatronics and Measurement Systems*, McGraw-Hill International Editions, 1999.
3. Lawrence J.Karnm, *Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics*, Prentice-Hall, 2000
4. Mikel P Groover, *Automation Production System and CIMS*, Prentice Hall.

5. Mayall, *Industrial Design*, Mc Gruw Hill
6. Niebel & Draper, *Product Design & Process Engineering*, Mc Graw Hill

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 106(P): PRODUCTION ENGINEERING LABORATORY

Teaching scheme: 2 hours practical per week **Credits:** 2

Objectives

- *To acquaint with machine tools like copying lathe, Capstan lathe, Surface grinding machine, Cylindrical grinding machine.*
- *To acquire knowledge on various advanced welding process*
- *To gather knowledge regarding NC and CNC machines.*
- *To impart training on copying lathe, CNC machine, TIG/MIG welding machines*
- *To study metallurgical properties of welded joints.*

Study of machines:

a) Copying lathe
b) Capstan lathe
c) Turret lathe
d) Cylindrical grinding machine
e) Surface grinding machine
f) CNC machines
g) MIG / TIG and Submerged arc welding machines
h) Spot welding machines
i) Metallurgical properties of welded joints

Exercises:

1) Exercise on Copying lathe
2) Exercise on CNC machine
3) Exercise on cylindrical / surface grinding and tool grinding machines
4) Exercise on MIG welding machine
5) Exercise on TIG welding machine
6) Non-destructive tests on welded joints

Reference Books

1. HMT, *Production Technology,* Tata McGraw Hill.
2. ASTME, *Tool Engineers Hand Book*.
3. Burghardt, Asilered, Anderson, *Machine Tool Operations I & II*, McGraw Hill.
4. W. A. J. Chapman, *Workshop Technology: Part 2*, CBS Publishers.
5. R. V. Rao, *Metal Cutting and Machine Tools*, S K Kataria & Sons
6. Robert Quesada and T.Jayapoovan, *Computer Numerical Control*, Pearson Education, 2006

Internal Continuous Assessment *(Maximum Marks-100)*

Regularity	30%
Record	20%
Test/s, Viva-voce	50%

MPE10 107(P): SEMINAR

Teaching scheme: 2 hours per week **Credits:** 2

Objective: *To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.*

- Individual students are required to choose a topic of their interest from Production engineering related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Production engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

- **Internal continuous assessment: 100 marks**

  Evaluation shall be based on the following pattern:

Report	=	50 marks
Concept/knowledge in the topic	=	20 marks
Presentation	=	30 marks
Total marks	=	100 marks

MPE10 201: COMPUTER INTEGRATED MANUFACTURING

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives

- *To provide a comprehensive survey of the design function and its importance in Computer Integrated Manufacturing.*
- *To examine technologies those have been developed to automate manufacturing operations.*

Module 1: (13 Hrs.)

Design and engineering – the design process – design for manufacturability (DFM) – component of design – design for assembly – computer aided design (CAD) – areas of application – benefits of CAD – computer aided manufacturing (CAM) – computer aided engineering (CAE) - computer integrated manufacturing (CIM) – needs of CIM – benefits of CIM - CAD-CAM continuum – CAD/CAM - reverse engineering – simultaneous engineering / concurrent engineering.

Module 2: (14 Hrs.)

Manufacturing systems – components of a manufacturing system – production machines – computer control system – classification of manufacturing systems – single station manufacturing cells – applications – numerical controller (NC) technology – computer assisted part programming – the APT language – programming of simple parts –computer numerical control (CNC) – direct numerical control (DNC) – combined DNC/CNC systems – adaptive control (AC) machining systems.

Module 3: (13 Hrs.)

Robotics technology – Types of Robots – Robot Technology Levels – Robot geometric configurations – basic robot motions – robot system – robot motion control techniques – path control – robot controller – end effectors / grippers – operational aids – robot drive systems – robot sensors – robot safety - robot-computer interface - industrial robot applications – robot programming- programming languages – user's programme – off-line programming – economic considerations of robotic systems – robot kinematics and dynamics - benefits of robots.

Module 4: (14 Hrs.)

Automated guided vehicles – types and technology – automated storage and retrieval system (AS/RS) - automated material handling system – Shop floor control – data logging and acquisition – automated data collection – bar codes – optical character recognition – vision or image processing – radio frequency identification – magnetic identification – voice technology – control types – programmable logic controllers – sensor technology – touch probes – fiber optic sensors.

Text Books:

1) S Kant Vajpayee, *Principles of computer integrated manufacturing,* Prentice hall of india, 2003
2) Sadhu singh, *Computer Aided Design and Manufacturing*, Kanna Publishers, Delhi
3) P Radhakrishnan & C.P.Kothanda Raman, C*omputer graphics and design*
4) Surender Kumar and A.K.Jha, *CAD/CAM*, Dhanpat Raj and Co., Delhi.

References:

1) Tien-Chien Chang, Richard A.Wysk and Hsu-Pin Wang, *Computer Aided Manufacturing*, Prentice Hall International, Inc.
2) Mikell P. Groover, *Automation production systems and computer integrated manufacturing*, Prentice hall of india, New Delhi, 2003
3) M P Groover and E W Zimmers, *CAD/CAM*, Prentice hall of india,1984

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I

Question 1: 20 marks
Question 2: 20 marks

Module II

Question 3: 20 marks
Question 4: 20 marks

Module III

Question 5: 20 marks
Question 6: 20 marks

Module IV

Question 7: 20 marks
Question 8: 20 marks

MPE10 202: MODERN MANUFACTURING PROCESSES

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives:

To understand fundamental machining principles and the mechanisms in the nontraditional machining processes.
To describe various advanced metal forming operations.

Module 1: (16 Hrs.)

Mechanical Processes: Ultrasonic Machining- Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitations of the process, advantages and disadvantages. Abrasive Jet Machining- Variables in AJM, metal removal rate in AJM. Water Jet Machining- Jet cutting equipments, process details, advantages and applications.

Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining- Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical Grinding – Material removal, surface finish, accuracy, advantages, applications.

Module 2: (14 Hrs.)

Thermal Metal Removal Processes: Electric Discharge Machining (EDM) or spark erosion machining processes, mechanism of metal removal, spark erosion generators, electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection,

applications. Wire cut EDM. Laser beam machining (LBM)- Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations.

Module 3: (10 Hrs.)

Plasma Arc Machining (PAM): Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C. plasma torch unit, safety precautions, economics, other applications of plasma jets. Electron Beam Machining (EBM) – Generation and control of electron beam, theory of electron beam machining, process capabilities and limitations.

Module 4: (10 Hrs.)

High Velocity Forming Processes:- Conventional versus High velocity forming methods – Material behavior – stress waves and deformation in solids – Stress wave induced fractures – Applications.
Explosive Forming Processes:- Principles – Explosives – Length of reactions – Energy in plastic deformations – Expression for change in size required for deforming a flat disc into a bulged form – Effect of process in material properties – Types of Explosive forming – die construction.
Magnetic Pulse Forming Processes: - General principles – Applications.

Text Books:

1) HMT, *Production Technology*, Tata Mc. Graw Hill, New Delhi.
2) Ghosh and Mallik, *Manufacturing Science*, East West Press.
3) ASTME, *High Velocity Forming of metals*, Prentice Hall of India.
4) J.Pearson, Explosive Forming of Metals.
5) Rinehart and Pearson, *Explosive working of metals*, Pergamon Press.
6) P.C.Pandey, H.S.Shan, *Modern Machining Processes*, Tata McGraw Hill
7) Ghosh and Malik, *Machining Science*, Affiliated East-West Press

References:

1. Benedict G.F, Marcel Dekker, *Non Traditional Manufacturing Processes*.
2. Mc Geongh J.A, *Advanced Methods of Machining*, Chapman and Hall
3. Kalpakjian, *Manufacturing Processes for Engineering Materials*, Addition Wesley, 4th Edition

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 203: PLANT MAINTENANCE & SAFETY

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To understand types of maintenance, concepts of various corrosions, failure data analysis and the concept of safety and measurement of safety performance.*

Module I (16 hours)

Types of Maintenance – Break down, Routine, Planned, Preventive, Diagnostic Maintenance. Condition Monitoring – Principles and methods . Contaminant monitoring, Spectral Oil Analysis Procedure, Ferrography. Vibration Monitoring and Analysis – Transducer selection, Frequency analysis. Condition Monitoring of Rolling Element Bearing.

Module II (12 hours)

Basic concepts of Corrosion, Forms of Corrosion, Corrosion Testing, Corrosion Monitoring Techniques, Corrosion Prevention. Industrial Lubrication, Selection of Lubricant, Lubrication Systems.

Module III (12 hours)

Reliability, Availability, Maintainability. Failure Data Analysis. MTTF, MTTR, Fault Tree Analysis, FMEA, FMECA. Reliability estimation.

Module IV (12 hours)

–
Introduction to the concept of safety-Need-safety provisions in the factory Act-Laws related to the industrial safety-Measurement of safety performance, Safety Audit, Work permit system, injury and accidents-Hazards, types of industrial hazards-nature, causes and control measures, Threshold limit values, Logics of consequence analysis-Estimation-Toxic release and Fire hazard, Emergency planning and preparedness.

REFERNCES:

1 R.A.Collacot – *Mechanical Fault Diagnosis and Condition Monitoring*. Chapman & Hall, London.
2. Mars G. Fontana – *Corrosion Engineering*. McGraw-Hill
3. L.S.Srinath – *Reliability Engineering*. Affiliated East West Press
4. Thomas J. Anton, *Occupational Safety and Health Management*, McGraw Hill.
5. Ian T.Cameron & Raghu Raman, *Process Systems Risk Management*, ELSEVIER Academic press.
6. Lees F.P, *Loss Prevention in Process Industries*, Butterworths, New Delhi.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 204 (A): GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To acquire comprehensive knowledge on Group Technology and Flexible Manufacturing approach.*

Module – 1 (14 Hrs.)
Group technology(GT); Role of GT in computer aided manufacturing(CAM), Impact of GT on system performance, Method of developing part families , classification and coding, Mono code, poly code, mixed code, opitz part coding system, hierarchical cluster algorithm, economics of GT.

Module – 2 (13 Hrs.)
Cellular manufacturing; Pull production- kanban system ,push production, work cell concepts, work cell applications, work cell design, linked work cell and sub-cell, work cell time, staffing work cell, equipment issues, issues in implementing cellular manufacturing.

Module – 3 (14 Hrs.)
Process planning; process planning for parts, preparation of route sheet, process planning for assemblies, draw backs of manual process planning, computer aided process planning(CAPP), approaches to computer aided process planning, variant and generative approach, process planning system, criteria for selecting a CAPP system , implementation issues, .

Module – 4 (13 Hrs.)
Flexible manufacturing system (FMS) and Flexible manufacturing cell (FMC); Types of FMS, advantages of flexible automation, components of FMS, work station, material handling and storage system, FMS layout configuration- inline, loop , ladder, open field, robot centered cell, FMS planning and design issues, FMS operational issues, bottle neck model.

References:

1. David .D.Bedworth, Mark.R.Hederson and Philip. M. wolfed, *Computer integrated design and manufacturing* ,McGraw hill international edition.
2. Mikell .P. Groover, *Automation, Production systems and Computer integrated manufacturing*, Prentice hall of India private limited.
3. John Nicholas, *Competitive manufacturing management- continues improvement, lean production and customer focused qualities*, McGraw-Hill international editions.
4. Tien – Cheng, Richared A Wysk and Hsu-pin Wang, *Computer aided manufacturing*, Prentice hall international ,Inc.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 204 (B): MANAGEMENT INFORMATION SYSTEM

Teaching scheme: 3 hours lecture and 1 hour tutorial per week
Credits: 4

Objectives:- *To provide knowledge on different types of Information systems and their applications in industry.*

Module – 1 (13 Hrs.)

The Concept of MIS - Role of MIS - Characteristic of MIS - Functional Subsystems - Activities Subsystems Pre-requisites of MIS-Contemporarily Approaches to MIS-Technical Approach, Behavioral Approach,-Socio-technical Approach, Technical Approach-Information as Strategic Resource-Use of Information for Complete Advantage.

Module – 2 (14 Hrs.)

Evolution of Computers-Computer Hardware-Generation of Computers-Complete Categories - Software - System Software, Application Software-Data Communication - Data Processing-Transaction Processing-Data Processing Modes-Data Transmission-Functions of Telecommunication- Communication-Transmission Channel- Characteristic of Communication Channel- Network - Topologies, Types of Networks, OSI, TCP/IP-Internet -Internal, External, ISDN - Multimedia-IT Enabled Services - SPO, Call Centers, MT, GIS-Information.

Module – 3 (14 Hrs.)

Management-Decision Making - Decision Types, Decision Making Process,-Decision Making Tools, Principle of Rationality, Principle of Logic & Interaction-Decision Making Models - Classical Model, Administrative-Model, Herbert, Simon Model-Information - Sources of Information, Types of Information, Information requirements, Techniques for Assessing-Information Requirements - Systems Analysis and Design-System- Types, Characteristics-Control- Control Process, Requirements of Good Control-System, Control System-Law of Requisite Variety-Systems Development-System Analysis, System Design, System Implementation, System Development Process-System Development Life Cycle-Rapid System Development Tools - Prototyping, CASE Tools, Object Oriented Systems 4

Decision Support System-The Decision Support System - Components, Characteristics, Structure -Group Decision Support System-Configuration, Features-Executive Information System / Executive Support System-Definition, Characteristic, Capabilities, Benefits-Expert System-Artificial intelligence Database Management System-DBMS Components-Database Model.

Module – 4 (13 Hrs.)

Data Warehousing & Data Mining-Data Warehousing Definition, Structure / Architecture-Data Mining - Information Security and Control-Information System Security Threats-External & Internal Threats Information System and Quality-Quality Assurance-Software Quality Assurance-Management Role in Software Quality Assurance -Quality Assurance Methods - Quality Profile Model, Construction Quality Model, Tick IT, Initiative-Functional applications of MIS -Stores & Purchase Management-Accounts Payable System-Inventory Management-Production Management System -Marketing Service System-Applications in Service Sector-MIS Application in Service Industry-Airlines, Hospital, Banking.

References:

1) Jerome Kanter – Managing with Information
2) Gordon B. Davis and Alson – Management Information Systems
3) Robert C Murdick Joel E Ross and James R Clagget – Information Systems for Modern management
4) Henry c Lucas Jr. – The Analysis Design and Implementation of Management Information Systems.
5) Kickson and Wheterbe – Management Information Systems.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 204 (C): METAL FORMING

Teaching scheme: 3 hours lecture and 1 hour tutorial per week Credits: 4

Objectives: *To impart knowledge on various aspects of metal forming and to develop the skill to analyze under different conditions.*

Module1. (12Hours)

State of stress - components of stress - principal stresses - Theory of plasticity – flow curve – true stress and true strain - yield criteria - Von Mises, Tresca yield criteria – relationship between tensile and shear yield stresses – two dimensional plastic flow – slip line field theory.

Module 2. (12 Hours)

Fundamentals of Metal forming - Classification of forming processes - Mechanics of metal working - Flow stress determination - Effect of temperature - strain rate and metallurgical structure on metal working - Friction and lubrication - deformation zone geometry - Workability–residual stresses.

Module 3. (15 Hours)

Forging - Classification of forging process – forging equipments - Open die forging and Closed die forging - die design - forging in plane strain - calculation of forging loads - forging defects- causes and remedies - residual stresses in forging.

Rolling: Classification of rolling processes - rolling mills - hot and cold rolling - rolling of bars and shapes - forces and geometrical relationship in rolling - analysis of rolling load - torque and power - rolling mill control - rolling defects.

Module 4. (14 Hours)

Extrusion- classification – equipments – deformation -, analysis of extrusion - tube extrusion and production of seamless pipes and tubes. Drawing of rods, wires and tubes - analysis of drawing.

Forming methods - Shearing, blanking, bending, stretch forming, deep drawing - sheet metal formability - formability limit criteria - defects in formed part.

Text Books:

1 Dieter.G.E ., *"Mechanical Metallurgy"* McGraw-Hill Co.
2 Nagpal.G.R., *"Metal Forming Processes"*, Khanna Pub., New Delhi.

References:

1. C W. Rowe, *"Introduction to the principles of Metal Working"*,
2. Kurt Lange, *"Handbook of Metal Forming"* Society of Manufacturing Engineers.
3. Avitzur, *"Metal Forming - Processes and Analysis"*, Tata McGraw-Hill Co., New Delhi.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I

Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE 10 205 (A): MANUFACTURING AUTOMATION

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To provide knowledge on various aspects of machine tool control, considering the different systems of the machine tool under different conditions.*

Module 1. (14 Hours)
Devices of numerical control systems – hydraulic systems – direct current motors – stepping motors – feedback devices – encoder – resolver – dc tachometers – digital to analog converter – data processing unit – data reader – distributors - data conversion – interpolation: linear and circular.
Module 2. (14 Hours)
Control loops – basic structure - incremental versus absolute systems – incremental open loop control – incremental closed loop control – absolute closed loop circuit – contouring control loops – mathematical analysis.
Module 3. (13 Hours)
Numerical control loops – magnetic numerical control systems – general electric systems – electronic data processing – geometrical data processing.
Module 4. (13 Hours)
Computer control concepts – DNC systems – CNC systems – interpolation systems - adaptive control systems – micro processor.
Hydraulic controls – elements of hydraulic systems like pumps, valves, filters, seals, accumulators.
Analysis of typical hydraulic circuits in machine tools – servo systems – electro hydraulic systems – hydro pneumatic circuits.
Text Books:
Yoram Koren and Joseph Ben-Uri, "*Numerical Control of Machine Tools*", Khanna Publishers.
References:

1. Groover MP, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Prenticehall.
2. Radhakrishnan P, "CNC machines", New Central Book Agency (P) ltd.
3. Yoram Koren, "Computer Control of Manufacturing Systems" Mc Graw Hill Publications.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 205 (B): QUANTITATIVE TECHNIQUES FOR MANAGERIAL DECISIONS

Teaching scheme: 3 hours lecture and 1 hour tutorial per week
Credits: 4

Objectives: - *To understand the principles of decision making, network techniques, inventory control and transportation problems related to managerial decisions.*

Module 1 (13 hours)

Decision making- strategic and tactical decisions-strategy formulation-models of decision making-single stage decisions under risk-incremental analysis-multistage decision making-decision trees-decision making under uncertainty- baye's decision theory.
Network Techniques- basic concepts- network construction- CPM and PERT networks-algorithm for critical path-slacks and their significance-crashing-network flow problems-the shortest route problem-minimal spanning tree problem.

Module2 (13 hours)

Inventory control-functions of inventory-structure of inventory problems-relavant cost-opposing costs-selective control techniques-dynamic inventory models under certainity-calssical EOQ model with and without back logging-production lot size model-quantity discount- safety stock-probabilistic model-one time mode-P system and Q system.

Module 3 (13 hours)

Statement of the LP problem- slack and surplus variables-basic feasible solutions- reduction of a feasible solution to basic feasible solution-artificial variable-optimality conditions-unbounded solutions-charnes ' M method-two phase method-degeneracy-duality.

Module 4 (13 hours)

Transportation problem- coefficient matrix and its properties-basic set of column vectors-linear combination of basic vectors-tableau format-stepping stone algorithm-UV method-inequality constraints-degeneracy in transportation problems - assignment problem-hungarian method

Reference Books

1. Hadley.G, *Linear programming*, Addison Wesley
2. Ravindran , Solberg, & Philips, *Operations Research*, John Wiley.
3. Riggs, *Economic Decision models for Engineers and Managers* , McGraw Hill International Students Edition.
4. Weist & Levy, *A management Guide to PERT and CPM*, Prentice hall of India
5. Starr & Miller, *Inventory control –Theory and Practice*, Prentice Hall of India

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 205 (C): RAPID PROTOTYPING

Teaching scheme: 3 hours lecture and 1 hour tutorial per week
Credits: 4

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.*

Module – I (14 hours)

Overview of Rapid Product Development:-Product Developing Cycle-Definition of Rapid Product Development-Virtual prototypical and rapid manufacturing technologies- Physical Prototyping & rapid manufacturing technologies-Synergic integration technologies.

Module – II (14 hours)

Two-Dimensional Layer- by Layer Techniques:- Stereolithography (SL), Solid Foil Polymerization(SFP), Selective Laser Sintering (SLS), Selective Powder Building (SPB), Ballistic Particle Manufacturing (PM), Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), Solid Ground curing (SGC), Laser Engineered Net Shaping (LENS). Laser Additive Manufacturing (LAM) - Segmented Object Manufacturing (SOM).

Module – III (13 hours)

Direct three Dimensional Techniques-Beam Interference Solidification (BIS), Ballistic Particle Manufacturing, Programmable Moulding.
Rapid tooling: Indirect Rapid tooling -Silicon rubber tooling -Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3D keltool

Module – IV (13 hours)

Other rapid prototyping technologies:-Three dimensional Printing (3DP), Solid based, Liquid based and powder based 3DP systems, Shape Deposition Manufacturing (SDM), Selective Laser Melting, Electron Beam melting.

Text Books:

1. Amitabha Ghosh, *Rapid Prototyping – A Brief Introduction*, Affiliated East West Press Pvt. Ltd., 1997.
2. Chua C.K., Leong K.F., and Lim C.S., *Rapid prototyping: Principles and applications*, second edition, World Scientific Publishers, 2003.

References:

1. Liou W.Liou, Frank W.Liou, *Rapid Prototyping and Engineering applications: A tool box for prototype development*, CRC Press, 2007.
2. Ali K. Kamrani, Emad Abouel Nasr, *Rapid Prototyping: Theory and practice*, Springer, 2006.
3. Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, *Rapid Tooling: Technologies and Industrial Applications*, CRC press, 2000.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I

Question 1: 20 marks
Question 2: 20 marks

Module II

Question 3: 20 marks
Question 4: 20 marks

Module III

Question 5: 20 marks
Question 6: 20 marks

Module IV

Question 7: 20 marks
Question 8: 20 marks

MPE10 206 (P): SEMINAR

Teaching scheme: 2 hours per week **Credits:** 2

Objectives: *To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him / herself esteem and courage that are essential for an engineer.*

- Individual students are required to choose a topic of their interest from Production engineering related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Production engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

- **Internal continuous assessment: 100 marks**

Evaluation shall be based on the following pattern:

Report	=	50 marks
Concept/knowledge in the topic	=	20 marks
Presentation	=	30 marks
Total marks	=	100 marks

MPE10 207 (P): MINI PROJECT

Teaching scheme: 2 hours per week **Credits:** 2

Objectives:

- *To practice the steps involved for the selection, execution, and reporting of the project.*
- *To train the students for group activities to accomplish an engineering task.*

Individual students are required to choose a topic of their interest. The subject content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects or shall be based on industrial visits. At the end of the semester, the students should submit a report duly authenticated by the respective guide, to the head of the department.

Mini Project will have internal marks 50 and Semester-end examination marks 50. **Internal marks** will be awarded by respective guides as per the stipulations given below.

- Attendence, regularity of student (20 marks)
- Individual evaluation through viva voce / test (30 marks)

Total (50 marks)

Semester End examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.

- Report = 25 marks
- Concept/knowledge in the topic = 15 marks
- Presentation = 10 marks

Total marks = 50 marks

MPE10 301(A) : Advanced Finite Element Methods

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives

- *To master linear finite element procedures and programming techniques.*
- *To understand the basic mathematics of finite element analysis and equip the students to formulate finite element procedures for engineering problems.*
- *To train the students in structural, thermal and flow analysis problems using finite element software.*
- *To introduce finite element procedures and programming techniques for non-linear and transient problems.*

Pre-requisites

- *A basic knowledge of Partial differential equations, Structural Mechanics, Heat transfer, Fluid Mechanics and Elementary Finite Element Method.*

Module I (14 hours)

Introduction – review of computational procedures with 1D elements – interpolation and shape functions – 2D elements – simple solid elements – element matrices for structural mechanics, heat transfer and fluid flow problems – choice of interpolation functions - convergence and completeness conditions – modelling considerations – symmetry - applications.

Module II (14 hours)

Isoparametric formulation – 1D and 2D elements – numerical integration – choice in numerical integration – patch test. Coordinate transformation – transformation of characteristic matrix – transformation of restraint directions. Imposition of constraints – Lagrange multiplier and penalty function methods. Error – sources of error – ill conditioning – convergence – error estimates.

Module III (13 hours)

Boundary value problems – weak and strong forms – functionals – Euler-Lagrange equations – Rayleigh-Ritz method – finite element formulation from a functional.Weighted-residual methods – Gelerkin, least-square and collocation methods – Gelerkin finite element formulation – applications to structural, thermal and fluid flow problems.

Module IV (13 hours)

Finite element formulation for non-linear problems – solution methods - Newton-Raphson method – modified Newton-Raphson method – convergence criteria – applications. Transient finite element procedures – FE equations and matrices - integration techniques –applications. Introduction to coupled analyses (fluid-structure interaction, thermo-mechanical problems) and contact problems.

REFERENCES:

1. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, *Concepts & Applications of Finite Element Analysis*, John Wiley & Sons
2. D. V. Hutton, *Fundamentals ofFinite Element Analysis*, TataMcGraw Hill
3. S. S. Rao, *The Finite Element Method in Engineering*, Butterworth Heinemann
4. J. N. Reddy, *An Introduction to the Finite Element Method*, McGraw Hill International Edition
5. K. J. Bathe, *Finite Element Procedures in Engineering Analysis*, Prentice Hall of India
6. O. C. Zienkiewics, R. L. Taylor, *The Finite Element Method*, Vol I & II, McGraw Hill
7. H. C. Huang, A. S. Usmani, *Finite Analysis for heat transfer*, Springler-Verlag, London.
8. D. R. J. Owen, Earnest Hinton, *Finite Elements in Plasticity, Theory & Practice*, Pineridge Press
9. G. W. Rowe, C. E. N. Sturgess, P. Hartley, I.Pillinger, *Finite Element Plasticity and Metal Forming Analysis*, Cambridge University Press, UK
10. Ted Belytschko, Wing Kam Liu, Brain Moran, *Non-linear Finite Elements for Continua and Structures*, John Wiley & Sons Ltd.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I

Question 1: 20 marks

Question 2: 20 marks

Module II

Question 3: 20 marks

Question 4: 20 marks

Module III

Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 301 (B): COMPUTATIONAL FLUID DYNAMICS

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *Develop an understanding of Computational fluid dynamics which has wide application in engineering. Learn to use control volume analysis to develop basic equations and to solve problems. Understand and use differential equations to determine pressure and velocity variations in internal and external flows. Understand the concept of viscosity and turbulence and its importance in real flows.*

Prerequisites: *A basic course fluid mechanics/dynamics*

Module 1 (14 Hrs.)

Conservation laws of fluid motion and boundary conditions. Governing equations of fluid flow and heat transfer. Mass conservation in three dimension. Momentum equation in three dimension. Energy equation in 3D. Equation of state. Navier stokes equation for a Newtonian fluid. Conservative form of the governing equations. Differential and integral form. Classification of fluid flow equation.
Turbulence and its modelling. Transition from laminar to turbulent flow. Effect of turbulence on the time averaged navier stokes equation. Characteristics of simple turbulent flows. Turbulent model. Mixing length turbulent model. The k-ε model. Reynolds stress equation model. Algebraic stress equation model.

Module 2 (13 Hrs.)

Finite volume method for convection diffusion problems- steady one dimensional convection and diffusion. The central difference scheme. Properties of discretisation scheme. The upwind differencing scheme. The hybrid differencing scheme. Power law scheme. Quick scheme. Other higher order schemes.
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Module 3 (14 Hrs.)

Solution algorithm for pressure velocity coupling in steady flow. The SIMPLE algorithm. Staggered grid. Momentum equations Assembly of a complete method- The SIMPLER algorithm. The SIMPLEC algorithm. The PISO algorithm The solution of discretised equations. The tridiagonal matrix algorithm. Finite volume method for unsteady flows. One dimensional unsteady heat equations- explicit and implicit schemes.-Implicit method for 2d and 3d problems. Discretisation of transient convection-diffusion equations. Solution procedure for Unsteady flow calculation.

Module 4 (13 Hrs.)

Implementation of boundary conditions- inlet and outlet boundary conditions- slip and no-slip boundary conditions – pressure boundary condition-symmetry periodic boundary conditions-Advanced topics and applications – Combustion modelling- The simple chemical reacting system-laminar flamelet model- Calculation of buoyant flows- The use of body filled co-ordinates in CFD-
Advanced examples.

Text Books

1. H.K Versteeg . *An introduction to computational fluid dynamics,* Longman Scientific
2. Suhas V. Patankar, *Numerical heat transfer and fluid flow*, Butter-worth Publishers
3. John. D. Anderson, *Computational fluid dynamics*, Basics with applications, Mc Graw Hill.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 301 (C): SYSTEM SIMULATION AND MODELING

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To acquaint with system concept, simulation, discrete event simulation and Simulation Modelling and Analysis of Manufacturing Systems.*

Module 1 (14 Hours)

System Concept: Systems and system environment, Components of a system, Discrete and continuous systems, Systems approach to problem solving, Types of system study, System analysis, system design and system postulation, System modelling, Types of models.
System Simulation: Technique of simulation, Comparison of simulation and analytical methods, Types of system simulation, Steps in simulation study, Monte Carlo simulation.
Concepts in Discrete Event Simulation: Event scheduling/Time advance algorithm, Modelling world views, Simulation programming tasks, Comparison and selection of simulation languages.

Module 2 (13 Hours)

Random Number Generation: Techniques for generating random numbers, Linear congruential method, Test for random numbers, Frequency tests, run tests, tests for autocorrelation, gap test, and Poker test.
Random Variate Generation: Inverse transformation technique, Exponential, Uniform, Weibull, Triangular, Empirical-Discrete and continuous distributions. Convolution method, Acceptance-Rejection technique.

Input Modelling for Simulation: Data collection, Identifying the distribution with data, Parameter estimation, Goodness of fit test, Chi square, Klomogrov and Smirnov tests, Selecting input model when data are not available.

Module 3 (14 Hours)

Verification and Validation of Simulation Models: Verification of simulation models, Calibration and validation of models, Face validity, Validation of model assumption, validating input-output transformation, Input-output validation using historical input data.
Output Analysis for a Single Model: Measures of performance and their estimation, Point estimation, Interval estimation, Output analysis for terminating simulations and Steady state simulations.
Meta modelling: Simple linear regression, Testing for significance of regression, Multiple linear regression.

Module 4 (13 Hours)

Simulation Modelling and Analysis of Manufacturing Systems: Objectives, Performance measures, Issues in simulation of manufacturing systems, Simulation software for manufacturing applications, Simulation of job shop manufacturing systems, Simulation Modelling and Analysis of Single Server and Single Queue Systems, Inventory systems and PERT networks.

Text Book:

1. Banks, J., Carson, J.S., Nelson, B.L., and Nicol, D.M., Discrete-Event System Simulation, Fourth Edition, Pearson Education, Inc., 2005.

References:

1. Deo, N., *System Simulation with Digital Computer*, Prentice Hall of India, 1997.
2. Askin R.G. and Standridge, C.R., *Modelling and Analysis of Manufacturing Systems*, John Wiley & Sons, 1993.
3. Gordon, G., *System Simulation, Second Edition*, Prentice Hall of India, 1995.
4. Law, A.W. and Kelton, W.D., *Simulation Modelling and Analysis*, Third Edition, McGraw Hill International, 2000.
5. Fishman, G.S., *Concepts and Methods in discrete Event Digital Simulations*, Wiley, New York, 1973.
6. Carrie, A., *Simulation of Manufacturing Systems*, John Wiley & Sons Ltd., 1988.
7.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 302 (A): INDUSTRIAL ENERGY MANAGEMENT

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To understand the concept of energy engineering, electrical system optimization, energy conservation, energy economics and environmental aspects of energy utilization.*

Module 1(14 hrs)

Energy Engineering- World energy outlook. Application of Non Conventional and Renewable Energy Systems - Use of Energy Efficient Technologies -Solar energy –solar energy collectors and energy storage-applications of solar energy. Wind energy-basic components of a wind energy conversion system-performance of wind machines-applications of wind energy. Energy from biomass – biomass conversion technologies-types of biogas plants-Energy conservation schemes-case studies.

Module 2 (14 hrs)
Electrical system optimization-Importance of power factor-Power factor correction-Energy efficient motors –lighting basics-energy efficient light sources-domestic, commercial or industrial lighting. Energy conservation in lighting schemes-case studies.
Energy conservation in HVAC system, energy conservation by cogeneration scheme-boiler efficiency improvement-waste heat recovery –case studies

Module 3 (13 hrs)

Energy economics-payback analysis-energy auditing and accounting-types-energy use profiles-the energy survey-Sankey diagram for energy audit- Energy Audit Instruments-Thermal Energy Efficiency & Audits - Electrical Energy Efficiency - Audits -case studies

Energy management- Maintenance management-Preventive maintenance schedule-Energy management organization.

Module 4 (13 hrs)
Energy and Environment. Environmental aspects of energy utilization-public health issues related to environmental pollution. Methods to measure pollution in industries-air pollution & water pollution. Compliance with standards-International Environmental Policy. Energy recovery by solid waste management. Environmental auditing-case studies.

References:

1. A.P.E.Thumann, *Fundamentals of Energy*, Engineering,Prentice Hall,1984.
2. A.P.E.Thumann, *Plant Engineers and Managers Guide to Energy Conservation*, 7e,UNR,1977.
3. W.F.Kenney, *Energy Conservation in the Process Industries*, Academic press,1984
4. M.H.Chiyogioji, *Industrial Energy Conservation*, Marcel Dekker,1979
5. C.B. Smith, *Energy Management Principles*, Pergamon Press, New York, 1981.
6. Amit Tyagi, *Handbook on Energy Audit and Management*, TERI, New Delhi, 2000
7. *Environmental Considerations in Energy Development*, Asian Development Bank (ADB) publication,Manila, 1991

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 302 (B): NANOTECHNOLOGY

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To understand the concept of nanotechnology, nanomaterials, charecterization of nano particles and emerging application of nanomaterials.*

Module I (14 hrs)

Broad introduction to nanotechnology, Essence of Nanotechnology, Nano in daily life, Brief account of nano applications, Properties of nano materials, Metal nano clusters, Semiconductor nano particles. some key examples of nanotechnology. Main engineering activities of design, manufacture and testing in a nanotechnology context.

Module II (14 hrs)

Physical Chemistry of Nanomaterials. Methods of synthesis of nanomaterial fabrication-"Top-down" vs. "bottom-up" approaches. Equipment and processes needed to fabricate nanodevices and structures. Self-assembly of nano particles and nano structural molecular materials, nanoscale molecular self assembly and self organization of surfactant solutions, Polymers, biological system and liquid crystals.

Module III (14 hrs)

Focus on different nanomaterials: Carbon nanotubes, Inorganic nanowires-, Organic molecules for electronics, Biological and bio-inspired materials, Metallic nanomaterials,
Different shape nanomaterials. Characterization of nano particles by Atomic Force Microscopy, Scanning Tunneling Microscopy, Transmission Electron Microscopy,Scanning Electron Microscopy.

Module IV (14 hrs)

Focus on emerging applications. Diagnosing Personal Health and Medical Applications .Lab on a chip, Super X-ray vision, mapping the genes, Understanding how pharmaceutical company develops drugs, Delivering a new drug the Nanotech way, Cooking cancer with

nano cells, Biomimetics. . Biological Materials -Introduction, Biological building blocks, Nucleic acids, Biological nanostructures.

Textbooks

1. Earl Boysen, *Nanotechnology by Richard Booker,* Wiley Publishing Inc., 2006.
2. Charles P. Poole Jr., Frank J. Owens, *Introduction to Nanotechnology*, John Wiley & Sons Publications, 2003.

References:

1. Tang, Zikang and Sheng, Ping, *"Nano science and technology: novel structures and phenomena"*, Taylor and Francis, 2003
2. Michael Rieth, *"Nano-Engineering in Science and Technology: An Introduction to the World of Nano design"*, World Scientific, 2003
3. R. Kelsall, I. Hamley and M. Geoghegan (Eds.), *"Nanoscale Science and Technology",*Wiley, 2005.
4. M. Di Ventra, S. Evoy and J. R. Heflin, Jr. (Eds.*), Introduction to Nanoscale Science and Technology,* Springer, 2004.
5. C. P. Poole, Jr., F. J. Owens, *Introduction to Nanotechnology*, Wiley, 2003.
6. S. A. Campbell, *The Science and Engineering of Microelectronic Fabrication*, Oxford,2001.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks
Question pattern:
Answer *ANY* 5 questions by choosing at least *ONE* question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 302 (C): OPTIMIZATION TECHNIQUES

Teaching scheme: 3 hours lecture and 1 hour tutorial per week **Credits:** 4

Objectives: *To understand the theory of simplex method, non-linear programming, algorithms for unconstrained optimization and sequential decision making*

Module (14 hours)
Theory of Simplex Method, Duality Theory, Duality theorems, Dual simplex method, Revised simplex method, Bounded variables algorithm, Sensitivity analysis, Parametric programming. Integer Programming: Cutting plane method, Branch and bound method.
Network Models and Solutions: Shortest Route problems, Minimal spanning tree problems, Maximal flow problems.

Module 2 (14 Hours)

Non-linear Programming Problems: General non-linear programming problems; convex, quasi-convex, concave and unimodal functions, Theory of unconstrained optimization- Necessary and sufficient conditions for extrema, Theory of constrained optimization- Lagrange multipliers and Lagrangian optimization, Inequality constraints, Kuhn-Tucker conditions.

Module 3 (13 Hours)

Algorithms for Unconstrained Optimization: Fibonacci search method, Golden section search method , Cauchy's (Steepest descent) method Algorithms for Constrained Optimization: Quadratic programming, Separable convex programming .

Multi-objective Decision Models: Introduction to multi-objective decision making, Concept of pareto-optimality, Goal programming formulation, The weighting method of solution, Analytic hierarchy process.

Module 4 (13 hours)

Sequential Decision Making (Stochastic Case): Stochastic processes, Markov processes, Markov chains, Markov decision problems, Algorithms for solving Markov decision problems, finite-stage models, infinite stage models.

Metaheuristics: Nature of metaheuristics, Tabu search, Simulated Annealing, Genetic Algorithm. Complexity of algorithms: Complexity of algorithms for combinatorial optimization problems.

References

1. Hillier, F.S. and Liberman, G.J., *Introduction to Operations Research*, McGraw-Hill International edition, Eighth Edition 2009.

Text books

1. Rao, S.S, *Optimization: Theory and Applications*, Second edition, Wiley eastern, 1994.
2. Ravindran, A., Philips, D.T., and Solberg, J.J., *Operations Research: Principles and Practice*, Second Edition, John Wiley & Sons, 1987.
3. Taha, H.A., *Operations Research: An Introduction*, Sixth Edition, Prentice-Hall of India, New Delhi, 1999.
4. Deb, K., *Optimization in Engineering Design*, Prentice-Hall of India, New Delhi, 1994.
5. Papadimitriou, C.H., and Steghtz, K., *Combinatorial Optimization: Algorithms and Complexity*, Prentice-Hall, New Jersey, 1982.
6. Simmons, D.M., Ravindran, A., *Non-linear Programming for Operations Research*, Prentice-Hall, New Jersey, 1975.
7. Reklatis, G.V., Ravindran, A., and Ragsdell, K.M., *Engineering Optimization: Methods and applications*, Wiley Interscience, New York, 1983.
8. Budnick F.S., McLeavey and R. Mojena, *Principles of Operations Research for Management*, 2/e, Richard D. Irwin Inc., Homewood, Illinois, 1991.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students at the beginning of the semester by the teacher.

Semester end examination: 100 marks

Question pattern:

Answer *ANY* 5 questions by choosing at least *ONE* question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

MPE10 303 (P): INDUSTRIAL TRAINING

Teaching scheme: 1 hour per week **Credits:** 1

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with production engineering during the semester break after second semester and complete within 15 calendar days from the start of third semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

Internal continuous assessment: Marks 50

MPE10 304 (P): MASTERS RESEARCH PROJECT (PHASE – I)

Teaching scheme: 22 hours per week **Credits:** 6

Objective:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project / experimental project and or computer simulation project on Production engineering or any of the topics related with Production engineering stream. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute subject to the conditions in clause 10 of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the masters research project phase-I during the third semester and the same is continued in the 4th semester (Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

Internal Continuous assessment:
First Review:

Guide 50 marks

Evaluation Committee 50 marks

Second review:

Guide 100 marks
Evaluation Committee 100 marks

Total **300 marks**

MPE10 401(P): MASTERS RESEARCH PROJECT (PHASE-II)

Teaching scheme: 30 hours per week **Credits:** 12

Objectives:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Masters Research project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Internal Continues assessment:

First review:

Guide 50 marks
Evaluation committee 50 marks

Second review:

Guide 100 marks
Evaluation committee 100 marks

Semester end Examination:

Project evaluation by external examiner: 150 marks

Viva-voce by internal and external examiner: 150 marks (75 marks each)