

ANNA UNIVERSITY TIRUCHIRAPPALLI**Tiruchirappalli – 620 024****Regulations 2007****Curriculum****M.E. MANUFACTURING ENGINEERING****SEMESTER I**

S. No.	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	MA5143	Engineering Statistics and Probability	3	1	0	100
2	MF5102	Computer Aided Metrology and Inspection	3	0	0	100
3	MF5103	Computer Aided Product Design	3	0	0	100
4	MF5104	Precision Engineering	3	0	0	100
5	E1****	Elective I	3	0	0	100
6	E2****	Elective II	3	0	0	100

SEMESTER II

S. No.	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	MF5151	Advanced Material Technology	3	0	0	100
2	MF5152	Computer Integrated Manufacturing	3	2	0	100
3	MF5153	Industrial Robotics	3	0	0	100
4	MF5154	Mechatronics	3	2	0	100
5	MF5155	Metal Cutting Theory and Practice	3	0	0	100
6	E3****	Elective III	3	0	0	100

SEMESTER III

S. No.	Subject Code.	Subject	L	T	P	Max. Marks
Theory						
1	E4****	Elective IV	3	0	0	100
2	E5****	Elective V	3	0	0	100
3	E6****	Elective VI	3	0	0	100
Practical						
4	MF5251	Project Work Phase I	0	0	12	*

SEMESTER IV

S. No.	Subject Code	Subject	L	T	P	Max. Marks
Practical						
1	MF5251	Project Wok Phase II	0	0	24	*

ELECTIVES

S. No.	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	MF5001	Fluid Power Automation	3	0	0	100
2	MF5002	Instrumentation and Control	3	0	0	100
3	MF5003	Design for Manufacture	3	0	0	100
4	MF5004	Metal Forming Theory and Practice	3	0	0	100
5	MF5005	Advances in Casting and Welding	3	0	0	100
6	MF5006	Total Quality Management	3	0	0	100
7	MF5007	Maintenance and Reliability Engineering	3	0	0	100
8	MF5051	Systems and Simulation	3	0	0	100
9	MF5052	Diagnostic Techniques	3	0	0	100
10	MF5053	Image Processing in Manufacturing	3	0	0	100
11	MF5011	Advances in CNC Systems	3	0	0	100
12	MF5012	Special Purpose Machine Tools	3	0	0	100
13	MF5013	Manufacturing System Design	3	0	0	100
14	MF5014	Human Factors in Engineering	3	0	0	100
15	MF5015	Engineering Economics and Financial Management	3	0	0	100
16	MF5016	Purchasing and Material Management	3	0	0	100
17	MF5017	Advances in Production Management	3	0	0	100
18	MF5018	Integrated Product and Process Development	3	0	0	100

MF5102 – COMPUTER AIDED METROLOGY AND INSPECTION

L	T	P
3	0	0

UNIT I LASER METROLOGY 8

LASER light source – LASER interferometer – LASER alignment telescope – LASER micrometer – on-line and in-process measurements of diameter and surface roughness using LASER – Micro holes and topography measurements – Straightness, flatness and roundness measurements.

UNIT II CO-ORDINATE MEASURING MACHINES 10

Coordinate measuring machines – Accessory elements – CMM software – Performance evaluations – Environmental control – Accuracy enhancement – Applications of CMM.

UNIT III OPTO ELECTRONIC MEASUREMENT SYSTEMS 10

Opto electronic devices contact and non contact types – Applications in on-line and in-process monitoring systems – Tool wear measurement – Manufacturing metrology – 3D Surface roughness – Pattern generation studies.

UNIT IV IMAGE PROCESSING 10

Shape identification – Edge detection Techniques – Normalisation – Grey scale correlation – Template Techniques – Surface roughness using vision system – Interfacing robot and image processing system – Measurement of length and diameters.

UNIT V COMPUTER INTEGRATED INSPECTION 7

Statistical evaluation of data using computer – data integration of CMM and data logging in computers.

Total: 45

REFERENCES

1. WATSON .J, "Optoelectronics", Van Nostrand Rein hold (UK)Co ltd.,1988
2. ROBERT.G. SEIPPEL, "Optoelectronics for technology and engineering", Prentice Hall,1989
3. ULRICH-REMBOLD, ARMBRUSTER AND ULZMANN, "Interface Technology for Computer Controlled Manufacturing Processes", Marcel Dekker Publication, 1993
4. THOMAS.G.G., "Engineering Metrology", Butterworth Publication, 1974.

MF5151 – ADVANCED MATERIALS TECHNOLOGY

L T P
3 0 0

UNIT I REVIEW OF MECHANICAL BEHAVIOUR OF MATERIALS 9

Plastic deformation in poly phase alloys – Strengthening mechanisms – Griffith's theory of failure modes – Brittle and ductile fractures – Damping properties of materials – fracture toughness – Initiation and propagation of fatigue cracks – Creep mechanisms – Hydrogen embrittlement of metals.

UNIT II SURFACE MODIFICATION OF MATERIALS 9

Mechanical surface treatment and coating – Case hardening and hard facing – thermal spraying – vapour deposition – ion implantation – Diffusion coating – Electroplating and Electroforming – Conversion coating – Ceramic and organic coatings – Diamond coating – Advanced surface modification of steels.

UNIT III ADVANCED HEAT TREATMENT OF MATERIALS 9

Unconventional surface hardening techniques – Heat treatment of critical mechanical elements like gears tools, dies, springs, shafts – Heat treatment of Al, Cu, Ni and Ti alloys – Polymer quenchants.

UNIT IV MODERN MATERIALS AND ALLOYS 9

Super alloys – Refractory materials – Ceramics and their applications – Low melting alloys – shape memory alloys – Metal matrix and ceramic matrix composites

UNIT V APPLICATIONS OF ADVANCED MATERIALS 9

Ti and Ni based alloys for gas turbine applications – Maraging and Cryogenic steels – Newer materials and their treatment for automobile applications – Materials for Aerospace, Marine and nuclear systems.

Total: 45

REFERENCES

1. Dowling, "Mechanical Behaviour of Materials, Engineering Methods of Determination, Fracture", McGraw Hill, 1999
2. P. Rama Rao, "Advances in Materials and their Applications", Wiley Eastern Ltd., 1993
3. Serope Kalpakjian, "Manufacturing Engineering and Technology" Third Edition, Addison Wisley Publishing co., 1995
4. Kenneth G. Budinski, "Surface Engineering for Wear Resistance", Prentice Hall, 1988.
5. D.R. Gabe, "Principles of Metal Surface Treatment and Protection", Pergamon Press, 1978.
6. Dieter, "Mechanical Metallurgy", McGraw Hill, 1989.
7. Dieter, "Engineering Design, A materials and Processing Approach", Third Edition, McGraw Hill, 1999.

MF5152 – COMPUTER INTEGRATED MANUFACTURING

L	T	P
3	2	0

UNIT I	MANUFACTURING TECHNOLOGY	8
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Overview – current themes in manufacturing – design – manufacture interface – overview of process planning technique.

UNIT II	PRODUCTION PLANNING AND CONTROL	10
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Discrete parts manufacturing – topology in manufacturing classification of FMS decision Lean production – BPR Master Production scheduling – Requirements Planning – JIT.

UNIT III	GROUP TECHNOLOGY AND PROCESS PLANNING	10
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Part families, classification and coding-type of codification – case study – computer aided process planning – retrieval and generative

UNIT IV	FLEXIBLE MANUFACTURING SYSTEMS	10
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Need classification – Integration – Interface – Software for FMS – Production flow analysis – flexible material handling – Petri network – applications.

UNIT V	MANUFACTURING SIMULATION	7
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Simulation language – type of software package – Simulation process – FIST codes – Case study

L: 45 T:15 Total: 60

REFERENCES

1. Chris McMohan and Jimmi Brown, "CAD CAM", Addison Wiley, 2000.
2. Donatas tijunela & Kirth E. Mckee, "Manufacturing High Tech Handbook", 2000.
3. Narahari and Viswanadham, "Performance Modelling and Analysis of Automated Manufacturing systems", Prentice Hall, 1998.

MF5153 – INDUSTRIAL ROBOTICS

L	T	P
3	0	0

UNIT I	INTRODUCTION	8
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Fundamentals of Robotics – Classification – Overview of drives, Sensors, grippers and manipulators – selection of robot

UNIT II	MODELLING OF ROBOT MANIPULATOR	12
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Kinematics – Differential Kinematics and static – dynamics – Trajectory planning – motion control – interaction control – Rigid body mechanics

UNIT III	CONTROL IN ROBOTS	10
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Actuators and Sensors – Fundamentals in electronic control – Instrumentation – feedback control – Robot arm control architecture of control – interfacing

UNIT IV	PROGRAMMING OF ROBOTS & VISION SYSTEMS	10
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Types – Selection of procedure – Case study of differential methods – Vision system – Robot intelligence – task planning.

UNIT V	APPLICATION OF ROBOTICS	5
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Application of robotics in machine shop – assembly – automation – tele operated robot – MHS – Processing operation.

Total: 45

REFERENCES

1. Lorenzo Scravico, “Modelling and Control of Robot Manipulator”, Tata Mc Graw Hill, 1990
2. James G Kerames, “Robot Technology Fundamentals”, Delmer Publisher, 2000.
3. Eolfram Staches, “Analytical Robotics and Mechatronics”, Tata Mc Graw Hill, 1999.

MF5154 – MECHATRONICS

L T P
3 2 0

UNIT I INTRODUCTION TO MECHATRONICS 8

Mechatronics – Integrated Design issues – Key elements – Design process – Advanced approaches in Mechatronics. Basics of fuzzy logics, neural networks and artificial intelligence.

UNIT II SENSORS AND TRANSDUCERS 9

Introduction to sensors and transducers – Sensors for motion and position measurement – Force, Torque and tactile sensors – flow sensors – temperature sensing devices – ultrasonic sensors – range sensors – vibration control using magneto structure transducers – fibre optic devices in mechatronics.

UNIT III ACTUATING DEVICES 9

DC and AC Drives – stepper motor – servo motor – fluid power – piezoelectric actuators – design and selection of actuating devices.

UNIT IV SIGNALS, SYSTEMS AND CONTROLS 10

Introduction to signals – systems and controls – system representation – Linearisation of Non linear systems – time delays – measures of system performance – Root locus and Bode plots.

UNIT V APPLICATIONS IN MECHATRONICS 9

Sensors for condition monitoring – Mechatronic control in Automated manufacturing – Artificial Intelligence – Fuzzy Logic applications in Mechatronics – Micro Sensors and Case studies.

L: 45 T: 15 Total: 60

REFERENCES

1. Devadas Shetty and Richard A.Kolk , "Mechatronics system Design", PWS publishing company, 1997
2. BOSCH, "Mechatronics Theory and Applications", 1998
3. W.Bolton , "Mechatronics" , Longmen, 1999
4. HMT, "Mechatronics", 1998.
5. D.A. Bradly, D. Dawson, N.C.Burd and A.J. Loader, "Mechatronics, Electronics in Products and Processes", Chapman and Hall, 1993.

MF51555 – METAL CUTTING THEORY AND PRACTICE

L	T	P
3	0	0

UNIT I INTRODUCTION 10

Basic mechanism of chip formation –Thin and Thick zone models – Types of chips – Chip breaker – Orthogonal Vs Oblique cutting – force and velocity relationship and expression for shear plane angle in orthogonal cutting – Energy Consideration in machining – Modern theories in Mechanics of cutting – Review of Merchant and Lee Shaffer Theories – critical comparison.

UNIT II TOOL NOMENCLATURE AND CUTTING FORCES 10

Nomenclature of single point tool – Systems of tool Nomenclature and Conversion of rake angles – Nomenclature of multi point tools like drills, milling cutters and broaches – Forces in turning, drilling and milling – specific cutting pressure – measurement of cutting forces.

UNIT III THERMAL ASPECTS OF MACHINING 10

Thermodynamics of chip formation – Heat distributions in machining – Effects of various parameters on temperature – Method of temperature measurement in machining – Hot machining – cutting fluids

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR 9

Essential requirements of tool materials – Developments in tool materials – ISO specifications for inserts and tool holders – Tool life – optimum tool life – Conventional and accelerated tool life tests – Concepts of machinability and machinability index – Economics of machining

UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING 6

Reasons for failure of cutting tools and forms of wear – mechanisms of wear – chatter in machining – Factors effecting chatter in machining – types of chatters – Mechanism of chatter based on Force Vs Speed graph – Mechanism of grinding – Various parameters affecting grinding process

Total: 45

REFERENCES

1. Shaw .M.C., "Metal cutting Principles", Oxford clarendon Press, 1984.
2. Bhattacharya., "Metal Cutting Theory and Practice", New central Book Agency (P) Ltd., 1984.
3. Venkatesh .V.C. and Chandrasekharan. H., "Experimental Techniques in Metal cutting", Prentice Hall of India, 1982
4. Juneja.B.L and Sekhon.G.S, "Fundamentals of metal cutting and machine tools", New Age International (P) Ltd., 1995
5. Kuppuswamy.G., "Principles of metal cutting", Universities Press(India)Ltd., 1996
6. Boothroy.D.G. and Knight. W.A, "Fundamentals of Machining and Machine tools", Marcel Dekker, 1989.

LIST OF ELECTIVES

MF5001 – FLUID POWER AUTOMATION

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UNIT I INTRODUCTION 5

Need for Automation – comparison with other power system – ISO symbols for fluid power elements – Economic consideration of fluid power systems – Oil hydraulics – pneumatic – Introduction and selection criterion.

UNIT II HYDRAULIC POWER GENERATION, CONTROL AND REGULATING ELEMENTS 12

Basic elements in a fluid power system – Hydraulic pumps, Gear, Vane, piston-selection and specification – drive characteristics Hydraulic actuators – Linear and Rotary – Selection specification and characteristics – cushioning.

UNIT III PNEUMATIC AND ELECTRO PNEUMATIC 8

Generation and control of compressed air – Elements in pneumatic circuits – Fluidic devices and its application Flip-Flop, SRT Flip flop – Use of electrical switches – relays – timers in fluid power circuits – Electro pneumatics.

UNIT IV CIRCUIT DESIGN 12

Design and methodology – Sequential circuits – cascade – Karnaugh –Veitch map – step counter methods – Compound and combination circuit design – Typical Industrial and hydraulic circuits – Synchronising and accumulator circuits – Circuits for machine tools – Aerospace application – Design and selection criteria – Electro pneumatic circuit design – Ladder diagram.

UNIT V COMPUTER CONTROL & MAINTENANANCE OF FLUID POWER CIRCUITS 8

Fuzzy logic in fluid power circuits – PLC in fluid powers – PLC ladder diagram – Installation – Fault diagnosis in fluid power circuits.

Total: 45

REFERENCES

1. Antony Esposito, "Fluid power system and control", Prentice Hall, 1998.
2. E.F. Fitch and J.B. Suryaat Madyn, "Introduction to fluid power Logic", McGraw Hill, 1988
3. Peter Rohner, "Fluid Power Logic circuit design", Macmillan Press, 1994.
4. "Hydraulic systems Handbook", Utility Publication, 1988.
5. Majumdar, "Oil Hydraulics Systems: Principles and Maintenance", Tata Mc Graw Hil, 2003.
6. Majumdar, "Pneumatic Systems: Principles and Maintenance", Tata Mc Graw Hil, 2003.

MF5002 – INSTRUMENTATION AND CONTROL

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3 0 0

UNIT I INTRODUCTION TO INSTRUMENTATION 5

Function block of instrumentation – Intelligent instruments – I/O elements – Automatic test equipment records – D/A converters – A/D converters – Types.

UNIT II ADAPTIVE CONTROL SYSTEMS 10

Definition of AC types – AC applications – Self tuning control systems – Real time parameter estimation – Expert System and neural network – Fuzzy control.

UNIT III COMPUTER CONTROL SYSTEM 10

Data acquisition system – Supervisory control – Direct Digital control – Programmable logic controls – Ladder logic diagrams – communication in PLC.

UNIT IV TRANSDUCERS AND MEASUREMENT PRINCIPLES 10

Variable resistance transducers – Variable reactive transducers – Piezo electric transducers – Fibre optic transducers – Laser instrumentation – analogue and digital type – incremental and absolute measurement – inductosyn – resolver.

UNIT V DIAGNOSTIC AND CONDITION MONITORING METHODS 10

Objectives of machine diagnostics – causes of failure in machine tools – Distribution of fault occurrences – Aims of monitoring – Telephone diagnostic method applied to CNC machine.

Total: 45

REFERENCES

1. M.P.Groover, "Automation, Production Systems and Computer Integrated manufacturing", Prentice Hall, 1987
2. Week, "Machine tools", John Wiley, 1980
3. A.J.Baauvans, "Digital Instrumentation", McGraw Hill, 1987.
4. C.S.Rangan,V.S.V.Mani and G.R.Sarma, "Instrumentation Devices and systems", Tata McGraw Hill,1983.

MF5003 – DESIGN FOR MANUFACTURE

L T P
3 0 0

UNIT I INTRODUCTION 6

Economics of process selection – General design principles of manufacturability – Proper material selection – Strength and mechanical factors – Application of form design.

UNIT II CASTING DESIGN AND WELDMENT DESIGN 10

Factors affecting casting design – Strength aspects – Sand casting and die casting design – Factors affecting weld-ment design – Gas and arc welding design

UNIT III FORMED METAL COMPONENTS AND NON METALLIC PARTS DESIGN 10

Design considerations for the manufacture of extruded – cold headed metal parts – Tube and section bends – powder metal parts – Thermo setting plastic parts – Reinforced – plastic/composite parts.

UNIT IV MACHINED COMPONENTS DESIGN 10

Design considerations for the manufacture of Turned parts – drilled parts – milled parts, planned, shaped and slotted parts – Ground parts – parts produced by EDM.

UNIT V ADVANCED TECHNOLOGY REQUIREMENTS 9

Product design requirements for group technology concepts and CNC machining – Part family concept and design principles

Total: 45

REFERENCES

1. James G.Bralla, "Handbook of Product Design for Manufacture", McGraw Hill Book co., 1986
2. Henry Peck, "Designing for Manufacture", Sir issac Pitman & Sons Ltd., 1973.
3. Matousek, "Engineering Design", Blackie & Sons, 1956.

MF5004 – METAL FORMING THEORY AND PRACTICE

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UNIT I THEORY OF PLASTICITY 15

Theory of Plastic deformation – Yield criteria – Work of plastic deformation – Equilibrium in Cartesian, Cylindrical and Spherical coordinates – Energy – Slab method – Upper bound and Lower bound solution methods – Overview of FEM Applications in Metal Forming Analysis – Formability studies

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 12

Analysis of Plastic deformation in Forging, Rolling, Extrusion and rod/wire drawing processes – Effects of friction – Calculation of forces – Work done – process parameters – equipments used – Defects – Applications – Recent advances in forging, Rolling, Extrusion and drawing processes – Experimental techniques of evaluation of friction in metal forming, ring compression and double cup extrusion tests.

UNIT III SHEET METAL FORMING 6

Conventional processes – HERF techniques – Explosive forming – electro-hydraulic forming – magnetic pulse forming – Principles and process parameters – Advantages – Limitations and Applications

UNIT IV P/M FORMING 6

Overview of P/M technique – Advantages – applications – Powder perform forging – Hot and cold Isostatic pressing – powder rolling – Tooling and process parameters.

UNIT V SPECIAL FORMING PROCESSES 6

Orbital forging – Isothermal forging – High speed extrusion – Rubber pad forming – Water hammer forming – Fine blanking – Super-plastic forming techniques – electro forming

Total: 45

REFERENCES

1. Schuler, "Metal Forming Handbook", Springer Verlag Publication, 1998
2. Hosford, W F and Caddell, R.M.. "Metal Forming: Mechanics and Metallurgy", Prentice Hall, 1993
3. Dieter, G.E., "Mechanical Metallurgy", Second Edition, McGraw Hill Co, 1980
4. Nagpal, G.R., "Metal Forming Processes", Khanna Publishers, 1998
5. Chakrabarthy, J, "Theory of Plasticity", McGraw Hill Co, 1987
6. Shiro Kobayashi, Soo-Ik-Oh-Altan, T, "Metal Forming and Finite Element Method", Oxford University Press, 1989
7. Narayanasamy, R., "Theory of Metal Forming Plasticity", Second Edition, Ahuja Book Company, 2001.
8. Altan T, Soo-Ik-Oh, Gegel, HL, "Metal Forming, fundamentals and applications", American Society of Metals, Metals Park, 1983.

MF5005 – ADVANCES IN CASTING AND WELDING

L T P
3 0 0

UNIT I CASTING METALLURGY AND DESIGN 9

Heat transfer between metal and mould – Solidification of pure metal and alloys – Shrinkage in cast metals – progressive and directional solidification – Principles of gating and restraining – Degasification of the melt – Design considerations in casting – Designing for directional solidification and minimum stresses – casting defects

UNIT II SPECIAL CASTING PROCESSES 9

Shell moulding – Precision investment casting – CO₂ – moulding – centrifugal casting – Die casting – Continuous casting.

UNIT III WELDING METALLURGY AND DESIGN 12

Heat affected Zone and its characteristics – Weldability of steels, cast iron, Stainless steel, aluminum and Titanium alloys – Hydrogen embrittlement – Lamellar tearing – Residual stress – Heat transfer and Solidification – Analysis of stresses in welded structures – pre and post welding heat treatments – Weld joint design – Welding defects – testing of weldment.

UNIT IV UNCONVENTIONAL AND SPECIAL WELDING PROCESSES 6

Friction welding – Explosive welding – Diffusion bonding – High frequency Induction welding – Ultrasonic welding – Electron beam welding – Laser beam welding

UNIT V RECENT ADVANCES IN CASTING AND WELDING 9

Layout of mechanised foundry – sand reclamation – Material handling in foundry – pollution control in Foundry – Recent trends in casting – Computer Aided design of Castings, Low pressure die casting, Squeeze casting and full mould casting process – Automation in welding – Welding robots – Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

Total: 45

REFERENCES

1. Jain, "Principles of Foundry Technology", Third Edition, Tata McGraw Hill, 2000.
2. Lal.M. and Khanna.O.P, "A Text Books of Foundry Technology", Dhanpat Rai & Sons, 1996.
3. Titoun.D. and Stepanov .YU.A., "Foundry Practice", MIR Publishers, 1981.
4. Iotrowski, "Robotic welding – A guide to selection and application", Society of Mechanical Engineers, 1987.
5. Cornu. J., "Advanced Welding systems", Volumes I,II and III, JAICO Publishers, 1994.
6. Lancaster. J.F., "Metallurgy of Welding", George Allen & Unwin Publishers, 1980.
7. Serope Kalpakjian, "Manufacturing Engineering and Technology" Third Edition, Addison Wesley Publishing Co.1995
8. P.N.Rao, "Manufacturing Technology (Foundry, Forming and Welding), Second Edition", Tata McGraw Hill Pub.Co. Ltd, 1998.

MF5007 – MAINTENANCE AND RELIABILITY ENGINEERING

L T P
3 0 0

UNIT I MAINTENANCE MANAGMENT 10

Need for maintenance – Objective – Concepts – Types of maintenance – Organisation – Trade force mix, type and location – Maintenance costs – Benefits – Computer Aided Maintenance management – Total productive maintenance.

UNIT II TYPES OF MAINTENANCE 8

Breakdown and Preventive maintenance – Advantages and Limitations – Maintenance prevention – Diagnostic maintenance – Design out maintenance – Opportunity maintenance.

UNIT III DIAGNOSTIC MAINTENANCE 10

Leak detection – wear monitoring – Temperature monitoring – Vibration monitoring – Signature analysis – Shock monitoring – Lubricant – Analysis – Methodology – Equipments – Applications

UNIT IV CONCEPTS OF RELIABILITY 7

Elements of Probability – Reliability Definition – Measures of Reliability – Failures – Classification of failures – Failure data Analysis – Availability – Criticality matrix – Event tree analysis - Utilization factor – Factors affecting reliability.

UNIT V DESIGN FOR RELIABILITY 10

Analysis of reliability data – Weibull analysis – Design and manufacture for Reliability – Reliability of parts and components – Design for system reliability – Economics of standby or redundancy in a production system – reliability testing – Types

Total: 45

REFERENCES

1. Higgins and Morrow, "Maintenance Engineering Handbook ", Tata McGraw Hill, 1985
2. Collact, "Mechanical Fault Diagnosis and Condition monitoring", McGraw Hill-1985
3. Miller & Blood, "Modern Maintenance Management", Tarapooriwala & sons, 1976.
4. Jentry EJ and Kumamoto,H, "Reliability Engineering and Test assessment", Prentice Hall, 1992.
5. Carter,A.D.S., "Mechanical Reliability", Macmillan, 1984.
6. Nakajima.S., "Introduction to TPM - Total Productive Maintenance", Productivity Press-1995
7. O'connor,P.D.T, "Practical Reliability Engineering", John Wiley, 1994.
8. Kelley.A.& M.J.Harris, "Management of Industrial Maintenance" , Newnes-Butter worth.

MF5052 – DIAGNOSTIC TECHNIQUES

L	T	P
3	0	0

UNIT I DEFECTS AND FAILURE ANALYSIS 7

Defect generation – types of failures – Defects reporting and recording – Defect analysis – Failure analysis – Equipment down time analysis – Breakdown analysis – TA, FMEA, FMECA.

UNIT II MAINTENANCE SYSTEMS 8

Planned and unplanned maintenance – Breakdown maintenance – Corrective maintenance – Opportunistic maintenance – Routine maintenance – Preventive maintenance, Predictive maintenance – Condition based maintenance system – Design out maintenance – selection of maintenance system.

UNIT III SYSTEMATIC MAINTENANCE 10

Codification and Cataloguing – Instruction manual and operating manual – Maintenance manual and Departmental manual – Maintenance time standard – Maintenance work order and work permit – job monitoring – Feedback and control – Maintenance records and documentation.

UNIT IV COMPUTER MANAGED MAINTENANCE SYSTEM 8

Selection and scope of computerization – Equipment classification – Codification of breakdown – material and facilities – Job sequencing – Material management module – Captive Engineering module.

UNIT V CONDITION MONITORING 12

Condition monitoring techniques – Visual monitoring – Temperature monitoring – vibration monitoring – Lubricant monitoring – Cracks monitoring – Thickness monitoring – Noise and sound monitoring – condition monitoring of hydraulic system – Machine diagnostics – Objectives – Monitoring strategies – Examples of monitoring and Diagnosis – Control structures for machine diagnosis.

Total: 45

REFERENCES

1. Sushil Kumar Srivastava, "Industrial Maintenance Management", S.Chand and company Ltd., 1998.
2. Manfred Weck, H.Bibring, "Hand Book of Machine Tools, Vol. 3", John Wiley & Sons,
3. Garg H.P, "Industrial Maintenance", S.Chand & company Ltd., 2000.

MF5053 – IMAGE PROCESSING IN MANUFACTURING

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3	0	0

UNIT I INTRODUCTION 8

Image representation and nomenclature – Relationship of image processing and computer vision – Digital image fundamentals – Geometric model for imaging and applications – Imaging requirements.

UNIT II IMAGE PROCESSING FUNDAMENTALS 12

Image transformers – Sampling – Enhancement – Restoration and conversions – Segmentation – Thresholding representation and description

UNIT III IMAGE ANALYSIS 10

Processing binary images – Image measurements – Multilevel image analysis – Higher dimensional modeling – Image based knowledge manipulation

UNIT IV PRACTICAL IMAGE PROCESSING 10

2D/3D Image acquisition – 3D image Visualisation – Imaging surfaces – Image processing system components

UNIT V APPLICATION IN MANUFACTURING 5

Measurement of surface finish – Sorting and counting of objects – Tool Wear measurement – Measurement technique – Robot application

Total: 45

REFERENCES

1. John C Russ, "The Image Processing Hand Book", Third Edition, CRC Press/IEEE Press, 2000
2. Robert J Schalkoff, "Digital Image Processing and Computer Vision", John Wiley & Sons Inc, 1998
3. Rafel C, Gon Zalez & Richar E Woods, "Digital Image Processing", Addison Wesley Publishing, 1993.
4. Ramesh C John, "Introduction to Machine Vision", Tata Mc Graw Hill, 1995.

MF5013 – MANUFACTURING SYSTEM DESIGN

L	T	P
3	0	0

UNIT I INTRODUCTION TO MANUFACTURING SYSTEMS ENGINEERING 10

Process Planning – Logical design of a process planning – Shortcomings of traditional process planning – Computer aided process planning – Computerization of files management – Variant (Retrieval) approach – generative approach – Semi generative approach – General remarks on CAPP developments and trends.

UNIT II PRODUCTION CONTROL 9

Overview of production control – Forecasting – Master production schedule – Materials requirements planning – Order release – shop floor control – Cellular manufacturing – JIT and MRP II – Computer generated time standards.

UNIT III LOADING AND SCHEDULING 8

Information retrieval for loading and scheduling – master scheduling – perceptual loading – dispatching – progress chasing – expediting – order scheduling devices

UNIT IV MATERIAL FLOW PATH ANALYSIS IN MANUFACTURING 9

Material handling function – Types of equipment used – conveyor systems – Automated guided vehicle systems – Guiding and routing – Traffic control and safety – Interfacing handling and storage with manufacturing – design factors in material handling systems.

UNIT V LAYOUT OF MANUFACTURING SYSTEMS 9

Plant layout – Definition – Objectives – Principles – Factors influencing layout – Types of layout – cellular layout – Tools and tooling system for cellular manufacturing

Total: 45

REFERENCES

1. G.Halevi and R.D.Weill, "Principles of Process Planning", Chapman and Hall, 1995
2. M.P.Groover, "Automatic Production System and Computer Integrated Manufacturing", PrenticeHall, 1990.
3. Bary Hawkes, "CAD, CAM Processes ", 1990.
4. Evert E. Adams Jr and Donold J Ebert, "Production and Operation Management", Prentice Hall of India, 1994
5. S.N.Chary, "Production and Operations Management", Tata McGraw Hill, 1991.

MF5015 – ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT

L T P
3 0 0

UNIT I FINANCIAL ACCOUNTING 12

Accounting Principles – Basic records depreciation – Depreciation methods – Preparation, interpretation of profit and loss statement – Balance sheets – Fixed assets – Current assets

UNIT II COSTING 10

Elements of cost – Cost Classification – Material cost – Labour costs – Overheads – Costs of a product – Costing systems – Cost determination – Process costing – Allocation of overheads – Standard costing – Variance analysis.

UNIT III WORKING CAPITAL MANAGEMENT 8

Current assets and Liability decisions – Estimation of working capital requirements – Management of accounts receivable – Inventory – cash – inventory valuable methods.

UNIT IV CAPITAL BUDGETING 7

Significance of capital budgeting – payback period – Present value method – Accounting rate of return method

UNIT V ENGINEERING ECONOMICS 8

Economics – Engineering economics – Demand analysis – Laws of demand – Production and cost – pricing methods – Cost volume profit analysis

Total: 45

REFERENCES

1. C.James , Vanhorn, "Fundamentals of Financial Management" , PHI, 1996.
2. Charles T. Homgren, "Cost Accounting", PHI, 1985.
3. S.N.Maheswari, "Management Accounting and Financial Control", Sultanchand,1992.
4. Prasanna Chandra, "Financial Management", Tata Mc Graw Hill, 1998
5. J.L.Riggs, "Engineering Economics", McGraw Hill, 1987.
6. G.B.S.Narang, "Production and Costing", Khanna Publishers, 1993.

MF5017 – ADVANCES IN PRODUCTION MANAGEMENT

L	T	P
3	0	0

UNIT I **ADVANCED TOPICS OF LINEAR PROGRAMMING** **10**

Revised simplex method – Introduction of additional constraints – Goal programming – Multi objective linear programming – Integer Programming techniques – all integer – mixed integer – Zero one type integer programming problems.

UNIT II **GEOMETRIC PROGRAMMING** **8**

Unconstrained minimization – Constrained minimization – Stochastic programming – Stochastic linear programming – Stochastic non linear programming – Stochastic dynamic programming

UNIT III **SIMULATION** **7**

Methodology – Computer generation of random numbers – Modeling theoretical distributions – Validation of simulation models – Application of simulation in various functional areas – Flow charting/Programming

UNIT IV **MARKOV PROCESS** **10**

Goal Programming – Investment theory – Replacement theory – Reliability theory – Quadratic Programming – Separable Programming

UNIT V **NONLINEAR PROGRAMMING** **10**

Constrained and Unconstrained optimization methods – equality constraints – inequality constraints – Lagranges multipliers – Taylors Series Expansion

Total: 45

REFERENCES

1. Hardy a. Taha, "Operations Research - An Introduction", College of McMillan international Inc., 1997.
2. S.S.Rao, "Optimization Theory and Applications", Wiley Eastern Ltd , 1984.
3. Phillips, Ravindaran, Solesberg, "Operations Research principles and Practices", Prentice Hall,1981.
4. M.S.Bazaram and Shetty, "Non-Linear Programming, Theory and Applications" , John Wiley, 1979

MF5018 – INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

(For M.E Programmes in Engineering Design/Product Design and Development/CAD)

L	T	P
3	0	0

UNIT I INTRODUCTION

5

Need for IPPD – Strategic importance of Product development – Integration of customer, designer, material supplier and process planner - Competitor and Customer – behaviour analysis
Understanding customer – promoting customer understanding – Involve customer in development and managing requirements – Organization – Process management and Improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION

5

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE

10

Implications – Product change – Variety – Component standardization – Product performance – Manufacturability – Product development Management – establishing the architecture – Creation – Clustering – Geometric layout development – Fundamental and incidental interactions – related system level design issues – Secondary systems – Architecture of the chunks – Creating detailed interface specifications

UNIT IV INDUSTRIAL DESIGN

10

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – Investigation of customer needs – conceptualization – refinement – Management of the industrial design process – technology driven products – User – driven products – Assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

15

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – Principles of prototyping – Planning for prototypes – Economic analysis – Understanding and representing tasks – baseline project planning – accelerating the project – Project execution – N.B.A.Consumer product design project is recommended.

Total: 45

REFERENCES

1. Kart T.Ulrich and Steven D.Eppinger, “Product Design and Development”, McGraw-Hill, 1999.
2. Kemneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, CA 90274(310)377-569, Workshop Book.
3. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992.
4. Stuart Pugh, “Tool Design – Integrated Methods for Successful Product Engineering”, Addison Wesley Publishing, 1991.
5. [www./me.mit/2.7444](http://www.me.mit/2.7444)