

**ANNA UNIVERSITY COIMBATORE-  
CURRICULAM 2007-FULL TIME MODE**

**M.E. MANUFACTURING ENGINEERING**

**SEMESTER-I**

Code no	Course Title	L	T	P	M
<b>THEORY</b>					
	<a href="#">Computational methods and probability</a>	3	1	0	100
	<a href="#">Metrology and computer aided inspection</a>	3	0	0	100
	<a href="#">Fluid power automation</a>	3	0	0	100
	<a href="#">CAD in manufacturing</a>	3	1	0	100
	<a href="#">Manufacturing processes</a>	3	0	0	100
	<a href="#">Computer numerical control and robotics</a>	3	0	0	100
<b>LAB</b>	<a href="#">Manufacturing engineering laboratory</a>	-	-	3	100

**SEMESTER-II**

Code no	Course Title	L	T	P	M
<b>THEORY</b>					
	<a href="#">Advanced materials and their processing</a>	3	0	0	100
	<a href="#">Micro systems technology</a>	3	0	0	100
	<a href="#">Computer integrated manufacturing</a>	3	0	0	100
E1	Elective I	3	0	0	100
E2	Elective II	3	0	0	100
E3	Elective III	3	0	0	100
<b>LAB</b>	<a href="#">Advanced manufacturing engineering laboratory</a>	-	-	3	100
<b>SEMINAR</b>		0	0	2	100

**SEMESTER-III**

Code no	Course Title	L	T	P	M
<b>THEORY</b>					
E4	Elective IV	3	0	0	100
E5	Elective V	3	0	0	100
E6	Elective VI	3	0	0	100
<b>PRACTICAL</b>					
	Project Work-PhaseI	0	0	12	*

**SEMESTER-IV**

Code no	Course Title	L	T	P	M
	Project Work-PhaseII	0	0	24	*

## LIST OF ELECTIVES

### M.E. MANUFACTURING ENGINEERING

Course code	Course title	L	T	P	M
	<a href="#">Metal forming theory and practice</a>	3	0	0	100
	<a href="#">Advances in casting and welding</a>	3	0	0	100
	<a href="#">Total quality management</a>	3	0	0	100
	<a href="#">Maintenance and reliability engineering</a>	3	0	0	100
	<a href="#">Image processing in manufacturing</a>	3	0	0	100
	<a href="#">Human factors in engineering</a>	3	0	0	100
	<a href="#">Purchasing and material management</a>	3	0	0	100
	<a href="#">Engineering economics</a>	3	0	0	100
	<a href="#">Rapid prototyping, tooling and manufacture</a>	3	0	0	100
	<a href="#">IT in manufacturing</a>	3	0	0	100
	<a href="#">Non traditional machining processes</a>	3	0	0	100
	<a href="#">Product development strategies</a>	3	0	0	100
	<a href="#">Six -sigma concepts</a>	3	0	0	100
	<a href="#">Finite element analysis</a>	3	0	0	100
	<a href="#">Integrated product and process development</a>	3	0	0	100
	<a href="#">Optimization techniques</a>	3	0	0	100
	<a href="#">Artificial intelligence in manufacturing</a>	3	0	0	100
	<a href="#">Design for manufacture and assembly</a>	3	0	0	100
	<a href="#">Flexible manufacturing systems</a>	3	0	0	100
	<a href="#">Manufacturing system design</a>	3	0	0	100
	<a href="#">Modeling and analysis of manufacturing systems</a>	3	0	0	100

# SEMESTER-I

## COMPUTATIONAL METHODS AND PROBABILITY

Vide M.E Production Engineering

## METROLOGY AND COMPUTER AIDED INSPECTION

Vide M.E Computer Integrated Manufacturing

## FLUID POWER AUTOMATION

Vide M.E Production Engineering

## COMPUTER NUMERICAL CONTROL AND ROBOTICS

Vide M.E Production Engineering

## CAD IN MANUFACTURING

3 1 0 100

**INTRODUCTION:** Role of numerical modeling and simulation in manufacturing , finite difference (FDM), finite element (FEM) and boundary element methods (BEM). (2)

**PARAMETRIC MODELING OF GEOMETRICAL ENTITIES:** Parametric representation of curves, wire frame models, curve manipulation; parametric representation of surfaces, surface models, surface manipulation; parametric representation of solids, boundary representation, constructive solid geometry; design applications. (12)

**FUNDAMENTALS OF FEM :** Weighted Residue Technique, variational approach, element types, plane triangular, quadrilateral, curved isoparametric elements, 3 dimensional elements, axisymmetric elements, automatic mesh generation. (18)

**APPLICATION OF FEM IN MODELING OF MANUFACTURING PROCESSES:** Elasto-plastic modeling of forming processes, forging, extrusion and rolling. Thermo, mechanical modeling of manufacturing processes , welding, casting, metal forming and machining (single point tool) (10)

**Total No of periods: (42)**

### REFERENCES

1. Ibrahim Zeid, "CAD/CAM Theory and Practice", McGraw, Hill Inc., New Delhi, 2003.
2. Reddy J N, "Introduction to the Finite Element Method", Second Edition, Tata McGraw Hill, 1993.
3. Shiro Kobayashi, Soo Ikoh and Taylan Atlan, "Metal Forming and the Finite Element Method", Shiro Kobayashi, Oxford and IBH Publishing, New Delhi, 1989.
4. Edward R Champion, "Finite Element Analysis in Manufacturing Engineering", McGraw Hill, New York, 1992.
5. Vera B Anand, "Computer Graphics and Geometric Modeling for Engineers", John Wiley and Sons Inc., New Delhi, 2000.
6. Radhakrishnan P and Subramanyan S, "CAD/CAM/CIM", Wiley Eastern Limited, 1997.

7. Owen D R J and Himton E , "Finite Elements in Plasticity, Theory and Practice", Pinevidge Press Ltd., 1980.

## MANUFACTURING PROCESSES

3 0 0 100

**CASTING:** Solidification of pure metal and alloys - Shrinkage in cast metals - Principles of gating and risering - Degasification of the melt - Design considerations in casting - Designing for directional solidification and minimum stresses - casting defects. (4)

**CASTING PROCESSES:** Shell moulding, Precision investment casting, Co<sub>2</sub> moulding, centrifugal casting, Die casting and Continuous casting - Recent trends in casting - Computer Aided design of Castings, Low pressure die casting, Squeeze casting, full mould casting process. (4)

**WELDING:** Heat affected Zone and its characteristics - Weldability of steels, cast iron, Stainless steel, aluminium 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 weldments. (5)

**SPECIAL WELDING PROCESSES:** Friction welding - Explosive welding - Diffusion bonding - High frequency Induction welding - Ultrasonic welding - Electron beam welding - Laser beam welding; Automation in welding - Welding robots. (4)

**FORMING:** Theory of Plastic deformation - Yield criteria - Work of plastic deformation – Plastic deformation in Forging, Rolling, Extrusion and Wire drawing processes - Effects of friction, Calculation of forces, Work done - process parameters – 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. (5)

**SHEET METAL FORMING:** Conventional processes - H E R F techniques - Explosive forming, electro - hydraulic forming, magnetic pulse forming - Principles and process parameters - Advantages - Limitations and Applications. (5)

**POWDER METALLURGY:** Overview of P/M technique – Advantages – applications - Powder preform forging - Hot and cold Iso-static pressing - powder rolling - Tooling and process parameters. (5)

**SPECIAL FORMING PROCESSES:** Orbital forging - Isothermal forging - High speed extrusion- Rubber pad forming - Water hammer forming - Fine blanking - Superplastic forming techniques- electro forming. (5)

**MATERIAL REMOVAL PROCESSES:** Mechanics of chip formation – Nomenclature of single and multi point cutting tools - Tool life and machinability - Types of tool wear and failure of cutting tools – cutting fluids; Machining processes with single and multipoint cutting tools – bulk and finishing processes – shaping, turning, milling, grinding and polishing – process parameters and their selection. (5)

**Total No of periods: (42)**

### REFERENCES

1. Hosford,W.F. and Caddell,R.M. - "Metal Forming: Mechanics and Metallurgy ", Prentice Hall,1993.
2. Dieter,G.E. - " Mechanical Metallurgy (Revised Edition II) "- McGraw Hill Co,1980.
3. Nagpal, G.R.- " Metal Forming Processes ", Khanna Publishers1998
4. Chakrabarthy, J. - " Theory of Plasticity ", McGraw Hill Co,1987.

5. Narayanasamy. R. - "Theory of Metal Forming Plasticity ", Ahuja Book Co., 2<sup>nd</sup> Ed., 2001
6. Lal. M. and Khanna.O.P-" A Text Books of foundry technology ", Dhanpat Rai & Sons,1996.
7. Heine Loper And Rosenthal," Principles of Metal Casting ", Tata McGraw Hill,1980
8. P.c. Mukherjee, "Fundamentals of Metal casting", Oxford - IBH,1979.
9. S. Kalpakjian - "Manufacturing Engineering and Technology (III Edition)"- Addison Wesley,1995.
10. P.N.Rao - "Manufacaturing Technology (Foundry,Forming and Welding) II Edition", Tata McGraw Hil, 1998.
11. Ghosh and A.K. Mallik, "Manufacturing Science", East-West Press Pvt. Ltd. 1993.
12. M.c. Shaw – "Metal Cutting Principles", Oxford Press, 2004
13. G. Kuppuswamy – "Principles of Metal Cutting – An Introduction", Universities Press, 1996.
14. G.k. Lal and s.k. Choudhary – " Fundamentals of Manufacturing Processes", Alpha Science, 2005

## **MANUFACTURING ENGINEERING LABORATORY**

1. Solid modeling and assembly of machine components using modeling software
2. Manual part program generation for a CNC machine
3. CNC part programming using CAM software
4. Measurement of cutting forces and surface finish in CNC milling(DoE concepts for experimentation)
5. Measurement of material removal rate and surface finish in grinding / AJM / EDM / USM
6. Measurement of roundness using concentricity tester
7. Programming of robot – revolute type robot
8. Sequencing of cylinders using pneumatic trainer kit
9. Programming of PLC for automation systems
10. Development of ANN model of machining parameters using MATLAB software

## **SEMESTER-II**

### **ADVANCED MATERIALS AND THEIR PROCESSING**

**Vide M.E Production Engineering**

### **MICRO SYSTEMS TECHNOLOGY**

**3 0 0 100**

**INTRODUCTION:** Definition, historical development, application. (3)

**VLSI TECHNOLOGY:** Refreshing basics of electronics, logic and memory chips, silicon water, epitaxy, lithography, diffusion, thin film deposition, assembly bulk micro machining. (14)

**MEMS:** Background and fundamentals – properties, micro fluidics, design and fabrication – modeling, fabrication techniques, application in various fields. (7)

**MICRO SENSORS:** Classification of sensors, signal conversion, ideal characteristics of sensor, scaling, mechanical sensors, displacement and accelerometers, pressure and flow sensors.(6)

**NANO MEASURING SYSTEMS:** In process or in situ measurement of position of processing point, post process and on line measurement of dimensional features and surface, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems. (4)

**APPLICATION OF NANO ENGINEERING:** Nano-grating system, nano-lithography, photolithography, electron beam lithography, machining of soft metal mirrors with diamond turning, mirror grinding of ceramics, ultra-precision block gauges, balls for rolling bearings, fabrication of CCDs, VCR head assemblies, optical fibres. (4)

**FUTURE TRENDS IN NANO ENGINEERING:** Development of intelligent products, nano processing of materials for super high density ICs, nano mechanical parts, micro machines. (2)

**Latest research topics in micro and nano technology.** (2)

**Total No of periods: (42)**

#### **REFERENCES:**

1. May G.S. and Sze S.M., "Fundamentals of Semiconductor Fabrication", John Wiley & Sons Inc, 2004.
2. Bharat Bhushan, "Handbook of Nano Technology", Springer, Germany, 2004.
3. Tai Ran Hsu, "Mems & Micro Systems Design and Manufacture", Tata McGraw Hill, 2003.
4. Norio Taniguchi, "Nanotechnology", Oxford University Press, New York, 2003.
5. Chang C.V. and Sze S.M., "VLSI Technology", Tata McGraw Hill, New Delhi, April 2003.
6. Mark J Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002.
7. Julian.W.Gardner, "Micro sensors, Principles and Applications", CRC Press, 1997.

## **COMPUTER INTEGRATED MANUFACTURING**

**3 0 0 4**

**INTRODUCTION:** Evolution of CAD/CAM and CIM, scope of CIM, segments of generic CIM, computers and workstations, an overview of CIM software. (4)

**GEOMETRIC MODELING AND DESIGN OPTIMISATION:** Geometric modeling techniques, automated drafting, graphic standards, engineering analysis, optimisation, principles of concurrent engineering. (4)

**CNC TECHNOLOGY AND ROBOTIC SYSTEMS:** Principles of numerical control, types of CNC machines, features of CNC systems, programming techniques, capabilities of a typical NC, CAM software, integration of CNC machines in CIM environment, DNC–flexible manufacturing systems. Robotic systems-types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, applications of robots in manufacturing and assembly. (8)

**GROUP TECHNOLOGY AND AUTOMATED PROCESS PLANNING:** Methods of developing part families, classification and coding systems, process planning, variant and generative process planning methods, AI in process planning. (4)

**MANUFACTURING SYSTEM SOFTWARE:** Production control–forecasting, master production schedule, MRP, capacity planning, shop floor control, inventory management, product routing, job costing, marketing applications. (4)

**FUNDAMENTALS OF NETWORKING :** Networking concepts, networking devices – repeaters, bridges, routers, gateways, hubs and switches. MAP, TOP, LAN, WAN. Network topologies – star, bus, ring. (4)

**RAPID PROTOTYPING SYSTEMS:** Rapid prototyping techniques, software for rapid prototyping, process optimization. (4)

**VIRTUAL ORGANISATION:** Paperless factory, introduction virtual reality and application, virtual prototyping and manufacturing instrumentation and measurement, virtual enterprises. (4)

**PROJECT:** Involving CAD/CAM/CAE activities for a selected product from industry. (6)

**Total No of periods: (42)**

**REFERENCES:**

1. Mikell P Groover, “Automation of Production Systems and Computer Integrated Manufacturing”, Pearson Education, New Delhi, 2001.
2. Lee Kunwoo, “CAD/CAM/CAE Systems”, Addison, Wesley, USA, 1999.
3. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall, India, New Jersey, 2003.
4. Radhakrishnan P, Subramanyan S and Raju V, “CAD/CAM/CIM”, 2<sup>nd</sup> Edition New Age International (P) Ltd, New Delhi, 2000.

**ELECTIVES E1,E2& E3 –Refer ELECTIVES**

**ADVANCED MANUFACTURING ENGINEERING LABORATORY**

1. Finite element analysis in turning.
2. Finite element analysis in milling.
3. Finite element analysis in metal forming.
4. Finite element analysis in injection moulding.
5. Finite element analysis in welding.
6. Study of reverse engineering using CMM
7. Study of Rapid prototyping techniques.
8. Process capability evaluation based on inspection data.
9. Use of statistical quality control software for process control.
10. Sequencing of cylinders using electro-pneumatic trainer kit.

**SEMESTER-III**

**ELECTIVES E4, E5& E6 –Refer ELECTIVES**

## **ELECTIVES**

### **METAL FORMING THEORY AND PRACTICE**

Vide M.E Production Engineering

### **ADVANCES IN CASTING AND WELDING**

Vide M.E Production Engineering

### **TOTAL QUALITY MANAGEMENT**

Vide M.E Production Engineering

### **MAINTENANCE AND RELIABILITY ENGINEERING**

Vide M.E Production Engineering

### **IMAGE PROCESSING IN MANUFACTURING**

Vide M.E Production Engineering

### **HUMAN FACTORS IN ENGINEERING**

Vide M.E Production Engineering

### **PURCHASING AND MATERIAL MANAGEMENT**

Vide M.E Production Engineering

### **ENGINEERING ECONOMICS**

Vide M.E Production Engineering

### **RAPID PROTOTYPING, TOOLING AND MANUFACTURE**

Vide M.E Production Engineering

**IT IN MANUFACTURING**  
Vide M.E Production Engineering

**NON- TRADITIONAL MACHINING PROCESSES**  
Vide M.E Production Engineering

**PRODUCT DEVELOPMENT STRATEGIES**  
Vide M.E Production Engineering

**SIX-SIGMA CONCEPTS**  
Vide M.E Production Engineering

**FINITE ELEMENT ANALYSIS**  
Vide M.E Production Engineering

**INTEGRATED PRODUCT AND PROCESS DEVELOPMENT**  
Vide M.E Production Engineering

**OPTIMIZATION TECHNIQUES**  
Vide M.E Production Engineering

**ARTIFICIAL INTELLIGENCE IN MANUFACTURING**  
Vide M.E Production Engineering

**DESIGN FOR MANUFACTURE AND ASSEMBLY**  
Vide M.E Production Engineering (core subject)

1.

**FLEXIBLE MANUFACTURING SYSTEMS**

**3 0 0 100**

**INTRODUCTION:** Definition of an FMS - types and configurations concepts - types of flexibility and performance measures. Functions of FMS host computer - FMS host and area controller function distribution. (5)

**DEVELOPMENT AND IMPLEMENTATION OF AN FMS:** Planning phases - integration - system configuration - FMS layouts - simulation - FMS project development steps. Project management - equipment development - host system development - planning - hardware and software development. (5)

**AUTOMATED MATERIAL HANDLING AND STORAGE:** Functions - types - analysis of material handling equipments. Design of conveyor and AGV systems, storage system performance - AS/RS - carousel storage system - WIP storage system - interfacing handling storage with manufacturing. (6)

**MODELLING AND ANALYSIS OF FMS:** Types of analysis: queuing- single server, multiple servers, queue disciplines, markovian queuing models. Simulation and petrinet modelling techniques. (6)

**DISTRIBUTED NUMERICAL CONTROL AND PROGRAMMABLE CONTROLLERS:** DNC system - communication between DNC computer and machine control unit - hierarchical processing of data in DNC system - features of DNC systems, PLC - control system architecture - elements of programmable controllers: languages, control system flowchart, comparison of programming methods. (6)

**PROCESS PLANNING:** Approaches to process planning, study of a typical process planning, manufacturing planning and control, overview of production control. (6)

**RECONFIGURABLE MACHINES AND SYSTEMS:** Challenges, enabling technologies for reconfiguration– system level design issues in RMS – reconfigurable machines. (4)

**FMS RELATIONALE:** Economic and technological justification for FMS – JIT, KANBAN, Poke Yoka. Tool management of FMS, typical case studies - future prospects. (4)

**Total No of periods: 42**

#### **REFERENCES:**

1. Parrish D J, "Flexible Manufacturing", Butter Worth Heinemann Ltd, Oxford, 1993.
2. Groover M P, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall India (P) Ltd, 1989.
3. Tien-Chien chang, Richard A Wusk, "An Introduction to Automated Process Planning Systems", Prentice Hall, Inc., Englewood cliffs, New Jersey, 1985
4. Considine D M and Considine G D, "Standard Handbook of Industrial Automation", Chapman and Hall, London, 1986.
5. Viswanadham N and Narahari Y, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India (P) Ltd, 1992.
6. Ranky P G, "The Design and Operation of FMS", IFS Pub. UK, 1988.

## **MANUFACTURING SYSTEM DESIGN**

**3 0 0 100**

**INTRODUCTION TO MANUFACTURING SYSTEMS ENGINEERING:**

Process Planning-Logical design of a process planning-Shortcomings of traditional process planning-Computer aided process planning-Computerization of files management-riant(Retrieval) approach-generative approach-Semi generative approach-General remarks on CAPP developments and trends. (9)

**PRODUCTION CONTROL:** 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. (8)

**LOADING AND SCHEDULING:** Information retrieval for loading and scheduling-master scheduling-perceptual loading-dispatching – progress chasing-expediting-order scheduling devices. (8)

**MATERIAL FLOW PATH ANALYSIS IN MANUFACTURING:** 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. (8)

**LAYOUT OF MANUFACTURING SYSTEMS:** Plant layout-Definition-Objectives-Principles-Factors influencing layout-Types of layout - cellular layout- Tools and tooling system for cellular manufacturing (9)

**Total No of periods: 42**

**REFERENCES:**

1. G.Halevi Ans R.D.Weill, " Principles of Process Plannning", Chappman and Hall , Madras 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 Donald J. Ebert, " Production and Operation Management ",PrenticeHall of India,1994
5. S.N.Chary, " Production and Operations Management ", Tata McGraw Hill,New Delhi,1991.

**MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS**

**3 0 0 100**

**MANUFACTURING SYSTEMS AND MODELS:** Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building. (8)

**MATERIAL FLOW SYSTEMS:** Assembly lines-Reliable serial systems, approaches to line balancing, sequencing mixed models. Transfer lines and general serial systems – paced lines without buffers, unpaced lines. Shop scheduling with many products. Flexible manufacturing systems- System components, planning and control. Group technology-Assigning machines to groups, assigning parts to machines. Facility layout-Quadratic assignments problem approach, graphic theoretic approach. (12)

**SUPPORTING COMPONENTS:** Machine setup and operation sequencing-integrated assignment and sequencing. Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking. (6)

**GENERIC MODELING APPROACHES:** Analytical queuing models, a single workstation, open networks, closed networks. Empirical simulation models-Event models, process models, simulation system, example manufacturing system (10)

**PETRI NETS:** Basic definitions – dynamics of Petri nets, transformation methods, event graphs, modeling of manufacturing systems. (6)

**Total No of periods: 42**

**REFERENCES:**

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