

# **St. PETER'S UNIVERSITY**

St. Peter's Institute of Higher Education and Research  
(Declared under section 3 of UGC Act 1956)  
Avadi, Chennai – 600 054.



## **M.E. (ADVANCED MANUFACTURING TECHNOLOGY) PROGRAMME**

(I TO IV SEMESTERS)

### **REGULATIONS AND SYLLABI**

(REGULATIONS – 2013)

**(Effective from the Academic Year 2013-'14)**

# M.E. (ADVANCED MANUFACTURING TECHNOLOGY)

(Regulations 2013)

## (Effective from the Academic Year 2013-'14)

- 1. Eligibility:** Candidates who passed (Mechanical / Production / Automobile / Manufacturing) of the university or any other equivalent examination thereto are eligible for admission to two year M.E. (Advanced Manufacturing Technology) programme.
- 2. Duration:** Two year comprising 4 semester. Each semester has a minimum 90 working days with a minimum of 5 hours a day. Candidates who have completed the duration of the programme of study are permitted to appear for the arrear (subjects) examinations, if any within two year after the duration of the programme.
- 3. Medium:** English is the medium of instruction and examination.
- 4. Weightage for internal and end assessment:** The weightage for continuous assessment (CA) and End assessment(EA) be 25:75 unless the ratio is specifically mentioned in the scheme of examinations.
- 5. Credit System:** Credit system be followed with 18 credits for each semester and each credit is equivalent to 25 hours of effective study provided in the time table.

### 6. Scheme of Examinations

#### I Semester

Code No.	Course Title	Credit	CA (marks)	EA (marks)	Total (marks)
<b>Theory</b>					
113AMPT01	Probability and statistics	3	25	75	100
113AMPT02	Optimization for Engineering Applications	3	25	75	100
113AMPT03	Advanced Materials Engineering	3	25	75	100
113AMPT04	Mechatronics in Manufacturing Systems	2	25	75	100
113AMPE**	<b>Elective I:</b> Advances in CNC Systems	3	25	75	100
113AMPE**	<b>Elective II:</b> Supply Chain Management	3	25	75	100
<b>Practical</b>					
113AMPP01	CIM and Mechatronics Laboratories	1	25	75	100
<b>Total</b>		18	175	525	700

#### II SEMESTER

Code No.	Course Title	Credit	CA (marks)	EA (marks)	Total (marks)
<b>Theory</b>					
213AMPT01	Advanced Operations Research	3	25	75	100
213AMPT02	Design for Manufacture and Assembly	3	25	75	100
213AMPT03	Computer Integrated Manufacturing	3	25	75	100
213AMPT04	Advanced Metal Joining Processes	2	25	75	100
213AMPE**	<b>Elective III:</b> Precision Engineering	3	25	75	100
213AMPE**	<b>Elective IV:</b> Plastics and Composite Materials	3	25	75	100
<b>Practical</b>					
213AMPP01	Simulation and Welding Laboratory	1	25	75	100
<b>Total</b>		18	175	525	700

### III Semester

Code No.	Course Title	Credit	CA (marks)	EA (marks)	Total (marks)
<b>Theory</b>					
313AMPT01	Rapid Prototyping and Manufacturing	3	25	75	100
313AMPT02	Advanced Metal Forming Technology	3	25	75	100
313AMPE**	<b>Elective V: Total Quality System and Engineering</b>	3	25	75	100
<b>Project</b>					
313AMPP01	Project (Phase I)	9	25	75	100
<b>Total</b>		<b>18</b>	<b>100</b>	<b>300</b>	<b>400</b>

### IV Semester

Code No.	Course Title	Credit	CA (marks)	EA (marks)	Total (marks)
<b>Project</b>					
413AMPP01	Project (Phase II)	18	25	75	100
<b>Total</b>		<b>18</b>	<b>25</b>	<b>75</b>	<b>100</b>

## LIST OF ELECTIVES

### SEMESTER I

	(ELECTIVE I)	Credit
113AMPE 05	Design of Advanced Hydraulic and Pneumatic Systems	3
113AMPE 06	Industrial Robotics and Machine Vision	3
113AMPE 07	Manufacturing Information systems	3
<b>113AMPE 08</b>	<b>Advances in CNC Systems</b>	3
113AMPE 09	Flexible Competitive Manufacturing System	3
<b>ELECTIVE II</b>		
<b>113AMPE 10</b>	<b>Supply Chain Management</b>	3
113AMPE 11	Advanced Metrology and Non Destructive Testing	3
113AMPE 12	Productivity Management and Re engineering	3
113AMPE 13	Supply chain Information Systems	3

### SEMESTER II

	(ELECTIVE III)	Credit
213AMPE 05		
213AMPE 06	Design of cellular Manufacturing system	3
<b>213AMPE 07</b>	<b>Precision Engineering</b>	3
213AMPE 08	Reliability and Total Productive Maintenance	3
213AMPE 09	e-manufacturing	3
213AMPE 10	Information System Analysis and Design	3
<b>ELECTIVE IV</b>		
213AMPE 11	Computer Aided Process Planning	3
213AMPE 12	Corrosion and Surface Engineering	3
213AMPE 13	Advanced Tool Engineering and Design	3
<b>213AMPE 14</b>	<b>Plastics and Composite Materials</b>	3

### SEMESTER III

	(ELECTIVE V )	Credit
<b>313AMPE 03</b>	<b>Total Quality System and Engineering</b>	3
313AMPE 04	Advances in Foundry Technology	3
313AMPE 05	Finite Element Analysis in Manufacturing Engineering	3
313AMPE 06	Advanced Agile and Lean Manufacturing Systems	3
313AMPE 07	Advances in Casting and welding	3

- 7. Passing Requirements:** The minimum pass mark(raw score) be 50% in End assessment(EA) and 50% in Continuous assessment (CA) and End Assessment(EA) put together. No minimum mark(raw score) in continuous assessment(CA) be prescribed unless it is specifically mentioned in the scheme of Examination.
- 8. Grading System:** Grading system on a 10 point scale be followed with 1mark=0.1 grade point to successful candidates as given below.

#### CONVERSION TABLE

(1 mark = 0.1 Grade point on a 10 point scale)

Range of Marks	Grade point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	F	<b>Reappearance</b>

#### Procedure for Calculation

Cumulative Grade Point Average(CGPA)	= $\frac{\text{sum of Weighted Grade Points}}{\text{Total Credits}}$
	= $\frac{\sum(CA+EA)C}{\sum C}$
Where Weighted Grade Points in each Course	= Grade Points (CA+EA) Multiplied by Credits
	= (CA+EA)C
Weighted Cumulative Percentage of marks(WCPM)	=CGPAx10

**9. Pattern of the Question Paper:** The question paper for End assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

**Part A:** 10 questions(with equal distribution to all units in the syllabus). Each question carries 2 marks.

**Part B:** 5 questions with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks. The total marks scored by the candidates will be reduced to the maximum prescribed in the regulations.

**10.Effective Period of Operation for the Arrear Candidates :**Two Year grace period is provided for the candidates to complete the arrear examination, if any.

## **11. Syllabus**

**Registrar**

## I Semester

113AMPT01

PROBABILITY AND STATISTICS

### Unit I      **CALCULUS OF VARIATION**

Introduction – Euler’s equation – several dependent variables Lagrange’s equation of Dynamics – Integrals involving derivatives higher than the first – Problem with constraints – Direct methods and eigen value problems.

### Unit II      **MATRIX THEORY**

Eigen values using QR transformations – generalized eigenvectors – canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

### Unit III      **LINEAR PROGRAMMING PROBLEM**

Graphical method – simplex method – Big M Technique – Integer programming.

### Unit IV      **SAMPLING DISTRIBUTIONS AND TESTING OF HYPOTHESIS**

Testing of hypothesis-Sampling distributions-Test based on Normal, t-distribution, chi-square and F-distribution-Analysis of Variance-One way and two way classifications.

### Unit V      **ANALYSIS OF VARIANCE AND TIME SERIES**

Design of experiments-Completely Randomized Design-Randomized Block Design-Latin Square Design-2 Factorial Design.

Time series-characteristics and Representation-Moving averages –Exponential Smoothing-Auto Regressive processes.

### References

1. Gupta, A.S, Calculus of variations with Applications, Prentice – Hall of India New Delhi, 1997.
2. Bronson, R., Matrix operations, Schaum’s outline series, McGraw Hill, New York, 1989.
3. Taha H.A, “Operation Research – An Introduction”, Prentice Hall of India, 2001.
4. Anderson, O.D., “Time Series Analysis: Theory and Practice”, I. North-Holland, Amsterdam (1982).
5. Gupta, S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”. Sultan Chand and Sons, New Delhi (2000).
6. Trivedi, K.S., “Probability and Statistics with Reliability, Queueing and Computer Science Applications, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (2003)

## 113AMPT02 OPTIMISATION FOR ENGINEERING APPLICATIONS

### OBJECTIVE:

Optimization is the act of obtaining the best results considering the constraints in any system. This course on optimization gives a in-depth knowledge on various search various search algorithms used for optimizing optimizing nonlinear systems. a given system. Traditional and non traditional algorithms used algorithms used for single and multi variable optimization problems are discussed.

### OUTCOME:

At the end of this course, students will be familiar with the principles of optimization and the numerous search techniques available to solve engineering problems of various intricacies.

### INTRODUCTION

Engineering application of optimization – optimal problem formulation – design variables – constraints – objective function – variable bounds. Classification of optimal problems – optimization algorithms.

### LINEAR PROGRAMMING

Introduction – standard form of linear programming – solutions for linear programming – simplex algorithm – two phase of the simplex method – revised simplex method – duality in LP, Decomposition principle – sensitivity analysis – linear complementary and fractional programming problems

### ONE DIMENSIONAL NON LINEAR PROGRAMMING

Single variable optimization variable optimization algorithms – optimal criteria. , - region elimination methods – Exhaustive search method - Fibonacci search method – golden section search - gradient search methods – Newton –Raphson method. -

Computer programming on region elimination and gradient search methods.

### MULTIVARIABLE UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria. – direct search methods – simplex search method, Hooke-Jeeves pattern search, Powell's conjugate direction method. , Gradient search methods -- Cauchy's steepest search method, Newton method, conjugate gradient search method, variable metric method (DFP).

Computer programming on direct search method and method and gradient search method.

### MULTIVARIABLE CONSTRAINED OPTIMIZATION ALGORITHMS

optimizationOptimization with equality constraint, in equality constraints – direct methods – indirect methods using penalty functions. Lagrange multipliers, Kuhn, Kuhn-Tucker conditions, transformation methods – Penalty function methods – Sensitivity analysis. – Computer programming on multivariable optimization algorithmsCharacteristics of a constrained problem – Kuhn Tucker Conditions. Direct search methods – cutting plane method, method of feasible direction, complex search method. Transformation techniques – penalty function method, method of multipliers. Sensitivity analysis – check for convergence of constrained optimization problems

### NON TRADITIONAL OPTIMIZATION ALGORITHMS

Non Traditional Optimization – Multi objective optimization, genetic algorithms and simulated annealing techniques, Meta heuristics search techniques – tabu search ant colony optimization. – Computer programming for these algorithms.

### Text book:

1. Singeresu S. Rao, "Engineering optimization – Theory and practice", New Age Intl. Ltd., Publishers, 2000.
2. Kalyanamoy Deb, "Optimization for engineering algorithms and examples", Prentice Hall of India, 2005.
3. Joshi M.C., Moudgalya K.M. "Optimization" Narosa Publishing House (P) Ltd, 2005.

### References:

1. Johnson Ray. C., "Optimum design of mechanical elements", Wiley, John & Sons, 1981.
2. Goldberg D.E., "Genetic algorithms in search, optimization and machine", Baren, Addison-Wesley, New york, 2004.

**AIM:**

To impart knowledge on advance concepts of material technology

**OBJECTIVES:**

To enlight the PG students on elastic, plastic and fractured behaviour of engineering materials. To train the PG students in selection of metallic and non-metallic materials for the various engineering applications.

**UNIT I ELASTIC AND PLASTIC BEHAVIOR**

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation and non metallic shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of non crystalline materials.

**UNIT II FRACTURE BEHAVIOUR**

Griffith's theory, stress intensity factor and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

**UNIT III SELECTION OF MATERIALS**

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

**UNIT IV MODERN METALLIC MATERIALS**

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

**UNIT V NON METALLIC MATERIALS**

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TiC, TaC, Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub> CBN and diamond – properties, processing and applications.

**REFERENCES:**

1. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 1988
2. Thomas H. Courtney, Mechanical Behaviour of Materials, (2<sup>nd</sup> edition), McGraw Hill, 2000
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, (3<sup>rd</sup> edition), Butterworth-Heinemann, 2001.
4. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4<sup>th</sup> Edition) Jaico, 1999.
5. ASM Hand book, Vol.11, Failure Analysis and Prevention, (10<sup>th</sup> Edition), ASM, 2002.
6. Ashby M.F., Material Selection in Mechanical Design, 3<sup>rd</sup> Edition, Butter Worth 2005.



## **113AMPT04 MECHATRONICS IN MANUFACTURING SYSTEMS**

### **OBJECTIVE:**

To understand the interdisciplinary concepts by focusing application of electronics concepts in Mechanical Engineering and also to know the design of products and processes using Mechatronics system design.

### **INTRODUCTION**

Introduction to Mechatronics - Definition - Mechatronics in Products – Classification of Mechatronics - Measurements Systems - Control Systems - Traditional design and Mechatronics Design.

### **SENSORS AND TRANSDUCERS**

Sensors and transducers - Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors.

### **MICROPROCESSOR INTRODUCTION**

Microprocessors in Mechatronics - Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters - Applications - Temperature control - Stepper motor control - Traffic light controller.

### **PLC APPLICATIONS**

Programmable Logic Controllers - Introduction - Basic structure - Input/Output processing - Programming - Mnemonics Timers, Internal relays and counters - Data handling - Analog input/output - Selection of PLC.

### **DESIGN OF MECHATRONICS SYSTEMS**

Design and Mechatronics - Designing - Possible design solutions - Case studies of Mechatronics systems.

### **Text Books**

- 1) Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, Addison Wesley Longman Ltd., 2005.
- 2) Devdas shetty, Richard A. Kolk, -Mechatronics System Design,- PWS Publishing company,2007
- 3) D.A. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 2001

### **Reference Books**

- 1) Brian Morriss, Automated Manufacturing Systems - Actuators,Controls, Sensors and Robotics, Mc Graw Hill International Edition, 1995.
- 2) Gopel, Sensors A comprehensive Survey Vol I & Vol VIII, BCH Publisher, New York,2002.
- 3)K.P.Ramachandran,G.K Vijayaraghavan, M.S. Balasundaram, "Mechatronics - Integrated Mechanical Electronic Systems" Wiley India Edition , 2008
- 4) Michael B. Histan and David G.Alciatore, " Introduction to Mechatronics and Measurement Systems ", McGraw Hill International Editions, 1999.
- 5) HMT Ltd., " Mechatronics ", Tata McGraw Hill Publishing Co. Ltd., 1998.
- 6) Ramesh S. Gaonkar, " Microprocessor Architecture ", Programming and Applications, Wiley Eastern, 1997.

**CIM LAB**

Computer Aided Drafting – Operating Systems – Wire Frame, Surface and Solid Modeling –Pro E Study - Helical Gear Solid Modeling using Pro-E – XL Mill CNC Milling [Projection] - Study of Profile Projector - Measurement of Thread Parameter Using Profile projector - Study of Co-ordinate Measuring Machine - XL Turn CNC Lathe [ Turning, Facing, drilling and Contouring] –study of feed back milling machine( linear and circular interpolation)- Manufacturing Simulation Using LEKIN Scheduling Software Package - Mini Project in LEKIN.

**MECHATRONICS LAB (TITLE OF EXPERIMENTS)****FIRST CYCLE**

1. Study of Mechatronics system Design
2. Introduction to Lab VIEW
3. Temperature control system using Lab VIEW
4. Design of Vehicle speed indicator using Lab VIEW
5. Vibration measurement system
6. Measurement of stress and Strain analysis using Load cell and Lab VIEW
7. Room temperature Measurement

**SECOND CYCLE**

1. Resistor simulation
2. Capacitor simulation
3. Simple Servo simulation
4. Data Acquisition using National Instrument's Data acquisition card
5. Color matching using Lab VIEW
6. Simple pendulum Simulation using Lab VIEW

## II Semester

213AMPT01

### ADVANCED OPERATIONS RESEARCH

#### OBJECTIVE

The subject provides knowledge on various types of programming, their analysis, concepts and methods of scheduling as well as introduction to queuing.

#### UNIT I

Integer Programming: Branch and bound algorithm and cutting plane algorithm. Multi-criterion and goal programming. stochastic Programming; quantile rules. Two-stage programming; use of fractional programming.

#### UNIT II

Sequencing and scheduling problems: 2 machine n-job and 3-machines n-job problems with identical machine sequence for all jobs; 2-job n-machine problem with different routings; branch and bound method for solving travelling-salesman problem.

#### UNIT III

Sensitivity analysis. parametric programming. project management: CPM and PERT; probability of project completion; PERT-crashing.

#### UNIT IV

Replacement problems: block and age replacement policies; dynamic programming approach for maintenance problems; replacement of items with long life.

#### UNIT V

Transient solution of M/M/1 queue; bulk queues (bulk arrival and bulk service); finite queues; queues in tandem; GI/G/1 queue and its solution; simulation of queues.

#### References:

1. Taha, H.A. (1982): Operations Research: An Introduction; MacMillan Publishing Company, New York.
2. Hillier, F.S. and Lieberman, G.J. (1962): Introduction to Operations Research; Holden Day.
3. Kanti Swaroop, Gupta, P.K. and Singh, M. M. (1985): Operations Research; Sultan Chand and Sons.
4. Churchman, C.W.; Ackoff, R.L. and Arnoff, E.L. (1957): Introduction to Operations Research; John Wiley.
5. Mckuisey, J.C.C. (1952): Introduction to the Theory of Games, McGraw Hill.
6. Kleinrock, L. (1975): Queuing Systems, Vol. I; John Wiley.
7. Hadley G. and Whitin, T.M. (1963): Analysis of Inventory Systems; Prentice Hall.
8. Starr, M. K. and Miller, D.W. (1962): Inventory Control - Theory and Practice; Prentice Hall.
9. Shamblin, J.E. and Stevens, G.T. (1974): Operations Research: A Fundamental Approach; McGraw Hill.

**DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY:** DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka-Yoke principle;  $6\sigma$  concept; design creativity.

**TOLERANCE ANALYSIS:** Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law.

**SELECTIVE ASSEMBLY:** Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples.

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

**TRUE POSITION TOLERANCING THEORY:** Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

**FORM DESIGN OF CASTINGS AND WELDMENTS:** Redesign of castings based on parting line considerations, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features- functional and manufacturing, component design-machining considerations, redesign for manufacture, examples.

**LEAN MANUFACTURING:** Need for lean concepts, different types of waste, metrics of manufacturing, an overview of value stream mapping- present state map, future state map, evaluation of benefits- Process FMEA, Design FMEA.

#### TEXT BOOK:

1. Harry PECK, `Designing for Manufacture`, Pitman Publications, London, 1993.
2. Matousek R, `Engineering Design- A Systematic Approach`, Blackie and Son Ltd., London, 1974.

#### REFERENCES:

1. Spotts MF, `Dimensioning and Tolerance for Quantity Production`, Prentice Hall Inc., New Jersey, 1983.
2. Oliver R Wade, `Tolerance Control in Design and Manufacturing`, Industrial Press Inc New York, 1967.
3. James G Bralla, `Hand Book of Product Design for Manufacturing`, McGraw Hill Publications, 1983.
4. Trucks H E, `Design for Economic Production`, Society of Manufacturing Engineers, Michigan, Second Edition, 1987.
5. Poka-Yoke, `Improving Product Quality by Preventing Defects`, Society of Manufacturing Engineers, Michigan, Second Edition, 1987
6. Creveling C M, `Tolerance Design – A Hand Book for Developing Optimal Specifications`, Addison Wesley Longman Inc., USA, 1997.
7. Pahi G and Beitz W, `Engineering Design-Systematic Approach`, Springer Verlag Pub., 1996.
8. Dennis P Hobbs, `Lean Manufacturing Implementation: A Complete Execution Manual for any Size Manufacturing`, J Rose Publishing Inc., 2003.
9. Mamboed M Farag, `Material Selection for Engineering Design`, Prentice Hall, New Jersey, 1997.

## **213AMPT03 COMPUTER INTEGRATED MANUFACTURING**

### **OBJECTIVE:**

This course will enable the student

- To gain knowledge on how computers are integrated at various levels of planning and manufacturing.
- To understand the flexible manufacturing system and to handle the product data and various software used for manufacturing

### **INTRODUCTION**

Meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management

### **GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING**

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing.

Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches – CAPP and CMPP process planning systems.

### **SHOP FLOOR CONTROL AND INTRODUCTION OF FMS**

Shop floor control-phases -factory data collection system -automatic identification methods-Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation - material handling and storage systems- FMS layout -computer control systems-application and benefits.

### **CIM IMPLEMENTATION AND DATA COMMUNICATION**

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- Product data management-CIM implementation software.

Communication fundamentals- local area networks -topology -LAN implementations - network management and installations.

### **OPEN SYSTEM AND DATABASE FOR CIM**

Open systems - open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP)

Development of databases - database terminology - architecture of database systems - data modeling and data associations - relational data bases - database operators - advantages of data base and relational database.

### **TEXT BOOKS**

1. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.

### **REFERENCES**

1. Yorem koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
3. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
4. Roger Hanman "Computer Intergrated Manufacturing", Addison – Wesley, 1997.
5. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1998.
6. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
7. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

## **213AMPT04    ADVANCED METAL JOINING PROCESSES**

### **Objective:**

- To provide knowledge about the principle and applications of latest welding processes
- To acquire essential significance of thermal effects of welding and subsequent remedial measures to reduce residual stresses and distortion in weldments.
- To gain knowledge about the Weldability of different commercially available materials, their corresponding weld joints design and automation of welding processes.

This subject deals with the recent welding processes and the Weldability of ferrous and non-ferrous metals and alloys. The effects of heat flow in welding and the resulting residual stresses and distortion have been emphasized. Good welding design principles and welding automation have been detailed.

### **1. SPECIAL WELDING PROCESSES**

Electron beam welding, laser beam welding, ultrasonic welding, explosion welding, electro slag and electro gas welding, cold pressure welding, Friction Stir welding, diffusion bonding and adhesive bonding.

### **2. HEAT EFFECTS OF WELDING**

Metallurgical effects of heat flow in welding-TTT curve- continuous cooling transformation diagrams- development of residual stress, methods of relieving or controlling welding residual stresses, types and control of distortion, pre-heat and post welding heat treatment.

### **3. WELDABILITY OF FERROUS AND NON-FERROUS ALLOYS**

Weldability of carbon and alloy steels, stainless steels, cast irons, copper and its alloys, aluminum and its alloys, titanium and its alloys, Ni and its alloys, weldability tests.

### **4. WELDING DESIGN**

Typical joints for different welding processes, principles of welding joint design and location of joint within the member, evolving good weld design, welding symbol- Blue print reading, welding design for static and fatigue loading, fracture toughness.

### **5. AUTOMATION IN WELDING**

Welding sequence and classification of processes, manual and semi-automatic, automatic, automated welding- adaptive controls- remote welding, robotic welding- selecting welding system, gravity welding and fire cracker welding, under water welding- wet and dry.

### **TEXT BOOKS:**

1. Parmar.R.S," Welding Processes and technology", Khanna Publishers,1992.
2. Parmar.R.S," Welding Engineering and technology", Khanna Publishers,1992.

### **REFERENCES:**

1. Davies.A.C, "Welding", Cambridge University Press, 10<sup>th</sup> Edition, 1996
2. Larry Jeffus, "Welding – Principles and Application", Delmar Publisher, New York, 4<sup>th</sup> , edition ,1999.
3. Welding hand book, vol.2 & 4 American Welding society, 8<sup>th</sup> Edition, 1998

## **213AMPP01 SIMULATION AND WELDING LABORATORIES**

Introduction to simulation languages- Simulation procedure-simulation of manufacturing systems-use of simulation software's - PROMODEL, ARENA, Flex sim, Pre Actor, CATIA, Simul8, Advanced Generic Schedule Simulator -. Evaluation of model and validation.

## III Semester

### 313AMPT01

### RAPID PROTOTYPING AND MANUFACTURING

#### Objective:

- This module is focused to provide a detailed knowledge on advanced manufacturing techniques, the Rapid Prototyping and Rapid Manufacturing Process.
- Focused to aid in understanding the need, types, application, method of operation and the future of Rapid Prototyping system in industrial application.
- This also aids in innovative thinking and develop business case studies in RP / RM techniques.

#### INTRODUCTION

Process requirements for Rapid Prototyping – Product Prototyping and Product Development – Prototyping - Need for Prototyping – Issues in Prototyping – Conducting Prototyping – Design Procedure – Prototype Planning and Management – Product and Prototype Cost Estimation – Fundamentals of Cost Concepts – Prototype Cost Estimation – Cost Complexities – Prototype Design Methods – Prototype Design tools – Morphological Analysis – Functional Efficiency Technique – Paper Prototyping – Selecting a Prototype – Learning from Nature.

#### VIRTUAL PROTOTYPING, MATERIALS SELECTION & PROCEDURE FOR PROTOTYPING

Using Commercial Software for Virtual Prototyping – Prototyping Materials – Material Selection Methods – Rapid Prototyping Overview – Rapid Prototyping Cycle - Rapid Prototyping Procedure – STL files – Converting STL File from Various CAD Files – Controlling Part Accuracy in STL Format – Slicing the STL File – Case Studies in Design for Assembly.

#### TYPES OF RAPID PROTOTYPING PROCESS

Types of RP Process – Stereolithography -- Fused Deposition Modelling – Selective Laser Sintering – 3D Printing Process -- Laminated Object Manufacturing – Electron Beam Melting Process -- History - Operation – Advantages and Disadvantages – Applications - Relation to Other RP Technologies - (applies to all the process) - Direct Laser Deposition.

#### APPLICATIONS OF RAPID PROTOTYPING

Investment Casting – Sand Casting – Permanent Mould Casting – Direct RP Tooling – Silicone Rubber Tooling – Investment Cast Tooling – Powder Metallurgy Tooling – Desktop Machining - Case Studies on Current Applications of RP- Novel Application of RP Systems - Future Trends of RP Systems.

#### RAPID MANUFACTURING

Rapid Manufacturing – Potential of RM on Design – Geometrical Freedom – Material Combinations – Customer Input – RM of Prototypes – Reverse Engineering – Interactive CAD Models – Role of Materials in RM – Materials for RM Process – Product Customisation and Case Studies – Future Developments Serving RM – Production Economics of RM – Cost of Manufacture – Application of RM in Medical, Automotive, Aeronautical, Space and Construction Industries.

#### TEXT BOOKS

1. Cooper, G.K (2001), Rapid Prototyping Technology Selection and Application, Marcel Dekker Inc, USA.
2. Hopkinson, N., Hague, R.J.M, and Dickens, P.M.(2006), Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK
3. Liou, W.F (2008), Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA
4. Kai., C.C, Lim, C.S. and Leong, F.K. (2008), Rapid Prototyping: Principles and Applications in Manufacturing, Wiley Publication.

#### FURTHER READING

1. International Journal of Advanced Manufacturing Technology
2. Rapid Prototyping Journal
3. The RPD Magazine
4. The tct Magazine
5. Wohlers Report



## **313AMPT02**

## **ADVANCED METAL FORMING TECHNOLOGY**

### **OBJECTIVE**

To give first level introduction to various metal forming technologies and to study forging, rolling, drawing and other unconventional forming techniques in detail.

### **INTRODUCTION**

Stress and strain - Three dimensional stress pattern - True stress and true strain - Principal stresses - Yield criteria - Von Mises criterion - Tresca's criterion - Von Mises Yield for plane strain problems - Coloumb function and sticking friction.

### **FORGING**

Forging - Forging in plane strain - Forging of circular disc - Effect of friction - Forging equipment - defects in forged products - Causes & Remedies.

### **ROLLING AND EXTRUSION**

Rolling and extrusion - Rolling of sheet and strip in plane strain conditions - Effect of friction - maximum draft , rolling load , torque and H.P - roll deflection - defect in rolled products - causes and remedies - forward and backward extrusion - Approximate extrusion loads - tube extrusion .

### **DRAWING**

Drawing - Rod and Wire drawing - Equilibrium equation - Strip drawing - tube drawing with mandrel - Effect of friction and cone angle - Defects in drawn parts.

### **UNCONVENTIONAL FORMING METHODS**

Unconventional forming - High energy rate forming - Explosive forming - Magnetic Pulse forming - Electro hydraulic forming - Super plasticity - Powder metallurgy - Techniques - Applications.

### **References:**

1. Roa P.N. "Manufacturing Technology ", Tata McGraw -Hill, 2005.
2. Avitzur , "Metal Forming Processes and Analysis ", Tata McGraw - Hill ,2005.
3. Dieter, "Mechanical Metallurgy ", Tata McGraw - Hill, 2005.
4. Harris, J.N., "Mechanical working of Metals - Theory and Practice", Pergamon Press ,1995
5. Taylour Altan , Soo-IK-Oh and Harold L.Gegel , "American Society for Metals " ,1983.

### **Web Reference:**

1. [www.kkai.com/matproc.html](http://www.kkai.com/matproc.html)

## **ELECTIVE I (SEMESTER I)**

### **113AMPE 05 DESIGN OF ADVANCED HYDRAULIC AND PNEUMATIC SYSTEMS**

#### **OBJECTIVE:**

To provide a first-level introduction to hydraulics and pneumatics to under-graduate students of mechanical engineering and also to provide the basic knowledge on various hydraulic and pneumatic circuits used in industries.

#### **INTRODUCTION**

Fluid Power - Hydraulic fluids - properties and selection. Pneumatic fluid – properties and selection. Advantages and Applications of Fluid Power. Fluid Power Industry.

#### **HYDRAULIC MOTORS AND PUMPS**

Oil hydraulic systems-Hydraulic Power Generators-Selection and specification of pumps, pumps, pump characteristics.

#### **ACTUATORS AND CONTROL UNITS**

Hydraulic actuators-Linear and Rotary Actuators- selection, specification and characteristics. Control and regulation elements-Pressure, direction and flow control valves-relief valves, non return and safety valves-actuation systems.

#### **HYDRAULIC CIRCUITS**

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

#### **PNEUMATICS – BASICS AND CIRCUITS**

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

#### **COMBINED CIRCUITS**

Installation, maintenance and special circuits – Pneumatic equipments – selection of components – design calculations- application – fault finding – hydro pneumatic circuits – use of microprocessors for sequencing – PLC, Low cost automation – Robotic circuits.

#### **References :**

1. Antony Esposito, "Fluid power with Applications", Prentice Hall,1980.
2. Dudleyt, A.Pease and John J.Pippenger, "Basic Fluid Power ",Prentice Hall, 1987.
3. Andrew Parr, "Hydraulic and pneumatics" ,(HB), Jaico publishing House, 1999.
4. Bolton.W. "Pneumatic and Hydraulic Systems", Butterworth – Heinemann, 1997.

#### **Web References:**

1. [www.pneumatics.com](http://www.pneumatics.com)
2. [www.fluidpower.com.tw](http://www.fluidpower.com.tw)

**ROBOTICS AND ITS COMPONENTS**

Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space, precision of movement.

Drives and control systems: Hydraulic systems, power supply – servo valve – sump – hydraulic motor – DC servo motors – stepper motors – operation.

Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link – Road Systems, Rotary to linear motion conversion, Ract and pinion drives, ball bearing screws, speed reducers, Harmonic drives.

**KINEMATICS OF ROBOT**

Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning.

**ROBOT END EFFECTORS**

Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers–Robot end effector interface.

Sensors: Position sensors – Potentiometers, encoders – LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers.

**MACHINE VISION**

Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation – Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations.

**FEATURE EXTRACTION**

Geometry of curves – Curve approximation, Texture and texture analysis, Image resolution – Depth and volume, Color processing, Object recognition by features, Depth measurement, specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression, Real time Image processing, Application of Vision systems.

**TEXT BOOK**

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)
2. Rafael C. Gonzalez, Richard E. Woods 'Digital Image Processing' Addition- Wesley Publishing Company, 2001.

**REFERENCES**

1. M.P. Groover, Industrial Robotics – Technology, Programming and Applications, McGraw-Hill, USA, 2004.
2. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991.
3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1997.
4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 2001.

**OBJECTIVES**

The students will learn the production planning and control system, the databases required to handle records and their maintenance, various methods of collecting data from the shop floor in order to analyze and improve the performance of the manufacturing system. They also understand the importance of information system along with scheduling techniques for customer requirement. They are also exposed to different case studies.

**INTRODUCTION**

This subject has been introduced to the students with an idea to impart to the students the knowledge on various manufacturing activities such as Materials Requirement Planning and Manufacturing Resources Planning so that they get to know about the role of information and communication in product manufacture besides understanding the importance of data, database and database management system. They also learn about the various techniques used to collect data from the shop floor in a way to analyze the performance of manufacturing system. They are also introduced to the concept of Part Based Manufacturing Information System that is widely used in modern manufacturing industries.

**PRODUCTION MANAGEMENT SYSTEM**

Introduction - the evolution of order policies from MRP to MRP II, the role of production organization control.

**DATABASE**

Database-Terminologies-Entities & Attributes - Data Models, Schema & Subschema-Data Independence-ER Diagram - Trends in Database.

**DATABASE MANAGEMENT SYSTEMS AND MODELS**

Designing database-Hierarchical Model-Network Approach-Relational Data Model-Concepts, Principles, Keys, Relational Operations-Functional Dependence-Normalization, Types - Query Languages.

**MANUFACTURING SHOP FLOOR CONTROL SYSTEM**

Manufacturing Consideration-Product and its structure, Inventory and Process Flow-Shop Floor Control-Data Structure and Procedure-Various Model- Order Scheduling Module, Input/Output Analysis Module, Stock Database- IOM Database.

**MANUFACTURING INFORMATION SYSTEM**

Information system for manufacturing- Parts Oriented Production Information System-Concepts and structure-Computerized Production Scheduling, Online Production Control System, Computer Based Production Management System-Case Study

**REFERENCES:**

1. Luca G. Sartori, "Manufacturing Information Systems", Addison-Wesley Publishing Company, 2003.
2. Date.C.J, "An Introduction to Database Systems", Narosa Publishing House, 2004.
3. Orlicky.G, "Material Requirements Planning", McGraw-hill Publishing & Co., 2002.
4. Kerr.R, "Knowledge Based Manufacturing Management", Addison Wesley, 2003.

**Web reference:**

1. [www.ist.psu.edu](http://www.ist.psu.edu)

**OBJECTIVE:**

This Course will enable the student

- To learn the elements involved in CNC Machines and Mechanism for converting program of instructions to mechanical action
- To generate program using various techniques and study of special type CNC machines

**INTRODUCTION**

Classification – Construction details of CNC machines – machine structure, guideways, feed drives – spindle, measuring systems – Drivers and controls – Spindle drives, feed drives, D.C.drives - A.C.drives

**CNC SYSTEM**

Introduction – Configuration of CNC system –interfacing – Monitoring – Diagnostics- Machine data – Compensations for machine accuracies – PLC programming – DNC – Adaptive control CNC systems.

**PROGRAMMING OF CNC MACHINES**

Various programming techniques – APT – Programming for various machines in ISO and FANUC – CAM packages for CNC Machines such as Uni graphics, LDEAS, Pro-Engineer, CATIA, ESPIRIT, MASTERCAM, etc.,

**TOOLING FOR CNC MACHINES**

Interchangeable tooling system – present and qualified tools – coolant fed tooling system – Modular fixture – quick change system – Automatic head changers – tooling requirements for turning and machining centres – Tool assemblies – tool magazines –ATC mechanisms – tool management.

**SPECIAL TYPES OF CNC MACHINES**

CNC grinding machines, EDM, Wire cut EDM, Punch press – Installation, Maintenance- Testing and performance, Evaluation of CNC Machines

**REFERENCES:**

1. Radhakrishnan,P "Computer Numerical Control Machines", New Central Book Agency, 1996
2. Sehrawat,M.S and NarangJ.S "CNC Mchines", Dhanpat Rai and Co., 1999
3. "Mechatronics", HMT Ltd, TATA McGraw Hill, Publishing Company Ltd., 1998
4. Thyer,G.E "Computer Numerical Control of Machine Tools", B.H.Newberg,1991
5. Krar.S "CNC Technology and programming", McGraw Hill, 1990
6. Peter Smid, "CNC Programming Hand Book", Industries Press Inc, 2000

**OBJECTIVE**

This Course will enable the student

- To Gather the information about Flexible manufacturing system concept in detail
- To learn the recent trends in Scheduling and Simulation

**INTRODUCTION**

Manufacturing in a competitive environment - Automation of manufacturing process - numerical control - material handling and movement - industrial robots - Sensor technology - flexible, fixturing - Design for assembly, disassembly and services.

**GROUP TECHNOLOGY AND CELL DESIGN**

Group technology - Part families - classification and coding - Production flow analysis - Machine cell design - Benefits

**FLEXIBLE MANUFACTURING SYSTEM AND APPLICATIONS**

Flexible Manufacturing System - Introduction - Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer.

**SOFTWARE INTEGRATION WITH FMS**

Computer software, simulation and database of FMS - System issues - Types of software - specification and selection Trends - Application of simulation software - Manufacturing data system - data flow - CAD/CAM considerations - Planning FMS database.

**LEAN MANUFACTURING**

Just in time - Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties - flexible work force - line flow strategy - preventive maintenance - Kanban system - strategic implications - implementation issues - MRD JIT - Lean manufacture.

**References:**

1. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt Ltd., New Delhi, 2005
2. Jha, N.K."Handbook of Flexible Manufacturing Systems",Academic Press Inc., 1991.
3. Kalpakjain, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co.1995.
- 4 Talichi Ohno, Toyoto, "Production System Beyond Large-Scale production", Productivity Press (India) Pvt Ltd.,1992.

## **ELECTIVE II**

**113AMPE 10**

**SUPPLY CHAIN MANAGEMENT**

### **UNIT I**

Introduction - Logistics - Concepts, Definitions, approaches, factors affecting logistics. Supply chain - basic tasks of the supply chain - the new corporate model.

### **UNIT II**

Supply Chain Management - The new paradigm, the modular company, the network relations, supply process – Procurement process- Distribution management.

### **UNIT III**

Evolution of Supply Chain Models - Strategy and structure - factors of supply chain - Manufacturing strategy stages, supply chain progress - model for competing through supply chain management - PLC grid, supply chain redesign - Linking supply chain with customer.

### **UNIT IV**

Supply Chain Activity Systems - Structuring the SC, SC and new products, functional roles in SC, SC design framework, collaborative product commerce (CPC)

### **UNIT V**

SCM Organization and Information System - The management task, logistics organization, the logistics information systems - Topology of SC application - MRP, ERP, Warehouse management system, product data management - cases.

### **REFERENCES:**

1. Scharj, P.B., Lasen, T.S., "Managing the global supply chain", Viva books, New Delhi, 2000.
2. Ayers, J.B., "Hand book of supply chain management", The St. Lencie press, 2000.
3. Nicolas, J.N., "Competitive manufacturing management - continuous improvement - Lean Productin, customer focussed quality", McGraw-Hill, NY, 1998.
4. Steudel, H.J. and Desruelle, P., "Manufacturing in the nineties - How to become a mean, lean and world class competitor", Van Notrand Reinhold, NY, 1992.

**OBJECTIVE**

To give introduction to the various measuring instruments which are most commonly used in industries and to study advancements in measuring methods and non destructive testing methods.

**INTRODUCTION**

Measuring Machines - Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Images shearing microscope- Use of computers- Machine vision technology - Microprocessors in metrology.

**STATISTIAL QUALITY CONTROL**

Statistical Quality Control - Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - reliability and life testing.

**BASIC NDT TESTS**

Liquid penetrants and magnetic particle tests - characteristics of liquid penetrants - different washable systems - Developers - applications - method of production of magnetic fields - Principles of operation of magnetic particle test - applications -Advantages and limitations.

**RADIOGRAPY**

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

**ULTRASONIC TESTING METHODS**

Ultrasonic and acoustic emission techniques - Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method -A, B, C scans -Principles of acoustics emission technique - Advantage and limitations - Instrumentation - applications.

**References:**

- 1.Jain,R.K."Engineering Metrology ", Khanna Publishers, 1997.
- 2.Barry Hull and Vernon John ," Non Destructive Testing ", Mac Millan, 1988
- 3.American Society for Metals ,"Metals Hand Book ", Vol II ,1976.
- 4.Progress in Acoustics Emission, " Proceedings of 10th International Acoustics Emission Symposium ", Japanese Society for NDI,1990.

**Web References:**

- 1.[www.metrologytooling.com](http://www.metrologytooling.com)
- 2.[www.sisndt.com](http://www.sisndt.com)
- 3.[www.iuk'tu-harburg.de](http://www.iuk'tu-harburg.de)



## **113AMPE 12 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING**

**Objective:** To study the productivity concepts, models, organisational transformation and reengineering concepts, tools and implementation. To enable the students to understand the concepts of productivity and reengineering and to make them apply these in the industries.

### **INTRODUCTION**

Introduction - Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle.

### **PRODUCTIVITY MEASURES**

Productivity Models - Productivity measurement at International, National and Organizational level, Total Productivity models. Productivity management in manufacturing and service sector. Productivity evaluation models, Productivity improvement models and techniques.

### **ORGANIZATIONAL TRANSFORMATION AND REENGINEERING**

Organizational Transformation - Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, DSMCQ and PMP model.

### **PROCESS IMPROVEMENT**

Re-engineering - Process Improvement Models, PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model.

### **TOOLS AND TECHNIQUES**

Re-engineering Tools and implementation - Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability.

### **References:**

1. Sumanth, D.J., "Productivity engineering and management", Tata McGraw Hill, New Delhi, 2008.
2. Edosomwan, J.A., "Organisational transformation and process re-engineering", British Library cataloging in pub. data, 2005.
3. Rastogi, P.N. "Re-engineering and Re-inventing the enterprise", Wheeler pub. New Delhi, 2006.
4. Premvrat, Sardana, G.D. and Shahay, B.S., "Productivity Management - A systems approach", Narosa Pub. New Delhi, 2007.
5. Lawrence Leemis. , "Reliability : Probabilistic models and Statistical methods", Prentice hall , 1995.

**OBJECTIVE:**

- To provide visibility about the role played by information system in supply chain enhancement.
- To provide a detailed knowledge about e-business and e-commerce application in real World supply chains.
- This subject is focused to develop knowledge & role of databases in SCM, along with the knowledge on future projected SC information system.

**INTRODUCTION**

World Wide Web – Web search elements – Web fundamentals – new technologies and innovations – Security protocols – Networks and numbers – Zones and domain names - Packets and protocols – OSI reference model – Intranet and its applications – Types of client server architecture – Extranet  
Role of IT in network design - forecasting – planning – transportation – sourcing – coordination.

**E -BUSINESS**

e – Business – Evolution of e-business – Types of e-business– Benefits of e-business - Dimensions of e-business and e-com – e-business infrastructure – ERP system – Enterprise structure modeling (Oracle application)– CRM – Selling chain management – infrastructure of selling chain – e-business servers – client connectivity - e-business case studies – e-business relationships with the stake holders – Internal & Internet based requisition development (Access / SQL)

**E -COMMERCE**

The concept of e-commerce - e-commerce activities – Advantages and issues of e-com – Building blocks of electronic commerce – e-commerce business models – Value chain in e-commerce – Electronic auctions - Forward, reverse & Internet Auction – Intermediary Oriented B2B – EDI - Business to Business (B2B)– Kaplan –Sawhney B2B matrix.

**APPLICATION OF E-COMMERCE**

Features and challenges of B2B exchanges – Buyer oriented B2B – Supplier oriented B2B – Business to Consumer (B2C) –Online retailing vs traditional retailing – Product suitability for online retailing – Alternative models of e-retailing: Amazon vs Webvan – elements of successful B2C strategy – Marketing on the internet – Consumer to Business (C2B) - Consumer to Consumer (C2C) – Case studies on e-commerce – m – commerce.

**ADVANCED SUPPLY CHAIN INFORMATION SYSTEMS**

SC information flows – A map of SCM Systems – Drivers of new SC systems & applications – ERP systems – E-sourcing/supply & web based systems– Types of systems – Reverse auctions – Evolving E-sourcing vendors - E-sourcing and fully integrated systems – Information visibility – Benefits of information visibility – e-supply chain fusion – The continuing evolution of E-Supply chains.

**REFERENCE BOOKS:**

1. Agarwala, N. K., Lal, A. and Agarwala, D. (2000), Business on the Net – An Introduction to the 'Whats' and 'Hows' of e-commerce, Macmillan India Ltd.
2. Awad, E.M. (2007), Electronic Commerce from Vision to Fulfillment, Prentice Hall India, 3<sup>rd</sup> Edition.
3. Burt, N.D., Dobler, W.D. and Starling, L.S. (2005), World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited.
4. Chakrabarti, R. and Kardile, V. (2002), The Asian Managers Handbook of e -commerce, McGraw Hill Publishing Company Limited.
5. Chopra, S., Meindl, P. and Kalra, D.V. (2008), Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc.
6. Elsenpeter, C.R and Velte, J.T. (2001), E Business: A Beginner's Guide, Tata McGraw Hill Publishing Company Limited.
7. Gerald, B., King, N. and Natchek, D. (2006), ORACLE E -Business Suite Manufacturing & Supply Chain Management, Oracle Press, Tata McGraw Hill Publishing Company Limited.
8. Kalakota, R and Robinson M (2009), e-business 2.0, Roadmap for Success, Pearson Education, Inc

## **ELECTIVE III (Semester II)**

### **213AMPE05 DESIGN OF CELLULAR MANUFACTURING SYSTEM**

#### **OBJECTIVE**

This Course will enable the student

- To Learn Various approaches involved in Cellular Manufacturing system.
- To Study about Machine Cell Layout and its performance in detail.

#### **INTRODUCTION**

Introduction-Introduction of Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.

#### **CELLULAR MANUFACTURING SYSTEM DESIGN AND APPROACH**

CMS planning and design - Problems in GT/CMS - Design of CMS - Models , traditional approaches and non-traditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks.

#### **MACHINE CELL LAYOUT**

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

#### **PERFORMANCE MEASUREMENT**

Performance Measurement and Control - Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.

#### **COMPARITIVE STUDIES**

Economics of GT/CMS - Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS -cases.

#### **References:**

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

**OBJECTIVE**

To study about the various machining techniques used in industries and to give first level introduction to micro machining techniques

**INTRODUCTION**

Concepts of accuracy-Introduction- Concepts of accuracy of machine tools –spindle and displacements accuracies –Accuracy of numerical control systems –Errors due to numerical interpolation – displacement measurement system and velocity lags.

**DIMENSIONING AND TOLERANCING**

Geometric dimensioning and tolerancing –Tolerance zone conversions –Surfaces, features of size, datum features –datum, oddly configured and curved surfaces as datum features ,equalizing datum –datum features of size representation-form controls, orientation controls –logical approach to tolerance.

**NANOTECHNOLOGY – AN INTRODUCTION**

Fundamentals of nanotechnology and measuring–Processing system of nanometer accuracies–mechanism of metal processing–nano physical processing of atomic-bit-units nano chemical and electrochemical atomic-bit processing. IN processing in-situ measurement position of processing point –post process and on-machine measurement of dimensional feature and surface – Mechanical and optional measuring system.

**POSITIONING SYSTEMS**

Nano-positioning systems of nanometer accuracy and repeatability –Guide systems for moving elements – Servo control systems for tool positioning –Computer aided digital and ultra precision position control.

**MANUFACTURING METHODS**

Application and future trends in nano technology –nano-Grating systems –Nano lithography, photolithography, and electron beam lithography –machining of soft materials, diamond turning , mirror grinding of ceramics –development of intelligent products –Nano processing of materials for super high density ICs-Nano-mechanical parts and micro nano machines.

**References:**

1. Murthy,R.L.,” Precision Engineering in manufacturing “, New age International (P) limited publishers ,1996.
2. James D.Meadows, ”Geometric dimensioning and tolerancing “, Marcel Dekker Inc., 1995.
3. Norio Tanigichi, ”nano Technology“, oxford university press, 2003.

## **213AMPE 08 RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE**

**Objective:** To study the reliability concepts, failure data analysis, reliability prediction and management and the concepts of total productive maintenance. To enable the students to understand the concepts of reliability and total productive maintenance and to make them apply these in the industries.

### **INTRODUCTION**

Introduction - Reliability function - MTBF - MTTF - morality curve -availability - Maintainability.

### **DISTRIBUTIVE FUNCTIONS**

Failure Data Analysis - Repair time distributions - exponential, normal, log normal, gamma, and Weibull - reliability data requirements - Graphical evaluation.

### **RELIABILITY PREDICTION**

Reliability Prediction - Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis - Standby Systems - Complex Systems.

### **RELIABILITY MANAGEMENT**

Reliability Management - Reliability demonstration testing -Reliability growth testing - Duane curve - Risk assessment - FMEA, Fault tree.

### **TOTAL PRODUCTIVE MAINTENANCE**

Total Productive Maintenance - Causes of Machine Failures - Downtime - Maintenance policies - Restorability predictions - Replacement models - Spares provisioning - Maintenance management - Cleanliness and House Keeping.

### **References:**

1. Paul Kales, "Reliability for technology, Engineering and Management", Prentice Hall, New Jersey, 1988.
2. Modarres, " Reliability and Risk analysis ", Meral Dekker Inc., 1933.
3. O'CONNOR,P.D.T', " Practical Reliability Engineering ", John Wiley-1994.
4. NAKAJIMA.S.. ," Introduction to TPM - Total Productive Maintenance", Productivity Press-1995.
5. Gopalakrishnan.P, and Banerji A.K., "Maintenance and Spare Parts Management ", Prentice Hall of India, New Delhi, 2005.
6. Dhillon B.S., " Engineering maintainability: How to design for reliability and easy maintenance ", Prentice Hall of India, New Delhi, 2005.
7. Ebeling, " An Introduction to reliability and maintainability Engineering ", Tata McGraw-Hill Limited, New Delhi, 2004.

**OBJECTIVE:**

This course is intended to teach the students about E manufacturing concepts (ie) use of IT in the manufacturing sector and advanced manufacturing systems like Lean manufacturing, Agile manufacturing etc.

**INTRODUCTION**

Introduction – Manufacturing operations – Manufacturing Industries and products – Manufacturing Support systems – E- manufacturing concept.

**MANUFACTURING STRATEGY**

Manufacturing strategy and supply chain – Forecasting systems – Dimensions of manufacturing strategy – Supply chain management concepts – Aggregate planning – Single stage inventory control.

**LEAN MANUFACTURING**

Lean Manufacturing – Principles of lean manufacturing – Lean flow- Two paths of implementing lean manufacturing – methodologies for change- environment for change – Pitfalls in implementing lean manufacturing.

**AGILE MANUFACTURING**

Agile manufacturing – Meaning and definition of Agility – Force pulling towards Agility – Three consequences converging physical products, information and services – Empowerment -Enterprise Integration – Concurrent operations – Planning internal alignment of company – Role of strategic planning departments.

**E-MANUFACTURING**

E-Manufacturing – Concepts of E-Manufacturing – Use of internet in manufacturing industries – E-business technology in manufacturing industry – Scope of applications - Implementation Methodology – Benefits of E- Manufacturing.

**References:**

1. Mikell P. Groover., "Automation , Production systems and Computer – Integrated Manufacturing ", Pearson – Prentice Hall, 2007.
2. Ronald G.Askin, " Design and Analysis of Lean Production System ", John Wiley and sons, 2002 .
3. Bedwprth D D, " Integrated Production control systems Management,Analysis, Design ", John Wiley and sons, Newyork , 2002
4. Vollman T E , " Manufacturing Planning and control Systems", Galgotia publication , New Delhi ,1998.
5. Paul Kenneth wright , " 21<sup>st</sup> Century manufacturing" , Prentice hall , 2001

**OBJECTIVE:** To study the computer based information system, management information systems, system development , quality, Knowledge based system and decision support system. To enable the students to understand the concepts of information systems and enable them to apply these practically in the industries.

### **COMPUTER BASED INFORMATION SYSTEM**

Computer Based Information System - Concept of Information and system – system classification – the challenge of information system – computers and information processing – managing data resource – organizing data in a traditional file environment – a modern database environment – designing database

### **MANAGEMENT INFORMATION**

Management information system – concepts – Design and implementation of MIS – Information system for decision making, types levels of decision making – MIS as a technique for making a programmed decisions – Decision – Assisting information systems – Conceptual Systems Design – Detailed System design

### **SYSTEM ANALYSIS AND DESIGN**

Overview of system Development – System Analysis – System Design-completing the system development process - the traditional system life cycle – stages and limitations of life cycle approach – case study

### **QUALITY**

Quality , Success and Services-traditional tool and methodologies for quality assurances- new approaches to quality – information system failure causes- the concept of implementation – controlling risk factor.

### **KNOWLEDGE BASED SYSTEMS**

Knowledge – based systems- decision support systems- group DSS- ESS- artificial intelligence- expert system- other intelligent technique –neural network, genetic algorithm, fuzzy logic.

### **REFERENCES:**

1. Kenneth C. Laudon and Jane P.Laudon, "Management Information systems", Prentice Hall of India Pvt., Ltd., 2007.
2. Robert G. Mudrick, Joel E.Ross and James R. Clagget, "Information system for modern Management", Prentice Hall of India, 2006
3. Davis . G.B., MIS, "Conceptual Foundation, Structure and Development" Mcgraw Hill Publishing, 2005
4. Chung.P.W.H and Lovegrove G., "Industrial Engineering Application of AI and expert systems", Gardon Breach Science publication,2006.

### **WEB REFERENCES:**

1. [www.dis.uniroma1.it](http://www.dis.uniroma1.it)

## Elective IV

### 213AMPE11 COMPUTER AIDED PROCESS PLANNING

**Objective:** To study the Process Planning concepts, Part Design Representation, Process engineering and planning and Computer Aided Process Planning Systems, Integrated Process Planning Systems. To enable the students to understand the concepts of Computer Aided Process Planning and to make them apply these in the industries.

#### INTRODUCTION

Introduction - The Place of Process Planning in the manufacturing cycle - Process Planning and Production Planning - Process Planning and Concurrent Engineering, CAPP, Group Technology

#### GROUP TECHNOLOGY

Part Design Representation - Design Drafting - Dimensioning - Conventional tolerancing - Geometric tolerancing - CAD - input/output devices - topology - Geometric transformation - Perspective transformation - Data Structure - Geometric modeling for process planning - GT coding - The opitz system - The MICLASS system- CODE system.

#### PROCESS PLANNING

Process engineering and process planning - Experience based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

#### COMPUTER AIDED PROCESS PLANNING

Computer Aided Process Planning Systems - Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP. - Process planning Softwares.

#### PROCESS PLAN SYSTEMS

An Integrated Process Planning Systems - Totally integrated process plans systems - An overview - Modulus structure - Data Structure, operation - Report generation, Expert Process Planning.

#### References:

1. Gideon Halevi and Roland D.Weill, " Principles of Process planning, A logical approach", Chapman Hall,1995.
2. Tien - Chien Chang, Richard A.Wysk, " An introduction to automated process planning systems ",Prentice Hall,1985
3. Chang, T.C., "An Expert process planning system", Prentice Hall, 1985
4. Nanua singh, "Systems approach to Computer Integrated Design and Manufacturing", John Wiley & Sons,1996
5. Rao, " Computer Aided Manufacturing",Tata McGraw Hill Publising CO.,2000

#### Web reference:

1. <http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm>
2. <http://Estraj.ute.sk/journal/engl/027/027.htm>



**OBJECTIVE**

The subject provides knowledge on various types of corrosion, their kinetics, testing and methods of protection as well as introduction to tribology.

**UNIT I INTRODUCTION**

Introduction tribology, surface degradation, wear and corrosion, types of wear, adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication-, expressions for corrosion rate. emf and galvanic series - merits and demerits -Pourbaix diagram for iron, magnesium and aluminium. Forms of corrosion - Uniform, pitting, intergranular, stress corrosion. corrosion fatigue. dezincification. erosion corrosion, crevice corrosion - Cause and remedial measures - Pilling Bedworth ratio - High temperature oxidation.

**UNIT II KINETICS OF CORROSION**

Exchange current density, polarization - concentration, activation and resistance, Tafel equation; passivity, electrochemical behaviour of active/passive metals, Flade potential, theories of passivity, Effect of oxidising agents

**UNIT III CORROSION IN INDUSTRIAL PRACTICE**

Atmospheric, pitting, dealloying, stress corrosion cracking, intergranular corrosion, corrosion fatigue, fretting corrosion and high temperature oxidation; causes and remedial measures, Corrosion failure – Inspection and analysis of corrosion damage

**UNIT IV TESTING**

Purpose of corrosion testing - Classification - Susceptibility tests for intergranular corrosion- Stress corrosion test. salt spray test humidity and porosity tests, accelerated weathering tests. ASTM standards for corrosion testing and tests for assessment of wear

**UNIT V PROTECTION METHODS**

Electroless plating and Anodising - Cathodic protection, metallic, organic and inorganic coatings, corrosion inhibitors - principles and practice - inhibitors for acidic neutral and other media. Special surfacing processes - CVD and PVD processes, sputter coating. Laser and ion implantation. Arc spray. plasma spray. Flame spray. HVOF.

**TEXT BOOKS**

1. Fontana and Greene. "Corrosion Engineering". McGraw Hill Book Co. New York. USA 1983.
2. Raj Narayan. "An Introduction to Metallic Corrosion and its prevention". Oxford & 1BH. New Delhi. 1983.

**REFERENCES**

1. Kenneth G Budinski. "Surface Engineering for Wear Resistance". Prentice Hall Inc.. Engelwood Cliff., New Jersey. USA 1988
2. Uhlig. H.H . "Corrosion and Corrosion Control". John Wiley & Sons. New York. USA. 1985.
3. ASM Metals Handbook. Vol.5. "Surface Engineering". ASM Metals Park. Ohio. USA. 1994.
4. ASM Metals Handbook. Vol.13,"Corrosion".ASM Metals Park. Ohio. USA. 1994

**OBJECTIVE:**

Sub assemblies, main assemblies, equipments, machines etc are manufactured by assembling different components together to perform a particular objective. These components are manufactured by different manufacturing methods like fabrication, machining, grinding and finishing etc. Every Mechanical Engineer should know about the Tool Engineering and Design. By keeping this in mind this syllabus is framed.

**1. MECHANISM OF CHIP FORMATION AND TYPES OF CHIPS**

Mechanism of chip formation, Types of chip, techniques for the study of chip form formation, chip tool interface, built- up edge, chip breakers etc - problems.

**2.FORCES IN METAL CUTTING**

Stress on the shear plane, Shear angle relationship in thin plane analysis. Minimum energy theory - stresses on the tool. Measurement of tool Forces - virtual tool dynamometers – evaluation of cutting forces, tool failures, work piece failure etc. with various real time problems.

**3. THERMAL ASPECTS OF METAL CUTTING**

Heat in metal cutting, Flow of heat, Methods of tool temperature measurement, significance of cutting tool temperature. Cutting fluids - Types and selection – evaluation of heat flow in both the tool and work piece.

**4. CUTTING TOOL MATERIAL AND TOOL WEAR**

Cutting tool materials - classification, application, heat treatment. Mechanisms of tool wear, Tool failure, Methods of tool wear Measurement. Tool life, Machinability index, Tool life equations, Universal machinability index, Economics of turning.

**5. THERMAL ANALYSIS WITH CFD SOFTWARE**

Introduction to CFD - various tools and techniques in CFD – various features of CFD – Applications of CFD – Comparisons of CFD with ANSYS and NISA – CFD in thermal analysis of metal cutting.

**6. JIGS & FIXTURES**

Fundamental ideas and principles of Jigs and Fixtures. Design of drill jigs and fixtures for turning, drilling, milling, broaching and grinding operations. Locating and clamping devices of jigs and fixtures. Indexing devices and types. Different types of jigs & fixtures. Design of a jig and fixtures for the given component by using Computer Aided Design (CAD).

**7. PRESS TOOLS & ECONOMIC ASPECTS OF TOOLING**

Dies, punches, types of presses, clearances, types of dies, strip layout, calculation of press capacity, center of pressure. Design consideration for die elements. Economics of tooling – Tool selection and tool replacement with respect to small tools.

**TEXT BOOKS:**

1. Ranganath.Bj., "Tool Engineering Design:", vikas publishing house pvt.ltd ,New delhi, 2005.
2. ASTME "Fundamentals of Tool design:.prentice hall of India pvt. ltd., New delhi.5 edition, 1985.
3. Sharma. p.c., "A Text Book of Production Engineering" s.chand& co. ltd., New delhi,2005
4. Rodin .p., "Design and Production of cutting tools:", MIR publishers,1968.
5. Donaldson, "Tool Design Handbook", Mcgraw hill, new work,1976.

**REFERENCES:**

1. Amerego.E.J and Brown.R.H., "The Machining of Metals".Prentice hall, 1969.
2. ELBS "Principles of jig and Tool design: Published by English Universities Michigan,1969.
3. "P.S.G Design Data Book", PSG college of Technology, DPV printers, coimbatore, 2005.
4. Production Tooling Equipment - S.A.J.Parsons, published by Macmillan, 1966.

**Objectives:**

To impart knowledge about different types of plastics and composites and their fabrication methods.

To acquire details about the effects machining and joining parameters on its quality

To gain knowledge about the different types of reinforcements and its corresponding fabrication methods of composites.

**INTRODUCTION**

Introduction – Chemistry and classification of Polymers – Properties of Thermo plastics Properties of Thermosetting plastics – Applications – Merits and Demerits.

**PLASTICS PROCESS**

Processing of plastics – Extrusion – Injection Moulding -Blow Moulding – Compression And transfer Moulding – casting – Thermo Forming.

Machining and joining of plastics – General Machining Properties of Plastics – Machining Parameters and their effect – joining of Plastics- Mechanical Fasteners – Thermal bonding – Press Fitting.

**COMPOSITE MATERIALS**

Introduction to Composite Materials – Fibers – Glass, Boron , Carbon , Organic , Ceramic and Metallic Fibers – Matrix Materials – Polymers, Metals and Ceramics.

**POLYMER MATRIX COMPOSITES**

Processing of Polymer Matrix Composites – Open Mould Processes, Bag Moulding, Compression Moulding With BMS and SMS - Filament winding – Pultrusion - Centrifugal Casting – Injection Moulding – Application of PMC` s

**METAL MATRIX COMPOSITES**

Processing of metal matrix composites – Solid State Fabrication Techniques – Diffusion Bonding – Powder Metallurgy Techniques – Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fiber – Liquid State Fabrication Method – Infiltration – Squeeze Casting – Rheo Casting – Compocasting – Application of MMC` s.

**REFERENCE:**

1. Harold Belofsky, "Plastics: Product Design and Process Engineering", Hanser Publishers, 1995.
2. Bera, E and Moet, A, "High Performance Polymers", Hanser Publisners ,1991
3. Hensen.F, "Plastics Extrusion Technology", Hanser Publishers, 1988.
4. Johnnaber F, "Injection Moulding Machines", Hanser Publishesr, 1983.
5. Rauwendaal, C, "Polymer Extrusion", Hanser Publishers, 1990.
6. Rosatao,D.V., "Blow Moulding Handbook", Hanser Publishers, 1989.
7. A.K.B hargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice-Hall of India Limited, New Delhi, 2005.

## **Elective V (Semester III)**

**313AMPE03**

**TOTAL QUALITY SYSTEM AND ENGINEERING**

**Objective:** To study the concepts of TQM, SQC and Acceptance sampling. To enable the students to apply these in the industries.

### **PRINCIPLES OF TQM**

Introduction - Principles of Quality Management - Pioneers of TQM - Quality costs - Quality system Customer Orientation - Benchmarking - Re-engineering - concurrent engineering

### **LEADERSHIP AND QUALITY AUDITING**

Practices of TQM - leadership - organizational structure - Team building - Information systems and documentation - Quality Auditing - ISO 9000 - QS 9000

### **TQM TECHNIQUES**

Techniques of TQM - Single vendor concept - JIT- Quality function deployment - Quality circles - KAIZEN - SGA - POKA - YOKE - Taguchi Methods.

### **STATISTICAL QUALITY CONTROL**

Statistical Quality control - Methods and Philosophy of Statistical process control - Control Charts for variables and Attributes - Cumulative sum and exponentially weighted moving average control charts - Other SPC Techniques - Process Capability Analysis - Six sigma accuracy.

### **SAMPLING**

Acceptance sampling - Acceptance sampling problem - Single sampling Plans for attributes - double, multiple and sequential sampling, Military standards - The Dodge - Roming sampling plans.

### **References:**

1. Mohamed Zairi, "Total Quality Management for Engineers", Woodhead Publishing Limited 1991.
2. Harvid noori and russel, "Production and operations management - Total Quality and Responsiveness", McGraw-Hill Inc, 1995
3. Suresh Dalela and Saurabh, "ISO 9000 - A Manual for total Quality Management", S.Chand and company Ltd., 1997
4. John Bank, 'The Essence of Total Quality Management ', Prentice Hall of india Pvt. Ltd., 1995.
5. Douglas C Montgomery, "Introduction to Statistical Quality Control", McGraw Hill, 1984
6. Grant E.L and Leavensworth, "Statistical Quality control", McGraw hill, 1984
7. Suganthi . L and Anand A Samuel, "Total Quality Management", Prentice - Hall of india, New Delhi, 2005.
8. Howard Gitlow, Alan Oppenheim and Proa Oppenheim, "Quality Management", McGraw-Hill Inc, 2005
9. Dale H. Besterfield ,and Etc, "Total Quality Management ", 3<sup>rd</sup> Edition , Pearson Education – Prentice Hall , 2007.

### **Web references:**

1. [www.ahepr.gov/research/feboo/0200ra15.htm](http://www.ahepr.gov/research/feboo/0200ra15.htm).
2. [www.mcb.co.uk/tam.htm](http://www.mcb.co.uk/tam.htm)

**OBJECTIVES:**

- To know about the casting metallurgy and design aspects of moulding, gating and riser.
- To learn about the special casting processes and foundry mechanization.
  
- To understand about the computer applications in foundry technology.

**INTRODUCTION**

Basics of casting techniques – Various aspects of advances in foundry technology – Scope of the study

Casting metallurgy & design - Solidification of pure metals and alloys - Fluidity- Shrinkage in cast metals - Absorption of gases - Degassing methods - Progressive solidification - Directional solidification - Hot spot & Junction - Design for moulding-Design for core support.

Principle of gating and riser - Improvement of yield efficiency - Simple problems in gating and risering for steels and cast irons

Special

casting processes - Shell moulding, investment casting, Carbon - Dioxide moulding, Centrifugal casting, Die casting, Continuous casting, Squeeze casting, Vacuum casting, Full mould processes, Semi-Solid metal casting, Thixocasting and Rheocasting process, Compo casting.

Foundry mechanization – Layout of mechanized foundry – Sand reclamation – Material handling in foundry – Pollution control in foundry – Casting defects – Identification, Analysis and Remedies.

Computer aided design and castings – Computer aided pattern making and use of rapid prototyping technology in foundry, Feeder design and solidification analysis, Gating design and mould filling analysis, Rapid tooling fabrication, Implementing rapid casting development technologies, Case study from industry.

**References:**

1. Jain "Principles of Foundry Technology", Tata Mc Graw Hill 3<sup>rd</sup> edition 2005.
2. "ASM Metals Hand book on Casting", Revised edition 1995.
3. Heine.R.W.Loper and Rosenthal "Principles of Metal Casting" Tata Mc Graw Hill, 1997.
4. Peter Beelay "Foundry Technology" Butterworth, Second edition, 2001.
5. Ravi.B "Metal Casting Computer aided Design and Analysis" Prentice Hall, 2005.
6. Srinivasan.N.K "Foundry Engineering" Khanna Tech pub co, New Delhi, 2000.

## **313AMPE05 FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING**

### **OBJECTIVE:**

The objective is to equip students with fundamentals of finite element principles so as to enable them to understand the behaviour of various finite elements and to be able to select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.

### **UNIT I INTRODUCTION**

Basics of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh Ritz methods – review of Variational calculus – Integration by parts – Basics of variational formulation.

### **UNIT II ONE DIMENSIONAL ANALYSIS**

Steps in FEA – Discretization, function – derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions – solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

### **UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS**

Global and Natural Co-ordinates – Shape functions for one and two dimensional elements – Three noded triangular and four noded quadrilateral element – Non linear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional axi symmetric analysis.

### **UNIT IV ANALYSIS OF PRODUCTION PROCESSES:**

FE Analysis of metal casting – Special considerations, latent heat incorporation, gap element – time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure - Basic concepts of plasticity – Solid and flow formulation – small incremental deformation formulation – FE Analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency.

### **UNIT V COMPUTER IMPLEMENTATION**

Pre Processing, Mesh generation, elements connectivity, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages such as ANSYS and DEFORM – Development of code for one dimensional analysis and validation.

### **TEXT BOOKS:**

1. Reddy, J.N, "An Introduction to the Finite element Method", McGraw – Hill, 1985.
2. Rao, "Finite Element Method in Engineering", Pergammon Press, 1989.

### **REFERENCES:**

1. Bathe, K.J., "Finite Element Procedures in Engineering Analysis, 1990.
2. Kobayashi, S, Soo-IK-Oh and Altan, T, "Metal forming and the Finite element Methods", Oxford University Press, 1989.
3. Lewis, R.W., Morgan, K, Thomas, H.R., and Seetharaman, K.N., "The Finite Element Method in Heat Transfer Analysis", John Wiley, 1994.

**OBJECTIVE**

Nowadays, almost all Industries are struggling in their business due to economy crisis. In this situation, they can go for a rapid change i.e. agility in their products to achieve and fulfill their customers demand. Simultaneously, the internal costs / wastages are to be minimized and or eliminated. This syllabus gives an excellent idea about the agility to meet the customer requirements, elimination of internal wastages and achieve the customer satisfaction. This syllabus is framed based on the above factors.

**1. INTRODUCTION TO AGILE MANUFACTURING**

Meaning and definition agility – concepts of agility – Agile manufacturing system – agile relationship models – products, services and enrichment of each customer – enrichment chain – moving from one time product to providing customer enrichment.

**2. AGILE BUSINESS STRATEGIES**

Generally accepted accounting principles – activity based costing – time based costing – budgeting procedures – dysfunctional organization and information systems – betrayal of trust – not sharing information – empowerment – enterprise integration – concurrent operations – external barriers.

**3. INTRODUCTION TO LEAN MANUFACTURING SYSTEM**

Meaning and definition of lean – Basic concepts of lean – elements of lean – functional areas of lean – Lean techniques – procedure to implement lean in manufacturing industries - prerequisites of becoming lean in manufacturing system – education and training.

**4. LEAN MANUFACTURING PRACTICES & IMPLEMENTATION**

System model for lean manufacturing – performance impacts of the lean manufacturing system – Lean manufacturing program – lean flow – paths of implementing lean manufacturing system – preparing and motivating people – roles in the change process – methodologies for change – environment for change – model of success factors in becoming lean.

**5. AGILE AND LEAN SOFTWARE**

Introduction to agile and lean simulation / scheduling software – Minitab / Flexsim / Tuppas / QAD / Preactor – features, concepts, tools, and techniques – Applications, Advantages, and limitations – real time problems and solutions.

**TEXT BOOKS**

1. Goldman, S.L. Nagal, R.N. and Press, K., 1995, "Agile competitors and virtual organizations", Van Nostrand Reinhold, New York.
2. Liker, J.K. (ed.), 1997, "Becoming lean", Productivity press, Oregon.

**REFERENCE BOOKS**

1. Montgomery, J.C. and Levine, L.O., 1995, "The transition to agile manufacturing", ASQC Quality Press, Wisconsin.
2. William M., Feld, "Lean Manufacturing tools, techniques and how to use them", The St. Lucie Press, Boca Raton, 2001.
3. Ronal G Askin, "Design and analysis of Lean Production System", John Wiley & Sons, 2002.

**OBJECTIVES:**

To provide knowledge about solidification of metals and corresponding design principles of casting.  
 To impart principles and applications of latest casting processes  
 To gain knowledge about thermal effects of welding, Weldability of ferrous and non-ferrous metals, residual stresses in weldments, good weld joint design principles and latest welding processes.  
 To acquire latest knowledge about automation in casting and welding.

**UNIT I**

Casting metallurgy and design-Heat transfer between metal and mould-Solidification of pure metals and alloys-Shrinkage in cast metals-Progressive and directional solidification-Principles of gating and riser-Degasification of the melt-Design considerations in casting- Casting defects, Designing for directional solidification and minimum defects.

**UNIT-II**

Special casting process-Shell Moulding, precision investment casting, CO<sub>2</sub>, Moulding, centrifugal casting, Die casting and continuous casting.

**UNIT-III**

Welding metallurgy and design-Heat affected zone and its characteristics-Weldability of steels, 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 weldment.

**UNIT-IV**

Unconventional and special welding processes-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-Layout of mechanized 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, full mould casting process. Automation in welding-Welding robots-Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

**References:**

1. Jain, "Principles of Foundry Technology", Tata McGraw Hill, 3rd Edition, 2005.
2. "ASM metals Hand book on Casting"-Revised Edn, 1995.
3. Lal.M. and Khanna.O.P."A Text Books of foundry technology", Dhanpat Rai & Sons, 1996.
4. "Foundry Engineering Handbook ", Utility Publishers Ltd., 1989.
5. Titoun.D. & Stepanov. Yu.A.,"Foundry Practice", MIR Publishers,Moscow, 1981.
6. Heine Loper & Rosenthal, "Principles of Metal Casting", Tata McGraw Hill, 2005.
7. Mukherjee,P.C., "Fundamentals of Metal casting Oxford"- IBH, 1979.
- 8.Iotrowski-"Robotic welding- a guide to selection and application"-Society of Mechanical Engineers. 1987.
9. Schwariz.M.M., "Source book on Innovative Welding Processes"-American society for metals(Ohio), 1981.
10. Cornu.J.,"Advanced Welding Systems"-Volumes I,II, and III, JAICO Publishers,1994.
11. Lancaster.J.F., "Metallurgy of welding"-George Allen & Unwind Publishers, 1980.
12. "Welding Handbook".(Section I) American Welding Society, 1986.
13. Kazakov.n.f.,"Diffusion bonding of materials", MIR Publishers, Moscow,1985.

**Registrar**