

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech (Advanced Manufacturing Systems)

(4 SEMESTER COURSE STRUCTURE AND SYLLABUS)

EFFECTIVE FROM THE YEAR 2016-17

I- SEMESTER:

<i>Subject Code</i>	SUBJECT	L	P	C
16D35101	Automation in Manufacturing	4	-	4
15D34103	Computer Aided Manufacturing	4	-	4
16D35102	Precision Engineering	4	-	4
15D34102	Materials Technology	4	-	4
	ELECTIVE-I	4	-	4
16D35103	Special Manufacturing Process			
16D35104	Product Data Management			
15D31110	Total Quality Management			
	ELECTIVE-II	4	-	4
15D34109	Composite Materials and Mechanics			
16D35105	Advanced Mechatronics			
15D34110	Enterprise Resource Planning			
16D35106	Advanced CAD/CAM Lab	0	4	2
TOTAL		24	4	26

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M.Tech – ADVANCED MANUFACTURING SYSTEMS**I- SEMESTER**

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AUTOMATION IN MANUFACTURING (16D35101)**UNIT – I**

OVER VIEW OF MANUFACTURING AND AUTOMATION: Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers.

UNIT – II:

MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES: Material handling, equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID.

UNIT – III:

MANUFACTURING SYSTEMS AND AUTOMATED PRODUCTION LINES: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells; Manual Assembly lines, line balancing Algorithms, Mixed model Assembly lines, Alternative Assembly systems. Automated production lines, Applications, Analysis of transfer lines.

UNIT – IV:

AUTOMATED ASSEMBLY SYSTEMS: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.

UNIT – V:

QUALITY CONTROL AND SUPPORT SYSTEMS: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

REFERENCES:

1. Automation, production systems and computer integrated manufacturing/ Mikell.PGroover/PHI/3rd edition/2012.
2. Automation, Production Systems and CIM/ Mike J P. Grower/PHI
3. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahmanyarn and Raju/New Age International Publishers/2003.
4. System Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley /96.
5. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009.
6. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good Heart/Willcox Publishers.

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M.Tech – ADVANCED MANUFACTURING SYSTEMS**I- SEMESTER****L P C**
4 - 4**COMPUTER AIDED MANUFACTURING (15D34103)****UNIT - I**

COMPUTE-AIDED PROGRAMMING: General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation.

UNIT - II

TOOLING FOR CNC MACHINES: Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

UNIT - III**POST PROCESSORS FOR CNC:**

Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, th creation of a DAPP— Based Post Processor.

UNIT - IV

MICRO CONTROLLERS: Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications and Programming of Micro Controllers. Programming Logic Controllers (PLC' s): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

UNIT - V

COMPUTER AIDED PROCESS PLANNING: Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

REFERENCES:

1. Computer Control of Manufacturing Systems / YoramKoren / McGraw Hill. 1983.
2. Computer Aided Design Manufacturing – K. Lalit Narayan, K. MallikarjunaRao and M.M.M. Sarcar, PHI, 2008.
3. CAD/CAM Principles and Applications, P.N.Rao, TMH
4. CAD / CAM Theory and Practice,/ Ibrahim Zeid, TMH
5. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
6. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson

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PRECISION ENGINEERING (16D35102)**(Common to Advanced Manufacturing Systems & Quality Engineering & Management)****UNIT I:**

CONCEPTS OF ACCURACY: Introduction – Concept of Accuracy of Machine Tools – Spindle and Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

GEOMETIC DEIMENSIONING AND TOLERANCING: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's – Datum Feature of Representation – Form controls, Orientation Controls – Logical Approach to Tolerancing.

UNIT II:

DATUM SYSTEMS: Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT III:

TOLERANCE ANALYSIS: Process Capability, Mean, Variance, Skewness, Kurtosis, 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.

UNIT IV:

TOLERANCE CHARTING TECHNIQUES: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum Features – functional and manufacturing Components design – Machining Considerations, Redesign for manufactured, Examples.

UNIT V:

FOUNDAMENTALS OF NANOTECHNOLGY: Systems of nanometer accuracies – Mechanism of metal Processing – Nano physical processing of atomic bit units. Nanotechnology and Electrochemical atomic bit processing.

MEASURING SYSTEMS PROCESSING: In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

REFERENCES:

1. Precision Engineering in Manufacturing/Murthy R.L./New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker inc. 1995.
3. Nano Technology / Norio Taniguchi / Oxford University Press, 1996.
4. Engineering Design – A systematic Approach / Matousek / Blackie & Son Ltd., London
5. Precision Engineering/VC Venkatesh& S Izman/TMH

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M.Tech – ADVANCED MANUFACTURING SYSTEMS**I- SEMESTER**

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MATERIALS TECHNOLOGY (15D34102)**UNIT I:**

Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non-crystalline material

UNIT II:

Griffith's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller parameter, Deformation and Fracture mechanism maps.

UNIT III:

Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT IV:

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.

UNIT V:

MODERN METALLIC MATERIALS: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Managing Steel, Inter metallic, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

NONMETALLIC MATERIALS: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, Al₂O₃, SiC, Si₃N₄, CBN and Diamond – properties, Processing and applications.

REFERENCES:

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2 nd Edition/2000
2. Mechanical Metallurgy/George E. Dieter/McGraw Hill, 1998.
3. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
4. Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson
5. Material Science and Engineering/William D Callister/John Wiley and Sons

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SPECIAL MANUFACTURING PROCESS (16D35103)**(ELECTIVE – I)****UNIT- I**

SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT- II

PROCESSING OF CERAMICS: Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT- III**FABRICATION OF MICROELECTRONIC DEVICES:**

Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

UNIT - IV

E-MANUFACTURING: Nano manufacturing techniques and micromachining, High Speed Machining and hot machining

UNIT -V

RAPID PROTOTYPING: Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapid manufacturing

REFERENCES:

1. Manufacturing Engineering and Technology /Kalpakijian / Adisson Wesley, 1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.
3. Microelectronic packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostr and Renihold,
4. MEMS & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH
5. Advanced Machining Processes / V.K.Jain / Allied Publications.
6. Introduction to Manufacturing Processes / John A Schey/McGraw Hill.

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PRODUCT DATA MANAGEMENT (16D35104)**(ELECTIVE – I)****UNIT - I**

Introduction -Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and customer – behavior analysis. Understanding customer – promoting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specification.

UNIT - II

CONCEPT GENERATION AND SELECTION: Task – Structured approaches – Clarification – Search –Externally and internally – explore systematically – reflect on the solutions and process – concept selection– methodology – benefits.

PRODUCT ARCHITECTURE: Implications – Product change – variety – component standardization –product performance – manufacturability.

UNIT - III

PRODUCT DEVELOPMENT MANAGEMENT: Establishing the architecture – creation – clustering –geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

INDUSTRIAL DESIGN: Integrate process design – Managing costs – Robust design – Integrating CAE,CAD, CAM tools – simulating product performance and manufacturing processing electronically – Need for industrial design – impact – design process.

UNIT - IV

Investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT - V

DESIGN FOR MANUFACTURING AND PRODUCTY DEVELOPMENT: Definition – Estimation of manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity. Prototype basics – Principles of prototyping – planning for prototypes – Economics analysis – Understanding and representing tasks – baseline project planning – accelerating the project execution.

REFERENCES:

1. Product Design and Development / Kari T. Ulrich and Steven D. Eppinger / McGraw Hill International Edns. 1999.
2. Concurrent Engg/integrated Product development / Kemmneth Crow / DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310)377-569, Workshop Book.
3. Effective Product Design and Development / Stephen Rosenthal / Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.
4. Tool Design–Integrated Methods for Successful Product Engineering / Staurt Pugh / Addsion Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41369-5.
5. Production and Operations Management/Chase/TMH

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TOTAL QUALITY MANAGEMENT (15D31110)**(ELECTIVE – I)****UNIT – I:**

INTRODUCTION: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT – II:

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

UNIT – III:

ORGANIZING FOR TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT – IV:

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT – V:

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

REFERENCES:

1. Total Quality Management / Joel E.Ross/Taylor and Francis Limited
2. Total Quality Management/P.N.Mukherjee/PHI
3. Beyond TQM / Robert L.Flood
4. Statistical Quality Control / E.L. Grant / McGraw Hill.
5. Total Quality Management- A Practical Approach/H. Lal
6. Quality Management/KanishkaBedi/Oxford University Press/2011
7. Total Engineering Quality Management/Sunil Sharma/Macmillan

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COMPOSITE MATERIALS AND MECHANICS (15D34109)**(ELECTIVE – II)****(Common to Product Design & Advanced Manufacturing Systems)****UNIT I****INTRODUCTION TO COMPOSITE MATERIALS**

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites.

UNIT II**MANUFACTURING OF COMPOSITES**

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces

UNIT III**INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS**

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT IV**LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES**

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

UNIT V**THERMAL ANALYSIS**

Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

REFERENCES

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber – Reinforced Composites: Materials, Manufacturing and Design", Maneeel Dekker Inc, 1993.
5. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
6. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
7. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.
8. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)
9. Chung, Deborah D.L., "Composite Materials: Science and Applications", Ane Books Pvt. Ltd./Springer, New Delhi, 1st Indian Reprint, 2009

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M.Tech – ADVANCED MANUFACTURING SYSTEMS**I- SEMESTER**

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ADVANCED MECHATRONICS (16D35105)**(ELECTIVE – II)****UNIT-I**

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT-III

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

UNIT-IV

Digital electronics and systems, digital logic control, micro-processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V

System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

REFERENCES:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran& GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
4. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
5. Mechatronics System Design / Devdasshetty/Richard/Thomson.
6. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
7. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton
8. Mechatronics – Principles and Application Godfrey C. Onwubolu, Wlsevier, 2006 Indian print

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ENTERPRISE RESOURCE PLANNING (15D34110)**(ELECTIVE – II)****(Common to Product Design & Advanced Manufacturing Systems)****UNIT I****ENTERPRISE RESOURCE PLANNING**

Principle – ERP framework – Business Blue Print – Business Engineering's Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models – Process Models

UNIT II**TECHNOLOGY AND ARCHITECTURE**

Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.

UNIT III**ERP SYSTEM PACKAGES**

SAP,.People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organisational and social issues.

UNIT IV

Overview – Architecture – AIM – applications – Oracle SCM. SAP : Overview – Architecture – applications -Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET

UNIT V**ERP PROCUREMENT ISSUES**

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.

REFERENCES:

1. Sadagopan.S , ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
2. Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
3. Vinod Kumar Crag and N.K.Venkitakrishnan ,Enterprise Resource Planning –Concepts and Practice, Prentice Hall of India, 1998.
4. ERPWARE , ERP Implementation Framework, Garg&Venkitakrishnan, Prentice Hall, 1999.
5. Thomas E Vollmann and BeryWhybark , Manufacturing and Control Systems, Galgotia Publications, 1998.

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0 4 2**ADVANCED CAD/CAM LAB (16D35106)**

Features and selection of CNC turning and milling centers.

Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles.

Practice in part programming and operating a machining center, tool panning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming.

Practice in Robot programming and its languages.

Robotic simulation using software. Robo path control, preparation of various reports and route sheets, Simulation of manufacturing system using CAM software, controller operating system commands

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M.Tech – ADVANCED MANUFACTURING SYSTEMS**II - SEMESTER:**

<i>Subject Code</i>	SUBJECT	L	P	C
16D35201	Simulation Modeling of Manufacturing Systems	4	-	4
16D35202	Quality Engineering in Manufacturing	4	-	4
15D34201	Design for Manufacturing	4	-	4
16D35203	Production and Operations Management	4	-	4
	ELECTIVE-III	4	-	4
16D35204	Industrial Robotics			
15D34207	Additive Manufacturing			
16D35205	Design and Manufacturing of MEMS and Micro Systems			
	ELECTIVE-IV	4	-	4
16D35206	Performance Modelling and Analysis of Manufacturing Systems			
16D35207	Intelligent Manufacturing Systems			
16D35208	Optimization Techniques			
15D54201	Research Methodology (Audit Course)			
16D35209	Manufacturing Simulation Lab	0	4	2
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M.Tech – ADVANCED MANUFACTURING SYSTEMS**II- SEMESTER**

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SIMULATION MODELING OF MANUFACTURING SYSTEMS (16D35201)**UNIT - I**

System - ways to analyze the system - Model - types of models - Simulation - Definition - Types of simulation models - steps involved in simulation - Advantages & Disadvantages. Parameter estimation - estimator - properties - estimate - point estimate - confidence interval estimates - independent - dependent - hypothesis - types of hypothesis- step - types I& 2 errors - Framing - string law of large numbers.

UNIT - II

Building of Simulation model validation - verification - credibility - their timing - principles of valid simulation Modeling - Techniques for verification - statistical procedures for developing credible model. Modeling of stochastic input elements - importance - various procedures - theoretical distribution - continuous - discrete their suitability in modeling.

UNIT - III

Generation of random variables - factors for selection methods - inverse transform - composition - convolution - acceptance - rejection - generation of random variables - exponential - uniform - weibull - normal Bernoullie - Binomial uniform - poisson - Simulation languages - comparison of simulation languages with general purpose languages Simulation languages vs Simulators - software features - statistical capabilities - G P S S - S1MAN- SIMSCRIPT - Simulation of WMJI queue - comparison of simulation languages.

UNIT - IV

Output data analysis - Types of Simulation w. r. t output data analysis – warm up period- Welch algorithm - Approaches for Steady - State Analysis - replication - Batch means methods - corn pan Sons.

UNIT - V

Applications of Simulation - flow shop system - job shop system - M/M/1 queues with infinite and finite capacities - Simple fixed period inventory system – New boy paper problem.

REFERENCES:

1. Simulation Modelling and Analysis / Law, A.M.&Kelton / McGraw Hill, Edition/
New York, 1991.
2. Discrete Event System Simulation / Banks J. & Carson J.S., PH / Englewood Cliffs N/ 1984.
3. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990.
4. A Course in Simulation / Ross, S.M., McMillan, NY, 1990.
5. Simulation Modelling and SIMNET/ Taha HA. / PH, Englewood Cliffs, NJ, 1987

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QUALITY ENGINEERING IN MANUFACTURING (16D35202)**UNIT - I**

QUALITY VALUE AND ENGINEERING: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type,S-type and L-type)

UNIT II:

TOLERANCE DESIGN AND TOLERANCING: Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT – III

ANALYSIS OF VARIANCE (ANOVA): Introduction to ANOVA, Need for ANOVA, NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT - IV

ORTHOGONAL ARRAYS: Typical test strategies, better test strategies, efficient test strategies, steps indesigning, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT - V

SIX SIGMA AND THE TECHNICAL SYSTEM: Six sigma DMAIC methodology, tools fpr process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

REFERENCES:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition, 1995.
2. Quality Engineering in Production systems / G. Taguchi, A. Elsayed et al /Mc.Graw Hill Intl. Edition, 1989.
3. Taguchi Methods explained: Practical steps to Robust Design /Papan P. Bagchi/ Prentice Hall Pvt. Ltd., New Delhi.

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DESIGN FOR MANUFACTURING (15D34201)
(Common to Product Design & Advanced Manufacturing Systems)**UNIT-I**

System Concept-Elements of System- Types and Characteristics of System-System Design Approach- System Development- Stages and phases of Development-Documentation and Models in System Development

System Modelling and Theories, Modelling Process, System Theory, Black Box Approach and State Approach

UNIT-II

Mathematical Formulation in System design, LPP with Graphical solution, - Network Flow Analysis

System Evaluation, Evaluation Factors, Needs for Evaluation, Benefits, Types and Stages in System Evaluation

UNIT-III

System Reliability, Block diagram, Block Failure, Definition of Reliability, Reliability and Probability, Failure Rate, Estimation, Reliability Indices. Reliability Tests.

UNIT-IV

System simulation- Need for Simulation, Steps in simulation, Simulation Models.

System Approach to Project Management- Project Management Systems and Functional management System, Classification, Techniques and Objectives.

UNIT-V

Manufacturing Systems-Classifications, Introduction to FMS and Computer Integrated Manufacturing System - Concepts of Group Technology

TEXT BOOKS:

1. R.C.Mishra and Simant –“**Mechanical System Design**”
2. Arora.A.,and Bhatia A-“**Management Information System**”. Excell Publication, New Delhi
3. Gopal Krishna P., and P RamamoothyV.E., -“**Text Book of Project Management**”, Macmillian, New Delhi.

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PRODUCTION AND OPERATIONS MANAGEMENT (16D35203)**(Common to Advanced Manufacturing Systems & Quality Engineering & Management)****UNIT -I****OPERATION MANAGEMENT:** Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.

Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

UNIT – II**VALUE ENGINEERING:** objective – types of values – function & cost – product life cycle-steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method.

Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout– line balancing.

UNIT - III**AGGREGATE PLANNING:** definition – Different Strategies – Various models of Aggregate Planning –Transportation and graphical models.

Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

UNIT - IV**SCHEDULING:** Policies – Types of scheduling – Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.

UNIT – V

PROJECT MANAGEMENT: Programming Evaluation Review Techniques (PERT) – three times estimation– critical path – probability of completion of project – critical path method – crashing of simple nature.

REFERENCES:

1. Operations Management/ E.S. Buffs/ John Wiley & Sons / 2007
2. Operations Management Theory and Problems/ Joseph G. Monks / Macmillan / McGraw Hill / 3rd Edition.
3. Production Systems Management/ James I. Riggs / John Wiley & Sons.
4. Production and Operations Management/ Chary/ McGraw Hill/2004
5. Operations Management/ Richard Chase/ McGraw Hill/2006
6. Production and Operation Management / PannerSelvam / PHI.
7. Production and Operation Analysis/ Nahima/ McGraw Hill/2004

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INDUSTRIAL ROBOTICS (16D35204)**(ELECTIVE – III)****UNIT - I**

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. **CONTROL SYSTEM AND COMPONENTS:** basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. **SENSORS:** Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog todigital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations. **ROBOT LANGUAGES:** Textual robot Languages, Generation, Robot language structures, Elements in function.

UNIT - V

ROBOT CELL DESIGN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work wheel controller.

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

REFERENCES:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
7. Robotics and Control / Mittal R K &Nagrath I J / TMH

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ADDITIVE MANUFACTURING (15D34207)
(Elective-III)**(Common to Product Design & Advanced Manufacturing Systems)****UNIT I****INTRODUCTION:**

Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.

UNIT II:**REVERSE ENGINEERING AND CAD MODELING:**

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT III**LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS:**

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV

POWDER BASED ADDITIVE MANUFACTURING SYSTEMS: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

UNIT V**OTHER ADDITIVE MANUFACTURING SYSTEMS**

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballistic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

REFERENCES

1. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
3. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2011.
5. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
6. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

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DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS (16D35205)**(ELECTIVE – III)****UNIT I:****OVERVIEW AND WORKING PRINCIPLES OF MEMS AND MICROSYSTEMS**

MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & Miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics.

UNIT II:**ENGINEERING SCIENCE FOR MICROSYSTEMS DESIGN AND FABRICATION:**

Atomic structure of Matter, Ions and Ionization, Molecular Theory of Mater and Intermolecular Force, Doping of Semiconductors, The diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics

UNIT III:**ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN:**

Static Bending of thin Plates, Mechanical Vibration, Thermo mechanics Fracture Mechanics, Thin-Film Mechanics, Overview of Finite Element Stress Analysis

UNIT IV:**THERMO FLUID ENGINEERING & MICROSYSTEMS DESIGN:**

Overview of Basics of Fluid Mechanics in Macro and Meso scales, Basic equations in Continuum Fluid dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid Flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a Micro pressure Sensor.

UNIT V:**MATERIALS FOR MEMS & MICROSYSTEMS AND THEIR FABRICATION:**

Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, chemical and physical vapor deposition, Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process

REFERENCES:

1. MEMs & Microsystems: Design & Manufacture/ Tai-Ran Hsu/Tata Mc-Graw Hill., ed./2002
2. An Introduction to Microelectromechanical Systems Engineering/ Maluf, M./ Artech House, Boston, 2000
3. Micro robots and Micromechanical Systems/ Trimmer, W.S.N/ Sensors & Actuators, vol19, no.1989.
4. Applied Partial Differential Equations/ Trim, D.W/ PWS-Kent Publishing/ Boston 1990.
5. Fundamentals of Microfabrication. Madou, M/ CRC Press, Boca Raton, 1997.
6. The Finite Element Method in Thermomechanics/ Hsu, T.R / Alien &Unwin, London.

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PERFORMANCE MODELLING AND ANALYSIS OF MANUFACTURING SYSTEMS**(16D35206)****(ELECTIVE – IV)****UNIT I:****MANUFACTURING SYSTEMS & CONTROL:**

Automated Manufacturing Systems – Modeling – Role of performance modeling – simulation models-Analytical models.Product cycle – Manufacturing automation – Economics of scale and scope – input/output model – plant configurations. Performance measures – Manufacturing lead time – Work in process – Machine utilization – Throughput – Capacity – Flexibility – Performability – Quality Control Systems – Control system architecture – Factory communications – Local area network interconnections – Manufacturing automation protocol – Database management system.

UNIT II:**MANUFACTURING PROCESSES:**

Examples of stochastic processes – Poisson process - Discrete time Markov chain models – Definition and notation – Sojourn times in states – Examples of DTMCs in manufacturing – Chapman – Kolmogorov equation – Steady-state analysis. Continuous Time Markov Chain Models – Definitions and notation – Sojourn times in states – examples of CTMCs in manufacturing – Equations for CTMC evolution – Markov model of a transfer line.Birth and Death Processes in Manufacturing – Steady state analysis of BD Processes – Typical BD processes in manufacturing.

UNIT III:**QUEUING MODEL:**

Notation for queues – Examples of queues in manufacturing systems – Performance measures – Little's result – Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns – Analysis of a flexible machine center.

UNIT IV:**QUEUING NETWORKS:**

Examples of QN models in manufacturing – Little’s law in queuing networks – Tandem queue – An open queuing network with feedback – An open central server model for FMS – Closed transfer line – Closed server model – Garden Newell networks.

UNIT V:**PETRINETS:**

Classical Petri Nets – Definitions – Transition firing and reachability – Representational power – properties – Manufacturing models.

Stochastic Petri Nets – Exponential timed Petri Nets – Generalized Stochastic Petri Nets – modeling of KANBAN systems – Manufacturing models.

REFERENCES:

1. Performance Modelling of Automated Manufacturing Systems/ Viswanadham, N and Narahari, Y/ Prentice Hall of India, New Delhi, 1994
2. Probability and Statistics with Reliability, Queuing and Computer Science Applications/ Trivedi, K.S./ Prentice Hall, New Jersey, 1982.
3. Fundamentals of Mathematical Statistics/ Gupta S.C. & Kapoor V.K./ 3rd Edition, Delhi, 1988

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INTELLIGENT MANUFACTURING SYSTEMS (16D35207)**(ELECTIVE – IV)****UNIT I:**

Computer Integrated Manufacturing Systems Structure and functional areas of CIM system, - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT II:

Components of Knowledge Based Systems - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Inference Engine, Knowledge Acquisition.

UNIT III:

Machine Learning - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT IV:

Automated Process Planning - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT V:

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

REFERENCES:

1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ YagnaNarayana/PHI/2006
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007
4. Neural networks: A comprehensive foundation/ Simon Hhaykin/ PHI.
5. Artificial neural networks/ B.Vegnanarayana/PHI
6. Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003
7. Neural networks/ James A Freeman David M S kapura/ Pearson education/2004
8. Introduction to Artificial Neural Systems/Jacek M. Zurada/JAICO Publishing House Ed. 2006.

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OPTIMIZATION TECHNIQUES (16D35208)**(ELECTIVE – IV)****(Common to Advanced Manufacturing Systems & Quality Engineering & Management)****Course Objectives:**

1. To introduce the advanced optimization techniques such as classical optimization techniques, numerical optimization techniques and genetic algorithms.
2. Learn the knowledge to formulate optimization problems

UNIT - I

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT - II

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT - III

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

UNIT – IV

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam and general optimization model of a machining process.

TEXT BOOKS:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

REFERENCES:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

Course Out comes:

1. Students at the end of the course learn advanced optimization techniques to show real-life problems
2. Students can able to formulate and solve various practical optimization problems in manufacturing and service organizations

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4 - 4**RESEARCH METHODOLOGY (AUDIT COURSE) (15D54201)**

DSC

RESEARCH METHODOLOGY

(Audit Course For M.Tech. –II Semester Program from 2015 admitted batches onwards)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text books:

1. Research Methodology:Methods and Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step by Step Guide for Beginners- Ranjit Kumar, Sage Publications (Available as pdf on internet)
3. Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

References:

1. Scientists must Write - Robert Barrass (Available as pdf on internet)
2. Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)

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MANUFACTURING SIMULATION LABORATORY (16D35209)

The students will be given training on the use and application of the following software to manufacturing problems:

1. Auto MOD Software.
2. PROMOD
3. SLAM-II
4. CAFIMS
5. Flexsim

They also learn how to write sub routines in C-language and interlinking with the above packages. Problems for modelling and simulation experiments:

1. AGV planning
2. ASRS simulation and performance evaluation
3. Machines, AGVs and AS/RS integrated problems
4. JIT system
5. Kanban flow
6. Material handling systems
7. M.R.P. Problems
8. Shop floor scheduling etc.