AFFILIATED INSTITUTIONS

ANNA UNIVERSITY, CHENNAI

CURRICULAM AND SYLLABI

REGULATIONS - 2009

M.E. PRODUCTION ENGINEERING

SEMESTER-I

Course code	Course Title	L	T	P	C
MA9325	Computational Methods and Probability	3	1	0	4
PE9311	Metrology and Quality Engineering	3	0	0	3
PE9312	Fluid Power Automation	3	0	0	3
PE9313	Design for Manufacture and Assembly	3	1	0	4
PE9314	Metal Cutting Theory and Practice	3	0	0	3
PE9315	Computer Numerical Control and Robotics	3	0	0	3
PRACTICALS					
PE9316	Production Engineering Laboratory	0	0	3	2
				Total Credits	**22**

MA9325 COMPUTATIONAL METHODS AND PROBABILITY L T P C
3 1 0 4

UNIT I INTRODUCTION TO COMPUTATIONAL METHODS: **(12)**
Examples, solving sets of equations, Gauss elimination method, Choleski method, Iterative methods, Relaxation method, System of non-linear equations- Newton Raphson method. Newton-Cotes integration formulas, Trapezoidal rule, Simpson's rules, Gaussian quadrature, Adaptive integration, Cubic spline functions - Bezier curves and Bsplines.

UNIT II NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: (9)
Laplace's equations, representations as a difference equation, Iterative methods for Laplace's equations, Poisson equation, examples, Matrix patterns, Sparseness, ADI method.
Least square approximation, fitting of non-linear curves by least squares, regression analysis.

UNIT III PROBABILITY AND CONCEPT OF RANDOM VARIABLE: (10)
Axiomatic Approach to Probability – Random variables – Discrete random variables: Bernoulli, Binomial, Geometric and Poisson – Continuous random variables – Uniform, Exponential, Gamma and Normal – Expectation of random variables – Jointly distributed random variable Moment Generating functions – Discrete case – Continuous case – Computing expectation by conditioning – Computing probabilities by conditioning – Applications.

UNIT IV THEORY OF ESTIMATION AND HYPOTHESIS (9)
Point estimation – characteristics of estimation – interval estimation – estimates of mean, standard deviation and properties.
Probability density function and applications of t, F, Chi square distributions –Large sample tests for means, variances, and proportions – Small sample tests for means, variances, and attributes

UNIT V RELIABILITY: (5)
Hazard Rate and Mean Time To Failure, Mathematical models for reliability systems - exponential and Weibull failure laws – System reliability – series system, parallel system, [k,n] system - system failure rate, system MTTF.

TOTAL : 45

REFERENCES :

1. Curtis F Gerald and Patrick O Wheatley, "Applied Numerical Analysis", Pearson Education, 2002.
2. Rajasekaran S, “Numerical Methods in Science and Engineering – A Practical Approach”, Wheeler Publishing, 1999, Second Edition
3. Akai “Applied numerical methods for engineers” Wiley India Edition, 2007
4. .Trivedi K.S., “Probability and Statistics with Reliability, Queueing and Computer Applications”, Prentice Hall, 2003.
5. Sheldon M.Ross, “Introduction to Probability Models”, Academic Press 2002.

PE9311 METROLOGY AND QUALITY ENGINEERING L T P C
3 0 0 3

UNIT I LASER METROLOGY: (14)

Introduction - types of lasers - laser in engineering metrology - metrological laser methods for applications in machine systems, methods of laser metrology – ray optical method - wave optical methods – interferometry - laser Doppler technique - laser Doppler anemometry - light in flight technique - contouring technique - interferometric arrangements - speckle metrology. Laser telemetric systems - laser and lead based distance measuring instrument - detection of microscope imperfections on high quality surface - description of the proposed surfing flaw monitoring technique - uses of laser – computer aided laser metrology - laser interferometer - the pitter N.P.L gauge interferometer – mechanical properties of measurements - basic requirements - two beam interferometry - applications of laser in industries - classification of optical scanning systems - high inertia laser scan technique - rotating mirror technique - single inclined mirror fully illuminated - over illuminated pyramidal spinner - flat field scan system - low inertia laser scan technique - vibrational deflectors - magnetic vibrational deflector - Iteration and scan enhancement - reflective scanner – refractive scanner - diffractive scanner - measurement and inspection - laser welding - laser hardening - laser gauging - bar coding.

UNIT II CO-ORDINATE MEASURING MACHINE: (6)

Types of CMM - constructional features of CMM – probe - touch trigger probe - non contact trigger probe - operation and programming – computer hardware - computer software - measuring systems - statistical process control - applications of CMM - advantages of CMM - role of CMM in inspection and measurement - measurement and timing of a typical manufactured part - role of CMM on reverse engineering - difficulties in reverse engineering - factors affecting CMM – present trends in CMM - achievements of CMM.

UNIT III MACHINE VISION: (5)

Image analysis and computer vision - computer vision systems – image analysis technique - spatial feature extraction - image segmentation - digital image processing - basic classes of problems - vision system for measurement - comparison of laser scanning with vision system.

UNIT IV QUALITY IN DESIGN AND MANUFACTURING ENGINEERING: (10)

Importance of manufacturing planning for quality – initial planning for quality – concept of controllability: self controls – defining quality responsibilities on the factory flow – self inspection – automated manufacturing – overall review of manufacturing planning – process quality audits – quality and production floor culture. Opportunities for improvement product design – early warning concepts and design assurance - designing for basic functional requirements – designing for time oriented performance (reliability) – availability – designing for safety – designing for manufacturability – cost and product performance – cost of quality – design review – concurrent engineering – improving the effectiveness of product development.

UNIT V QUALITY MANAGEMENT SYSTEM: (10)

Need for quality management system – design of quality management system - quality management system requirements – ISO 9001 and other management systems and models - improvements made to quality management systems. Basic quality engineering tools and techniques – statistical process control - control limits – control charts for variables - X, R charts – control charts for defective - p, np charts – control charts for defects - c charts. Techniques for process design and improvement - Taguchi methods for process improvement - six sigma - the ‘DRIVE’ framework for continuous improvement.

TOTAL: 45

REFERENCES :

1. Oakland J.S., “Total Quality Management - Text with Cases”, Butterworth – Heinemann – An Imprint of Elseiver, First Indian Print, New Delhi, 2005.
2. Elanchezhian C., Vijaya Ramnath B. and Sunder Selwyn T., “Engineering Metrology”, Eswar Press, Chennai, 2004.
3. John A.Bosch, Giddings and Lewis Dayton, “Coordinate Measuring Machines and Systems”, Marcel Dekker, Inc., 1999.
4. Juran J.M. and Gryna F.M., “Quality Planning and Analysis”, Tata McGraw Hill Edition , New Delhi, 1995.
5. ASTME, “Hand Book of Industrial Metrology”, Prentice Hall.

PE9312 FLUID POWER AUTOMATION L T P C

3 0 0 3

UNIT I INTRODUCTION (6)

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

UNIT II HYDRAULIC POWER GENERATION, CONTROL AND REGULATING ELEMENTS (11)

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

UNIT III PNEUMATICS AND ELECTRO PNEUMATICS (9)

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

UNIT IV CIRCUIT DESIGN (11)

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

UNIT V COMPUTER CONTROL & MAINTENANCE OF FLUID POWER CIRCUITS: (8)

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

TOTAL: 45

REFERENCES :

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

PE9313 DESIGN FOR MANUFACTURE AND ASSEMBLY L T P C
3 1 0 4

UNIT I PROCESS CAPABILITY AND TOLERANCES: (8)

Process capability, mean, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances-ISO standards-surface finish, review of relationship between attainable tolerance grades and different machining and sheet metal processes. Cumulative effect of tolerances- Worst Case Method, Root Sum Square Method, dimensions following truncated normal distributions, Monte Carlo Simulation.

UNIT II SELECTIVE ASSEMBLY: (6)

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

UNIT III DATUM SYSTEMS AND FIXTURE DESIGN: (5)

Degrees 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 translational and rotational accuracy, geometric analysis and applications.

UNIT IV TRUE POSITION THEORY: (6)

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

UNIT V FORM DESIGN OF CASTINGS, WELDMENTS AND SHEET METAL COMPONENTS (5)

Redesign of castings based on parting line considerations, minimising core requirements,redesigning cast members using weldments, form design aspects of sheet metal components.

UNIT VI TOLERANCE CHARTING TECHNIQUE: (5)

Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

UNIT VII REDESIGN FOR MANUFACTURE: (5)

Design features to facilitate machining : datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples.

UNIT IX DFMA TOOLS: (5)

Computer Aided DFMA , Poke Yoka principles, Axiomatic design method, quality function deployment, design for six sigma, lean manufacturing, waste identification and elimination, value stream mapping, sensor interface for fool-proof system design.

L:45 T:15 TOTAL: 60

REFERENCES :

1. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.
2. Matousek, "Engineering Design - A Systematic Approach", Blackie and Son Ltd., London,1974.
3. Micheal Wader “Lean Tools: A Pocket Guide to Implementing Lean Practices”, Productivity and Quality Publishing Pvt Ltd., 2002.
4. Spotts M F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., 1983.
5. Oliver R Wade, "Tolerance Control in Design and Manufacturing" Industrial Press Inc., New York, 1967.
6. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
7. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, Second Edition, 1987,
8. Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992
9. Basem Said El—Haik, “Axiomatic Quality”, John Wiley and Sons, 2005.

PE9314 METAL CUTTING THEORY AND PRACTICE L T P C
3 0 0 3

UNIT I INTRODUCTION. (9)

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

UNIT II TOOL NOMENCLATURE AND CUTTING FORCES (9)

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

UNIT III THERMAL ASPECTS OF MACHINING (9)

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

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR (9)

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

UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING: (9)

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

TOTAL : 45

REFERENCES :

1. Shaw .M.C., " Metal cutting Principles ",Oxford clarendon Press,1984.
2. Bhattacharya. - " Metal Cutting Theory and Practice ", New central Book Agency(p) Ltd.,Calcutta1984.
3. Venkatesh .V.C. & Chandrasekharan.H. - " Experimental Techniques in Metal cutting ", Prentice Hall of India,1982
4. Juneja.B.L and Sekhon.G.S- " Fundamentals of metal cutting and machine tools ", New Age International(p) Ltd., 1995
5. Xing Sheng LI & Low I.M., Editors Advanced Ceramic Transtech publications,1994.
6. Kuppuswamy.G.- " Principles of metal cutting ", Universities Press(India)Ltd., 1996
7. Boothroy.D.G. and knight. W.A " Fundamentals of Machining and Machine tools "- Marcel Dekker,New York, 1989.

PE9315 COMPUTER NUMERICAL CONTROL AND ROBOTICS L T P C
3 0 0 3

UNIT I INTRODUCTION TO MACHINE TOOLS: (5)

Basic machine tool elements, types, applications, calculation of capacity, specifications, standards on NC machine tool, installation of NC machine, hard machining, high speed machining.

UNIT II CNC MACHINES: (8)

Machine structure, slides, guide ways, recirculating ball screws, spindle,bearing arrangements, tool magazines, turrets, ATC, APC, belts, pneumatic and hydraulic peripherals, design and selection of CNC machines, work holding, soft jaw, hard jaw, tooling for CNC.

UNIT III CONTROL SYSTEM AND INTERFACING: (6)

Open loop, closed loop, block diagram of CNC system, PLC, interpolation, standard and optional features of a control system, motors, drives, feedback devices, MCB, switches, interfacing of motor, controller, compensations, correction factors, trouble shooting.

UNIT IV PART PROGRAMMING: (7)

Coding of preparatory functions, miscellaneous function, ISO, EIA standards, axis definition, datum, absolute and incremental programming, tool offset, positioning control, point-to-point, linear, circular, spline interpolation, coordinate systems, cutter diameter compensate, fixed cycles, drilling, boring, area clearance programming, part programming examples

UNIT V CNC PROGRAMMING USING CAM PACKAGES: (5)

Model creation, post processing, data exchange between softwares, NC code generation, input to CNC machine, case studies, typical features of CAM packages, tool path simulation, post processing, multi axis machining, programming examples

UNIT VI ROBOTICS: (7)

Classification of robots, major components of robot, specifications, mechanical elements used in robot, motion conversion, end effectors, electrical elements, control of robotic joints, robotic sensory devices, applications.

UNIT VII ROBOT KINEMATICS: (7)

Homogeneous coordinates, homogeneous transformation and manipulator, forward solution, inverse solution, motion generation, Jacobian control.

TOTAL: 45

REFERENCES :

1. Steve Krar, “Computer Numerical Control”, Industrial Press Inc., New York, 2001.
2. Richaerd D. Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering – An Integral Approach”, Prentice-Hall India, New Delhi, 2001.
3. David Gibbs, Thomas M. Crandell, “An Introduction to CNC Machining and Programming” Industrial Press Inc., New York, 2000.
4. Yoram Koran, Joseph Ben-uri, “Numerical Control of Machine Tools”, Kanna Publishers, New Delhi, 1998.
5. Thyer G.E., “Computer Numerical Control of Machine Tools”, BHNEWNES, Second Edition,1991.

PE9316 PRODUCTION ENGINEERING LABORATORY L T P C
0 0 3 2

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

TOTAL : 45