AFFILIATED INSTITUTIONS
ANNA UNIVERSITY, CHENNAI
CURRICULAM AND SYLLABI
REGULATIONS - 2009
M.E. PRODUCTION ENGINEERING

SEMESTER-I

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<tr>
<th>Course code</th>
<th>Course Title</th>
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<tr>
<td>MA9325</td>
<td>Computational Methods and Probability</td>
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<td>PE9311</td>
<td>Metrology and Quality Engineering</td>
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<td>PE9312</td>
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<td>PE9313</td>
<td>Design for Manufacture and Assembly</td>
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<td>PE9314</td>
<td>Metal Cutting Theory and Practice</td>
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<td>PE9315</td>
<td>Computer Numerical Control and Robotics</td>
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<td>PE9316</td>
<td>Production Engineering Laboratory</td>
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UNIT I  INTRODUCTION TO COMPUTATIONAL METHODS:  (12)

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)

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.

REFERENCES:
UNIT I  
**LASER METROLOGY:**

UNIT II  
**COORDINATE MEASURING MACHINE:**
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:**
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:**

UNIT V  
**QUALITY MANAGEMENT SYSTEM:**

TOTAL: 45
REFERENCES:

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:
UNIT I PROCESS CAPABILITY AND TOLERANCES: (8)

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 II 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.

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 III 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 IV 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.

Redesign for Manufacture: (5)
Design features to facilitate machining : datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples.

UNIT V 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.
REFERENCES:

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

REFERENCES:

PE9315  COMPUTER NUMERICAL CONTROL AND ROBOTICS

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:

PE9316 PRODUCTION ENGINEERING LABORATORY

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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