

## II SEMESTER

### INDUSTRIAL ROBOTICS

|                            |            |            |      |
|----------------------------|------------|------------|------|
| Subject Code               | : 16 MPE21 | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 04       | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 50       | Exam Marks | : 80 |

#### Module 1

**FUNDAMENTAL CONCEPTS OF ROBOTICS:** History, present status and future trends, Robotics. Robot, Definition. Robotics Systems and Robot Anatomy, Specification of Robotics. Resolution, Repeatability and Accuracy of a Manipulator

**ROBOT DRIVES:** Power transmission systems and control Robot drive mechanisms, hydraulic-electric-pneumatic drives. Mechanical transmission method – Rotary-to-Rotary motion conversion. Rotary-to-linear motion conversion end effectors – types-grip pind problem Remote-Centered compliance Devices-Control of Actuators in Robotic Mechanisms.

#### Module 2

**SENSORS AND INTELLIGENT ROBOTS:** Sensory devices – Non-optical-Position sensors – Optical position sensors – velocity sensors – proximity sensors: Contact and non-contact type-Touch and slip sensors – Force and Torque Sensors – AI and Robotics.

**COMPUTER VISION FOR ROBOTICS SYSTEMS:** Robot vision systems – Imaging components – Image representation – Hardware aspects-Picture coding – Object Recognition and Categorization- Visual inspection – software considerations – applications – commercial – Robotics vision systems.

#### Module 3

**COMPUTER CONSIDERATIONS FOR ROBOTIC SYSTEMS:** Computer architecture for robots, hardware, Computational elements in robotic applications – Robot programming – sample programs path planning – Robot's computer system.

#### Module 4

**TRANSFORMATIONS AND KINEMATICS:** Homogeneous Co-ordinates – Co-ordinate Reference Frames – Homogeneous Transformations for the manipulator – the forward and inverse problem of manipulator kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D.H. Matrices controller architecture.

#### Module 5

**ROBOT CELL DESIGN AND CONTROL:** Specifications of Commercial Robots – Robot Design and Process specifications – motor selection in the design of a robotic joint – Robot Cell layouts – Economic and Social aspects of robotics.

**APPLICATIONS OF ROBOTS:** Capabilities of Robots – Robotics Applications – Obstacle avoidance – Robotics in India – The future of Robotics

#### TEXT BOOKS:

- **Robotics Engineering An integrated approach** - Richard D Klafter, Thomas A Chmielewski, Michael Negin – Prentice Hall of India Pvt. Ltd. - Eastern Economy Edition, 1989.
- **Robotics: Control Sensing, Vision, intelligence** - Fu KS Gomaler R C, Lee C S G - McGraw Hill Book Co. - 1987.

## REFERENCE BOOKS:

- **Handbook of Industrial Robotics** - Shuman Y. Nof - John Wiley & Sons, New York - 1985.
- **Robotics Technology and Flexible Automation** - Deb SR - McGraw Hill BookCo. - 1994.

## NON-TRADITIONAL MACHINING PROCESSES

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|----------------------------|-------------|------------|------|
| Subject Code               | : 16 MPE 22 | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 04        | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 50        | Exam Marks | : 80 |

### Module 1

**Introduction:** Need for non-traditional machining processes. Processes selection classification on – comparative study of different processes.

**Mechanical Process:** Ultrasonic Machining-Definition-Mechanism of metal elements of the process-Tool feed mechanism. Theories of mechanics of causing effect of parameter applications.

### Module 2

**Abrasive Jet Machining:** Principles - parameters of the process applications-advantages and disadvantages.

**Thermal Metal Removal Process:** Electric discharge machining Principle of operation – mechanism of metal removal basic EDM circuitry-spark erosion Analysis of relaxation type of circuit material removal rate in relaxation circuits. Applications.

### Module 3

**Electro Chemical and Chemical Processes:** Electro chemical machining (ECM) Classification ECM process-principle of ECM Chemistry of the ECM parameters of the processes-determination of the metal removal rate - dynamics of ECM process, Electro Chemical Grinding-Electro Chemical holding Electrochemical deburring.

### Module 4

**Plasma arc Machining:** Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal, PAN parameters-process characteristics - type of torches applications.

**Electron Beam Machining (EBM):** Introduction-Equipment for production of Electron beam - Theory of electron beam machining , applications.

**Laser Beam Machining (LBM):** Introduction-principle of generation of lasers Equipment and Machining procedure-Types of Lasers-Process characteristics-advantages and limitations-applications

**Ion Beam Machining:** Introduction-Mechanism of metal removal and associated equipment-process characteristics applications

### Module 5

**High Velocity Forming Process:** introduction - development of specific process selection-comparison of conventional and high velocity forming methods - Types of high velocity forming methods- explosion forming process-electro hydraulics forming magnetic pulse forming.

## REFERENCE BOOKS:

- **New technology Institution of Engineers** - Bhattacharya - India
- **Production Technology** - HMT - Tata McGraw Hill - ISBN-10; 0070964432
- **Modern Machining Process** - P.C Pandya & H.S. Shan - Tata McGraw Hill - ISBN: 0070965536 - Publishing Date: Feb-80
- **Metals Hand Book** - ASM - Vol-3.
- **High Velocity Forming of Metals** - F.M Wilson - ASTM EPretice Hall.
- **Modern Manufacturing Method** - Adithan- New Age International (p) Limited - ISBN: 8122408176, 2007.
- **Modern Machining Processes** - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.

## SURFACE TREATMENT & FINISHING

|                            |                   |            |      |
|----------------------------|-------------------|------------|------|
| Subject Code               | : <b>16 MPE23</b> | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 04              | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 50              | Exam Marks | : 80 |

### Module 1

**Fundamentals of Electro plating**, galvanizing, Hot dip metal coating, thin coating, chromium plating, Nickel plating.

### Module 2

**Vacuum coating**, FVD & CVD metal spraying - Methods, surface preparation, mechanical **Properties of sprayed metals**, **plasma coating**.

### Module 3

**Plastic coating of metal** - PVC coating Spheroidising process details, phosphate coating - mechanism of formation.

**Testing of surface coating**-methods.

### Module 4

**Heat treatment methods**, Annealing, Normalizing, Tempering, Case hardening methods, flame hardening sub zero treatment. **Heat treatment methods for gears, spindles, cutting tools**.

### Module 5

**Advanced coating technologies**: Hard facing, electro deposition technique, nanocoatings, coating characterization

## REFERENCE BOOKS:

- **Surface preparations & finishes for Metals** - James A Murphy - McGraw Hill.
- **Principles of metal surface treatment and protection** - Pergamon Press Gabe, David Russell - Description, Oxford ; New York - 2d ed., 1978.
- **Handbook of metal treatment and testing** - John Wiley & Sons.

- **Heat Treatment of Metals** – Zakrov - MIR Publications.
- **Metals Hand Book** – ASM.

### **ADVANCED JOINING PROCESSES**

|                            |                    |            |      |
|----------------------------|--------------------|------------|------|
| Subject Code               | : <b>16 MPE 24</b> | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 04               | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 50               | Exam Marks | : 80 |

#### **Module 1**

**Distortion-** methods to avoid distortion.Stresses in Joint Design.

**Welding and Cladding of dissimilar materials**, overlaying and surfacing.

#### **Module 2**

**Electro Slag**, Welding Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding and Thermit welding.

**Advanced soldering and Brazing processes different types, Welding of plastics.**

#### **Module 3**

**Inspection of Welds:** Destructive techniques like Tensile, Bend, Nick break, Impact & Hardness. Non-Destructive techniques like 'X' rays, Ultrasonic, Magnetic particle, Dye Penetrant, Gamma ray inspection.

**Welding Symbols-** Need for, Representing the welds, Basic weld symbols, Location of Weld, Supplementary symbols, Dimensions of welds, Examples

#### **Module 4**

**Welding Design** - Introduction, Principles of sound welding design, Welding joint design.Welding positions, Allowable strengths of welds, under steady loads.

**Quality Control in Welding** - Introduction, Quality assurance v/s Quality control, Weld quality, Discontinuities in welds, their causes and remedies and Quality conflicts.

#### **Module 5**

**Computer-Aided Welding Design** - Introduction. Principles of sound welding design, Wilding joint design. Welding positions. Allowable strengths: of welds. 1D1der steady loads. Weld throat thickness. Solved and um solved examples.

#### **REFERENCE BOOKS:**

- **Welding Engineering Handbook** - A.W.S.
- **Welding Engineering** - Rossi - McGraw Hill.
- **Advanced Welding processes** - Nikodaco&Shansky - MIR Publications.
- **Welding Technology** - O.P. Khanna
- **Welding for Engineers** - Udin, Funk &Wulf

**ELECTIVE II  
NON-DESTRUCTIVE TESTING**

|                            |                     |            |      |
|----------------------------|---------------------|------------|------|
| Subject Code               | : <b>16 MPE 251</b> | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 03                | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 40                | Exam Marks | : 80 |

**Module 1**

**Introduction to ND Testing:** Selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation.

**Module 2**

**Magnetic Particle Inspection:** Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations

**Module 3**

**Eddy Current Inspection:** principles, operation variables, procedure, inspection coils, and detectable discounts by the method.

**Microwave Inspection:** Microwave holography, applications and limitations.

**Module 4**

**Ultrasonic inspection:** Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks,

**Module 5**

**Radiography Inspection:** principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, applications.

**Optical Holography:** Basics of Holography, recording and reconstruction - Acoustical Holography: systems and techniques applications. Indian standards for NDT.

**REFERENCE BOOKS:**

- **Non Destructive Testing** - McGonnagle JJ – Garden and reach New York.
- **Non Destructive Evolution and Quality Control** - volume 17 of metals hand book 9 edition Asia internal 1989.
- **The Testing instruction of Engineering materials** - Davis H.E Troxel G.E wiskovil C.T - McGraw hill.

## SIMULATION AND MODELING OF MANUFACTURING SYSTEMS.

|                            |             |            |      |
|----------------------------|-------------|------------|------|
| Subject Code               | : 16 MPE252 | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 03        | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 40        | Exam Marks | : 80 |

### Module 1

**Principle of Computer Modelling And Simulation:** Monte Carlo simulation. Nature of computer-modeling and simulation. Limitations of simulation, areas of applications.

**System and Environment:** Components of a system -discrete and continuous systems, Models of a system -a variety of modeling approaches.

### Module 2

**Discrete Event Simulation:** Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, too server queue , simulation of inventory problem.

**Statistical Models in Simulation:** Discrete distributions, continuous distributions.

### Module 3

**Random Number Generation:** Techniques for generating random numbers- Mid square method -the mod product method -Constant multiplier technique -Additive congruential method -Linear congruential method -Tests for random numbers -The Kolmogorov-Smimov test -the Chi-square test.

**Random Variable Generation:** Inversion transforms technique-exponential distribution. uniform distribution, weibul distribution, continuous distribution, generating approximate normal variates-Erlang distribution.

### Module 4

**Empirical Discrete Distribution:** Discrete uniform -distribution poisson distribution -geometric distribution -acceptance -rejection technique for Poisson distribution gamma distribution.

### Module 5

**Design and Evaluation Of Simulation Experiments:** variance reduction techniques -antithetic variables, variables-verification and validation of simulation models.

**Simulation Software:** Selection of simulation software, simulation packages.

### TEXT BOOKS:

- **Discrete Event System Simulation** - Jerry Banks & .John S Carson II - Prentice Hall Inc.-1984.
- **Systems Simulation** - Gordan. G. - Prentice Hall India Ltd - 1991.

### REFERENCE BOOKS:

- **System Simulation with Digital Computer** - NusingDeo - Prentice Hall of India - 1979.
- **Computer Simulation and Modeling** - Francis Neelamkovil - John Wiley& Sons - 1987.

- **Simulation Modeling with Pascal** - RathM.Davis& Robert M O Keefe - Prentice Hall Inc. - 1989.

## PRODUCT DATA MANAGEMENT

|                            |                     |            |      |
|----------------------------|---------------------|------------|------|
| Subject Code               | : <b>16 MPE 253</b> | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 03                | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 40                | Exam Marks | : 80 |

### Module 1

**Introduction:** Introduction to PDM-present market constraints need for collaboration- Internet and developments in server-client computing.

**Components of PDM:** Components of a typical PDM set-up hardware and software- document management creation and viewing of documents -creating parts-version control of parts and documents – case studies.

### Module 2

**Configuration Management:** Base lines-product structure configuration management -case studies.

### Module 3

**Projects and Roles:** Creation of projects and roles -life cycle of a product- life cycle management - automating information flow -work flows-Creation of work flow templates -life cycle -work flow integration -case studies.

### Module 4

**Change Management:** Change issue -change request-change investigation- change proposal-change activity-case studies.

### Module 5

**Generic Products and Variants:** Products configuration comparison between sales configuration mild products generic-generic product modeling in configuration modeler-use of order generator for variant creation -registering of variants in product register-case studies.

## REFERENCE BOOKS:

- **Computer Integrated Design and Manufacturing** - David Bed worth. Mark Henderson & Philips Wolfe - McGraw Hill Inc. - 1991.
- **Visual Modeling with Rational Rose and UML** - Terry Quatrain - Addison Wesley - 1998.
- **Wind-chill** - RS.O Reference manuals - 2000.

## AGILE MANUFACTURING

|                            |             |            |      |
|----------------------------|-------------|------------|------|
| Subject Code               | : 16 MPE254 | IA Marks   | : 20 |
| No. of Lecture Hours/Week  | : 03        | ExamHours  | : 03 |
| Total No. of Lecture Hours | : 40        | Exam Marks | : 80 |

### Module 1

**Introduction** - What is agile Manufacturing? - Competitive environment of the future the business case for agile manufacturing conceptual frame work for agile manufacturing.

### Module 2

**Four Core Concepts:** Strategy driven approach - integrating organization, people technology interdisciplinary design methodology.

### Module 3

**Agile Manufacturing and Change Management:** The change implications. Post failures in advanced manufacturing, changes on the way, traditional management accounting, paradigm, investment appraisal, product costing - performance, measurement and control systems, Traditional organization, control technological and design paradigms traditional problems in workplace- organizational issues - role of technology.

### Module 4

**Agile Manufacturing Enterprise Design:** Agile manufacturing - enterprise design.. system concepts as the basic manufacturing theory - joint technical & organizational design and a model for the design of agile manufacturing enterprise, enterprise design process insights into design processes, what is interdisciplinary design, Main issues - simple design example.

### Module 5

**Skill & Knowledge Enhancing Technologies for Agile Manufacturing:** Skill and Knowledge enhancing Technologies - scheduling - technology design strategic-Design Concepts. Design and Skill of Knowledge enhancing Technologies for machine tool systems - Historical overview, Lessons, problems and Future development.

### REFERENCE BOOKS:

- **Agile manufacturing - Forging new Frontiers** - Paul T. Kidd - Addison Wesley Publication - 1994.
- **Agile Manufacturing – Proceedings of International Conference** - Dr. M.P Chowdiah (Editor) – TataMcGraw Hill Publications - 1996.
- **On agile manufacturing** - Tata McGraw Hill Publications -1996
- **Agile manufacturing - Forging Neat Furniture's** - Paul T Kidd – Addition Wesley Pub – 1994.
- **World Class Manufacturing** - Paul T Kidd - Washington: National - 1994



## **Laboratory Exercises**

### **14 MPE 26**

- Study of pick and place Robot- basic components, configuration, and work volume.
- Experiments with Robot. Kit for minimum four assembly activities and programming.
- Programming of robots by manual, lead through and off line methods.
- Programming languages for stacking of objects in increasing or decreasing size. Palletizing operations, assembly and inspection operation etc.
- To become acquainted with the operation of a revolute-type 6 DOF robot. To program a robotic system using a teaching pendant and a high level programming language. Emphasis is made on the constraints associated when positioning and orienting an object within a 3-D space. The practical includes point-to-point tasks and continuous robot motion.