

II SEMESTER INDUSTRIAL ROBOTICS

Subject Code	: 16MSE21	IA Marks	: 20
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	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.

Module – 3

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.

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 problems 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:

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

REFERENCE BOOKS:

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

NON-TRADITIONAL MACHINING PROCESSES

Subject Code	: 16MSE22	IA Marks	: 20
No. of Lecture	: 04	Exam Hours	: 03
Hours/Week			
Total No. of Lecture	: 52	Exam Marks	: 80
Hours			

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.

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

Module – 2

Thermal Metal Removal Process: Electric discharge machining Principle of operation – mechanism of metal removal basic EDM circuitry-spark erosion get Analysis of relaxation type of circuit material removal rate in relaxation circuits- critical resistance parameters in RC Circuit-Dielectric fluids-Electrodes for spark surface finish. Applications.

Plasma arc Machining: Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal, PAN parameters-process characteristics - type of torches 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-Hydrodynamics of ECM process-polarization-.Tool Design-advantages and disadvantages - applications. Electro Chemical Grinding-Electro Chemical holding Electrochemical deburring.

Chemical Machining: Introduction-fundamental principle types of chemical machining Maskants- Etchants- Advantages and disadvantages-applications.

Module – 4

Electron Beam Machining (EBM): Introduction-Equipment for production of Electron beam - Theory of electron beam machining Thermal & Non thermal types characteristics - 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-electrohydraulics forming magnetic pulse forming.

REFERENCE BOOKS:

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

NON-DESTRUCTIVE TESTING

Subject Code	: 16MSE23	IA Marks	: 20
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	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

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

Module – 3

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 – 4

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

Module – 5

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

Microwave Inspection: Microwave holography, applications and limitations.

REFERENCE BOOKS:

1. **Non Destructive Testing** - Mc Gonnagle JJ – Garden and reach New York.
2. **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

SURFACE TREATMENT & FINISHING

Subject Code	: 16MSE24	IA Marks	: 20
No. of Lecture	: 04	Exam Hours	: 03
Hours/Week			
Total No. of Lecture	: 52	Exam Marks	: 80
Hours			

Module – 1

Fundamentals of Electro plating, galvanizing, Hot dip metal coating, thin 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 Spherodising 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:

1. **Surface preparations & finishes for Metals** - James A Murphy - McGraw Hill.
2. **Principles of metal surface treatment and protection** - Pergamon Press Gabe, David Russell - Description, Oxford ; New York - 2d ed., 1978.
3. **Handbook of metal treatment and testing** - John wiley & sons.
4. **Heat Treatment of Metals** – Zakrov - MIR Publications.
5. **Metals Hand Book** – ASM.

SIMULATION AND MODELING OF MANUFACTURING SYSTEMS.

Subject Code	: 16MSE251	IA Marks	: 20
No. of Lecture	: 03	Exam Hours	: 03
Hours/Week	: 03		
Total No. of Lecture	: 40	Exam Marks	: 80
Hours			

Module – 1

Principle of Computer Modeling 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. Ivica Cmkovic, Ulfaskluna and Annita borsen Dohlgvist Publisher Artechhouse.

Module – 4

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

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:

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

REFERENCE BOOKS:

1. **System Simulation with Digital Computer** - Nusing Deo - Prentice Hall of India - 1979.
2. **Computer Simulation and Modeling** - Francis Neelamkovil - John Wiley & Sons - 1987.
3. **Simulation Modeling with Pascal** - Rath M.Davis & Robert M O Keefe - Prentice Hall Inc. - 1989.

FINITE ELEMENT METHODS

Subject Code	: 16MSE252	IA Marks	: 20
No. of Lecture Hours/Week	: 03	Exam Hours	: 03
Total No. of Lecture Hours	: 40	Exam Marks	: 80

Module – 1

Introduction: Equations of equilibrium, stress-strain relations for 2-D and 3-D, Potential energy and equilibrium, Boundary conditions, Von Misses Stresses

Module – 2

FEM for 1-D Problems: General procedure for FEA, Raleigh Ritz method, Galerkin Approach, shape functions, stiffness matrix, load vectors, temperature effects, Applications of boundary conditions using elimination, penalty and multi-constraint approaches, Application problems – 1-D bar element. Trusses and beams

Module – 3

FEM for 2-D Problems: Shape functions, stiffness matrix, strain matrix, load vectors for CST Elements and application problems

Module – 4

FEM for Axisymmetric Problems: Axisymmetric formulation, triangular elements, PE approach, Body force term, application problems

FEM for Scalar Field Problems: 1-D Steady state heat transfer, torsion, potential flow and fluid flow in ducts and application problems

Module – 5

Dynamic Analysis: Equations of motion for dynamic problems --consistent and lumped mass matrices --formulation of element mass matrices free vibration and forced vibration problems formulation,

REFERENCE BOOKS:

1. **Introduction to Finite Elements in Engineering** - Tirupathi R. Chandrupatla, Ashok D Belegundu - Prentice Hall India Pvt. Ltd., New Delhi – Third Edition, 2003.
2. **Concepts and Applications of finite Element Analysis** - Cook R.D, Malkus D.S & Plesha M.E - John Wiley & Sons - 1989.
3. **Applied Finite Element Analysis** - Segerlind L .J - John Wiley & Sons Edition - 1984.
4. **The Finite Element Method in Engineering** - Rao SS - Pergomon Press, Oxford - 2nd Edition, 1984.
5. **Finite Element Procedures in Engineering Analysis** - Bathe K .J - prentice Hall, NewJersey -1982.
6. **Energy and Finite Element Methods in Structural mechanics** - Shames III & Dym C L - Wiley eastern ltd – 1995.

AGILE MANUFACTURING

Subject Code	: 16MSE253	IA Marks	: 20
No. of Lecture	: 03	Exam Hours	: 03
Hours/Week			
Total No. of Lecture	: 40	Exam Marks	: 80
Hours			

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:

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

ADVANCED JOINING PROCESSES

Subject Code	: 16MSE254	IA Marks	: 20
No. of Lecture Hours/Week	: 03	Exam Hours	: 03
Total No. of Lecture Hours	: 40	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, Welding joint design. Welding positions. Allowable strengths: of welds. Under steady loads. Weld throat thickness. Solved and unsolved examples.

REFERENCE BOOKS:

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

Laboratory Exercises

Subject Code	: 16MSE26	IA Marks	: 20
No. of Lecture Hours/Week	: 03	Exam Hours	: 03
Total No. of Lecture Hours	: 36	Exam Marks	: 80

01. Study of pick and place Robot- basic components, configuration, work volume
02. Experiments with Robot. Kit for minimum four assembly activities and programming
03. Programming of robots by manual, lead through and off line methods
04. Programming languages for stacking of objects in increasing or decreasing size. Palletizing operations, assembly and inspection operation etc.
05. 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.