Mechanical Engineering Department

Ph.D. Course Structure

(Effective from Session 2025-26)

FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

Proposed Revised Curriculum & Syllabus

Ph.D. Programme

[w. e. f. Academic Year 2025-26]

Before Board of Studies for Consideration & Approval

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM UNIVERSITY DELHI-NCR, SONEPAT

39, Rajiv Gandhi Education City, Sonepat

Haryana-131029

SRM UNIVERISTY DELHI-NCR, SONEPAT FACULTY OF ENGINEERING AND TECHNOLOGY

ENGINEERING GRADUATES EMPLOYABILITY ATTRIBUTES

Sound Knowledge & Skill of Basic Science &Engineering Sciences

An Engineer should be able to apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

Problem formulation, Analysis & Solving

An Engineer should be able to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.

Design and Development of a Solution

An Engineer must be able to design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Investigation

An Engineer should use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Modern Tools Usage

An Engineer should be able to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

The Engineer and the Society

An Engineer should be able to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering practice.

Individual and Teamwork

An Engineer should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Lifelong Learning

An Engineer must recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Environment and Sustainability

An Engineer must understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Professional Ethics

An Engineer should be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.

Effective Communication

An Engineer should be able to communicate effectively on complex Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

SRM UNIVERISTY DELHI-NCR, SONEPAT

FACULTY OF ENGINEERING AND TECHNOLOGY

ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES (EPEOs)

1. Advancement to a professional position by virtue of their knowledge, skills and attitude.
2. Recognition for solving engineering problems and developing design solutions that consider safety and sustainability.
3. Work as successful professionals in diverse engineering disciplines and enterprises;
4. Increasing responsibilities of technical and managerial leadership in their work organizations;
5. Professional development through a commitment to career-long learning.

ENGINEERING PROGRAM EDUCATIONAL LEARNING OUTCOMES (EPELOs)

1. An ability to identify, formulate, and solve real time engineering & socio-economic problems by applying principles of engineering, science, mathematics, humanities and social sciences
2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice.
3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
4. an ability to adapt and work with multidisciplinary teams and communicate effectively;
5. An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks.
6. an understanding of professional and ethical responsibility;
7. An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

DOCTOR OF PHILOSOPHY (Ph.D.)

(Mechanical Engineering)

TOTAL CREDITS:

Program core	Total Credits
	14

Ph.D. Course Structure

S..NO	Course-Code	Title	Hrs./Week			Credit
			L	T	P	
GROUP I						
1	MEP009	MATERIAL SCIENCE	4	0	0	4
2	MEP002	MANUFACTURING TECHNOLOGY	4	0	0	4
3	MEP007	FOUNDATIONS OF NANOSCALE SCIENCE AND TECHNOLOGY	4	0	0	4
4	MEP010	RAPID PROTOTYPING TECHNIQUES	4	0	0	4
GROUP II						
1	MEP003	MATERIALS CHARACTERISATION TECHNIQUES	4	0	0	4
2	MEP 005	ADVANCES IN PRODUCTION AND INDUSTRIAL ENGINEERING	4	0	0	4
3	MEP001	PRODUCTION PLANNING & CONTROL	4	0	0	4
4	MEP011	INDUSTRIAL ROBOTICS	4	0	0	4
GROUP III						
1	MEP004	GAS TURBINE AND JET PROPULSION	4	0	0	4
2	MEP006	COMPUTATIONAL FLUID DYNAMICS	4	0	0	4
3	MEP008	ADVANCED HEAT AND MASS TRANSFER	4	0	0	4
4	MEP012	ELEMENTS OF MECHATRONICS	4	0	0	4
GROUP IV						
1	RES 701	RESEARCH METHODOLOGY	4	0	0	4
2	CPE-RPE	RESEARCH AND PUBLICATION ETHICS	2	0	0	2
Total Credit			**14**			

Note:

1. All the subjects of course work are categorized in to four (04) groups. The Ph.D. candidate can choose the any one group among the group-I, group-II and group-III based on his/her specialization of Ph.D. work. The subjects listed in that particular group will be applicable for his/her course work examination.
2. Subject of group-IV is compulsory for all the Ph.D. candidates for their course work examination.

Sub. Code: MEP009	Sub: MATERIAL SCIENCE	
Unit. No.	**Particulars**	**Contact hours**
1.	INTRODUCTION: Classification of materials, Structure property relationship in material, multiphase materials, Modern materials – polymers, ceramics, composites, nanomaterials. CRYSTAL IMPERFECTIONS: Point and line imperfections, Frankel Defects, Schottky defects, dislocations, Burger Vectors, Surface Imperfections, Stacking faults.	8
2.	DIFFUSION IN SOLIDS: Fick's law of diffusion, Temperature dependence of diffusion coefficients, The Kirkendall effect, the atomic model of diffusion.	8
3.	MAGNETIC MATERIALS: Magnetic behaviour of materials, classification of magnetic materials, Ferromagnetism and Antiferromagnetism, The soft and hard magnetic materials, magnetic bubbles and magnetic bubble memory.	8
4.	DIELECTRICS: Polarization and dielectric constant, Basic relationships, Frequency and temperature dependent dielectric constant, Claussius Mossotti equation, dielectric loss factor, basic considerations, relaxation time and activation energy, tangent of dielectric loss angle, displacement and complex dielectric constant and basic equations, ferrites.	8
5.	SUPERCONDUCTORS: Zero resistivity, critical magnetic field and critical current density, Meissner effect, Type I & II Superconductors, Josephson effect, High Tc superconductors, BCS theory of superconductivity.	8

REFERENCE BOOK:

1. Material Science and Engineering byV.Raghavan
2. Introduction to Materials Science for Engineers by James F.Shackelford
3. Electrical Properties of Materials by G.C.Jain
4. Material Science by A.J.Dekker

Sub. Code: MEP002	Sub: MANUFACTURING TECHNOLOGY	
Unit. No.	**Particulars**	**Contact hours**
1.	Unit 1: Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.	8
2.	Unit 2: Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM -Mechanics of cutting, models, Parametric Analysis, WJM -principle, equipment, process characteristics, performance.	8
3.	Unit 3: EDM - principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM. LBM - working , equipment , PAM - working , system ,performance EBM - working , equipment , process parameters ECM - principle, equipment, mechanical properties, MRR, parameter analysis	8
4.	Unit 4: 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.	8
5.	Unit 5: 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.properties of nano-materials, introduction to micromachining, High Speed Machining and rapid prototyping process.	8

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology / Kalpakijian / Adisson Wesley.
2. Process and Materials of Manufacturing / R. A. Lindburg / PHI.
3. Microelectronic packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostrand 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 / Mc Graw Hill

Sub. Code: MEP007	Sub: FOUNDATIONS OF NANOSCALE SCIENCE AND TECHNOLOGY	
Unit. No.	**Particulars**	**Contact hours**
1.	NANOTECHNOLOGY: Background, what is nanotechnology, types of nonotechnology and nano-machines, top down and bottom up techniques, atomic manipulation-nanodots, semi-conductor quantum dots, self-assembly monolayers, Simple details of characterization tools- SEM, TEM, STM, AFM.	8
2.	NANOMATERIALS: What are nanomaterials? Preparation of nanomaterials- solid state reaction method, Chemical Vapor Deposition, Sol-gels techniques, Electrodeposition, Ball Milling, Introduction to lithography, pulse laser deposition (PLD), Applications of nanomaterials	8
3.	CARBON TUBES: New forms of carbon, Carbon tubes-types of nanotubes, formation of nanotubes, Assemblies, purification of Carbon nanotubes, Properties of nanotubes, applications of nanotubes.	8
4.	OPTICS, PHOTONICS AND SOLAR ENERGY: Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, Solar cells, Optically useful nanostructured polymers, Photonic Crystals.	8
5.	FUTURE APPLICATIONS: MEMs, Nanomachines, Nanodevices, quantum computers, Opto-electronic devices, quantum electronic devices, Environmental and Biological applications.	8

REFERENCE BOOKS:

1. Nanotechnology-Basic Science and Emerging Technologies Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, Overseas Press.

2. Nanotechnology-A Gentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner, Prentice Hall.

3. Nanotechnology Rebecca L Johnson, Lerner Publications.

4. Introduction to Nanotechnogy Charles P. Poole Jr., Chapman and Hall/CRS

Sub. Code: MEP003	Sub: MATERIALS CHARACTERISATION TECHNIQUES	
Unit. No.	**Particulars**	**Contact hours**
1.	X-Ray Methods: Production and detection of X-rays, X-ray spectra, X-ray absorption and diffraction, Scattering factors (Atomic scattering factor and geometrical scattering factor), Reciprocal lattice, Diffractometers and spectrometers, Methods of analysis: Powder and Laue, Electron microproble analysis.	12
2.	Surface analysis techniques: Auger, ESCA, ISS, SIMS, methods of surface analysis (principle, instrumentation and detection) Mass spectrometers and spectrographs, Moss bauer spectrometry, Neutron activation analysis, Nuclear magnetic resonance spectroscopy.	12
3.	Electron microscopy: Electron microscope, construction, contrast, resolving power, depth of focus, specimen preparation, Scanning electron microscopy.	8
4.	Thermal analysis: Gravimetric analysis, Differential thermal analysis.	8

REFERENCE BOOK:

1. X-ray diffraction methods by BD Culity

2. Instrumental methods of Chemical analysis: Willard Merritt and Dean

3. Methods of Chemical analysis by Ewings

4. Electron microscopy of thin crystrals: Hirsch, Nicholson Pashley and Whelan

Sub. Code: MEP005		Sub: ADVANCES IN PRODUCTION AND INDUSTRIAL ENGINEERING
Unit. No.	**Particulars**	**Contact hours**
1.	Unit 1 : Quantitative techniques Optimization techniques, Simulation Using Software, Non-linear Programming, Goal Programming, Inventory Management , Supply Chain Management, Project Management, Resource Optimization.	8
2.	Unit 2 : Robotics And Automation CAD / CAM, Rapid Prototyping, Flexible Manufacturing Systems And Group Technology (MICLASS, OPTIZ), Cell Formation in GT. Analysis of Vision System, Robot kinematics and dynamics, Trajectory Planning in robotics, Avoiding obstacles by robot.	8
3.	Unit 3 : Reliability / Maintenance Fault Tree Analysis & Event Tree Analysis, Accelerated reliability testing, Nonparametric reliability evaluation, Failure Modes Effects Analysis & Failure Modes Effects and Criticality Analysis, reliability evaluation of complex system, Evaluation of system reliability.	8
4.	Unit 4: Advanced Machine Tool Design Design of elements like Bed, Columns, Guideways, Design of Guides using FEA, Lumped parametric method, Design of spindles based on deformation and rigidity, Reliability based design, static and dynamic rigidity, stability analysis.	8
5.	Unit 5 : Metrology and Quality Control Error due to Numerical Interpolation, displacement measurement technique, Error types and their evaluation, Image processing and its applications in metrology, Laser trackers, micro and nanometrology, Process capability- Process Capability Index. Quality Control, Statistical Quality Control, Quality assurance systems.	8

REFERENCE BOOKS:

1. Gupta P. K. and Hira D. S. : Operations Research, S Chand & Company Ltd.
2. Robotics for Engineers – Yoram Koren, Tata McGraw Hill.
3. Plant Layout and Material handling James M Apple,2"d Edition., John, Wiely and Sail.
4. Production Flow Analysis for Planning Group Technology – John L. Burbridge
5. Concepts in Reliability in Engineering – L. S. Srinath, Affiliated East West Press.
6. Precision Engineering in Manufacturing , R.L. Murthy.
7. Fundamentals of Tribology – S.K.Basu, B.B. Ahuja and S.N. Sengupta, PHI.
8. Design of Machine Tools – Latest Edn. – S. K. Basu and D. K. Pal, Oxford – IBH.

Sub. Code: MEP001	**Sub: PRODUCTION PLANNING & CONTROL**	
Unit. No.	**Particulars**	**Contact hours**
1.	UNIT-I General: Functions of production planning and control, preplanning planning, control, plant layout, simplification and standardization, time and motion study.	8
2.	UNIT-II Product Development and Design: Effect of competition on design, Long-range Planning, Company policy, product analysis, marketing aspects, the product characteristics, functional aspect, operational aspect, durability and dependability, Aesthetic aspect; Economic analysis, Profit and competitiveness, The three S's:- Standardization, Simplification and Specialization. Break Even Analysis.	8
3.	UNIT-III Inventory Control :Definition, classification, objectives of inventory control, functions, economic order quantity various inventory models. Numericals on inventory control. Inventory carrying costs, factors affecting inventory costs. V.E.D. analysis, S-D-E analysis, F-S-N analysis H-M-L analysis and ABC analysis. Safety stocks, their objectives safety stocks and service levels.	8
4.	UNIT-IV Evaluation of Material and Processes : Introduction, value analysis, consideration of new techniques and materials, value analysis tests, material utilization of a product or assembly. Numerical problems on material utilization of a product. Value engineering job plan and various phases of job plan in systematic value engineering approach.	8
5.	UNIT-V Routing, Loading and Scheduling: Introduction, Scheduling Procedure, Master Schedule, its objectives, Order scheduling, Loading by scheduled period, Dispatching, Job card, Job order. Commercial Loading & Scheduling Devices.	8

REFERENCE BOOKS:

1. Production Planning and control: Samuel Eilon
2. Production Planning and Control: K.C. Aggarwal & K.C. Jain
3. Industrial Engg. & Operation Management by S.K. Sharma & Savita Sharma.
4. Production Planning and Control: King J.R.
5. Production Planning and Control: Sharma, Hari Rraghu Rama.
6. Production Planning and Control: Narasimhan Seetha-rama L.

Sub. Code: MEP004	**Sub: GAS TURBINE AND JET PROPULSION**	
Unit. No.	**Particulars**	**Contact hours**
1.	UNIT-I Introduction: Introduction to simple gas turbine; open cycles considering heat exchanger; reheater; multispool arrangement; combined cycles and cogeneration scheme; closed cycle; industrial applications of gas turbine.	8
2.	UNIT-I I Power Cycles : Efficiencies & specific work output of heat exchanger cycles; reheat cycles; cycles with intercooled compression; various component loses.	8
3.	UNIT-III Combustion Systems: Combustion process; types of combustion systems; operational requirements; combustion chamber performance. Turbine Axial Flow : Turbine- Elementary theory of axial flow turbine; swirl angle; total to total stage efficiency; flow coefficient; floe coefficient; loss coefficient for the nozzle blades; methods of blade cooling. Radial flow turbine- specific work output; various efficiencies	8
4.	UNIT-IV Jet Propulsion & Turbojet Engine: Introduction; net thrust; propulsion efficiency; intake & propelling nozzle efficiency; turbojet engine -actual cycle analysis ; typical engine performance; corrected engine performances; thrust augmentation. Turboprop & Ramjet Engine: Turboprop Engine process & cycle analysis; engine performances; Ramjet engine; jet expansion; overall process and performance.	8
5.	UNIT-V Rocket Engine Solid and liquid propellant rocket motor cooling; propellant section; performance and design.	8

REFERENCE BOOKS:

1. Gas turbine theory by H. Cohen & GFC Rogers
2. Jet propulsion and gas turbine theory gy Zucrow, John Wiley.
3. Jet propulsion by Hesse, Pitman.
4. Theory and design of gas turbine & jet engine by Vincent, Mcgraw Hill.

Sub. Code: MEP006	Sub: COMPUTATIONAL FLUID DYNAMICS	
Unit. No.	**Particulars**	**Contact hours**
1.	UNIT-I Introduction: Introduction to C.F.D. models of the flow, governing differential equations – continuity equation, momentum equation, energy equation, Navier- stokes equation, physical boundary conditions.	8
2.	UNIT-II Mathematical behavior of governing equation: Classification of quasi linear partial differential equation, General method of determining the Classification of partial differential equation, hyperbolic, parabolic, elliptic equations.	8
3.	UNIT-III Discritization methods: Finite difference methods, difference equations, explicit & implicit approach, errors & analysis of stability. Basics of finite control volume method, errors & analysis of stability.	8
4.	UNIT-IV Heat conduction problem: Solution of One dimensional heat conduction through a pin fin by F.D.M solution of two dimensional heat conductional in a plate by F.D.M. Control volume formulation of the heat conduction problem and its solution.	8
5.	UNIT-V Heat conduction with convection & diffusion : Steady state one dimensional convection and diffusion, unwinding, exact solution, exponential scheme, hybrid scheme, power law scheme, Discritization equation for two dimensions & three dimensions, false diffusion.	8

REFERENCE BOOKS:

1. Numerical heat transfer and fluid flow by suhas. V. patankar

2. Computational fluid dynamics by John.d.Anderson, Jr.

3. Introduction to Computational fluid dynamics by Anil .W. Date

Sub. Code: MEP008	**Sub: ADVANCED HEAT AND MASS TRANSFER**	
Unit. No.	**Particulars**	**Contact hours**
1.	UNIT-I Conduction: Review of the basic laws of conduction, convection and radiation. General heat conduction equation in different co-ordinates. One dimensional steady state conduction with variable. Thermal conductivity and with internal distributed heat sources, extended surfaces review, Tapered fins, design considerations. Two dimensional steady-state conduction, semiinfinite and finite flat plates and cylinders, graphical method, relaxation technique. Unsteady state conduction in solids with infinite thermal conductivity, infinite thick-solids, periodic variation, solutions using Grolber's and Heisfer's charts.	10
2.	UNIT-II Convection: Hydrodynamic and thermal boundary layers, differential equations, momentum and energy and their solutions, heat transfer in turbulent flow, eddy heat diffusivity, Reynold's analogy between skin friction and heat transfer. Free convection, empirical correlations, regimes of boiling, Nucleate and film boiling.	10
3.	UNIT-III Heat Exchangers Introductions, effectiveness and number of transfer units, design of heat exchangers. Radiation Introduction, laws of radiation, heat exchange between black bodies and non-black bodies, shape factor algebra, Radiation shields, electrical net-work approach of radiation heat exchange.	10
4.	Mass Transfer Introduction, Fick's law, General equation of mass diffusion steady state, diffusion through a plain membrane, diffusion of water vapour through air, Mass transfer coefficient, convective mass transfer. Heat Pipe Introduction, Working of Heat pipe, Different types of Heat Pipe, Detail of Heat Pipe components, Advantages of Heat Pipe, Application of Heat Pipe, Performance of Heat Pipe, Limitation of Heat Pipe, Analysis and Design of Heat Pipe.	10

REFERENCE BOOKS:

1. Principles of Heat Transfer by Kreith

2. Heat Transfer by Holman.

3. Fundamentals of Heat and Mass-transfer by D.S. Kumar

4. Heat and mass transfer by Eckert Darke.

MEP010	RAPID PROTOTYPING TECHNOLOGIES

Unit	Particulars	Contact Hrs
1	**Introduction & History of Rapid Prototyping** - Need for the compression in Product development Growth of RP Industry, Classification of RP, Stereo lithography(SLA) system & principle, Process parameter, process details of SLA, Data preparation, data files of SLA , Machine details & Application of SLA	8
2	**Selective Laser Sintering (SLS)- Introduction, SLS Machine Type –** Details, SLS principle of operation, Process parameters of SLS, Data preparation for SLS, Fused Deposition Modeling (FDM) – Introduction, FDM Principles, Process Parameters, Path generation & Application of FDM, Solid Ground curing (SGC) - Principle of operation, SGC machine details & application,	8
3	**Laminate Object Manufacturing (LOM) -** Principle of operation, LOM materials, LOM Process details & Application, Concepts modelers – Principle, Thermal Jet Printer, Sander model maker – Explanation, 3-D Printer, Genesis Printer & HP Systems, Object Qudra system	8
4	**Rapid tooling** -Indirect rapid tooling, Silicon Robber tooling, Aluminium filling epoxy tooling, Spray metal tooling, Direct rapid tooling, Quick cast process, copper Polyamide, DMILS – explanation, Prometals, sand casting tooling, Soft tooling & hard tooling	8
5	**STL files, Solid View, Magics, Imics,** Magic communicator, Internet based software, Rapid Manufacturing – Introduction, Factors influencing accuracy, Data preparation errors, Part building errors, Errors in finishing, Influence of build orientation	8

TEXT BOOKS:

1. Paul F. Jacobs: "Stereo lithography and other RP & M Technologies", SME, NY 1996.
2. Flham D. T &Dinjoy S.S "Rapid Manufacturing" Verlog London 2001.
3. Lament wood, Rapid automated, Indus press New York

REFERENCES BOOKS:

1. Terry Wohlers "Wohler's Report 2000" Wohler's Association 2000.
2. Gurumurthi, Rapid prototyping materials, IISc Bangalore.

MEP011	INDUSTRIAL ROBOTICS

Unit	Particulars	Contact Hrs
1	**Introduction :** Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control.	8
2	**Components and Operations :** Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators - director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.	8
3	**Sensing and Machine Vision :** Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis	8
4	**Robot Programming :**Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation - Search techniques - A1 and Robotics.	8
5	**Industrial Applications :**Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.	8

TEXT BOOKS:

1. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
2. Mikell P. Groover, Industrial Robotics Technology Programming and Applications, McGraw Hill Co., Singapore, 1995.

REFERENCES BOOKS:

1. Fu, K. S., Gonzalez, R. C., & Lee, C.S.G., Robotics control, sensing, vision and intelligence, McGraw Hill Book Co., Singapore, 1987.
2. Craig, J. J., Introduction to Robotics mechanics and control, Addison-Wesley, London, 1999.
3. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotic engineering - An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989

MEP012	ELEMENTS OF MECHATRONICS

Unit	Particulars	Contact Hrs
1	**INTRODUCTION** Introduction to Mechatronics systems, Mechatronics system components - Measurement Systems, Control Systems, Open and Closed Loops Systems, Sequential Controllers with examples – Water level controller, Shaft speed control, Washing machine control, Automatic camera and Engine management systems	8
2	**MICROPROCESSOR IN MECHATRONICS** Development of microprocessor systems, 8085 – Architecture, Pin diagram, Input and Output peripheral circuits, communications – Input, Output and Memory with timing diagrams, A/D and D/A convertors. Introduction to design and recent developments in microprocessors and controllers.	8
3	**ELECTRICAL DRIVES AND CONTROLLERS** Introduction, Electromagnetic Principles, Solenoids and Relays, Electrical drives - stepper motors, servo motors. Programmable logic controller - Programming units - Memory - Input - Output Modules - Mnemonics - Timers - Internal relays - Counters - Shift Registers - Programming the PLC using Ladder diagram - Simple example of PLC application	8
4	**SENSORS AND TRANSDUCERS** Resistive, capacitive and inductive transducers, Electric Position Sensors, Limit Switches, Optical encoders – Absolute and Incremental, Proximity Sensors, Solid State Sensors and Transducers, Temperature and pressure sensors.	8
5	**MECHATRONICS SYSTEM DESIGN AND APPLICATION** Mechatronics in Engineering Design, Traditional and mechatronics design, Applications 1– Pick and Place robots, Car park barriers, Bar code reader, Wind screen wiper wing stepper motor control. Case studies – Coin counters, Robot walking machine.	8

TEXT BOOKS:

1. Bolton, W., *Mechatronics*, Addison Wesley, 2nd Edition, New Delhi, 1999.
2. Bradley, D.A., Dawson D., Dawson, D. BurdN.C.and Loader A.J.,*Mechatronics*, Chapman and Hall Publications, New York, 1993.
3. GalopVisoy, A., and Devries, W.R., *Microcomputer Applications in Manufacturing*, John Wiley, New York, 1989.

REFERENCES BOOKS:

1. James Harter, *Electromechanics, Principles and Concepts and Devices*, Prentice Hall, New Delhi.
2. David W. Pessen, *Industrial Automation Circuit Design and Components*, John Wiley, New York, 1990.
3. Rohner, P., *Automation with Programmable Logic Controllers*, Macmillan / McGraw Hill, New York, 1996.
4. Brian Morris, *Automatic Manufacturing Systems Actuators*, *Controls and Sensors*, McGraw Hill, New York, 1994.
5. Goankar, R. S., *Microprocessor Architecture Programming and Applications*, Wiley Eastern, New Delhi, 1997.
6. Godfrey C. Onwuvolu, *Mechatronics Principles and applications*, Butterworth-Heinemann, New Delhi.

Sub. Code:CPE-RPE	**Sub: RESEARCH AND PUBLICATION ETHICS**

Syllabus in detail

THEORY

- **RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

- **RPE 02: SCIENTIFICCONDUCT (5hrs.)**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

- **RPE 03: PUBLICATION ETHICS (7 hrs.)**

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

- **RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**

1. Open access publications and initiatives

2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

RPE 05: PUBLICATION MISCONDUCT (4hrs.)

A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)

A. Databases (4 hrs.)

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics