

AFFILIATED INSTITUTIONS
ANNA UNIVERSITY , CHENNAI
REGULATIONS - 2009
CURRICULUM I TO IV SEMESTERS (FULL TIME)
M.E. MECHATRONICS
SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA9319	<u>Numerical Methods & Graph Theory</u>	3	1	0	4
2	MR9311	<u>Sensors in Automation</u>	3	0	0	3
3	MR9312	<u>Concepts in Mechanical Engineering</u>	3	0	0	3
	MR9313	<u>Concepts in Electronics Engineering</u>				
4	MR9314	<u>Fluid Power Automation</u>	3	0	0	3
5	E1	Elective I	3	0	0	3
6	E2	Elective II	3	0	0	3
PRACTICAL						
7	MF9326	<u>Automation Lab</u>	0	0	3	2
TOTAL			18	1	3	21

ELECTIVES FOR M.E. MECHATRONICS ENGINEERING

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MR9001	<u>Industrial Instrumentation</u>	3	0	0	3
2	MF9062	<u>Artificial Intelligence</u>	3	0	0	3
3	QE9014	<u>Metrology and Inspection</u>	3	0	0	3
4	MR9002	<u>Machine Vision and Applications</u>	3	0	0	3
5	MR9003	<u>Mechatronics elements and programming of CNC machines</u>	3	0	0	3
6	MR9004	<u>Automotive Electronics</u>	3	0	0	3
7	MR9005	<u>Opto Electronic Instrumentation</u>	3	0	0	3
8	MR9006	<u>Machine Tool Control and Condition Monitoring</u>	3	0	0	3
9	MR9007	<u>Network and Distribution System</u>	3	0	0	3
10	MR9008	<u>Medical Electronics and Instrumentation</u>	3	0	0	3
11	MR9009	<u>Real Time Embedded System</u>	3	0	0	3
12	MR9010	<u>Mechatronics System Design</u>	3	0	0	3
13	MR9011	<u>Telematics</u>	3	0	0	3
14	MR9012	<u>Mechatronics for Aircraft</u>	3	0	0	3
15	MF9063	<u>Lean Manufacturing system and Implementation</u>	3	0	0	3
16	MF9061	<u>Non-Destructive Evaluation</u>	3	0	0	3
17	MR9013	<u>Material Handling, Storage And Assembly Automation</u>	3	0	0	3
18	MF9053	<u>Materials Management & Logistics</u>	3	0	0	3

MA9319 NUMERICAL METHODS AND GRAPH THEORY L T P C
3 1 0 4

AIM:

To solve some engineering models and problems by using Numerical Analysis and Graph Theoretical concepts.

OBJECTIVES:

The engineers will have an exposure on various topics such as Systems of Equation, Interpolation and Numerical Integration, Initial and Boundary Value Problems, Fundamentals of Graphs, Graphs Algorithms to understand their applications in engineering problems.

UNIT I SYSTEMS OF EQUATIONS 12

Simultaneous linear equations – Direct method – LU decomposition methods - Gauss elimination, Gauss Jordan methods – Iterative methods – Jacobi and Gauss-Seidel methods.

UNIT II INTERPOLATION AND INTEGRATION 12

Hermite's interpolation – Cubic Spline Interpolation – Gaussian – Numerical Integration – Trapezoidal and Simpson rules – Newton-Cotes formula – Gaussian quadrature – cubature.

UNIT III NUMERICAL METHODS FOR ODE 12

Single step methods – multi step methods – Taylor series and Euler methods – Runge Kutta method of fourth order – Multi step methods – Adams-Bashforth, Milnes Predictor-Corrector methods – Boundary value problems by Finite difference method.

UNIT – IV FUNDAMENTALS OF GRAPHS 12

Graphs – sub graphs - Complements – Graph isomorphism – vertex degree: Eulerian graphs – Planar graphs – Hamiltonian paths, tree and Cut-sets.

UNIT – V TREES AND ALGORITHMS 12

Kruskal's algorithm – Dijkstra's shortest path algorithm, Prim's algorithm – Transport Networks.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
2. Froberg, C.E. Numerical Mathematics, The Benjamin/Cummings Publishing Co., Inc., 1985.
3. Grimaldi R.P., Discrete and Combinatorial Mathematics, Pearson Education Inc., 1999.

REFERENCES:

1. Froberg, C.E. Numerical Mathematics, The Benjamin/Cummings Publishing Co., Inc., 1985.
2. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
3. Bondy, J.A. and Murthy, U.S.R., Graph Theory with Applications, Macmillan,

AIM:

To impart knowledge on various types of sensors and transducers for Automation in Manufacturing Engineering.

OBJECTIVE:

- To study basic concepts of various sensors and transducers in Manufacturing Engineering
- To develop knowledge in selection of suitable sensor in manufacturing requirement

UNIT I INTRODUCTION 9

Definition – Measurement Techniques – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – calibration techniques – Potentiometer – strain gauges – optical encoders.

UNIT II INDUCTANCE AND CAPACITANCE TRANSDUCER 9

LVDT – RVDT – Synchro – Microsyn – Applications: Pressure, position, angle and acceleration. Capacitance circuitry – Feed back type condenser microphone – frequency modulating oscillator circuit – Dynamic capacitance variation – A.C. Bridge for Amplitude Modulation – Applications: Proximity, microphone, pressure, displacement.

UNIT III PIEZOELECTRIC & MAGNETIC SENSORS 9

Piezoelectric Materials and properties – Modes of deformation – Multimorphs – Environmental effects – Applications: Accelerometer, ultrasonic. Magnetic Sensors – types, principle, requirement and advantages: Magneto resistive – Hall effect - Eddy current.

UNIT IV RADIATION AND ELECTRO CHEMICAL SENSORS AND APPLICATIONS 9

Photo conductive cell, photo voltaic, Photo resistive – Fiber optic sensors – X-ray and Nuclear radiation sensors – Electrochemical sensors: Electrochemical cell, polarization, sensor Electrodes and electroceramics in Gas Media.

UNIT V RECENT TRENDS IN SENSORS AND APPLICATIONS 9

Film sensors – micro-scale sensors – Particle measuring systems – Applications and case studies of Sensors in Automobile Engineering, Aeronautics, Machine tools and Manufacturing processes

TOTAL: 45 PERIODS

REFERENCES:

1. Patranabis D., Sensor and Actuators, Prentice Hall of India (Pvt) Ltd., 2005.
2. Renganathan S., Transducer Engineering, Allied Publishers (P) Ltd., 2003
3. Ernest O. Doebelin, Measurement system, Application and design, , Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004
4. Bradley D.A., and Dawson, Burd and Loader, Mechatronics, Thomson Press India Ltd., 2004
5. Bolton W., Mechatronics, Thomson Press, 2003.

AIM:

To impart knowledge of basic mechanical engineering to the students.

OBJECTIVE:

To make the students to understand the concepts, design, construction and properties of mechanical elements

UNIT I MECHANISMS 11

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint & motion - Degrees of freedom – Slider crank – Single and double – Crank rocker mechanisms – Inversions – applications. Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II TRANSMISSION SYSTEMS 12

Types of friction – friction in screw and nuts – pivot and collar – thrust bearings – collar bearing – plate and disc clutches – belt (flat & vee) and rope drives – creep in belts – Jockey pulley – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tension – condition for maximum power transmission – basics of brakes, journal and rolling element bearings hydrostatic and aerostatic bearings – recirculating ball screw and nut assembly.

UNIT III VIBRATION 8

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

UNIT IV DESIGN OF MACHINE ELEMENTS 7

Design of shafts – Springs – screw and fasteners – Gear profile and geometry – nomenclature of spur & helical gears – worm and worm wheel.

UNIT V MACHINE TOOLS 7

Machine tool construction-features – operations of lathe, milling machine, drilling machine – Drive system for machine tools – mechanical, hydraulic and electric stepped and variable speeds – spindle speeds and feed drives-linear and reciprocation motion generation.

TOTAL: 45 PERIODS

REFERENCES:

1. Bansal Dr.R.K."Theory of Machines" Laxmi Publications (P) Ltd., New Delhi 2001.
2. G.C.Sen . and A. Bhattacharya, "Principles of machine tools" , New Central book Agency, 1999.
3. Joseph Edward Shigley, Charles R.Mischke, "Mechanical Engineering Design" Mcgraw Hill International Edition, 1992.
4. S.G. Kulkarni, "Machine Design", Tata McGraw Hill,2003.
5. Malhotra .D.R. and Gupta .H.C. "The Theory of machines" Satya Prakasam, Tech. India Publications, 1989.
6. Acherkan.N, "Machine tool Design" , vol 3, MIR Publishers, 1978

AIM:

To understand the basics and working principles of electronic components and their applications

OBJECTIVE:

This course is intended for learning the Fundamentals, properties and applications of Electronic Components, Characteristics and applications of all types of power circuits, principles and operations of Operational Amplifiers. This course is also gives the ideas of Digital Electronics and all types of Analog and Digital Modulation techniques.

UNIT I ELECTRONIC COMPONENTS AND DEVICES 9

Resistors, Capacitors, Inductors, Transformers – Properties, types and applications; Junction diodes, Zener diodes, Bipolar transistors, Field Effect transistors, Unijunction Transistors, MOS Devices, LEDs – Characteristics and applications; Feedback amplifiers, Oscillators, Power amplifiers.

UNIT II POWER CIRCUITS 6

Rectifiers and Filters; Regulated Power Supply – Switching Power Supplies, Thermal Considerations, Thyristor Devices – SCR, DIAC, TRIAC, QUADRAC – operating mechanism, characteristics and applications.

UNIT III OPERATIONAL AMPLIFIERS 12

Principles, Specifications, Ideal characteristics, Arithmetic Operations using Op-Amps, Integrator, Differentiator, Comparator, Schmitt Trigger, Instrumentation Amplifier, Active filters, Linear Rectifiers, Waveform Generators, D/A converters.

UNIT IV DIGITAL ELECTRONICS 12

Number systems – Logic gates – Boolean algebra – Simplification of Boolean functions using Map method. Tabulation method – Combinational logic circuits: Full adder, Code Converters, Multiplexers, Decoders – Sequential logic circuits: Flip-flops, Counters, Shift registers – A/D Converters.

UNIT V COMMUNICATION PRINCIPLES 6

Modulation: Need, Principles, Types – Analog Modulation, AM, FM – Digital Modulation: PWM, PCM, FSK – Demodulation techniques – Transmitters and receivers.

TOTAL: 45 PERIODS**REFERENCES:**

1. Jacob Mill Man, Micro electronics Digital and Analog circuits & Systems – McGraw-Hill 2004.
2. Fanco, design with Operational amplifiers and Analog Integrated Circuits, TMH, 2005
3. Taub and Schilling, Principles of Communicating systems, 3rd edition TMH, 2005
4. Ray & Chaudary, Linear Integrated Circuits, New Age 1991.
5. Malvino & Leach, Digital Principals & application, TMH 2002

AIM:

To impart knowledge in the area of hydraulics, pneumatic and fluid power components and its functions.

OBJECTIVE:

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulics and pneumatic circuits using ladder diagram.

UNIT I INTRODUCTION 5
Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS 8
Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.

UNIT III CONTROL AND REGULATION ELEMENTS 8
Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves-Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN 10
Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS 7
Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL: 45 PERIODS

REFERENCES:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
2. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
3. Durbey.A.Peace, Basic Fluid Power, Prentice Hall Inc, 1967
4. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
5. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978.
6. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.
7. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.

AIM:

To impart knowledge in the area of hydraulics and pneumatic components and its functions.

OBJECTIVE:

- To make the students to learn the basic concepts of hydraulics and pneumatics and its applications in the area of manufacturing process.
 1. To simulate the various hydraulics and pneumatics circuits
 2. Study of Sensors and Transducers.
Potentiometer, Strain gauge, Torque, LVDT, Hall-effect, speed, Vibration, Pressure.
 3. Study of Temperature Transducer.
 4. Study of optical Transducer.
 5. Exercises on Operational amplifier circuits.
 6. Study of Fiber optic sensors.
 7. Electronic Power controls of DC and AC motors.
 8. Study of Hydraulic and Pneumatic components.
 9. Exercise on Hydraulic circuits.
 10. Exercise on Electro hydraulic circuits.
 11. Study of Electro Pneumatic Sequencing circuits.
 12. Study of Hydraulic and Pneumatic Circuits using simulation software.
 13. Exercise on Hydraulic and Pneumatic circuits using PLC.

AIM:

To understand and know the measurements of various industrial instruments and data presentation systems.

OBJECTIVE:

This course is intended for learning the Pressure Measurement. All types of Flow Measurements, All types of temperature, humidity, strain and vibration measurements, classification and characteristics of Data Presentation Systems.

UNIT – I PRESSURE MEASUREMENT 9

Pressure Standards – Dead weight gauge, Manometers – Elastic elements: Diaphragms, Bellows, Bourdon tubes – Low pressure measurement: McLeod gauge, Knudsen gauge, Thermocouple and Pirani gauge, Ionization gauge – High pressure measurement – I/P and P/I Converters, Transmitters.

UNIT – II FLOW AND LEVEL MEASUREMENTS 9

Head-type flow meters: Orifice, Venturi, Nozzle – Rotameter – Anemometers: Hot wire and Hot film – Electromagnetic flowmeters – Turbine flowmeter – Ultrasonic Flowmeter – Electric methods for level measurement: Resistance switching type, Conductance probe type, Capacitance type – Ultrasonic, Nuclear Radiation methods of Level measurement.

UNIT – III TEMPERATURE AND HUMIDITY MEASUREMENT 9

Temperature Standards Range – Resistance Temperature Detectors (RTDs), Two wire and Three wire configuration – Thermocouples: Lead and Cold Junction Compensation Techniques – Radiation pyrometers – Humidity measurements – Transmitters.

UNIT – IV STRAIN AND VIBRATION MEASUREMENTS 6

Stress – strain relation – Strain measurement considerations – Static and Dynamics Measurements – Calibration of Strain gauges – Load Cells – Vibration Measurements.

UNIT – V DATA PRESENTATION SYSTEMS 12

Classification – Characteristics – Digital display elements, LEDs, LCDs, - Dot matrix systems, alphanumeric displays – Graphic display: CRT – Recording: Chart recorders, CRO, X-Y Recorders, Printers, Magnetic recorders, Digital recording techniques Signal conditioning methods – Data Acquisition Systems – Data Loggers – Outline and Features of PC Based Instruments – Virtual Instruments.

TOTAL: 45 PERIODS**REFERENCES**

1. Ernest O.Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw-Hill Book Company, 1998.
2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.
3. B.C.Nakra and K.K.Chaudary, Instrumentation Measurement and Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1985.
4. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw-Hill Publishing Ltd., New Delhi, 1999.

AIM:

To understand the various types and applications of Fuzzy Logics and Artificial Neural Networks.

OBJECTIVE:

This course is intended for learning the basic concepts, Operations and Principles of Fuzzy Logic, applications of various Fuzzy Logic systems, architecture and Taxonomy of Neural Networks. This course is also gives the ideas of ANN Architectures, Genetic Algorithms. Meta Heuristic techniques and Applications in Design and Manufacturing.

UNIT – I INTRODUCTION TO FUZZY LOGIC 8

Basic concepts in Fuzzy Set theory – Operations of Fuzzy sets – Fuzzy relational equations – Propositional, Predicate Logic – Inference – Fuzzy Logic Principles – Fuzzy inference – Fuzzy Rule based systems – Fuzzification and defuzzification – Types.

UNIT – II FUZZY LOGIC APPLICATIONS 10

Fuzzy logic controllers – Principles – Various industrial Applications of Fuzzy logic control – Adaptive Fuzzy systems – Fuzzy Decision making – Fuzzy classification – Fuzzy pattern Recognition – Image Processing applications – Fuzzy optimization.

UNIT – III INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 8

Fundamentals of Neural networks – Neural network architectures – Learning methods – Taxonomy of Neural Network Architectures – Standard back propagation Algorithms – Selection of various parameters – Variations.

UNIT – IV OTHER ANN ARCHITECTURES 10

Associative memory – Exponential Bidirectional Associative Memory – Adaptive Resonance Theory – Introduction – Adaptive Resonance Theory 1 – Adaptive Resonance Theory 2 – Applications – Kohen Self organizing maps – counter propagation networks – Industrial Applications.

UNIT – V RECENT ADVANCES 10

Fundamentals of Genetic Algorithms – Hybrid systems – Meta heuristic techniques like simulated Annealing, Tabu Search, Ant colony optimization, Perpetual self organizing, Artificial immune systems – Applications in Design and Manufacturing.

TOTAL: 45 PERIODS

REFERENCES:

1. Klir, G.J. Yuan Bo, 'Fuzzy sets and Fuzzy Logic: Theory and Applications', Prentice Hall of India Pvt. Ltd., 1997.
2. Jacek M. Zurada, 'Introduction to Artificial Neural Systems' Jaico Publishing House, 1994
3. Simon Haykin, 'Neural Networks – A comprehensive foundation', Prentice Hall, 2nd Edition, 1998.
4. Laurene Fausett, 'Fundamentals of Neural Networks, Architectures, Algorithms and Applications, Prentice Hall, Englewood cliffs, 1994.
5. S. Rajasekaran, GA Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithms', Prentice Hall of India Private Limited, 2003.

AIM:

To enable the learner to get familiar with the fundamental and advanced aspects of manufacturing metrology and quality control.

OBJECTIVE:

To make the learner to design and fabricate inspection methods and systems in incorporating electronic systems for inspection and quality control in engineering.

UNIT – I FUNDAMENTALS AND CONCEPTS IN METROLOGY 9

Standards of measurement – Analog and digital measuring instruments-comparators – Limits, Fits and Tolerances – Gauge design – Angular measurements – Surface Roughness – Form errors and measurements.

UNIT – II INSPECTION AND GENERAL MEASUREMENTS 12

Inspection of gears and threads – Tool makers' microscope – Universal measuring machine – use of Laser interferometer in machine tool Inspection – use of laser in on-line Inspection – Laser micrometer – Laser Alignment telescope.

UNIT – III OPTO ELECTRONICS IN ENGINEERING INSPECTION 6

Use of opto electronics in Tool wear measurement – Micro hole measurement and surface Roughness – Applications in In-Process measurement and on line Inspection.

UNIT – IV MACHINE VISION 9

Fundamentals of Image Processing – Steps involved in Image Processing – Machine Vision applications in manufacturing and metrology.

UNIT – V COORDINATE METROLOGY AND QUALITY CONTROL 9

Co-ordinate measuring machines – Applications and case-studies of CMM in Inspection – Use of Computers in quality control – Control charts – Reliability.

TOTAL: 45 PERIODS**REFERENCES**

1. Jain R.K. Engineering Metrology – Khanna Publishers – 2000
2. Robert G. Seippel – Opto Electronics for technology and engineering – Prentice Hall – New Jersey 1989.
3. Anil.K.Jain Fundamentals of digital Image Processing – Prentice Hall of India Pvt. Ltd., - 2004
4. Dale.H. Besterfield Total Quality Management Pearson Education Asia – 2002
5. Manuals of C.M.M. and systems.

AIM:

To impart knowledge on image processing and machine vision applications

OBJECTIVE:

To understand and apply the machine vision analysis and applications.

UNIT – I INTRODUCTION 9

Human vision – Machine vision and computer vision – benefits of machine vision – Block diagram and function of machine vision system implementation of industrial machine vision system.

UNIT – II IMAGE ACQUISITION 12

Scene constraints-lighting sources, types and setups – Lighting parameters – working principle – Analog and Digital Cameras – General problem in capturing the image – selection of camera – optics in camera.

UNIT – III IMAGE PROCESSING 9

Image formation – filtering technique – Pixel processing – Processing of binary and grey scale images – Operators – types – segmentation – edge detection – Morphology.

UNIT – IV IMAGE ANALYSIS 6

Feature extraction-decision making – pattern recognition – colour image processing – 3D image processing.

UNIT – V MACHINE VISION APPLICATION 9

Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile and Bio medical field - Case studies

TOTAL: 45 PERIODS**REFERENCES**

1. Springer, 'Digital Image Processing', 2003
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing Analysis and machine vision publisher, 1995.
3. Richard.O.Duda, Peter.E.Hurt, Pattern Classification and Scene Analysis Publishers, 2000.
4. Rafael C.Gonzales, Richard.E.Woods, 'Digital Image Processing Publishers, 1992.
5. Nello Zuech, 'Understanding and Applying Machine Vision Marcel dekker Inc. 2000.

AIM:

To introduce the application of Mechatronics in machine tools.

OBJECTIVE:

To explain in detail about the various Mechatronics elements in CNC machines and also programming of CNC machines.

**UNIT – I INTRODUCTION OF NC, CNC, DNC AND ADAPTIVE
CONTROL**

6

Classification of machine tools – types, functions and processes - fundamentals of NC and CNC technologies

Adaptive control - types, application and benefits - general configuration of adaptive control and function – reasons for process change - practical problems with adaptive control - example for feedback and adaptive control.

UNIT – II MECHATRONIC ELEMENTS IN CNC MACHINE TOOLS

9

CNC systems - configuration of the CNC system – interfacing – monitoring – diagnostics - machine data - compensations for machine accuracies - PLC in CNC – PLC programming for CNC, steps in programming and case studies - machine structure -types of loads on CNC machine - guide ways and types - mechanical transmission elements - elements for rotary motion to linear motion - ball screw and types - roller screw and types - rack and pinion - various torque transmission elements - requirements of feed drives and spindle drive.

**UNIT – III MECHATRONICS ELEMENT IN CNC MEASURING SYSTEM AND
TOOLING**

12

Measuring systems - feedback devices - velocity feedback - analog and digital - position feedback - rotary and linear. Tooling - requirement and planning - preset, qualified and semi qualified tools. Fixtures – requirement - unified and modular fixtures - tool identification - touch trigger probe- tool coding - EEPROM tools.

Tool condition monitoring - various indirect and direct methods. Identification and gauging of work piece. Tool locking system - ball lock mechanism and contact pressure monitoring. Automatic tool changing system - types and benefits - tool magazine –sensors in CNC.

UNIT – IV CNC PROGRAMMING

14

Machine axes identification - primary, secondary and tertiary - manual CNC programming - Milling programming fundamentals - compensation and offset in milling -fixed cycles in milling - repetitive programming - loops, sub programs and macros. Turning programming fundamentals - compensation and offset in turning - fixed cycles in turning.

Computer assisted programming in APT - basic geometry definition - cutter motion definition - postprocessor statements - generation and execution of APT programs.

UNIT – V TESTING AND MAINTENANCE OF CNC MACHINES 5
 Verification of technical specification and functional aspects, Verification during idle running & machine tool and the work piece accuracy - Installation of CNC machines - Maintenance of CNC machines - machine elements – hydraulic elements - electrical and electronic elements – maintenance schedules.

TOTAL: 45 PERIODS

REFERENCES:

1. Jonathan Lin,S.C., “Computer Numerical Control (From Programming to Networking)”, Delmar Publishers Inc., 2000.
2. HMT Limited, “Mechatronics”, Tata Mcgraw-Hill Publishing Co Ltd, 2002.
3. Groover,M.P., “Automation, Production System and CIM”, Prentice Hall of India Pvt. Ltd, 2003.
4. Grahamt.Smith, “Advanced Machining: The Handbook of Cutting Technology”, IFS Publications Ltd., 1989
5. Sehwatt,M.S., and Narang,J.S., “CNC Machine”, Dhanpat Rai And Co, 2002.
6. Jayakumar,V., and Mahendran,B., “Computer Aided Manufacturing”, Lakshmi Publications 2005.
7. Radhakrishnan,P., “CNC Machine”, New Central Book Agency, 2000.
8. Stenerson and Curran, “Computer Numerical Control-Operation and Programming”, PHI Learning Pvt. Ltd., 2008.

MR 9004 AUTOMOTIVE ELECTRONICS L T P C
3 0 0 3

AIM:

To understand the design and specifications of various automotive electronic control systems.

OBJECTIVE:

This course is intended for learning the Fundamentals of Automobile Engineering, Automotive applications of all types of sensors and actuators systems. This course is gives the brief ideas of automotive engines, Engine control functions, Fuel delivery systems. All types of transmission control systems, Electromagnetic Interference and Electronic Dashboard Instruments.

UNIT – I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 6
 Introduction to Automobile Engineering, Automotive Engines, Automotive Control Systems – Components of Electronic Engine Management – Current trends in Automobiles.

UNIT – II AUTOMOTIVE SENSORS AND ACTUATORS 9
 Introduction – Basic Arrangement – Automotive applications of Pressure, Flow, Temperature sensors – Position, Speed and Acceleration Sensors – Exhaust gas sensors – Engine knock, Engine torque sensors – Automotive actuators.

UNIT – II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9

Fiber optic sensors – fiber optic instrumentation system – types of modulators – detectors – application in instrumentation – interferometric method of measurement of length – moiré fringes – measurements of pressure, temperature, current, voltage liquid level and strain – fiber optic gyroscope – polarization maintaining fibers.

UNIT – III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – three level and four level lasers – properties of laser – laser modes – resonator configuration – Q-switching and mode locking – cavity dumping – types of laser: gas lasers, solid lasers, liquid lasers and semi conductor lasers.

UNIT – IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length velocity, acceleration, current voltage and atmospheric effect – material processing laser heating, welding melting and trimming of materials – removal and vaporization.

UNIT – V HOLOGRAM AND MEDICAL APPLICATION 9

Holography – basic principle: methods: holographic interferometry and applications, holography for non – destructive testing – holographic components – medical applications of lasers, laser and tissue interaction – laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology.

TOTAL: 45 PERIODS

REFERENCES:

1. Ghatak A.K. and Thiagarajar K, Optical electronics foundation book, TMH, New Delhi, 1991 Keiser G, Optical Fiber Communication, McGraw Hill, 1991.
2. John and Harry, Industrial lasers and their applications McGraw Hill, 1974.
3. John F Read, Industrial applications of lasers, Academic Press, 1978
4. MonteRoss, Laser applications, McGraw-Hill 1968.

MR 9006 MACHINE TOOL CONTROL AND CONDITION MONITORING

**L T P C
3 0 0 3**

AIM:

To impart knowledge on machine tool control and conditioning monitoring.

OBJECTIVE:

To introduce various types of machine tool control and various condition monitoring techniques.

UNIT – I OVERVIEW OF AUTOMATIC CONTROL IN MACHINE TOOLS 11

Open loop and closed loop system in machine tools- process model formulation-transfer function-control actions-block diagram representation of mechanical pneumatic and electrical systems. Process computer - peripherals-Data logger-Direct digital control-Supervisory computer control.

UNIT – II DRIVE SYSTEMS AND FEED BACK DEVICES IN MACHINE TOOLS 9
Hydraulic and Pneumatic drives, Electrical drives – A.C. Motor, D.C. Motor, Servo motor and Stepper motor. Feed back devices - Syncro, resolver, diffraction gratings, potentiometer, Inductosyn and encoders-application in machine tools.

UNIT – III ADAPTIVE CONTROL AND PLC 10
Adaptive control-types – ACC, ACO, Real time parameter estimation, Applications - adaptive control for turning, milling, grinding and EDM. Programmable logic controller-Functions-Applications in machine tools.

UNIT – IV VIBRATION, ACOUSTIC EMISSION / SOUND. 8
Primary & Secondary signals, Online and Off-line monitoring. Fundamentals of Vibration, Sound, Acoustic Emission. Machine Tool Condition Monitoring through Vibration, Sound, Acoustic Emission, Case Studies

UNIT – V CONDITION MONITORING, THROUGH OTHER TECHNIQUES 7
Visual & temperature monitoring, Leakage monitoring, Lubricant monitoring, condition monitoring of Lube and Hydraulic systems, Thickness monitoring, Image processing techniques in condition monitoring.

TOTAL: 45 PERIODS

REFERENCES:

1. Manfred Weck, “Hand Book of Machine Tools” –Vol.3, John Wiley & Sons,1984.
2. Sushil Kumar Srivstava, “Industrial Maintenance Management”S.Chand & Company Ltd., New Delhi, 1998.
3. Mikell P.Groover, “Automation Production system and Computer Integrated Manufacturing”, Prentice Hall of India Pvt. Ltd., 1995.

MR 9007 NETWORKS AND DISTRIBUTION SYSTEMS L T P C
3 0 0 3

AIM:

To impart the knowledge of networking and distribution systems to the students

OBJECTIVE:

This course is intended for learning the Introduction to networks, definition of layers, reference models, Different Architectural Protocols and Standards, different protocols, Network interconnection, Distribution system models, and distribution file system.

UNIT – I NETWORK FUNDAMENTALS 6
Introduction to networks, definition of layers, services, interfaces and protocols, communication themes, switching techniques-circuit switched, package switched and message switched networks – reference models, (OSI, TCP/IP, ATM) layers and duties comparison of models.

UNIT – II ARCHITECTURAL PROTOCOLS AND STANDARDS 9
Physical Layer-General Description, Characteristics, Signalling Limits, Media Types and Comparison, Topologies, Examples of Physical Layer (RS232-C, ISDN, ATM, SONNET) Data link layer – sliding window protocols, A104A protocols, LAN protocols – Performance, specification and verification IEEE-Standards.

UNIT – III NETWORK INTERCONNECTION 6
Internet working – interconnection issues, bridges-transparent & source routing bridges, routers, flow and congestion command algorithms, gateways - Network security Internet protocols.

UNIT – IV DISTRIBUTED SYSTEMS 12
Models: Hardware concepts-software concepts-client server models-communication: Layout protocols-Remote procedure call-Remote object invocation-message oriented communication-synchronization Mechanism: clock-logical clocks-Election Algorithms-mutual exclusion- Case study: Amoeba-Mach-Chorus.

UNIT – V DISTRIBUTED FILE SYSTEM 12
Design:File service interface-Directory server Interface- Implementation:File usage-system structure-Caching replication- Trends in distributed file systems: New Hardware-scalability-Wide area networking-Mobile users-Fault tolerances-Multimedia.

TOTAL: 45 PERIODS

REFERENCES:

1. Stallings, S.W. Data and computer communications, IV Edition, Prentice Hall of India, 2006.
2. Tanenbaum, A.S. Computer Networks, Prentice Hall of India, III Edition, 2006.
3. Keiser, Local Area Network, Tata Mc GrawHill, 1999.
4. Kesav S. An engineering approach to computer networking, Addison – Wesley, 1999.
5. Comer E-Internetworking with TCP/IP(Volume 1), Principles, Protocols and architecture, III Edition, Prentice Hall of India, 1999.
6. Forouzan B, - Introduction to Data Communication & Networking McGraw Hill 1998.
7. Tanenbaum, A.S, Marten vansteen.“Distributed systems principles and paradigms” Prentice Hall of India, 2006.
8. Tanenbaum, A.S, “Distributed operating systems” Pearson Education, 1995.

MR 9008 MEDICAL ELECTRONICS AND INSTRUMENTATION L T P C
3 0 0 3

AIM:

To understand the concepts and operations of various medical electronic instruments.

OBJECTIVE:

This course is intended for learning the brief review of human physiology and anatomy, different types of sensors used in biomedicine, selection criteria for transducers and electrodes, different types Electro-Physiological Measurement, Measurement of blood pressure, gas volume, flow rate of CO₂ and O₂ in exhaust air, Medical Imaging Parameter Measurements, Cardiac pacemakers, defibrillators ventilators and Therapeutic devices.

- UNIT – I ANATOMY, PHYSIOLOGY AND TRANSDUCERS 9**
 Brief review of human physiology and anatomy – cell and their structures – electrical mechanical and chemical activities – action and resting potential – different types of electrodes – sensors used in biomedicine – selection criteria for transducers and electrodes – necessity for low noise pre-amplifiers – differential amplifiers –Chopper amplifiers – electrical safety – grounding and isolation.
- UNIT – II ELECTRO – PHYSIOLOGICAL MEASUREMENT 9**
 ECG – EEG – EMG - ERG – lead system and recording methods – typical waveforms – applications.
- UNIT – III NON-ELECTRICAL PARAMETER MEASUREMENTS 9**
 Measurement of blood pressure – blood flow cardiac output – cardiac rate – heart sound – measurement of gas volume – flow rate of CO₂ and O₂ in exhaust air – pH of blood – ESR and GSR measurements.
- UNIT – IV MEDICAL IMAGING PARAMETER MEASUREMENTS 9**
 X-Ray machine – computer aided tomography – magnetic resonance imaging system – ultra sonography – endoscopy – different types of telemetry system – laser in biomedicine.
- UNIT – V ASSISTING AND THERAPETIC DEVICES 9**
 Cardiac pacemakers – defibrillators ventilators – muscle stimulators – diathermy – introduction to artificial kidney artificial heart – heart lung machine – limb prosthetics – orthotics – elements of audio and visual aids.

TOTAL:45 PERIODS

REFERENCES

1. Webster J.G., Medical Instrumentation: Application and Design, 3rd Edition, John Wiley and Son, 1999.
2. Khandpur R.S. Hand book of Biomedical instrumentation and Measurements, Tata McGraw-Hill New Delhi 1987.
3. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley and Sons, USA, 1975.
4. Well G. Biomedical Instrumentation and Measurements, Prentice Hall, New Jersey, 1980.
5. Koryla J., Medical and Biological Application of Electro chemical devices John Wiley and Sons, Chichester, 1980
6. Wise D.L., Applied Bio-sensors, Butterworth USA, 1989
7. Jackson and Webster, Medicine and Clinical Engineering Prentice Hall, New Delhi, 1979.

AIM:

To impart knowledge in the area of real time embedded system.

OBJECTIVE:

To teach and understand about the definitions, high level language descriptions of software for embedded system.

UNIT – I INTRODUCTION TO EMBEDDED SYSTEMS 6

Definitions – Brief overview of micro-controllers, microprocessors and DSPs, - Typical classification and application scenarios of embedded systems.

UNIT – II EMBEDDED SYSTEM COMPONENTS AND INTERFACE 9

Embedded processors – Memory Devices – Interface and Peripherals – Power and its Management.

UNIT – III EMBEDDED SYSTEM DESIGN AND DEVELOPMENT 9

Design Methods and techniques – Models and languages – State Machine and state tables in embedded design – High level language descriptions of S/W for embedded system, Java based embedded system design – Simulation and Emulation of embedded systems.

UNIT – IV REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS 12

Event based, process based and graph based models, Petrinet models-Real time languages – The real time Kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services – Real time languages and their features.

UNIT – V CASE STUDIES IN REAL TIME EMBEDDED INSTRUMENTS 9

Specific examples of time-critical and safety-critical embedded systems applications in automotives, aerospace, medicine and manufacturing.

TOTAL: 45 PERIODS

REFERENCES

1. Ball S.R., Embedded microprocessor Systems – Real World Design, Prentice Hall, 1996
2. Herma K., Real Time Systems – Design for distributed Embedded Applications, Kluwer Academic, 1997.
3. Gassle.J., Art of Programming embedded systems, Academic Press, 1992.
4. Gajski, D.D. Vahid, F., Narayan S., Specification and Design of Embedded Systems, PTR Prentice Hall, 1994.
5. Intel manual on 16 bit embedded controllers, Santa Clara, 1991
6. C.M. Krishna, Kang G. Shin, Real Time systems, McGraw Hill 1997
7. Raymond J.A. Buhr, Donaid L, Balley: An Introduction to Real time Systems, Prentice Hall international, 1999.

AIM:

To impart the knowledge in the area of Telematics.

OBJECTIVE:

This course is intended for learning the applications of telemetry, in either commercial or defense/space organizations. Applications include telemetry as applied to control and monitoring of space vehicles as well as telecommunications, automotive testing, in-plant industrial system control and electrical power transmission telemetry systems.

UNIT – 1 INTRODUCTION 6

Types of telemetry systems - Basic radio telemetry system - Radio Frequency (RF) Link - Components of telemetry system - Antennas - Near-Earth and Deep Space Applications - Telemetry standards - Understanding dB: Decibels, Power Ratio, Voltage Ratio, dB Conversions.

UNIT – 2 TELEMETRY TECHNIQUES 12

Carrier Modulation - Amplitude and Frequency Modulation (AM and FM) -FM: Ground Station, Frequencies, Techniques, Modulation Index Spectra - Guard Bands - FM Channel Mixing - Signal Sampling - Pulse Amplitude Modulation (PAM), PAM Ground Station -PCM Encoder -- PCM Ground Station - Data Bus: ARINC-429 - MIL-STD-1553 - IRIG-106, Chapter 8 (1553 and 429) - Recent Updates - MIL-STD-1553 Future - Other Buses

UNIT – 3 THE COMPUTER AND THE TELEMETRY SYSTEM 12

Data Words - Data Transfer Mechanisms - PC Computers - Getting Data to Disk - Buffer Servicing: CVT vs. Data Driven - Bus Standards - PC Systems - PC Software –Environment: Portability and Ruggedness - Buses: ISA, PCMCIA (PC Card) - PCI, VME - USB, FireWire (IEEE 1394) - SCSI (Internal), Fibre Channel - ATA and Serial ATA

RAID and Networked Storage - Networking Growth - Ethernet: Rates, Components, Physical Medium - Fiber Connectors - Software Protocols - UDP vs. TCP - Data Flow Down - Display Devices - Graphics Display Engines: Tabular, Bar Charts, Strip Charts, Alarm Pages, Quick Look - IADS - ILIAD - LabView - MatLab - Global Majic - Quinn Curtis - DataViews - Parameter Databases - Telemetry Attribute Transfer Standards (TMATS) - "Hard" Programming (Patch Panels) - Strip charts

RF Transmission: UHF Bands - Digital Signal Transmission - Popular Modulation Types - Antennas - Bit Error Rate (BER) - System BER Testing - Future Visions...JTRS

UNIT – 4 MISSION PLANNING AND DATA MINING 7

Mission Planning - Work Breakdown Structure - Mission Support Process - The Next Challenge (Data Mining) - Data Mining Tool Requirements - brief discussion of future trends, including iNet.

UNIT - 5 APPLICATIONS 8

Applications in healthcare, fleet management, intelligent transportation, automotive, advanced manufacturing, supply chain management and defence & security as case studies to explain the deployment and effectiveness of telematic systems.

TOTAL : 45 PERIODS

REFERENCE:

1. Telemetry Systems Engineering, Frank Carden, Russ Jedlicka, Robert Henry, Artech House Publishers Boston, MA, USA, ISBN-13: 9781580532570.
2. Practical Radio Engineering and Telemetry for Industry, David Bailey, Elsevier, ISBN-13: 978-0-7506-5803-4.
3. Telematics and Transport Behaviour (Advances in Spatial Science) by Peter Nijkamp, G. Pepping, D. Banister, Springer-Verlag Telos (May 1996) ISBN-13: 978-3540609193.
4. Handbook of Telemetry and Remote Control by Elliot L Gruenberg, McGraw-Hill, 1967.

MR 9012

MECHATRONICS FOR AIRCRAFT

**L T P C
3 0 0 3**

AIM:

To understand the Design, Architecture and Operations of Aircraft Systems

OBJECTIVE:

This course is intended for learning the architecture and design of Avionics systems, components of airplane, sensors and actuation systems in Aircraft, Testing methodologies and Aircraft navigation systems. This course gives the ideas of air speed, air temperature, Angle of attack measurements, pressure, torque, fuel flow, engine vibration, monitoring and integration of GPS and INS utilization of navigation systems in aircraft.

UNIT – I AVIONICS SYSTEM ARCHITECTURE & DESIGN 9

Need for Avionics in Civil and Military aircraft and Space systems, integrated avionics, Avionics system architecture, design and evaluation. Fault tolerant systems - hardware, and software, Future architecture. Data buses- MIL-STD-1553B, ARINC-429 and 629, STANAG-3910 and 3838, DOD-STD-1773, HSDB, CAN bus, Avionics Full Duplex Switched Ethernet (AFDX) comparison of buses

UNIT – II CONFIGURATION OF AIRPLANE AND ITS COMPONENTS 9

Fundamentals - components of an airplane and their functions - motions of a plane - Cockpit displays - MFDs, MFK, HUD, DVI, HOTAS, Helmet mounted display,

UNIT – III AIRCRAFT SENSORS AND ACTUATION SYSTEMS 9

Gyroscope- Principles , Gyro equations, Rate Gyros - Rate integration and free Gyro, Vertical and Directional Gyros, Laser Gyroscopes, Accelerometers. Types of actuation systems-Linear and non-linear actuation system, modeling of actuation systems, Servo-loop analysis actuator design - testing methodologies, Performance testing equipments for sensors and actuation systems.

UNIT – IV AIRCRAFT INSTRUMENTS 12

Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement. Direct reading compass, magnetic heading reference system-detector element, Pressure , temperature fuel quantity and engine power measurement and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring. Electrical Power requirement for Military and Civil standards. Solar battery design.

UNIT – V AIRCRAFT NAVIGATION SYSTEMS

6

Inertial Navigation – Satellite navigation - GPS -system description -basic principles - position and velocity determination-signal structure-DGPS, Integration of GPS and INS-utilization of navigation systems in aircraft

TOTAL: 45 PERIODS

REFERENCES:

1. Collinson R.P.G. 'Introduction to Avionics', Chapman and Hall, 1996
2. Cary R .Spitzer, The Avionics Handbook,Crc Press, 2000.
3. Pallet, E.H.J. 'Aircraft Instruments & Integrated systems', Longman Scientific and Technical, McGraw-Hill, 1992.
4. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,1997
5. Pallett, E.H.J. 'Aircraft instruments, principles and applications', Pitman publishing Ltd., London, 1981.

MF 9063 LEAN MANUFACTURING SYSTEM AND IMPEMENTATION **L T P C**
3 0 0 3

AIM:

To introduce the concepts of lean manufacturing system.

OBJECTIVES:

- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.

UNIT – I INTRODUCTION TO LEAN MANUFACTURING

7

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT – II CELLULAR MANUFACTURING, JIT, TPM

9

Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT – III SET UP TIME REDUCTION, TQM, 5S, VSM

10

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT – IV SIX SIGMA

9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

UNIT – V CASE STUDIES

10

Various case studies of implementation of lean manufacturing at industries.

TOTAL: 45 PERIODS

REFERENCES:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Rother M. and Shook J, 1999 'Learning to See: Value Stream Mapping to Add Value and Eliminate Muda' , Lean Enterprise Institute, Brookline, MA.
3. Mikell P. Groover (2002) 'Automation, Production Systems and CIM.

MF 9061

NON-DESTRUCTIVE EVALUATION

**L T P C
3 0 0 3**

AIM:

To stress the importance of NDT in engineering.

OBJECTIVES:

To introduce all types of NNDT and their applications in Engineering.

UNIT – I Non-Destructive Testing: An Introduction, Visual Inspection & Liquid Penetrant Testing 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT – II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.

Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT – III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.

Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT – IV ULTRASONIC TESTING & RADIOGRAPHY 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks.

Principle of Radiography, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography

UNIT – IV MATERIALS PLANNING 10
Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT – V INVENTORY MANAGEMENT 10
ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

REFERENCES

1. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 1996.
2. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 1996.
3. Guptha P.K. and Manmohan, Problems in Operations Research, Suttan Chand & Sons, 2003.
4. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management – Eswar Press – 2005.
5. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.
6. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.