## ANNA UNIVERSITY, CHENNAI
### AFFILIATED INSTITUTIONS
#### B.E. INSTRUMENTATION AND CONTROL ENGINEERING
##### REGULATIONS – 2017
#### CHOICE BASED CREDIT SYSTEM
##### OPEN ELECTIVES (Offered by Other Branches)
### V SEMESTER
#### OPEN ELECTIVE I

<table>
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<th>S.No</th>
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### VII SEMESTER
#### OPEN ELECTIVE II

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OBJECTIVES:

- To make the students conversant with basics of polymer chemistry
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMERS AND SPECIALITY POLYMER


UNIT II ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS


UNIT III PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES

Chromatography: Basic principles of column & TLC – principles and applications.

UNIT IV THERMODYNAMICS

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van’t Hoff isotherm and isochore (problems).

UNIT V NANOCHEMISTRY

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties (surface to volume ratio, melting point, optical and electrical). nanoparticles, nanocluster, nanorod, nanotube (CNT: SWNT and MWNT) and nanowire, synthesis - precipitation, thermolysis,
hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications (electronic and biomedical). Fullerenes: Types - $C_{60}$ - preparation, properties and applications.

OUTCOMES

- The knowledge gained on polymer chemistry, thermodynamics, spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS


REFERENCES


OCE551 AIR POLLUTION AND CONTROL ENGINEERING

OBJECTIVE:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

UNIT I INTRODUCTION

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility - Ambient Air Quality and Emission standards.

UNIT II METEOROLOGY


UNIT III CONTROL OF PARTICULATE CONTAMINANTS

UNIT IV  CONTROL OF GASEOUS CONTAMINANTS

UNIT V  INDOOR AIR QUALITY MANAGEMENT
Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

OUTCOMES:
The students completing the course will have
- an understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- ability to identify, formulate and solve air and noise pollution problems
- ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to ensure quality, control and preventive measures.

TEXTBOOKS:

REFERENCES:

OAT 551  AUTOMOTIVE SYSTEMS  L T P C
3 0 0 3

OBJECTIVES:
- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNITI  AUTOMOTIVE ENGINE AUXILIARY SYSTEMS
Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system.
UNIT II VEHICLE FRAMES AND STEERING SYSTEM

UNIT III TRANSMISSION SYSTEMS
Clutch- types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints — Hotchkiss Drive and Torque Tube Drive- rear axle- Differential-wheels and tyres.

UNIT IV SUSPENSION AND BRAKES SYSTEMS
Suspension Systems- conventional Suspension Systems - independent Suspension Systems- leaf spring – coil spring – taper-lite - eligo,s spring Types of brakes - Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient.

UNIT V ALTERNATIVE ENERGY SOURCES
Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOKS:

REFERENCES:
OBJECTIVES
• To learn the fundamentals of data models
• To learn conceptual modeling using ER diagrams.
• To study SQL queries and database programming
• To learn proper designing of relational database.
• To understand database security concepts
• To understand Information retrieval techniques

UNIT I         DBMS AND CONCEPTUAL DATA MODELING  9
Purpose of Database System – Data independence - Data Models – Database System Architecture –
Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases –
Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.

UNIT II            DATABASE QUERYING                                                                                        11

UNIT III           DATABASE PROGRAMMING                        7
Database programming with function calls, stored procedures - views – triggers. Embedded SQL.
ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM,
implementing functions, views, and triggers in MySQL / Oracle.

UNIT IV           DATABASE DESIGN                                                                                                    9

UNIT V           ADVANCED TOPICS                                                                                                      9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
• understand relational data model, evolve conceptual model of a given problem, its mapping to relational model and Normalization
• query the relational database and write programs with database connectivity
• understand the concepts of database security and information retrieval systems

TEXT BOOKS:
REFERENCES:

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<tr>
<th>OIT552</th>
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OBJECTIVES:
- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODUCTION TO CLOUD COMPUTING

UNIT II VIRTUALIZATION

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD

UNIT V CASE STUDIES

OUTCOMES:
On Completion of the course, the students should be able to:
- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.
- Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.
TEXT BOOKS:

REFERENCES:

OMF551 PRODUCT DESIGN AND DEVELOPMENT  L T P C  3 0 0 3

OBJECTIVE:
- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I INTRODUCTION

UNIT II CONCEPT GENERATION AND SELECTION

UNIT III PRODUCT ARCHITECTURE

UNIT IV INDUSTRIAL DESIGN
design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

TOTAL: 45 PERIODS

OUTCOME:
• The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:

REFERENCES:

OME552 VIBRATION AND NOISE CONTROL 3 0 0 3

OBJECTIVES:
The student will be able to understand
• Basic about the noise and its control methods
• the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components
• About the noise in the automotive sources
• Various control techniques in controlling noise and vibrations.
• Know about the source of noise

UNIT I BASICS OF VIBRATION 9
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II BASICS OF NOISE 9
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.
UNIT III     AUTOMOTIVE NOISE SOURCES

UNIT IV     CONTROL TECHNIQUES
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V     SOURCE OF NOISE AND CONTROL
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

OUTCOMES:
- Understand the basic of noise and vibrations.
- Understanding causes, source and types of vibrations in machineries
- Gaining knowledge in sources and measurement standard of noise
- Ability to design and develop vibrations and noise control systems.
- Ability to know techniques in controlling the noise and vibrations.

TOTAL: 45 PERIODS

TEXT BOOK:

REFERENCES:
UNIT I SPECTROMETRY

UNIT II MOLECULAR SPECTROSCOPY

UNIT III NMR AND MASS SPECTROMETRY

UNIT IV SEPARATION METHODS

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY

TEXT BOOKS

REFERENCE

TOTAL: 45 PERIODS
OBJECTIVES:
The student should be made to:
- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

UNIT I  FUNDAMENTALS & LINK LAYER
Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction

UNIT II  MEDIA ACCESS & INTERNETWORKING
Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols ( IP, ICMP, Mobile IP)

UNIT III  ROUTING

UNIT IV  TRANSPORT LAYER

UNIT V  APPLICATION LAYER

OUTCOMES:
At the end of the course, the student should be able to:
- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network

TEXT BOOK:

REFERENCES:


OME751 DESIGN OF EXPERIMENTS L T P C

OBJECTIVE:
- To impart knowledge on various types of experimental designs conduct of experiments and data analysis techniques.

UNIT I FUNDAMENTALS OF EXPERIMENTAL DESIGNS 9
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT II SINGLE FACTOR EXPERIMENTS 9
Completely Randomized Design- effect of coding the observations- model adequacy checking- estimation of model parameters, residuals analysis- treatment comparison methods-Duncan’s multiple range test, Newman-Keuel’s test, Fisher’s LSD test, Tukey’s test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT III FACTORIAL DESIGNS 9
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- $2^K$ Design with two and three factors- Yate’s Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT IV SPECIAL EXPERIMENTAL DESIGN 9
Blocking and Confounding in $2^K$ Designs- blocking in replicated design- $2^K$ Factorial Design in two blocks- Complete and partial confounding- Confounding $2^K$ Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of $2^K$ Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of $2^K$ Design

UNIT V TAGUCHI METHODS 9
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design.

TOTAL: 45 PERIODS

OUTCOME:
- Able to apply experimental techniques to practical problems to improve quality of
processes/products by optimizing the process/product parameters.

TEXT BOOK:

REFERENCES:

OCS752 INTRODUCTION TO C PROGRAMMING

OBJECTIVES
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions and structures

UNIT I INTRODUCTION
Structure of C program – Basics: Data Types – Constants – Variables – Keywords – Operators: Precedence and Associativity – Expressions – Input/Output statements, Assignment statements – Decision-making statements – Switch statement – Looping statements – Pre-processor directives – Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers
Text Book: Reema Thareja (Chapters 2,3)

UNIT II ARRAYS
Introduction to Arrays – One dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.
Text Book: Reema Thareja (Chapters 5)

UNIT III STRINGS
Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Introduction to Pointers – Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.
Text Book: Reema Thareja (Chapters 6 & 7)

UNIT IV FUNCTIONS
Introduction to Functions – Types: User-defined and built-in functions - Function prototype - Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by ‘n’ devices (passing an array to a function) – Menu-driven program to count the
numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character (passing an array to a function)

Text Book: Reema Thareja (Chapters 4)

UNIT V STRUCTURES
Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structures and functions)

Text Book: Reema Thareja (Chapters 8)

TOTAL:45 PERIODS

OUTCOMES
Upon completion of this course, the students will be able to
- Develop simple applications using basic constructs
- Develop applications using arrays and strings
- Develop applications using functions and structures

TEXT BOOK

REFERENCES:
stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT III         SIX SIGMA METHODOLOGIES  9
Design For Six Sigma (DFSS), Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN) - Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP) - Developing communication plan – Stakeholder

UNIT IV         SIX SIGMA IMPLEMENTATION AND CHALLENGES  9
Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach – implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

UNIT V         EVALUATION AND CONTINUOUS IMPROVEMENT METHODS  9
Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

TOTAL: 45 PERIODS

OUTCOME:
• The student would be able to relate the tools and techniques of lean sigma to increase productivity

REFERENCES:
3. Fred Soleimannejed, Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004

OAN751        LOW COST AUTOMATION                           L    T    P    C
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OBJECTIVES
• To give basic knowledge about automation
• To understand the basic hydraulics and pneumatics systems for automation
• To understand the assembly automation

UNIT I          AUTOMATION OF ASSEMBLY LINES  9
Concept of automation - mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line
UNIT II AUTOMATION USING HYDRAULIC SYSTEMS 9
Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT III AUTOMATION USING PNEUMATIC SYSTEMS 9

UNIT IV AUTOMATION USING ELECTRONIC SYSTEMS 9
Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT V ASSEMBLY AUTOMATION 9
Types and configurations - Parts delivery at workstations - Various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

TOTAL: 45 PERIODS

OUTCOMES:
• Upon completion of this course, the students can able to do low cost automation systems
• Students can do some assembly automation

TEXT BOOKS:

REFERENCES

OCH751 PROCESS MODELING AND SIMULATION L T P C
TOTAL: 45 PERIODS

OBJECTIVE:
• To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I INTRODUCTION
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.
UNIT II  STEADY STATE LUMPED SYSTEMS  9
Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III  UNSTEADY STATE LUMPED SYSTEMS  9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV  STEADY STATE DISTRIBUTED SYSTEM  7
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V  UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES  13

TOTAL : 45 PERIODS

OUTCOME:
- Upon completing the course, the student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I  CLASSIFICATION OF SIGNALS AND SYSTEMS 12
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids.
Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II  ANALYSIS OF CONTINUOUS TIME SIGNALS 12
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

UNIT IV  ANALYSIS OF DISCRETE TIME SIGNALS 12
Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties

UNIT V  LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 12

TOTAL: (L:45+T:15): 60 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:

- To be able to determine if a given system is linear/causal/stable
- Capable of determining the frequency components present in a deterministic signal
- Capable of characterizing LTI systems in the time domain and frequency domain
- To be able to compute the output of an LTI system in the time and frequency domains

TEXT BOOK:

REFERENCES:
OBJECTIVE:
To understand the various destructive and non destructive testing methods of materials and its industrial applications.

UNIT I INTRODUCTION TO MATERIALS TESTING
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II MECHANICAL TESTING
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III NON DESTRUCTIVE TESTING

UNIT IV MATERIAL CHARACTERIZATION TESTING
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V OTHER TESTING

TOTAL: 45 PERIODS

OUTCOMES:
1. Identify suitable testing technique to inspect industrial component
2. Ability to use the different technique and know its applications and limitations

TEXT BOOKS:

REFERENCES: