Course Objectives:

The Student will learn different mathematical concept that can be used in finding solutions to many engineering problems and in formulating mathematic models to represent engineering applications.

   06 Hours


Roots of polynomial-Polynomials in Engineering and Science, Muller’s method, Bairstow’s Method Graeffe’s Roots Squaring Method.

   06 Hours


   14 Hours

5. Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engg


Text Books:

Reference Books:
1. Pervez Moin “Application of Numerical methods to Engineering”.

Course Outcomes:
The Student will be able to
1. Model some simple mathematical models of physical Applications.
2. Find the roots of polynomials in Science and Engineering problems.
3. Differentiate and integrate a function for a given set of tabulated data, for Engineering Applications.

FINITE ELEMENT METHOD

Course Objectives

1. Introduce the various aspects of FEM as applied to engineering problems.
2. Apply the fundamental concepts of mathematical methods and theory of elasticity to solve simple continuum mechanics problems.

1. Introduction to Finite Element Method : Engineering Analysis, History, Advantages, Classification, Basic steps, Convergence criteria, Role of finite element analysis in computer-aided design., Mathematical Preliminaries, Differential equations formulations, Variational formulations, weighted residual methods

   6 Hours

2. One-Dimensional Elements-Analysis of Bars and Trusses, Basic Equations and Potential Energy Functional,1D Bar Element, Admissible displacement function, Strain matrix, Stress recovery, Element equations, Stiffness matrix, Consistent nodal force vector: Body force, Initial strain, Assembly Procedure, Boundary and Constraint Conditions, Single point constraint, Multi-point constraint, Truss Element, Shape functions for Higher Order Elements, $C^0$, $C^1$ elements


13 Hours


14 Hours


11 Hours

5. Dynamic Considerations: Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, beam element. Lumped mass matrix, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.

6 Hours

Text Books:

Reference Books:
4. Bathe K. J. Finite Elements Procedures, PHI.

Course Outcome:

Students will be able to

1. Define the element properties such as shape function and stiffness matrix for the various elements.
2. Formulate element properties for 1D and 2D elements.
3. Develop skill to solve simple beam problems using the steps of FEM.
MATERIALS FOR CRYOGENIC AND HIGH TEMPERATURE APPLICATIONS

Course Objective:

The course provides fundamental knowledge on materials for cryogenic and high temperature applications.

Sub Code : 14 MST13 IA Marks : 50
Hrs/ Week : 04 Exam Hours : 03
Total Hrs. : 50 Exam Marks : 100

1. Introduction: Historical Background – Introduction to Cryogenic propellants – Liquid hydrogen, Liquid helium, Liquid nitrogen and Liquid oxygen and their properties.


12 Hours


13 Hours

3. Cryogenic Fluid Storage And Transfer Systems: Basic storage vessels, insulations, un insulated and porous insulated lines, vacuum insulated lines, cryogenic valves, cool down process.

Measurement Systems For Low Temperatures: Introduction, Temperature scales and fixed points, Metallic resistance thermometers, thermo couples, constant volume gas thermometers, magnetic thermometers, vapour pressure thermometers.

12 Hours

4. Vacuum Technology: Importance flowregimes in vacuum system, components of vacuum system, mechanical vacuum pumps, diffusion pumps, vacuum gaugs and valves.

6 Hours
5. **Cryogenic In Aerospace Applications:** Cryogenic liquids in missile launching and space simulation – storage of cryogenic liquids- Effect of cryogenic liquids on properties of Aerospace materials – Cryogenic loading problems – Zero gravity problems associated with cryogenic propellants – Phenomenon of tank collapse – Elimination of Geysering effect in missiles.  

**TEXT BOOKS:**

**REFERENCE BOOKS:**

**Course Outcome:**

Students will be able to understand the concept of materials for cryogenic and high temperature applications.

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**NANOSCIENCE AND NANOMATERIALS**

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**Course Objective:**

The Course gives exposure to Nanoscience and Naonotechnology,its properties and design

1. **Introduction To Nanoscience And Nanotechnology:** History, background scope and interdisciplinary nature of nanoscience and nanotechnology, scientific revolutions, nanosized effects surface to volume ratio, atomic structure, molecules and phases, energy at the nanoscale molecular and atomic size, quantum effects, types of nanotechnology and nano machines.

Classification Of Nanostructures: Zero dimensional, one-dimensional and two dimensional nanostructure materials-clusters of metals, semiconductors, ceramics and nanocomposites, sizedependent phenomena, quantumdots nanowires, tubes, nanosheets, nano and mespores, topdown and bottomups approaches, mismomers and misconception of nanotechnology, importance of nanoscalematerials and their devices.  

2. **Properties Of Nanomaterials:** Mechanical properties-Thermo physical properties - Electrical properties Electric properties – Electro chemical properties Magnetic properties - optical properties-Catalytic property – properties of gas permeation and separation membranes.

12 Hours


14 Hours


6 Hours


6 Hours
TEXT BOOKS:

REFERENCE BOOKS:

Course Outcome:
Students will be able to understand the importance of nanoscience and nanomaterials in industrial applications.

ADVANCED MATERIALS AND PROCESSING
Sub Code : 14 MST151 IA Marks : 50
Hrs/ Week : 04 Exam Hours : 03
Total Hrs. : 50 Exam Marks : 100

Course Objective:
Knowledge of advanced materials used in various engineering applications is very essential for an engineer, the course aims at providing an understanding of various advanced materials and its processing.


General Properties and Structure: Atoms, molecules bonds in solids, Crystalline - Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behaviour.

Non Ferrous Alloys: Alloys of copper, Aluminium, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application.

12 Hours


13 Hours


7 Hours


6 Hours

TEXT BOOKS:
1. Engineering Metallurgy - Raymond and Higgens - ELBS/EA

REFERENCE BOOKS:
5. Material science and metallurgy - by Callister, John Willey & Sons.

Course Outcome:
Students get to understand various advanced materials used in industrial applications

ADVANCED FOUNDRY TECHNOLOGY

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Course Objective:
Advanced foundry technology gives students insight into various concepts and methods used in foundry
1. **Solidification of Casting:** Concept of solidification of metals. Homogenous and heterogeneous nucleation. Growth mechanism. Solidification of pure metals and alloys. Mechanism of columnar and dendritic growth. Coring or Segregation. Solidification time and Chvorinov's rule. Concept of progressive and directional solidifications.

**Principles of Gating and Risering:** Purpose of the gating system. Components of the gating System and its functions. Design of the gating System. Different types of gates. Gating ratio and its functions. Definition and functions of the riser. Types of risers and their application. Design of the riser - its shape. Size and location. Use of insulating material and exothermic compounds in risers. **12 Hours**

2. **Design of Casting and Quality Control:** Factors to be considered in casting design. Design consideration in pattern making, moulding techniques and core making and assembly. Cooling stresses and hot spots in casting and modification in casting geometry to overcome them. Casting defects and factors responsible for them. Different inspection and testing methods to evaluate the casting. Quality control activities in a foundry. Salvaging methods of defective casting.

**Furnace Technology:** Study of various furnaces used in foundry, construction and operation of crucible and hearth furnaces. Resistance, Arc and Induction furnaces—their construction. Operation and application. Heat treatment furnaces and drying ovens used in foundry. **12 Hours**


4. **Aluminium Foundry Practice:** Composition, properties and application of common aluminum alloy casting. Melting and casting of Al-alloys. Gating and risering of Al-alloy casting.

**Copper Alloy Foundry Practice:** General characteristics of common cast copper alloys. Melting and casting of copper alloys. Gating and risering of Cu-alloy castings. **12 Hours**

5. **Foundry Mechanization and Modernization:** Introduction to modernization. Mechanization of foundry and its advantages. Mechanization of sand plant, moulding and core making mechanization in melting, pouring and shakeout units. Material handling equipments and conveyor systems. Brief sketches and description of layouts of job. Captive and mechanized foundries. **6 Hours**

**TEXT BOOKS:**

**REFERENCE BOOKS:**
Course Outcome:
Students learn advances in foundry technology which enable them to realise its application in Modern Foundry/

NON DESTRUCTIVE TESTING

Sub Code : 14 MST153 IA Marks : 50
Code Hrs/ : 04 Exam Hours : 03
Week Total Hrs. : 50 Exam Marks : 100

Course Objective:
Exposure to various non destructive testing methods in essential in advanced manufacturing applications, the course aims at giving an insight into various Non Destructive Testing methods used in practice.

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

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

**12 Hours**

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

Microwave Inspection: Microwave holography, applications and limitations.

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

**18 Hours**

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

**7 Hours**

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

**7 Hours**
   **6 Hours.**

**TEXT BOOKS:**

**REFERENCE BOOKS:**

**Course Outcome:**

Students will be able to understand significance and suitability of various non destructive testing methods in industrial applications.

**SELECTIONS OF MATERIALS IN ENGINEERING**

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**Course Objective:**

Course aims at providing students information about various aspects of material testing, selection of mechanical properties and application of materials to different industrial applications.

1. **Introduction to Selection of Mechanical Properties**: Types of materials Static strength, Toughness, Stiffness, Fatigue Creep, Fatigue & Thermal Properties.  
   **6 Hours**

2. **Selection for corrosion resistance** The nature of the corrosion process, selection of materials for resistance to atmospheric corrosion, selection of materials for resistance to oxidation at elevated temperatures, selection of materials for resistance to corrosion in the soil, selection of materials for resistance to corrosion in water, selection of materials for chemical plant, degradation of polymeric materials.

   **Selection of materials for resistance to wear**: The mechanisms of wear, The effect of environment on wear Surface treatment to reduce wear, Erosive wear, Selection of materials for resistance to erosive wear. 
   **12 Hours**
3. **The relationship between materials selection and materials processing:** The purpose of materials processing, the background to process selection. The casting of metals and alloys, wrought products, the manufacture of plastics. Fabrication from powder, Fastening and joining.  
7 Hours

4. **Materials for Aerospace Application:** Principal characteristics of aircraft structures, Property requirements of aircraft structures, Requirements for high-speed flight, Candidate materials for aircraft structures.  
**Materials for ship structures & automotive application:** The ship girder, Factors influencing materials selection for ship hulls, Materials of construction.  
13 Hours

5. **Materials for engines and power generation:** Internal combustion, External combustion.  
**Materials for bearings & High Temperature Application:** Rolling bearings, Plain bearings.  
12 Hours

**TEXT BOOKS:**
1. F A A Crane and J A Charles.

**REFERENCE BOOKS:**

**Course Outcome:**

Students will be able to demonstrate their knowledge in selection of engineering materials for various engineering applications.

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**Material Characterization Laboratory – Lab 1**

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**Note:**
- These are independent laboratory exercises
- A student may be given one or two problems stated herein
- Student must submit a comprehensive report on the problem solved and give a presentation on the same.
1. Determine the effect of heat treatment on formability limits of automotive steels.

2. Establish relationship between microhardness and grain size of aluminum alloy castings.

3. Construct the hardanability curves on automotive / structural steels.

4. Assess the defects of castings / welding by ultrasonic or eddy current test.

5. Correlate microstructure with hardness of rolled /extruded/forged steels.


7. Study the effect of quenching media on microstructure and hardness of high speed steels.

8. Heat treatment of super alloys (Titanium/nickel/iron based)

9. Microstructure studies on electroplated components (Titanium/nickel/Iron based)

10. Correlation of microstructure and hardness of Anodized surfaces.
II Semester
COMPOSITE MATERIALS TECHNOLOGY

Course Objective:

The course aims at providing knowledge on composite materials and its fabrication.

1. Introduction to Composite Materials: Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepregs, and sandwich construction.

Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two-dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Invariant properties. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems. 12 Hours


Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems. 12 Hours


Manufacturing and Testing: Layup and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining, joining and repair. NDT tests – Purpose, Types of defects, NDT method - Ultrasonic inspection, Radiography, Acoustic emission and Acoustic ultrasonic method. 14 Hours

4. Metal Matrix Composites: Re-inforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications. 6 Hours

5. Applications: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites. 6 Hours
**Text Books:**

**Reference Books:**

**Course Outcome:**
Students develop expertise in Composite materials application and its analysis in designing components for engineering applications.
SMART MATERIALS AND STRUCTURES

Course Objective:

Knowledge of smart materials and structures is essential designing mechanical systems for advanced engineering applications, the course aims at training students in smart materials and structures application and analysis.

   3 Hours

   7 Hours

3. Smart Sensor, Actuator and Transducer Technologies smart sensors: accelerometers; force sensors; load cells; torque sensors; pressure sensors; microphones; impact hammers; mems sensors; sensor arrays smart actuators: displacement actuators; force actuators; power actuators; vibration dampers; shakers; fluidic pumps; motors smart transducers: ultrasonic transducers; sonic transducers; air transducers.
   10 Hours

4. Measurement, Signal Processing, Drive and Control Techniques quasi-static and dynamic measurement methods; signal-conditioning devices; constant voltage, constant current and pulse drive methods; calibration methods; structural dynamics and identification techniques; passive, semi-active and active control; feedback and feed forward control strategies.
   12 Hours

5. Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products: Case studies incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering smart structures and products. Emphasis on structures, automation and precision manufacturing equipment, automotives, consumer products, sporting products, computer and telecommunications products, medical and dental tools and equipment.
   18 Hours

Reference Books:


Course Outcome:
Students will be able to develop expertise in Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products

TESTING OF MATERIALS

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Course Objective:
Students are oriented to various testing methods used to characterize materials in engineering applications.

1. **Testing machines and sensors**: types of Universal Testing machines and principles of operations, Machine stiffness, load and strain measurement. Calibration and verification of UTM.

Friction, wear and surface testing: Testing of sliding contact, damage, abrasive wear, adhesive wear, erosive wear. Testing and determination of surface characteristics of solid materials.(Surface roughness measurements)

12 Hours

2. **Importance of calibration of Testing Instruments**: Calibration methods and standards. Tests / experiments based on methods with active reference to various codes and standard for each test.


12 Hours

   *6 Hours*

**Speed & Control of Testing** Background ,Developments in testing Machine Technology, Effects of testing rates on properties ,Results before servo control ,Results from servo controlled machines.

   *13 Hours*

4. **Strain Rate Testing** Aim of Recommendations ,Abbreviations and Symbols ,Test Machine Requirements ,Specimens Measurements , Data Processing , General Definitons Strength Hardening Constitutive Relations to Model Material Strain Rate Dependency.

   *7 Hours*

5. **Lubrication & Determination of characteristics of lubricants**: Introduction, Types of lubricants, characteristics of lubricants Methods of lubrication, four ball testing.

   *6 Hours*

**TEXT BOOKS:**

**REFERENCE BOOKS:**
1. ASM Vol Testing of materials
4. Relevant codes and standards.

**Course outcome:**
Students will be able to understand and correlate various testing methods used in industries.

**NON-TRADITIONAL MACHINING**

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**Course learning objectives:**
1. To demonstrate the need for development of newer/ non-traditional machining processes.
2. The student will be able to identify different energy sources like fluid motion, electric current, high speed electrons, high energy radiation, etc.
3. To analyse the concept, mechanism, parameters associated with the processes.
4. To demonstrate the operational principles, advantages applications, limitations of the various non-traditional machining processes.

Ultra Sonic Machining: Definition, Mechanism of metal removal, elements of the process, Tool feed mechanisms, Theories of mechanics, effect of parameters, Different types of concentrators, horn design, applications, Limitations.

Abrasive Jet Machining: Principle, Process parameters, Influence of process parameters on MRR, applications, advantages and disadvantages.

14 Hours


14 Hours

3. Chemical Machining: Introduction, fundamental principle types of chemical machining, Maskants, Etchants, Advantages and disadvantages, applications, chemical blanking, chemical milling (contour machining), Hydrogen embrittlement.

Plasma arc Machining: Introduction, Plasma, Generation of Plasma and equipment, Mechanism of metals removal, PAM parameters, process characteristics, types of torches, applications.


12 Hours


Ion Beam Machining: principle, equipment, working, sputtering rate, applications.

6 Hours


6 Hours

Text Books:
2. Modern Machining Processes - P.K Mishra

Reference Books:

1. New technology - Bhattacharya, Institution of Engineers, India
4. High velocity forming of metals - F.M Wilson ASTME PreticeHall.
5. Modern Manufacturing Methods - Adithan

Course Outcomes:
1. Student will be in a position to appreciate the merits of non traditional machining and its application in Industries.
2. Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.
3. Students will be able to decide a process suitable for a particular material based on the availability of the sources.

SURFACE TREATMENT AND FINISHING

- Sub Code : 14MST251
- IA Marks : 50
- Hrs/ Week : 04
- Exam Hours : 03
- Total Hrs. : 50
- Exam Marks : 100

Course Objective:
Students will be able to learn various surface treatment and finishing techniques used in various industrial applications.


Vacuum coating, FVD & CVD metal spraying - Methods, surface preparation, mechanical. 12 Hours

2. Properties of sprayed metals, Various types and plasma coating.

Plastic coating of metal - PVC coating Spherodising process details, phosphate coating - mechanism of formation. 14 Hours

3. Testing of surface coating- Various methods used.

Heat treatment methods, Aneleaing, Normalizing, Tempering, Case hardening methods, flame hardening sub zero treatment 12 Hours

4. Heat treatment methods for gears, spindles, cutting tools. 6 Hours
Advanced coating technologies: Hard facing, electro deposition technique, nanocoatings, coating characterization

TEXT BOOK:

REFERENCE BOOKS:
4. Metals Hand Book – ASM.

Course Outcome:
Students will be able gain knowledge in surface treatment, electroplating, surface coating and heat treatment techniques.

AGILE MANUFACTURING

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Course Objectives:
The Student will
1. Get an overview of Agile Manufacturing, need and strategies.
2. Know the process of developing an agile manufacturing/enterprise. Integrating Product/Process development.
3. Learn the computer control of agile manufacturing.

1. Agile Manufacturing: Definition, business need, conceptual frame work, characteristics, generic features. Four Core concepts: Strategy driven approach-integrating organization, people technology, interdisciplinary design methodology.

2. Developing Agile Manufacturing: Enterprise design, System concepts as the basic manufacturing theory-joint technical & Organizational design and a model for the design of agile manufacturing enterprise. Enterprise design process insights into design processes, what is interdisciplinary design, main issues, simple design example.
Integration of Product /Process Development: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches.  

12 Hours


13 Hours


Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in Agile manufacturing, Role of standards.  

12 Hours

5. Design of Skill & Knowledge: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.  

7 Hours

TEXT BOOKS:

REFERENCE BOOKS:

Course Outcomes:
Students will be able to:
1. Understand conceptual frame work of agile manufacturing environment.
2. Get insight into Enterprise design process, apply interdisciplinary design concepts.
3. Develop characteristic difference between lean manufacturing and agile manufacturing and appreciate benefits that can be derived by adopting newer manufacturing strategies.

ADVANCED MOULDING TECHNIQUES

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Course Objective:
The course gives complete overview of advanced moulding techniques in various industrial applications.

1. Injection Moulding Technology: Microprocessor control injection moulding machine, close loop control, open loop control, CNC control, multi color injection moulding, rotary injection moulding, structural foam moulding, sandwich injection moulding.

Metal injection moulding: contact injection moulding, moulding of cellular product like EPS, steam chest moulding, future trends in injection moulding like external & internal inter locking alignment of large moulds, processing of specialty polymers.

10 Hours

2. Extrusion: General consideration during extrusion process like specific heat, latent heat, internal conductivity, shape & size of granular hygroscopic nature over temperature, effect of flow property like relaxation time & defects like shark skin, elastic turbulence, influence of TG, TM & crystal growth rate, cooling rate, impact strength, manufacturing of woven sacks etc. co extrusion, co extruded pipe, multilayer pipe, foam pipe, biaxial oriented pipe.

8 Hours

3. Lamination: Lamination by extrusion coating, twin screw extrusion, co-rotating & counter rotating, feeding mechanism in twin screw extruder, roll of side feeder & injection feeder, principles of compounding, mixing mechanism etc.

6 Hours


8 Hours

5. Reaction Injection Moulding (RIM): RIM of Polyurethane, material for RIM, liquid RIM & its advantages over conventional injection moulding, RRIM.

12 Hours

5. PTFE Moulding: Processing techniques used for PTFE, Material consideration, sintering, Ram extrusion, and Paste extrusion, Iso statistic. Moulding and skewing technique for PTFE processing.

14 Hours

Advancement in Other Processing Technique: New techniques like Resin transfer moulding, Pultrusion. Filament winding, multi layer rotation moulding, Electro plating and printings, Centrifugal casting, Shrink film, Clink film.
TEXT BOOKS:
1. Injection Moulding, Rubin.
2. Extrusion – Berln.

REFERENCE BOOKS:
1. Extrusion Die Design, M. V. Joshi.
2. Polymer Chemistry, Gowriker

Course Outcome:
Students will be able to demonstrate their knowledge in the field of advanced moulding methods.

MANUFACTURING OF ELECTRONIC COMPONENTS

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Course Objective:
Students will be able to learn manufacturing of electronic components like IC’s, Silicon wafer, electronic assembly which gives them processing methods used in electronic industries.

1. **Introduction**: Important components of Electronic products. Types of Semiconductor materials and properties and their properties.

Manufacturing ICs: The functions of ICs manufacturing of diodes. Production of a single IC component classification of IC Architecture.

12 Hours

2. **Manufacturing of Silicon Water**: Fabrication of IC on silicon wafers Fabrication of IC on Silicon wafers. Diffusion doping, Ion Implantation, Rapid thermal processing- Thermal oxidation Monolithic processing, Lithography, Photolithography, Etching processes.

Thin film Deposition: Physical vapour Deposition, chemical vapor deposition, Epitoxial growth, IC component interconnection, IC yield and economics.

12 Hours

3. **IC packing**: Types of packaging process.


12 Hours

4. **Electronic Assembly**: General Description of Electronic Assembly detailed study of
sequences of operation for through-hole and surface mount process.


**TEXT BOOKS:**

**REFERENCE BOOKS:**

**Course Outcome:**
Students will be able to realise intricate manufacturing techniques associated with manufacturing electronic components.

**Advanced Material Processing Laboratory – Lab 2**

| Subject Code: 14MCM 26 | IA Marks : 25 |
| Hour s/Week : 6 | Exam Hours : 03 |
| Total Hours : 84 | Exam Marks : 50 |

**Note:**
- These are independent laboratory exercises
- A student may be given one or two problems stated herein
- Student must submit a comprehensive report on the problem solved and give a presentation on the same.

1. Fractography analysis of failed mechanical components.
2. Effect of heat treatment on fatigue life of structural steels.
3. Hot corrosion testing on super alloys.
4. Friction stir welding on non ferrous alloys.
5. Study on heat affected zone (HAZ) - microstructure and microhardness of TIG welded Aluminum alloys (T6) /ferrous alloys.
7. Use of simulation package like deform - to study the effect of process parameters on the extruded/forged/rolled products.
9. Construction of merchant circle diagram for turning operation of mild steel and to compute power requirement for turning operation.
10. Prediction of cooling curves of castings using the commercially available FEA software.
Course Objective:

The course aims at providing knowledge about various aspects of plastic processing.

1. Plastic Processing: Basic principle of processing, shape and size, processing parameters, their effect and behavior, Rheology of ideal fluids, and real polymers, Effects of melt behavior on processing and product performance.

2. Injection Moulding: Principles, process variables, moulding cycle, machinery used, parts and function, specification, construction and maintenance of injection moulding machine, start up and shut down procedure, cylinder, nozzles, interaction of moulding variables, press capacity, projected area, shot weight, concepts and their relationship to processing, trouble shooting in injection moulding, microprocessors controlled injection moulding machines.

3. Extrusion: Basic principles of extruders, and extrusion process, different types of extrudes i.e. barrel, screw, drive mechanics, head, constructional features of dies, sizing and haul-off equipment for extruders of mono filaments and tubes, blown film lines, wire and cable covering system, pipe profile extrusion, co-extrusion, process variables in extrusion like heating, temperature control, dies well, and melt fracture, spacing and orientation, treating, printing and sealing, quality of extruder products, fault, causes and remedy.

Compression and Transfer Moulding: Techniques, various types of compression moulds, machinery used, and common moulding faults and remedies. Transfer moulding, its advantage over compression moulding, equipment used, press capacity, integral mold, and auxiliary mould, moulding cycle, ram pressure, clamping pressure, faults and remedies.

4. Blow Moulding: Blow moulding process, processing parameter, materials used, hand operated and automatic blow moulding machine, extrusion blow moulding, moulding cycle, faults and remedies.

Thermo Forming: Basic principles, types of thermoforming, thermoforming moulds, processing parameters, faults and remedies. Rotational Moulding: Basic principle, charge size, wall thickness, temperature control, fault causes and remedies.

5. Processing of Engineering Plastics: precautions, and start up procedure, preheating, shutdown procedure, quality control, and waste management. Ram
Extrusion of PTFE, Processing of reinforced plastics, like filament winding, Hand-lay-up, spray moulding, SMC, DMC, Centrifugal casting, pultrusion, resin transfer moulding.

**6 Hours**

**TEXT BOOKS:**
1. Plastic Processing Data Hand Book – Dominic V Rosato P.E.

**REFERENCE BOOKS:**

**Course Outcome:**
Students will demonstrate their understanding of plastic processing, injection moulding, extrusion and thermo forming.

**SIMULATION MODELING OF MANUFACTURING SYSTEMS**

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**Course Objective:**
The course aims at providing knowledge about modeling and simulation techniques which can be used for analysis manufacturing systems.


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

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

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

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

6. **Random Variate Generation:** Inversion transforms technique-exponential distribution, uniform distribution, weibul distribution, continuous distribution, generating, approximate normal variates - Erlang distribution.
4. **Empirical Discrete Distribution:** Discrete uniform –distribution, Poisson distribution -geometric distribution -acceptance -rejection technique for Poisson distribution gamma distribution

6 Hours

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

8 Hours

Text Books:

Reference Books:

Course Outcome:
Students will be able to demonstrate their understanding in various simulation and modeling techniques.

BIO MATERIAL AND TECHNOLOGY

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Course Objective:

Students learn about various biomaterials and the technology associated with its testing

1. **Introduction**: Definition of Bio materials , Classification of Bio materials, Comparision of properties of some common bio materials, effects of physiological fluid on properties of
bio materials, surface properties, physical and Mechanical properties of Bio materials.

**Metallic Implants Materials**: Stainless Steel, Co-based alloys, Ti and Ti based alloys, Important of stress corrosion cracking, Host tissue reaction with Bio metal, corrosion behaviour, hard tissue replacement implant, orthopedic implant, dental implants, Percutaneous and skin implants, Vascular implants, Heart valve implant.  

12 Hours

2. **Polymeric Implant Materials**: polyolefins, polyamides, acrylic polymers, fluoro carbon polymers, Silicon rubber acetals. Visco elastic behaviour, creep recovery, stress relaxation, strain rate sensitivity, importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives, aging and environmental stress cracking, physiochemical characteristics of bio polymers, bio degradable polymers for medical purpose and their biological applications.

**Ceramic Implant Materials**: Definitions of Bio ceramics, common type of Bio ceramics, Aluminium oxides, Glass ceramics, Carbons. Bioresorbable and Bioactive ceramics, Importance of wear resistance and low fracture toughness. Host Tissue reactions, Importance of Interfacial tissue reaction.  

14 Hours

3. **Composite Implant Materials**: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement, polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

**Bio Compatibility And Toxicological Screening Of Bio Materials**: Definition of bio compatibility, blood compatibility and tissue compatibility, toxicity tests, acute and chronic toxicity (in situ implantation, tissue culture, haemolysis, thermomogenic, potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenesity and special tests.  

12 Hours


6 Hours

5. **Sterilisation Techniques**: ETO, gamma radiation, autoclaving, Effects of Sterilisation on material properties.  

6 Hours

**TEXT BOOKS:**

**REFERENCE BOOKS :**

**Course Outcome:**
Students will be able to know various biomaterials and its testing methods and will be able to understand the significance of its use in various industrial applications.

**MECHANICAL BEHAVIOUR OF MATERIALS**

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**Course Objective:**
The course aims at giving complete exposure to mechanical behavior of materials and characterization of materials.

1. **Strength of materials**- basic assumptions, elastic and plastic behaviour, stress–strain relationship for elastic behaviour, elements of plastic deformation of metallic materialsMohr’s circle, yielding theories.

2. **Theory of plasticity**: Elements of theory of plasticity, dislocation theory properties of dislocation, stress fields around dislocations, application of dislocation theory to work hardening, solid solution strengthening, grain boundary strengthening, dispersion hardening 10 Hours

3. **Ductile and Brittle Fracture**: Ductile and brittle fracture, Charpy and Izod testing, significance of DBTT, ECT, NDT and FATT; elements of fractography - Griffith’s theory, LEFM– COD and J integral –determination of KIC, COD and J integral.

4. **Characteristics of fatigue failure**: Initiation and propagation of fatigue cracks, factors affecting fatigue strength and methods of improving fatigue behaviour – testing analysis of fatigue data, mechanics of fatigue crack propagation, corrosion fatigue. 14 Hours

5. **Introduction to creep**:- creep mechanisms, creep curve, variables affecting creep, accelerated creep testing, development of creep resistant alloys, Larsen Miller parameter – Manson Hafred parameter. 6 Hours

6. **Stages of failure analysis**, classification and identification of various types of fracture. Overview of fracture mechanics, characteristics of ductile and brittle fracture. General concepts, fracture characteristics revealed by microscopy, factors affecting fatiguelife Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure. Some case studies failures. 13 Hours

7. **Types of wear**, analyzing wear failure. Corrosion failures- factors influencing corrosion failures, overview of various types of corrosion stress corrosion cracking, sources, characteristics of stress corrosion cracking. Procedure for analyzing stress corrosion cracking, various types of hydrogen damage failures. 7 Hours

8. **Causes of failure in forging**: failure of iron and steel castings, improper heat treatment, stress concentration and service conditions. Failure of weldments - reasons for failure procedure for weld failure analysis. 6 Hours
TEXT BOOKS

REFERENCES BOOKS

Course Outcome:
Students will develop skill sets to analyse behaviour of materials and analyse its characteristics to find its adoptability for an industrial application.

EXPERIMENTAL METHODS IN ENGINEERING
Sub Code : 14MST424 IA Marks : 50
Hrs/ Week : 04 Exam Hours : 03
Total Hrs. : 50 Exam Marks : 100

Course Objective:
The knowledge of experimental methods in engineering is very essential from the point of view of measurements and experiments that are adopted in industries for evaluation of various parameters, the present course aims at providing a complete insight in this regard.

1. Introduction: Basic concepts of measurement methods, single and multipoint measurement Min space and time. Processing of experimental data, curve fitting and regression analysis. Data Acquisition systems: Fundamentals of digital signals and their transmission, A/D-and D/A converters, Basic components of data acquisition system. Computer interfacing of digital instrument and data acquisition systems; Digital multiplexes, Data acquisition board (DAQ), Digital image processing fundamentals. 8 Hours


Modeling and Simulation of Measurement System: Lumped analysis, first order and second order systems: Frequency response and time constant calculation. Response of a generalized instrument to random data input, FFT analysis. 12 Hours

3. Temperature Measurement: Measurement Design, Construction and Analysis of liquid and gas thermometers, resistance thermometer with wheat stone bridge, Thermo-electric effect, Construction, testing and calibration of thermocouples and thermopiles, Analysis of effect of bead size and shielding on time constant and frequency response, characteristics of thermocouple, pyrometers, radiation thermometers.

Interferometry & Humidity measurement: interferometers, Humidity measurement: Conventional methods, electrical transducers, Dunmox humidity and microprocessor based dew point instrument, Calibration of humidity sensors. 12 Hours
4. **Flow and Velocity Measurement**: Industrial flow measuring devices, design, selection and calibration, velocity measurements, pitot tubes, yaw tubes, pitot static tubes; frequency response and time constant calculation. Hot-wire anemometer; 2d/3d flow measurement and turbulence measurement. Laser application in flow measurement, Flow visualization techniques, Combustion photography.  

5. **Measurement of Pressure, Force, and Torque**: Analysis of liquid manometer, dynamics of variable area and inclined manometer, Pressure transducers, Speed and torque measurement; speed and torque measurement of rotating system.

Air Pollution sampling and measurement: Units for pollution measurement, gas sampling techniques, particulate sampling technique, gas chromatography.

12 Hours

**TEXT BOOKS:**

**REFERENCE BOOKS:**

**Course Outcome:**
Students learn various experimental and measurement techniques which they can adopt in practical applications.