

SAUA1201	MATERIALS AND MESEAUUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the design, selection and processing of materials for a wide range of applications in engineering and other applications
- To understand how and why the properties of materials are controlled by structure and bonding at the atomic scale and by features at the microscopic and macroscopic levels.
- To understand how and why the structure and properties of a material may be controlled by processing.
- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications.

UNIT 1 INTRODUCTION TO MATERIALS**9 Hrs.**

Basic Principles: Crystal structure: BCC –FCC –HCP –Methods to determine crystal structure – Atomic radius – Atomic Packing Factor – Allotropy –Solid solutions, Intermetallic compounds, Atomic Diffusion – Laws of diffusion –Factors affecting diffusion. Phase diagrams: Solidification of metals, phase rules, construction of phase diagram, Isomorphous diagram, Eutectic diagram showing partial solid solubility, Peritectic system.

UNIT 2 FERROUS AND NON – FERROUS ALLOYS**9 Hrs.**

Iron – Iron carbide equilibrium diagram, Cooling curves of pure Fe, Critical points in Fe – Fe₃C equilibrium diagrams, Steels – types of plain carbon steels, stainless steels – their typical compositions, properties and applications, effects of alloying elements on steel, IS designation of steels – Cast iron and its types – their typical compositions, properties and applications. Aluminium and its alloys, Ti & its alloys, Nickel & its alloys – Composition, Properties & applications.

UNIT 3 HEAT TREATMENT OF STEEL**9 Hrs.**

Annealing – Full annealing – Stress relief – Recrystallization – Spheroidizing, Normalizing, Hardening, Tempering, Austempering, Martempering – Hardenability and its determination, TTT diagram and CCT diagram. Case hardening techniques - Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening, Agehardening, Precipitation hardening

UNIT 4 INTRODUCTION TO METROLOGY AND LINEAR MEASUREMENT**9 Hrs.**

Accuracy, precision, resolution and sensitivity of measuring instruments, classification of errors in measurements, alignment errors. Linear Measuring Instruments – Evolution – Types – Classification – gauge design – concepts of interchangeability and selective assembly – Comparators, slip gauges – Types – Angular measuring instruments – Sine bar, angle gauges, autocollimator, angle dekkor, tool maker's microscope, Bevel protractor, clinometers, spirit levels– Alignment telescope – Applications, Surface roughness measurement.

UNIT 5 TEMPERATURE, FLOW AND ADVANCED MEASUREMENT TECHNIQUES**9 Hrs.**

Temperature – thermo couple, RTD, thermistor-electrical resistance thermometer- pyrometers. Flow – Turbine type flow meter, magnetic flow meter, ultra sonic flow meter, thermalflow meter and hot wire anemometer. : Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature: bimetallic strip. Interferometry – laser interferometers – types – applications – Computer Aided Inspection-Basic concept of Coordinate Measuring Machines(CMM)– Types of CMM – Constructional features–Probes– laser interferometer, working principle, applications, alignment and errors; Machine Vision, elements of vision system, applications in manufacturing.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Acquire knowledge of physical and mechanical properties of materials including heat treatment, destructive and non-destructive testing of materials.
- CO2 - Recognize and state the Iron-Carbide phase diagram and TTT Diagrams sufficiently to visualize them in discussions of heat treatment of steels and cast irons.
- CO3 - Select appropriate materials for specific engineering applications considering manufacturing and working conditions
- CO4 - Describe structures of metallic materials and their effects on mechanical properties
- CO5 - Understand the significance of measurement system, errors.
- CO6 - Check alignment of various components in various mechanisms using advanced measurement tools.

TEXT / REFERENCE BOOKS

1. Avener S.H, "Introduction to Physical Metallurgy", 2nd Edition, McGraw Hill, Indian Edition, 2017.
2. Raghavan V, "Material Science and Engineering", 5th Edition, Prentice Hall, 2005.
3. William D Callister "Material Science and Engineering", John Wiley and Sons 2007.
4. Khurmi.R.S, Sedha R.S, "Material Science", 4th Edition, S.Chand & Co., 2009
5. Dieter.G.E, "Mechanical Metallurgy", 3rd Edition, McGraw Hill, 1988.
6. Beckwith T.G. and Marangoni, "Mechanical Measurements", Addison Wesley, 2000.
7. Gupta I C, "Text Book of Engineering Metrology", Dhanpat Rai Publishers, 2003.
8. Jain R.K., "Engineering Metrology", Khanna Publishers, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**