MATERIALS, TESTING AND EVALUATION

IV Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB08	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

COURSE OBJECTIVES:

The course should enable the students to:

I. Make measurements of behaviour of various materials used in Civil Engineering.
II. Provide physical observations to complement concepts learnt.
III. Introduce experimental procedures and common measurement instruments, equipment, devices.
IV. Disclose the variety of established material testing procedures and techniques.

COURSE OUTCOMES (COs):

CO 1: Identify the different engineering materials, properties, manufacturing process of materials.

CO 2: Describe the mechanical behaviour and characteristics, elastic and plastic deformation of metals, strength properties and background of fracture mechanics.

CO 3: Conduct mechanical testing of various metals like iron, steel and various non-ferrous metals, impact testing, background of fracture toughness of different materials, creep, fatigue.

CO 4: Understand the standard testing procedure of bricks, sand, concrete, soils, bitumen and bitumen mixes.

CO 5: Describe the properties, mechanical behaviour of polymers, metals, composites, cementitious materials and special materials.

COURSE LEARNING OUTCOMES (CLOs):

1. Identify the properties of engineering materials like cement, sand, concrete, ceramics, bitumen, structural steel etc.
2. Explain the classification of engineering materials and uses of materials.
3. Understand the manufacturing process of cement, concrete, bitumen, glass, plastics, metals, paints and other engineering materials.
4. Classify the steel, glass, varnishes, adhesives, carbon composites.
5. Explain the mechanical behaviour and characteristics of different metals.
6. Understand the importance of elasticity principle, characteristics and plastic deformation of metals.
7. Explain standards for different materials, stress-strain interpretation.
8. Describe the fundamentals of internal friction, creep, brittle fracture of steel.
9. Understand the concept of fatigue of materials, structural integrity assessment procedure.
10. Perform the mechanical testing of various metals like iron, steel and non-ferrous metals.
11. Explain elastic deformation and plastic deformation of metals.
12. Understand the impact testing, fatigue and creep of materials.
13. Explain fracture toughness of different materials like steel and non-ferrous metals.
14. Explain the testing procedures of bricks and sand.
15. Describe the testing procedures of fresh and hardened concrete.
16. Understand the properties of soil by conducting the different tests.

17. Explicate the procedures of testing bitumen and bitumen mixes.
18. Understand the testing procedures of polymers and polymer based materials.
19. Explain the behaviour of metals under various loads.
20. Describe the mechanical behaviour of composite materials.
21. Discuss the properties of cementitious materials like fly ash, blast furnace slag.

MODULE -I	**INTRODUCTION TO ENGINEERING MATERIALS**	**Classes: 09**

Cements, Sand, Concrete (plain, reinforced and steel fiber / glass fiber reinforced, light weight concrete, high Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical Material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses.

MODULE -II	**INTRODUCTION TO MATERIAL TESTING**	**Classes: 09**

Introduction to material Engineering; Mechanical behavior and mechanical characteristics; Elasticity principle and characteristics; plastic deformation of metals; tensile test-standards for different material (brittle, quasi-brittle, elastic) True stress-strain interpretation of tensile test; hardness tests; bending and torsion test; strength of ceramic; Internal friction, creep fundaments and characteristics; Brittle fracture of steel-temperature transition approach; Background of fracture mechanics; fracture toughness testing for different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics.

MODULE-III	**STANDARD TESTING & EVALUATION PROCEDURES**	**Classes: 09**

Mechanical testing of various metals; naming systems for various irons, steels and nonferrous metals; elastic deformation; plastic deformation.

Impact test and transition temperatures; fracture mechanics background; fracture toughness-different materials; Fatigue of material; Creep.

MODULE-IV	**STANDARD TESTING PROCEDURES**	**Classes: 09**

Tests & testing of bricks, Tests & testing of sand, Tests & testing of concrete, Tests & testing of soils, Tests & testing of bitumen & bituminous mixes.

MODULE-V	**TESTING PROCEDURES OF SPECIAL MATERIALS**	**Classes: 09**

Testing of polymers and polymer based materials, tests and testing of metals, special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.

Text Books:

1. Chudley, R., Greeno, "building construction handbook", R. Butterorth Heinemann, 6th edition, 2006.
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, "Highway Materials and Pavement Testing", Nem Chand & Bros, 5th Edition.
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications.

Reference Books:

1. Kyriakos Komvopoulos, "Mechanical Testing of Engineering Materials", Cognella, 2011.
2. E.N. Dowling, "Mechanical Behaviour of Materials", Prentice Hall International, 1993.
3. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000)

Web References:
1. https://nptel.ac.in/courses/105102088/