1152AU119	AUTOMOTIVE MATERIALS	L T P C 3 0 0 3

1. Preamble

This course imparts the knowledge on the structure, properties, heat treatment, mechanical property evaluation and applications of ferrous and non-ferrous metals to select the appropriate material for suitable applications.

2. Prerequisite

1150PH101 Engineering Physics

3. Links to other courses

- Engine Design and Development
- Vehicle Design and Data Characteristics

4. Course Educational Objectives

Students undergoing this course are expected to:

- Gain knowledge in properties and structures of solids.
- Acquire the knowledge about various phase diagrams of both ferrous and non-ferrous metals.
- Attain knowledge in heat treatment of steels, properties of non ferrous alloys and evaluate the mechanical properties of different metals.
- Impart the knowledge about the failure mechanism of ductile and brittle materials.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain the different crystallographic structures and crystal imperfection in solids	K2
CO2	Explain the different types of phase diagrams and properties of ferrous and non ferrous metals.	K2
CO3	Apply different heat treatment process in metal industries.	K3
CO4	Distinguish different strengthening mechanism and fracture.	K2
CO5	Interpret the mechanical properties of the given material.	K2

6. Correlation of COs with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	L	L				M		M		M	H
CO2	H	H	H	L	L				M		M		M	M
CO3	H	H	H	L	L				M		M		M	M
CO4	H	H	H	L	L				M		M		M	M
CO5	H	H	H	L	L				M		M		H	H

H- High; M-Medium; L-Low

7. Course Content

UNIT I CRYSTALLOGRAPHY L-9

Classification of Materials, Engineering Properties of Materials, Structure of Solid Materials- BCC, FCC & HCP Structures - Atomic Packing Factor - Miller Indices, Crystallographic Direction, Crystallographic Plane, Solid Solution, Types of Solid Solution, Crystal Imperfection - Point Defects, Line Defects – Edge Dislocation, Screw Dislocation, Surface Defects and Volume Defects.

UNIT II FERROUS AND NON FERROUS METALS AND PHASE DIAGRAM L-9

Introduction to Phase Diagram, Gibbs Phase Rule, Binary Equilibrium Diagram, Isomorphus System - Tie Line Rule and Lever Rule, Iron-Iron Carbide Diagram, Effect of Alloying Additions on Steel (Mn, Si, Cr, Mo, V Ti & W) , Types of Steel - HSLA - Maraging Steels – Trip Steels, Tool Steels, Types Stainless Steels —Types of Cast Irons - Copper and its Alloys – Aluminum and its Alloys.

UNIT III HEAT TREATMENT L-9

Importance of Heat Treatment – TTT - Time Temperature Transformation Diagram (Isothermal Transformation Diagram), CCT Diagram – Cooling Curves Superimposed on I.T. Diagram, Types of Heat Treatment Processes – Different Types of Annealing Process, Normalizing, Quenching and Tempering of Steel – Hardenability - Grossman's Critical Diameter, Jominy End Quench Test – Austempering, Martempering Case Hardening, Carburizing, Nitriding, Cyaniding, Carbonitriding – Flame and Induction Hardening.

UNIT IV MECHANICAL PROPERTIES OF MATERIALS & FRACTURE L-9

Mechanisms of Plastic and Elastic Deformations, Slip and Twinning, Recover Recrystallization and Grain Growth - Strengthening Mechanism - Strain Hardening, Precipitation Hardening, Refinement of Grain, Solid Solution Strengthening, Types of Fracture - Ductile and Brittle Fracture - Griffith's Theory, Creep - Mechanisms of Creep - Creep Resistant Materials, Fatigue Failure - Sn Curve - Factors Affecting Fatigue Life, Prevention of Fatigue Failure.

UNIT V MECHANICAL TESTING L-9

Tensile Test - Stress Strain Curves for Ductile and Brittle Materials - Mild Steel, Copper, Concrete and Cast Iron, Proof Stress, Yield Point Phenomenon - Compression and Shear Loads, Hardness Tests (Brinell, Vicker's and Rockwell) - Impact Test- Izod and Chorpy, Fatigue and Creep Test, Fracture Toughness Tests. Non- Destructive Testing Processes.

Total: 45 Periods

8. Text Books

1. Sidney H. Avner, Introduction to Physical Metallurgy, Tata Mcgraw Hill, 2010.
2. Raghavan V. Physical Metallurgy, Prentice – Hall of India Private Limited, 2nd Edition 2006.

9. References

1 Dieter, G. E., Mechanical Metallurgy, McGraw Hill, Singapore, 2012.

2 Thomas H. Courtney, Mechanical Behaviour of Engineering Materials, McGraw Hill, Singapore, 2011.

3 William D Callister "Material Science and Engineering", John Wiley and Sons, 2010.