# Lesson Plan

**Subject : Material Engineering (ES-204)**
**& Materials Engineering Lab (ES-206LA)**

**Lesson plan Duration : 15 Weeks**

**Work load (Lecture/Tutorial/Practical) per week**: L / T / P: 3 / 2 / 4 (Hrs)

| Lecture No | Theory | Practical | |
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| | | Day | Topic |
| 1 | **Unit I:** Crystallography: Review of Crystal Structure | 1 | To Study various Crystal Structures through Ball Models. |
| 2 | Space Lattice, Co-ordination Number ,Number of Atoms per Unit Cell | | |
| 3 | Atomic Packing Factor | | |
| 4 | Imperfection in Metal Crystals: Crystal Imperfections and their Classifications | | |
| 5 | Point Defects, Line Defects, Edge dislocation | 2 | To study the components and functions of Metallurgical Microscope. |
| 6 | Screw Dislocation | | |
| 7 | Surface Defects, Volume Defects | | |
| 8 | Introduction to Engineering materials and Standard Materials Designation: Introduction to Engineering materials | | |
| 9 | Steel Terminology, Standard Designation System for Steels | 3 | To learn about the process of Specimen Preparation for metallographic examination. |
| 10 | Indian Standard specifications for steels as per BIS: Based on Ultimate Tensile Strength and based on Composition | | |
| 11 | AISI-SAE standard designation for Steels and Aluminium Alloys | | |
| 12 | **Unit II :** Phase Diagrams: Alloy Systems, Solid solutions, Hume Rothery's Rules, Intermediate phases | | |
| 13 | Phase Diagrams, Gibbs Phase Rule | 4 | To perform Standard test Methods for Estimation of Grain Size. |
| 14 | Cooling curves, The Lever Rule, binary phase diagrams | | |
| 15 | Applications of Phase Diagrams, Phase Transformation, Micro constituents of Fe-C system | | |
| 16 | Allotropic Forms of Iron ,Iron-iron carbide phase diagram, Modified Iron Carbon Phase Diagrams | | |
| 17 | Isothermal Transformation, TTT Curve | 5 | To perform Microstructural Analysis of Carbon Steels and low alloy steels. |
| 18 | Heat Treatment: Heat treatment of steels, Annealing, Normalising, Hardening, Tempering | | |

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| 19 | Case Hardening, Ageing, Aus tempering and Mar tempering, Surface Hardening, | | |
| 20 | Mass Effect, Equipments for Heat Treatment, Major Defects in Metals or Alloys due to faulty Heat treatment. | 6 | To perform Microstructural Analysis of Cast Iron. |
| 21 | **Unit III:** Deformation of Metal: Elastic and Plastic Deformation, Mechanism of Plastic Deformation | | |
| 22 | Slip; Critical Resolved Shear Stress, Twinning, | | |
| 23 | Conventional and True Stress Strain Curves for Polycrystalline Materials | | |
| 24 | Yield Point Phenomena, Bauschinger Effect, Work Hardening | 7 | To perform Microstructural Analysis of Non-Ferrous Alloys: Brass & Bronze. |
| 25 | Failure of Materials: Fatigue, Fatigue fracture, fatigue failure | | |
| 26 | Mechanism of Fatigue Failure, Fatigue Life calculations | | |
| 27 | Fatigue Tests, Theories of Fatigue | | |
| 28 | Creep: Creep Curve , Types of Creep, Factors affecting Creep | 8 | To perform Microstructural Analysis of Non-Ferrous Alloys: Aluminium Alloys. |
| 29 | Mechanism of Creep, Creep Resistant Material, Creep Fracture | | |
| 30 | Creep Test, Stress Rupture test | | |
| 31 | **Unit IV:** Introduction to Metallography: Metallography, Phase analysis, Dendritic growth | | |
| 32 | Cracks and other defects Corrosion analysis, Intergranular attack (IGA) | 9 | To Perform annealing of a steel specimen and to analyze its microstructure. |
| 33 | Coating thickness and integrity, Inclusion size, shape and distribution | | |
| 34 | Weld and heat-affected zones (HAZ) | | |
| 35 | Distribution and orientation of composite fillers, Graphite nodularity | | |
| 36 | Intergranular fracturing | 10 | To Perform Hardening of a steel specimen and to analyze its microstructure |
| 37 | Materials Characterization Techniques: Characterization techniques | | |
| 38 | X-Ray Diffraction (XRD), Scanning Electron Microscopy | | |
| 39 | Transmission electron microscopy, atomic force microscopy | | |
| 40 | Scanning tunneling microscopy, Atomic absorption spectroscopy | | |