

## LESSON PLAN FOR ACADEMIC SESSION: 2026-27 (WINTER)

|                                                      |                                                   |                                                                                                                        |
|------------------------------------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>Discipline:<br/>Metallurgical<br/>Engineering</b> | <b>Semester : 3rd</b>                             | <b>Name of the Teaching Faculty : Arpita Jena</b>                                                                      |
| <b>Subject : Material<br/>Testing</b>                | <b>No. of days / week<br/>class allotted : 03</b> | <b>Semester From :<br/>20/7/2026 to 05/11/2026<br/>Nos. of Weeks per semester : 15</b>                                 |
| <b>Week</b>                                          | <b>Class Day</b>                                  | <b>Theory Topics</b>                                                                                                   |
| 1 <sup>ST</sup>                                      | 1 <sup>st</sup>                                   | Introduction to Material Testing                                                                                       |
|                                                      | 2 <sup>nd</sup>                                   | Importance & objectives of material testing                                                                            |
|                                                      | 3 <sup>rd</sup>                                   | Classification of materials: Metals, ceramics, polymers, composites                                                    |
| 2 <sup>ND</sup>                                      | 1 <sup>st</sup>                                   | Properties of Materials □ Elastic and Plastic Deformation                                                              |
|                                                      | 2 <sup>nd</sup>                                   | Standard organizations: ASTM, ISO, IS, DIN Mechanical Properties of Materials                                          |
|                                                      | 3 <sup>rd</sup>                                   | Elastic and Plastic Deformation □ Stress-strain behavior, Hooke's Law                                                  |
| 3 <sup>RD</sup>                                      | 1 <sup>st</sup>                                   | Yield strength, ultimate tensile strength (UTS), fracture strength □ Ductility, brittleness, toughness, and resilience |
|                                                      | 2 <sup>nd</sup>                                   | Yield strength, ultimate tensile strength (UTS), fracture strength □ Ductility, brittleness, toughness, and resilience |
|                                                      | 3 <sup>rd</sup>                                   | Revision                                                                                                               |
| 4 <sup>TH</sup>                                      | 1 <sup>st</sup>                                   | Fatigue and creep                                                                                                      |
|                                                      | 2 <sup>nd</sup>                                   | Fatigue and creep                                                                                                      |
|                                                      | 3 <sup>rd</sup>                                   | Revision                                                                                                               |
| 5 <sup>TH</sup>                                      | 1 <sup>st</sup>                                   | Destructive Testing (DT) Methods                                                                                       |
|                                                      | 2 <sup>nd</sup>                                   | Tensile Test: stress-strain behavior, yield strength, tensile strength, ductility, and toughness                       |
|                                                      | 3 <sup>rd</sup>                                   | stress- strain curve,                                                                                                  |
| 6 <sup>TH</sup>                                      | 1 <sup>st</sup>                                   | modulus of elasticity, proof stress, true stress and true strain curve                                                 |
|                                                      | 2 <sup>nd</sup>                                   | modulus of elasticity, proof stress, true stress and true strain curve                                                 |
|                                                      | 3 <sup>rd</sup>                                   | Revision                                                                                                               |
| 7 <sup>TH</sup>                                      | 1 <sup>st</sup>                                   | Relationship between True stress vs Engineering Stress, True Strain vs Engineering Strain                              |
|                                                      | 2 <sup>nd</sup>                                   | Compression Test: Compressive strength and plastic deformation                                                         |
|                                                      | 3 <sup>rd</sup>                                   | Hardness Testing: o Brinell Hardness Test (BHN) o Rockwell Hardness Test (RHN),                                        |
| 8 <sup>TH</sup>                                      | 1 <sup>st</sup>                                   | Vickers Hardness Test (VHN) o Mohs Hardness Test.                                                                      |
|                                                      | 2 <sup>nd</sup>                                   | Impact Testing: Charpy and Izod tests, Discuss about transition temperature                                            |
|                                                      | 3 <sup>rd</sup>                                   | ductility, brittle fracture                                                                                            |
| 9 <sup>TH</sup>                                      | 1 <sup>st</sup>                                   | Fatigue Testing: Different stress cycles, S-N curves,                                                                  |
|                                                      | 2 <sup>nd</sup>                                   | endurance limit, procedure of fatigue testing and fatigue testing machine,                                             |

|                  |                 |                                                                                                                                                                                                                                       |
|------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | 3 <sup>rd</sup> | Mention different metallurgical factors that affect fatigue behavior                                                                                                                                                                  |
| 10 <sup>TH</sup> | 1 <sup>st</sup> | Creep Testing: Stages of creep, effect of temperature and stress, creep rate,                                                                                                                                                         |
|                  | 2 <sup>nd</sup> | creep rupture strength, engineering creep curve, constant stress creep curve and Andrade concept equi- cohesive temperature,                                                                                                          |
|                  | 3 <sup>rd</sup> | creep rupture strength, engineering creep curve, constant stress creep curve and Andrade concept equi- cohesive temperature,                                                                                                          |
| 11 <sup>TH</sup> | 1 <sup>st</sup> | State various factors that affect creep, creep testing machine, stress rupture test                                                                                                                                                   |
|                  | 2 <sup>nd</sup> | Fracture mechanics: Types of fractures: Ductile, brittle, fatigue, creep                                                                                                                                                              |
|                  | 3 <sup>rd</sup> | Crack initiation and modes of Crack propagation                                                                                                                                                                                       |
| 12 <sup>th</sup> | 1 <sup>st</sup> | Crack initiation and modes of Crack propagation • Case studies of real-world material failures                                                                                                                                        |
|                  | 2 <sup>nd</sup> | Non-Destructive Testing (NDT) Methods,                                                                                                                                                                                                |
|                  | 3 <sup>rd</sup> | Visual Inspection: Surface defects, cracks, surface roughness                                                                                                                                                                         |
| 13 <sup>th</sup> | 1 <sup>st</sup> | Visual Inspection: Surface defects, cracks, surface roughness<br>□ Liquid Penetrant Test (LPT): Surface crack detection □<br>Magnetic Particle Testing (MPT): Detection of surface & subsurface defects                               |
|                  | 2 <sup>nd</sup> | Visual Inspection: Surface defects, cracks, surface roughness<br>□ Liquid Penetrant Test (LPT): Surface crack detection □<br>Magnetic Particle Testing (MPT): Detection of surface & subsurface defects                               |
|                  | 3 <sup>rd</sup> | Revision                                                                                                                                                                                                                              |
| 14 <sup>th</sup> | 1 <sup>st</sup> | Revision                                                                                                                                                                                                                              |
|                  | 2 <sup>nd</sup> | Ultrasonic Testing (UT): Internal defect detection using high-frequency waves □ Radiographic Testing (RT): X-ray and gamma-ray testing for welds and castings □ Eddy Current Testing (ECT): Conductivity & defect detection in metals |
|                  | 3 <sup>rd</sup> | Revision                                                                                                                                                                                                                              |
| 15 <sup>th</sup> | 1 <sup>st</sup> | Advanced Material Testing Techniques & Industrial Applications & Case Studies (5 hours) □ Nanoindentation                                                                                                                             |
|                  | 2 <sup>nd</sup> | Advanced NDT techniques (phased array ultrasound technique) □ Quality control and material selection                                                                                                                                  |
|                  | 3 <sup>rd</sup> | Revision                                                                                                                                                                                                                              |

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