Syllabus: Material Testing Lab(BME352)

BME352- MATERIALS TESTING LAB

CO-1: Students will be able to perform different destructive and non-destructive testing methods to measure various mechanical properties. **(K2)**
CO-2: Students will be able to analyse the effect of different heat-treatment processes on the Hardness. **(K4)**
CO-3: Students will be able to simulate the material using simulating software / measure the mechanical properties of 3-D printed components. **(K3)**

List of Experiments: (At least 8 of the following)

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines (this test should be conducted on MS Specimen – prior and after the various heat-treatment processes like Annealing / Normalizing / Hardening etc.; with this, 2 experiments can be designed: one for Annealing or Normalizing and another for Hardening / Tempering).
5. Fatigue test on fatigue testing machine.
6. Creep test on creep testing machine.
7. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.
8. Modelling of Graphene / any other materials structure using LAMMPs (LAMMPS Molecular Dynamics Simulator) or any other simulation software and studying the mechanical properties.
9. Measurement of mechanical properties (tensile test, compression test, hardness test / flexural test) of specimen made by 3-D printing

Material Testing Laboratory Manual

Experiment 1: Tensile Test of Mild Steel on UTM

Objective:

To determine yield strength, ultimate tensile strength, percentage elongation and reduction in area of a mild steel specimen and plot stress–strain curve.

Apparatus:

Universal Testing Machine (UTM), Mild steel specimen, Vernier caliper, scale.

Theory:

In tensile testing, a specimen is subjected to gradually increasing tensile load until fracture occurs.

Stress = Load / Original Area

Strain = Extension / Original Length

Procedure:

1. Measure diameter and gauge length of specimen.

2. Fix specimen in grips of UTM.

3. Apply tensile load gradually.

4. Record load and extension.

5. Continue loading until fracture occurs.

6. Plot stress vs strain curve.

Observation Table:

S.N	Load (N)	Extension (mm)	Stress (MPa)	Strain

Result:

Ultimate tensile strength and yield strength of mild steel specimen are determined.

Experiment 2: Shear and Bend Test on UTM

Objective:

To determine shear strength and bending strength of the given specimen.

Apparatus:

Universal Testing Machine, shear test fixture, bending fixture, mild steel specimen.

Theory:

Shear stress acts parallel to the cross section of material.

Shear Stress = Load / Area

Procedure:

Shear Test:

1. Fix shear tool in UTM.

2. Insert specimen.

3. Apply load gradually.

4. Note load at failure.

Bending Test:

1. Place specimen on bending supports.

2. Apply load at the center.

3. Record load and deflection.

Result:

Shear and bending strength of the specimen were determined.

Experiment 3: Impact Test (Charpy / Izod)

Objective:

To determine impact strength of material using impact testing machine.

Apparatus:

Charpy/Izod impact testing machine, notched specimen.

Theory:

Impact test measures the energy absorbed by a material during sudden fracture.

Impact Energy = Initial Energy – Final Energy

Procedure:

1. Place the notched specimen in the machine.

2. Raise the pendulum to initial height.

3. Release pendulum.

4. Record absorbed energy.

Result:

Impact strength of the specimen was determined.

Experiment 4: Hardness Test (Rockwell / Brinell / Vickers)

Objective:

To determine hardness of mild steel before and after heat treatment.

Apparatus:

Rockwell hardness tester, Brinell/Vickers tester, furnace.

Theory:

Hardness is resistance of material to indentation.

Heat Treatment Processes:

Annealing – heating and slow cooling to soften metal.

Normalizing – heating and air cooling for fine grains.

Hardening – heating and quenching for high hardness.

Tempering – reheating hardened steel to improve toughness.

Procedure:

1. Clean specimen surface.

2. Place specimen on hardness tester.

3. Apply load.

4. Measure indentation.

5. Calculate hardness value.

Observation Table:

S.N	Specimen	Heat Treatment	Hardness Value

Result:

Hardness values before and after heat treatment were determined.

Experiment 5: Fatigue Test

Objective:

To determine fatigue strength of material.

Apparatus:

Fatigue testing machine, mild steel specimen.

Theory:

Fatigue occurs due to repeated cyclic loading below yield strength.

Relationship between stress and cycles is shown by S-N curve.

Procedure:

1. Mount specimen in fatigue machine.

2. Apply cyclic load.

3. Run machine until fracture.

4. Record number of cycles.

Observation Table:

S.N	Stress(MPa)	Number of cycle (N)

Result:

Fatigue strength and endurance limit of specimen were determined.