UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN MEKANIKAL

BMCB 2423 – MATERIALS SCIENCE

TUTORIAL 5

1. A specimen of copper having a rectangular cross section 15.2 mm × 19.1 mm is pulled in tension with 44,500 N forces, producing only elastic deformation. Calculate the resulting strain.

2. An aluminum bar 125 mm long and having a square cross section 16.5 mm on an edge is pulled in tension with a load of 66,700 N, and experiences an elongation of 0.43 mm. Assuming that the deformation is entirely elastic, calculate the modulus of elasticity of the aluminum.

3. A cylindrical rod of steel (E =207 GPa) having a yield strength of 310 MPa is to be subjected to a load of 11,100 N. If the length of the rod is 500 mm, what must be the diameter to allow an elongation of 0.38 mm?

4. A cylindrical specimen of hypothetical alloy having an original area of 120 x 10^{-6} m^2 is tensile tested to fracture and found to have engineering fracture strength of 250 MPa. If it's cross sectional area at fracture is 100 x 10^{-6} m^2, determine:
   i. the ductility in terms of percent reduction in area (% *RA*).
   ii. the true stress at fracture.

5. A cylindrical rod 120 mm long and having a diameter of 15.0 mm is to be deformed using a tensile load of 35,000 N. It must not experience either plastic deformation or a diameter reduction of more than 1.2 × 10^{-2} mm. Of the materials listed below, which are possible candidates? Justify your choice(s).

Material	Modulus of Elasticity (GPa)	Yield Strength (MPa)	Poisson's Ratio
Aluminum alloy	70	250	0.33
Titanium alloy	105	850	0.36
Steel alloy	205	550	0.27
Magnesium alloy	45	170	0.35

6. A Brinell hardness measurement is made on a ductile iron using a 10 mm diameter sphere of tungsten carbide. A load of 3,000 kg produces a 3.91 mm diameter impression in the iron surface. Calculate the Brinell hardness number, HB of this alloy.
7. The Ti – 6Al – 4V orthopedic implant material gives a 3.27 mm diameter impression when a 10 mm diameter tungsten carbide sphere is applied to the surface with a 3,000 kg load. Calculate the Brinell hardness number, HB of this material.

8. A large tower is to be supported by a series of steel wires; it is estimated that the load on each wire will be 13,300 N. Determine the minimum required wire diameter, assuming a factor of safety of 2 and a yield strength of 860 MPa for the steel.