EX/FTBE/ME/T/215/2018

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING, 2018
(2^{nd} Year, 1^{st} Semester)

MECHANICS OF SOLID

Time: Three hours

Full Marks: 100

Answer any *five* questions

1. a) For a vector $\vec{A}$ with direction cosines l, m, n show that unit vector can be expressed as $\vec{a} = li + mj + nk$ (10)

   b) A vector has a line of action that goes through the coordinates (0, 2, 3) and (-1, 2, 4). If the magnitude of this vector is 100 units, express the vector in terms of the unit vectors i, j , and k. (10)

2. a) Given a force $\vec{F} = (20i + 10j + Pk)$ N. If this force is to have a component 20 N along a line having a unit vector $\vec{r} = 0.6i + 0.8k$, what should be the value of P? What is the angle between F and r ? (10)

   b) A force $\vec{F} = (10i + 6j + 3k)$ N acts at position (3, 0, 2)m. At point (0, 2, -3)m an equal but opposite force $(-\vec{F})$ acts. What is the couple moment? What are the direction cosines of the normal to the plane of the couple? (10)

3. Write down the equations of equilibrium for a rigid body subjected to co-planar system of forces. Define statically determinate and statically indeterminate problems.

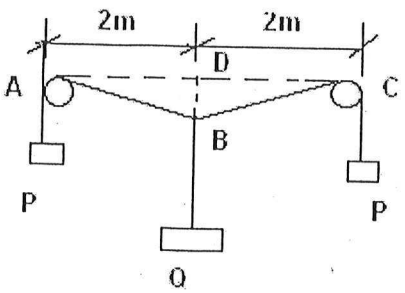

Figure 03

A weight Q is suspended from point B of an inextensible cord ABC, the ends of which are pulled by equal weights P over-hanging small pulleys A and C which are on the same level (Figure Q3). Neglecting the radii of the pulleys determine the sag BD if AC = 4 m, P = 20 N and Q = 10 N. (20)

4. a) An aluminium bar 2.0 m long has a square cross-section of area 3.0 cm^2 over 1.0 m of its length and 3.0 cm diameter circular cross-section over the other 1.0 m length. Determine the elongation of the bar under a tensile load of 4000 kgf. Take the value of Young's Modulus of Elasticity, $E = 0.8 \times 10^6$ kgf/cm^2. (10)

   b) Derive the equation defining the deflection curve of a uniformly loaded simply supported beam. Also show that maximum deflection occurs at mid-span of the beam.beam. (10)

5. a) For torsion of a circular shaft with usual notations show that

$$\tau_{max}/R = \tau/r = (G\theta)/L \quad (10)$$

   b) A steel shaft 6 mm in diameter turns at 10,000 rpm. What is the maximum power that such a shaft may develop if the assigned working stress in shear is 350 kgf/cm^2. (10)

6. a) A cantilever beam of length 1 m is subjected to uniformly distributed load of intensity, w = 10 kgf/cm. Draw the shear force and bending moment diagrams for the beam showing the important coordinates therein. (10)

   b) A 1 m long beam with rectangular section of 10 cm width and 20 cm height is simply supported at the ends. If the beam is loaded with a uniformly distributed load of 100 kgf/m throughout the span, determine the bending stress at the mid-span at a point 5 cm above the bottom of the beam. (10)