EX/FTBE/ME/T/215/2018(S)

B.E. Food Technology and Bio-Chemical Engineering Examination, 2018

(2nd Year, 1st Semester)

Mechanics of Solid

Time: Three hours Full Marks: 100

Answer any **five** questions

1. (a) For a vector A with direction cosines l, m, n show that the unit vector can be expressed as a = li + mj + nk (10)
   (b) The force F is expressed as a function of position as

   $F = (10x - 6)i + (x^2z)j + (xy)k$.

   What are the direction cosines of the force at position (1, 2, 2) ? What is the position along the x coordinate where $F_x = 0$? F_x is the scalar component of F along x-axis. (10)

2. (a)Three points have coordinates expressed in metres as follows:
   A(4,4,5), B(-2,-4,3) and C(3,-6,-2). A force of magnitude 100 KN is applied at A and is directed towards B. Determine the vector expression for the component of the force in the direction of AC. (10)

   (b) The turnbuckle **(Fig. Q2(b))** is tightened until the tension in cable *AB* is 1.2 kN. Calculate the magnitude of the moment about point *O* of the force acting on point *A*. Then determine the magnitude of the moment about the *x*- axis. (10)

3. (a) The vertical mast (**Fig. Q3(a)**) supports 4 kN force and is constrained by the two fixed cables *BC* and *BD* and by a ball-and-socket connection at *A*. Calculate the tension in cables *BD and BC*. (10)

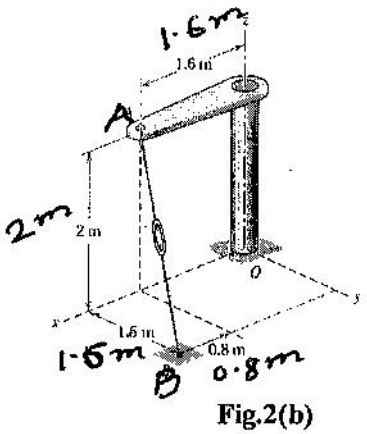

Fig.2(b)

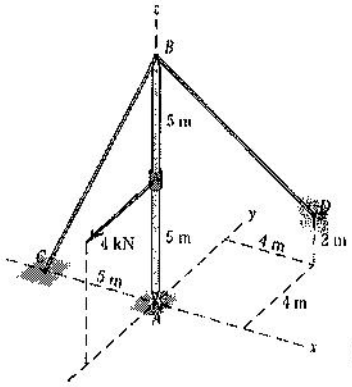

Fig. Q3(a)

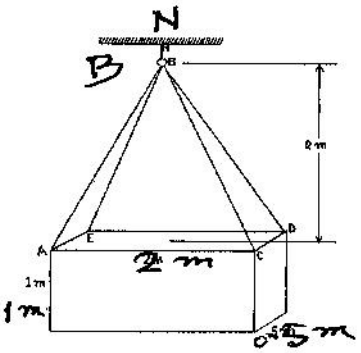

Fig. Q3(b)

[Turn over

EX/FTBE/ME/T/215/2018(S)

B.E. Food Technology and Bio-Chemical Engineering Examination, 2018

(2nd Year, 1st Semester)

Mechanics of Solid

3. (b) A block having a mass of 500 kg is held by five cables as shown in **Fig. Q3(b).** What are the tensions in these cables? Lower cables are identical and are identically connected at ends. (10)

4. (a) A mild steel tensile test specimen, having a circular cross-section of diameter, d = 1.25 cm shows an elongation reading of 0.005 cm over a gauge length of 5.0 cm. Calculate the tensile stress in the material, assuming that Young's Modulus of Elasticity, $E = 0.8 \times 10^6$ kgf/cm^2. (05)

(b) Determine the total elongation of a prismatic bar of length l and cross-sectional area A which hangs vertically under its own weight W. (05)

(c) Derive the equation defining the deflection curve of a uniformly loaded simply supported beam. Also find the expression for the maximum deflection at the free end. (10)

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

$$T/J = (G\theta)/L \qquad (10)$$

(b) A hollow steel shaft is to have outside diameter d and inside diameter d/2. Calculate the proper value of d for the shaft if it is to transmit 200 hp at 105 rpm with a working stress in shear of 420 kgf/cm^2. (10)

6. A simply supported beam of length 3.6 m is to carry a uniformly distributed load of intensity, w = 1,600 kgf/m. The cross-section is to be rectangular with depth h and width b = h/2. If the allowable bending stress in tension or compression is 84 kgf/cm^2, what is the required depth h for the cross-section? Also draw shear force and bending moment diagrams of the beam.

(20)