Ref. No.: Ex/PHARM/ME/T/113/2019

B. PHARMACY FIRST YEAR FIRST SEMESTER – 2019

Subject: APPLIED MECHANICS

Time : Three Hours **Full Marks : 100**

(Answer Any Five Questions)

1. (a) Determine a vector of magnitude 18 units which is perpendicular to both the vectors $\vec{A} = (4i - j + 3k)$ and $\vec{B} = (-2i + j - 2k)$ units. (6)

(b) A force $\vec{F}$=**6i+3j+2k** acts at a position (3, 0, 1) metres. At point (0, 1, -3) metres an equal and opposite force –**F** acts. Determine the couple moment and the direction cosines normal to the plane of the couple. (6)

(c) The resultant of two forces P and Q acting at an angle θ is equal to $(2m + 1)\sqrt{P^2 + Q^2}$ and when they act at an angle of $(90^0$-$\theta)$, the resultant is $(2m - 1)\sqrt{P^2 + Q^2}$. Prove that, $\tan\theta = \frac{m-1}{m+1}$. (8)

2. (a) What is meant by equilibrium of rigid bodi State the conditions for equilibrium. (2+3)

(b) The mass center G of the 1400-kg rear-e ne car is located as shown (**Fig. 1**). Determine the normal force under each tire when the ca n equilibrium. State any assumptions. (7)

(c) The 20-kg homogeneous smooth spl rests on the two inclines (**Fig. 2**). Determine the contact forces at A and B. (8)

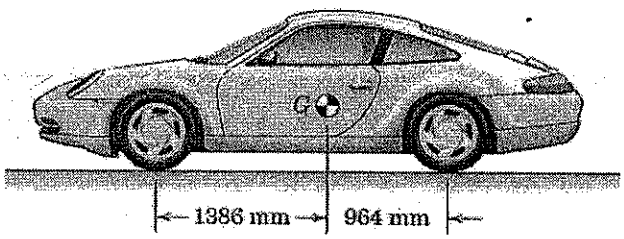

Fig. 1

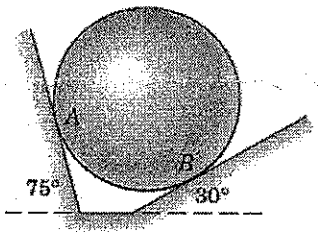

Fig. 2

3. (a) A block A of weight 1000N rests on a block B of weight 2000N which rests on a rough horizontal floor (**Fig. 3**). The block A is tied to a wall by a cable at 30^0 to the horizontal. Find the minimum horizontal force ***P*** required to just move the block B to the right. Find also the tension in the cable. Take coefficient of friction at all contact surfaces as 0.30. (10)

(b) Two blocks connected by a horizontal link AB are supported on two rough planes as in **Fig. 4**. The coefficient of friction for the block A on the horizontal plane is 0.4 and for block B on the inclined plane is 0.364. What is the smallest weight W of the block A for which equilibrium of the system can exist. (10)

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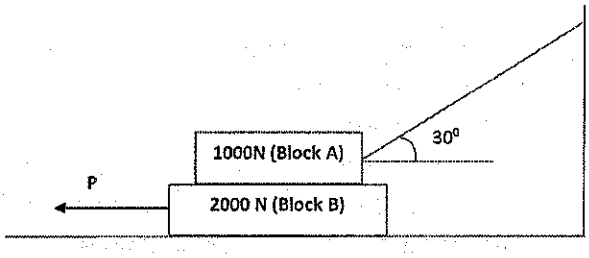

Fig. 3

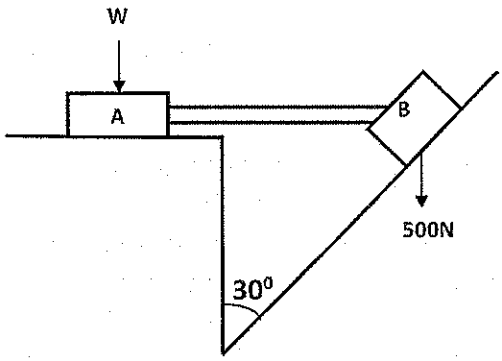

Fig. 4

4. (a) State the Pappus-Guldinus Theorems. (5)

(b) Determine the center of gravity of a solid hemisphere of radius *R*. State any assumptions made. (7+1)

(c) A solid hemisphere of diameter 60mm is placed on the top of a solid cylinder, whose diameter is also 60mm. The height of the cylinder is 80mm. Determine the common center of gravity of the composite body. (7)

5. (a) A vehicle of weight 50kN is moving with a velocity of 3m/s along an inclined plane with a gradient of 2%. It travels along the plane 50m and then travels 100m along the level track. The track resistance is 300N throughout. A spring bumper is provided on the level track to stop the vehicle after travelling 100m over the track level. Find out the spring strength if the vehicle stops after compressing 40cm of the spring. (10)

(b) Determine the extension of a circular bar of length *L* tapering uniformly from a diameter of d_1 at one end to a diameter of d_2 at the other end and subjected to an axial pull of *P*. (10)

6. (a) Draw the shear force and bending moment diagrams for a simply supported beam carrying a uniformly distributed load of '*w*' per unit length over the whole span of the beam. Specify all the sign conventions adopted. (8+2)

(b) Draw the shear force and bending moment diagrams for a simply supported beam *AB* of span 8 *metres* (**Fig. 5**) carrying concentrated loads of 4kN, 10kN and 7kN at distances of 1.5 *metres*, 4 *metres* and 6 *metres* from the left end support. Locate the position of the maximum bending moment. (9+1)

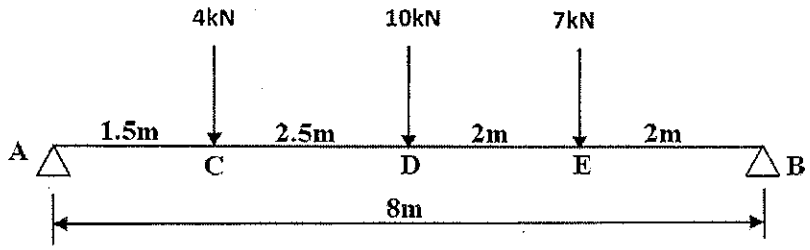

Fig. 5

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7. (a) An aluminum bar 1.0m long has 4.0cm diameter circular cross-section over 0.50m of its length and 3.0cm diameter circular cross-section over the other 0.50m length. Determine the elongation of the bar under a tensile load of 2000kgf. Take the value of Young's Modulus of Elasticity, E=0.8X10^{6}kgf/cm^2. (8)

(b) Draw the shear force and bending moment diagrams for the cantilever beam loaded as shown in **Fig 6**. Locate all important coordinates. (10+2)

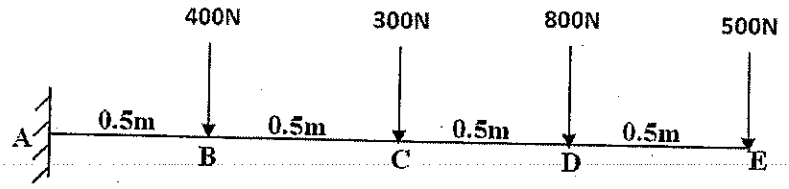

Fig. 6

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