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ET-202(A)

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B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering)

Term-End Examination

June, 2011

ET-202(A) : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any five** questions. All questions carry **equal** marks. Use of calculator is allowed.*

1. (a) State and explain varignon's theorem. **2+6=8**

The side of a regular hexagon ABCDEF is 0.6 m. Forces 2, 4, 6, 8, 10, and 12 N are acting along the sides AB, CB, DC, DE, EF and FA respectively. Find algebraic sum of moments about A.

(b) Determine the reactions of the beam loaded as shown in figure - 1. **6**

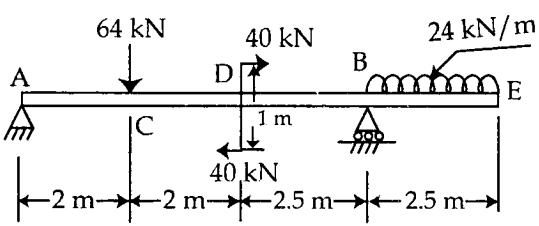

Figure - 1

2. (a) State the laws of dry friction. **2+6=8**

Find the minimum force P needed to start block B, shown in figure - 2, moving to the right if coefficient of friction is 0.2 between A and B. It is 0.25 between B and ground. The weight of block A and B are 160 N and 320 N respectively.

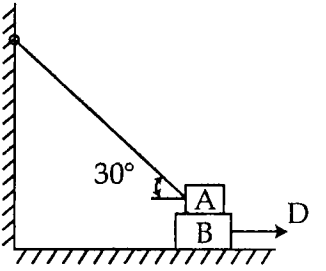

Figure - 2

(b) The weight of block 'Q' is 2.4 kN, find the minimum value of weight of block 'P' to maintain equilibrium as shown in figure 3. The coefficient of friction between block P and the surface is 0.3 and that between block Q and the surface is 0.25. **6**

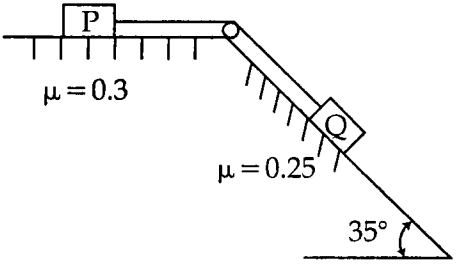

Figure - 3

3. (a) An overhanging beam ABC is simply supported at A and B. It projects beyond the support B upto point C and loaded as shown in figure 4. Draw SFD and BMD. Find location of point of contraflexure. 7

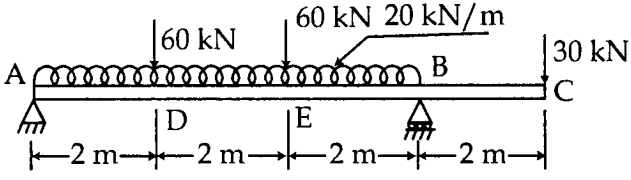

Figure - 4

(b) Determine the forces in members DE and DC in truss shown in figure 5. 7

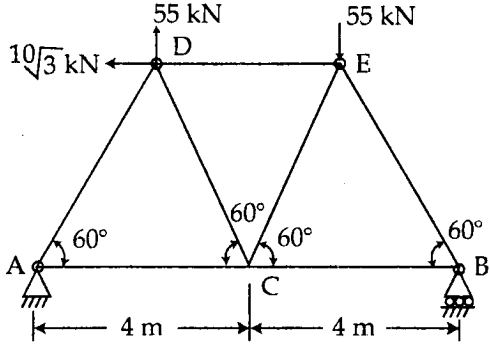

Figure - 5

4. (a) A circular rod of variable cross-section is built in at one end. It is subjected to three axial forces as shown in figure - 6. Find maximum normal stress and change in the length of the bar. Assume E = 200 GPa. 7

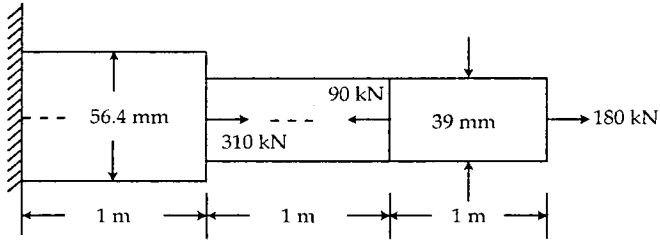

Figure - 6

(b) A rigid bar carrying a load P equal to 60 kN is supported by three wires 1, 2, 3 having cross-sectional areas 1,1.5, 2 sq.cm respectively. The material of wires 1, 2, 3 are copper, steel, aluminiums respectively. The length of wires 1 and 3 is 2 m each whereas length of 2 is 1.5 m as shown in figure - 7. Find tension in each of the wires. Assume $E_{cu} = 1 \times 10^4$ kN/cm^2, $E_{steel} = 2 \times 10^4$ kN/cm^2 and $E_{Al} = 0.7 \times 10^4$ kN/cm^2. 7

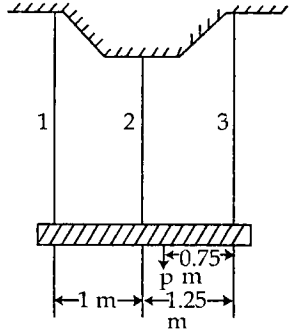

Figure - 7

5. (a) Determine area moment of inertia of circular lamina of radius a = 10 cm about its centroidal axis xx as shown in figure 8 by first principles. 6

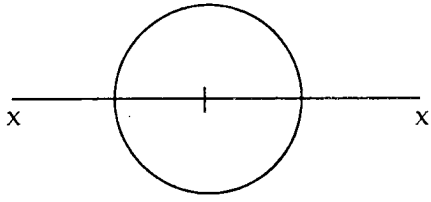

Figure - 8

(b) A weight of 3 kN is raised by a rope which is wrapped round a drum 100 cm in diameter and weighing 600N. It has a radius of gyration of 45 cm. The drum is rotated by an electric motor which exerts constant torque of 4000 Nm. If rope is tight when drum begins to rotate, determine ; 8

(i) acceleration of cage

(ii) tension in the rope

6. (a) A body falls freely under the action of gravity. It passes two points 24 m apart vertically in 0.5 seconds. From which point above the higher point did the body start to fall ? 7

(b) The motion of particle in XOY plane is defined by the following equation. 7

$$\vec{r}\,(t) = 3t\,\vec{i} + (4t - 3t^2)\,\vec{j}$$

The distances are in meters. Find its radius of curvature and its acceleration when it crosses x-axis again.

7. (a) A projectile is fired from the edge of a 160 m high cliff with an initial velocity of 200 m/sec. at an angle of elevation 35° with horizontal. Neglecting air resistance, determine ; 7

(i) the horizontal distance from the gun to the point where projectile strikes the ground,

(ii) the maximum height reached by the projectile above the ground.

(b) The mass of an elevator is 750 kg It is ascending at an acceleration of 5 m/sec^2. The mass of operator is 70 kg. Assuming that the operator is standing on spring scales during ascension, what will be scale reading ? Also determine the tension in the cable. 7

8. (a) A compound pulley system has a mass of 30 kg and a radius of gyration equal to 450 mm. It supports two masses as shown in figure - 9. Determine acceleration of falling mass, angular acceleration of the pulley and tension in each chord. 7

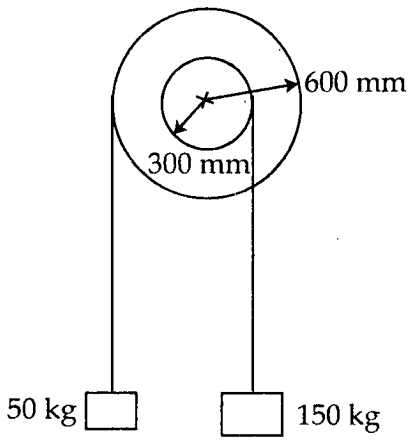

Figure - 9

(b) In a construction of pile-driving for building a pile driver drops a 25 kg mass freely through a height of 3 m on the top of pile having its own mass equal to 50 kg. If pile is driven into the ground through 7.5 cm, determine average resistance of the ground to the pile driving and energy lost in the impact. 7