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ET-202(A)

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

BTCLEVI/BTMEVI/BTELVI/BTECVI/BTCSVI

Term-End Examination

December, 2011

ET-202(A) : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

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

1. (a) Determine the minimum value and direction of the force required at the centre of the wheel to start it over the step 300 mm high. The diameter of the wheel is 1.2 m and its weight is 1.6 kN. **6**

(b) Determine the reactions of the beam loaded as shown in figure. **8**

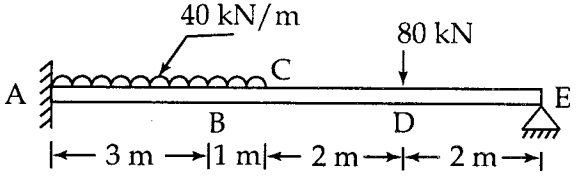

Figure 1

There is a hinge at B.

2. (a) Determine the load W for the system shown in figure 2 so that the blocks A and B are just on the point of sliding. The coefficient of friction between the blocks and ground is 0.2. The weight of blocks is 16 kN each. 6

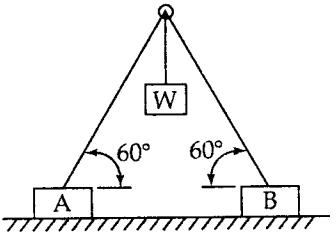

Figure 2

(b) Two 8° wedges are used to push a block horizontally as shown in figure 3. If coefficient of friction is 0.25 for all surfaces of contact, determine the minimum load 'p' required to push the block B weighing 12 kN. 8

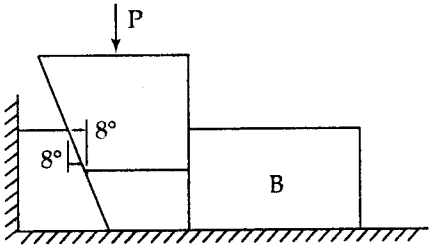

Figure 3

3. (a) A simply supported beam of span 9 m carries a u. d.l. and two point loads as shown in figure 4. Draw SFD and BMD for the beam. 7

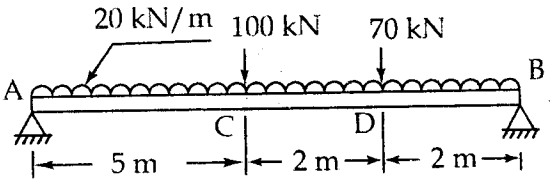

Figure 4

(b) Find the forces in all the members of the truss shown in figure 5. 7

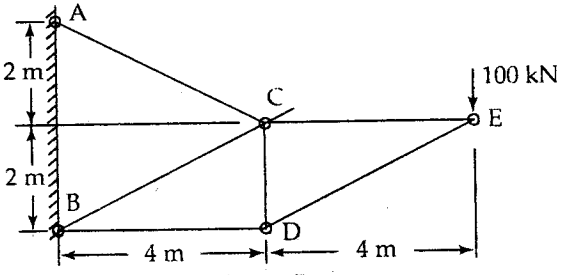

Figure 5

4. (a) A steel rod circular in section tapers from 2 cm diameter to 3 cm diameter in a length of 60 cm. Find out increase in length of the bar under a concentric pull of 30 kN. Assume $E = 2.1 \times 10^7$ N/cm^2. 6

(b) A rigid steel plate is supported by three pillars of concrete as shown in figure 6. Each pillar has cross-section 300×300 mm^2. Before application of load P, the middle pillar is shorter than other two by 1 mm. Determine the maximum load 'P' if the allowable stress is 20 MPa and modulus of elasticity is 3×10^4 MPa. 8

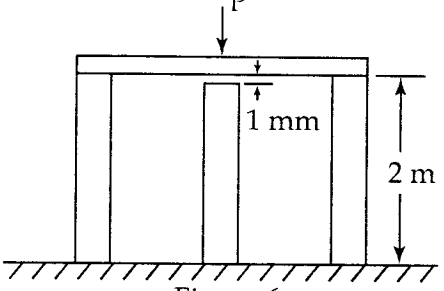

Figure 6

5. (a) Explain principal axes and how they are determined ? 2+5

Determine the principal moment of inertia of the angle section $150 \times 150 \times 10$ mm and locate their orientation.

(b) Blocks A and B of mass 20 kg and 45 kg respectively are connected by a weightless rope over a frictionless pulley as shown in figure 7. Assume a coefficient of friction of 0.2 for all the planes. Determine velocity of system after 5 seconds when it starts from rest : 7

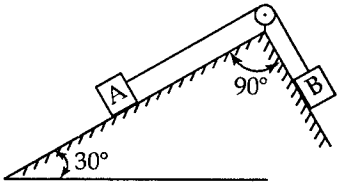

Figure 7

6. (a) The body is moving along a straight line with acceleration 'a' given by $a = 3 - 4t$ where 't' is time in seconds. 7

The velocity of the body at an instant 5 seconds after the start of observation is 30 m/sec. The distance of the body is 100 m from the origin, 10 seconds after the start of observation.

Determine :

(i) acceleration, velocity and distance from the origin at the start of observation.

2+5

(ii) the time and distance of body from the origin when velocity becomes zero.

(b) Explain simple harmonic motion.

An unknown mass of 'm' kg attached to the end of a spring of unknown stiffness 'k' has a natural frequency of 94 cpm. When a 0.433 kg mass is added to 'm' the natural frequency is lowered to 76.7 cpm. Determine the value of 'm' and 'k'.

7. (a) A locomotive is moving with velocity 1.6 m/sec and acceleration at the rate of 2 m/sec^2. It has wheel of radius 0.8 m as shown in figure 8. Determine the acceleration of points P_1, P_3 and P_4. 7

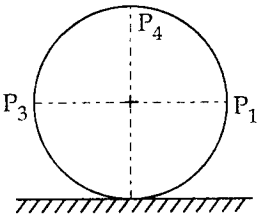

Figure 8

(b) A block B moves with an acceleration along the horizontal plane by means of a mass A attached to it by a flexible in-extensible massless rope passing over a smooth pulley as shown in figure 9. The coefficient of friction between block B and the plane is 0.2. Mass of block B is 2 kg and that of A is 1.2 kg. Discuss the motion. 7

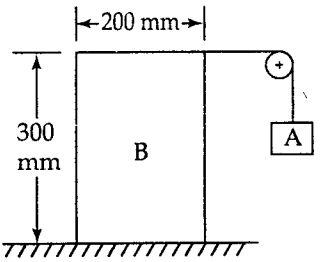

Figure 9

8. (a) A solid sphere and a thin hoop of equal masses 'm' each and radii 'R' are connected together by a rod in such a way that they are free to roll without slipping down the inclined plane as shown in figure 10. Assuming frictionless bearing determine the acceleration of the assembly and the force in the connecting rod. 7

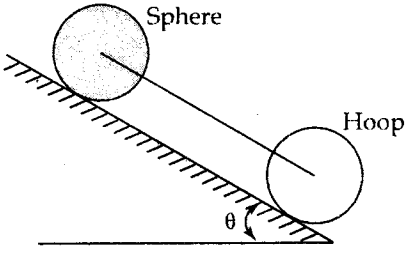

Figure 10

(b) A mass of 4 kg moving with a velocity of 10 m/sec. along X direction follows another mass of 10 kg moving with 5 m/sec. in the same direction. Determine the final velocities of two masses if e = 0.6. Under the following conditions also find velocities - **2+3+2**

(i) the impact is fully plastic. Determine loss in kinetic energy also.

(ii) the impact is perfectly elastic.