Mr. Anil Kumar civil

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
END SEMESTER EXAMINATION - 2015
B.Tech. II Semester

COURSE CODE: 10B11CE211 MAX. MARKS: 45
COURSE NAME: Engineering Mechanics
COURSE CREDITS: 04 MAX. TIME: 3 HRS

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

Section-A (9 × 1 = 9 marks)

Q.1. (i) Why is it necessary to have at least three non-concurrent reactions for a 2D body to be stable?

(ii) Why are trusses / frames in practice made indeterminate? What is the necessary condition for a structure to be *just* stable?

(iii) Can you apply principle of transmissibility of forces on a non-rigid body? If yes/no, why?

(iv) How is dynamic equilibrium achieved in D'Alembert's approach?

(v) Is it possible to convert a system of non-concurrent forces to a force-and-couple system? If yes / no, give example.

(vi) In what situations, twisting can occur in beams of a building frame? Illustrate with a sketch.

(vii) Can moment of inertia be negative? If yes / no, justify.

(viii) Directions of velocity and acceleration are _____ at the top position of the trajectory of a projectile.

(ix) Which of the following statements are correct?

A vehicle moving along a banked circular path

(I) overturns if the centrifugal force is more than lateral frictional force.

(II) skids if the moment of centrifugal force is more than that of its weight about point of contact.

(III) slides inward if speed is less than optimum speed.

Section-B (3 × 4.5 = 13.5 marks)

Q.2. Two simply supported light beams AD and DC are hinged internally at D. Find the reaction at the support B using the principle of virtual work, if the beams are loaded as shown in **Fig. 1.**

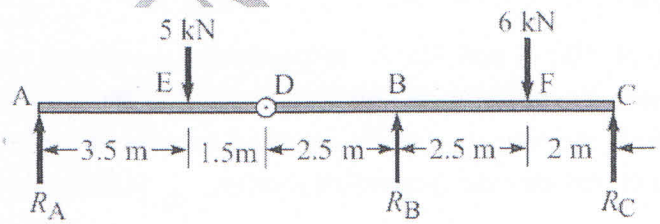

Fig. 1.

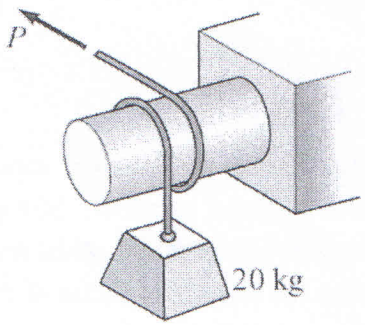

Fig. 2.

Q.3. A 20-kg load hangs at the end of a rope wound 1.25 times around the fixed shaft as shown in **Fig. 2.** (*a*) Determine the horizontal force *P* required at the other end of the rope to raise the load at a slow and steady speed. (*b*) If no force is applied, check whether the load stays back? (*c*) Find the force required to keep the load in equilibrium. The coefficient of friction between the rope and fixed shaft is 0.05.

Q.4. An enemy target is known to be 10 m behind a 3-m high wall (**Fig. 3**). If a gunman is 20 m in front of the wall in the same horizontal plane as the target, determine the angle of projection and the least velocity of firing the shell so that it hits the target. Ignore the thickness of the wall.

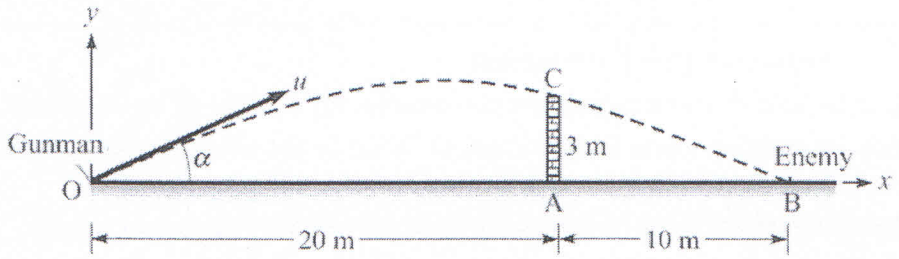

Fig. 3.

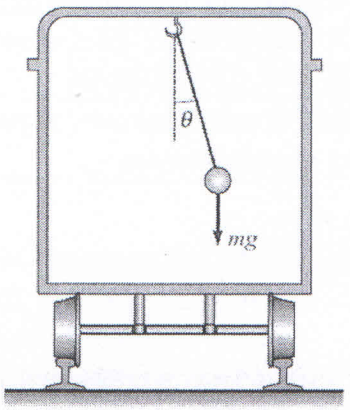

Fig. 4.

SECTION-C (22.5 marks)

Q.5. A ball weighing 1.5 N suspended by a rope from the ceiling of a railway carriage was found to make an angle $\theta = 10°$ with vertical when the railway carriage was negotiating a curve of radius 150 m (**Fig. 4**). Calculate the speed of the carriage and the tension in the rope. **(6 marks)**

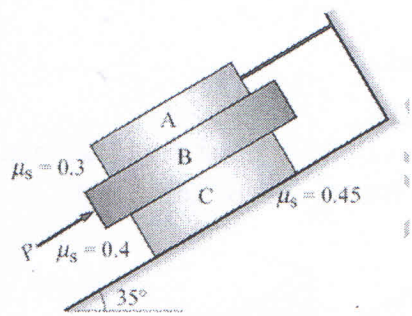

Fig. 5.

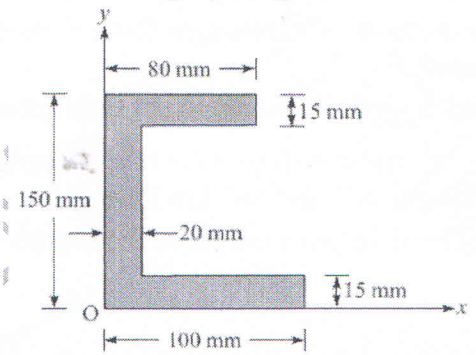

Fig. 6.

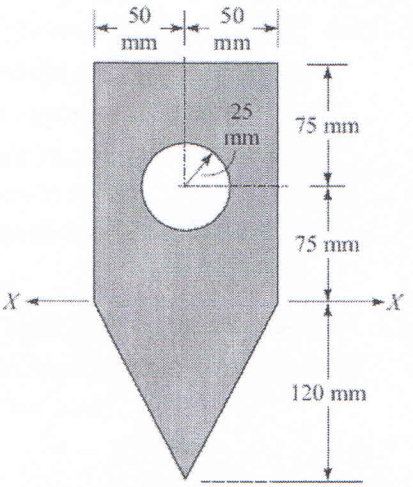

Fig. 7.

Q.6. Three flat blocks A, B and C weighing 300 N, 500 N and 400 N, respectively, are placed on a 30°-inclined plane, as shown in **Fig. 5**. A force P parallel to the plane is applied to push middle block up the plane. Block A is restrained from moving by a cable attached to a fixed support. Determine the minimum value of P, which just prevents the impending motion. **(4.5 marks)**

Q.7. Find the centroid of the plane lamina shown in **Fig. 6.** **(6 marks)**

Q.8. Find the centroid of the plane lamina about X-axis as indicated **Fig. 7.** **(6 marks)**

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