B.Tech. Degree I & II Semester Supplementary Examination in Marine Engineering May 2016

MRE 105 ENGINEERING MECHANICS

Time : 3 Hours Maximum Marks : 100

I. A bar AB 15 m long is hinged to a vertical wall at A, making an angle 60° to the vertical (upwards) and carries a load of 200 kN, hanging vertically from B. The bar is supported by a horizontal rope CD where point 'D' is at 10 m from point 'A'. Find the tension in the rope and reaction of the hinge at A. (16)

OR

II. Find the least force required to drag a block of weight W placed on a rough inclined plane having inclination 'α' with the horizontal. The tractive force applied to the block makes an angle 'θ' to the inclined plane. Consider the following cases. (16)

(i) The block is to move up the plane.

(ii) The block is to move down the plane.

III. (a) Find the centroid of a semi circular section having outer and inner radii 200 mm and 160 mm respectively. (9)

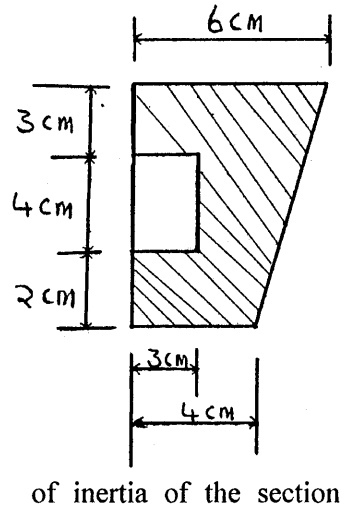
(b) Write notes on: (8)

(i) Radius of gyration.

(ii) Principal axes.

OR

IV. (a) (9)



Determine the moment of inertia of the section shown in figure about horizontal centroidal axis.

(b) Write notes on : (8)

(i) Polar moment of inertia

(ii) Product of inertia.

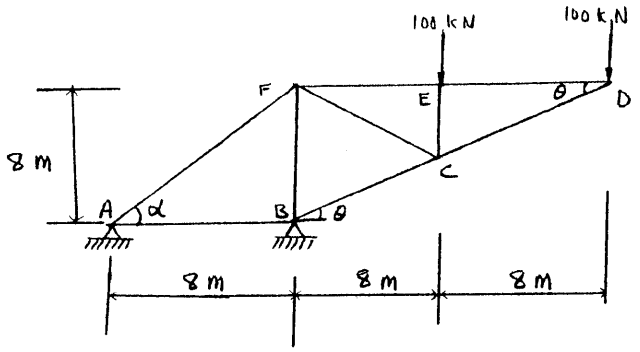
V. (a) A simply supported beam of span 9 meters having a point load of 1000 kN at its mid span and a UDL of 2 kN/m spread over half the distance of span from the mid point towards left. Find the support reactions using method of virtual work. (9)

(b) (i) Explain stable and unstable equilibrium. (8)

(ii) What is a Redundant structure?

OR

VI. (17)



Determine the reactions at A and B and forces in all the members of the truss shown in figure.

VII. (a) A particle of mass 5 gram executes SHM, with a period of 2.5 seconds. The amplitude is 10 cm. Find out (9)

(i) Displacement, velocity and acceleration when it is $\frac{1}{5}^{th}$ period from one extreme end.

(ii) Force acting on the mass at this position.

(iii) Time elapsed when the particle is at 6 cm from the centre of oscillation.

(b) A pile hammer of 250 kg mass is made to fall freely on a pile from a height of 6 m. If the hammer comes to rest in 0.012 second, determine the change in momentum, impulse and average force. (8)

OR

VIII. (a) A body of mass 10 kg is made to fall from 3 cm height on a spring of stiffness 120 N/cm. Find the displacement of the spring. Use the concept that total energy of the mass-spring system remains constant. (9)

(b) The acceleration of a particle is expressed as $a = 10 - x$. The particle starts with no initial velocity at position x = 0. Determine (i) The velocity of the particle when x = 8 m (ii) The position of the particle where the velocity is again zero and (iii) The velocity of the particle when acceleration becomes zero. (8)

IX. A projectile is sent from point 'A' with a velocity 'V'. Find the least value of 'V' so that it passes through points B and C. The coordinates of A, B and C are (0,0), (4.8, 3.6) and (8.4, 0) meters. (16)

OR

X. Find the speed of a vehicle rounding a curve of 30 m radius without side slip or skidding: (16)

(i) On a level road, $\mu = 0.2$

(ii) On a banked road, 1 in 8, $\mu = 0.8$

(iii) At what speed can the vehicle travel on banked road if $\mu = 0$.

XI. (a) Write notes on D'Alembert's principle of rotation. (7)

(b) Two masses of 800 kg and 600 kg are attached at the ends of a rope. The rope passes over a pulley of 80 cm diameter. The pulley mass is 100 kg and its radius of gyration is 40 cm about its axis of rotation. Determine the torque applied on the pulley to raise the mass of 800 kg with an acceleration of 1 m/s^2. Neglect weight of rope and friction between rope and pulley. (10)

OR

XII. (a) Explain "principle of angular momentum in rotation". (7)

(b) A right circular cylinder of mass 'm' and radius 'r' is suspended from a chord that is wound around its circumference. If the cylinder is allowed to fall freely, determine the acceleration of its mass centre 'G' and the tension induced in the chord. (10)

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