Reg. No. | | | | | | | | | | | | |

Question Paper Code : X 60837

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Second Semester
Civil Engineering
ME 2151/ME 25/CE 1151/10122 ME 205/080120002 – ENGINEERING MECHANICS
(Regulations 2008/2010)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. State Lames Theorem.
2. What is the difference between a resultant force and equilibrant force ?
3. Distinguish between a couple and a moment.
4. State Varignon's theorem.
5. Define centroid and centre of gravity of an area.
6. What do you mean by polar moment of inertia ?
7. Determine the smallest radius that should be used for a highway if the normal component of the acceleration of a car travelling at 54 km/h is not to exceed $1 m/s^2$.
8. What are the conditions under which the motion of a projectile is parabolic ?
9. When do we say that the motion of a body is impending ?
10. How do, at any given instant, the velocity and acceleration of different points of a rigid body vary when it is undergoing translation ?

PART – B **(5×16=80 Marks)**

11. a) Determine the stretch in each spring for equilibrium of the weight W = 40 N block as shown in Fig. Q.11 (a). The springs are in equilibrium position. The stiffness of each spring is given as : k_1 = 40 N/m, k_2 =50 N/m and k_3 = 60 N/m.

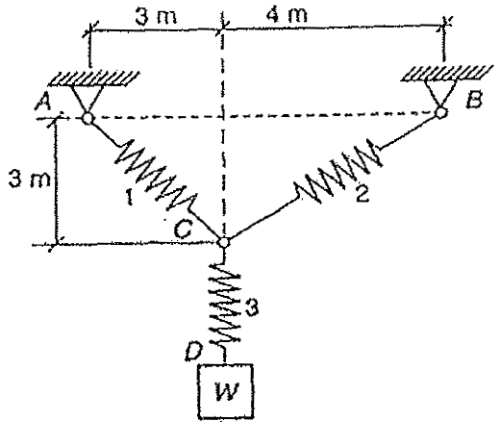

Fig. Q.11 (a)

(OR)

b) The 200 kg crate in Fig. Q.11 (b) is suspended using the ropes AB and AC. Each rope can withstand a maximum of 10 kN before it breaks. If AB always remains horizontal, determine the smallest angle θ to which the crate can be suspended before one of the ropes breaks.

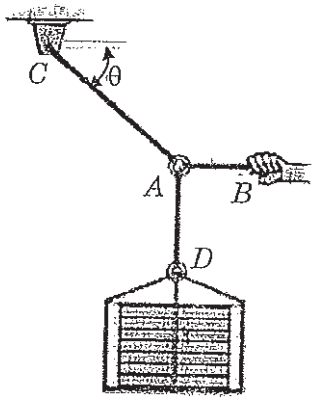

Fig. Q.11 (b)

12. a) i) A force (10i + 20j – 5k)N acts at a point P(4, 3, 2)m. Determine the moment of this force about the point Q(2, 3, 4)m in vector form. Also find the magnitude of the moment and its angles with respect to x, y, z axes. **(8)**

ii) A plate ABCD in the shape of a parallelogram is acted upon by two couples, as shown in the figure. **(8)**

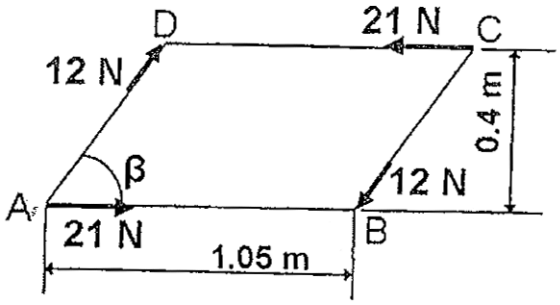

Fig. Q.12(a)(ii)

Determine the angle β if the resultant couple is 1.8 N.m clockwise.

(OR)

b) Two beams AB and CD are shown in figure. A and D are hinged supports. B and C are roller supports.

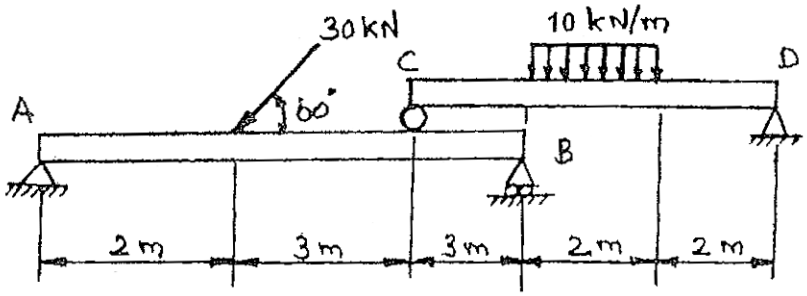

Fig. Q.12(b)

i) Sketch the free body diagram of the beam AB and determine the reactions at the supports A and B. **(9)**

ii) Sketch the free body diagram of the beam CD and determine the reactions at the supports C and D. **(7)**

13. a) i) Derive the expressions for the location of the centroid of a triangular area shown in figure, by direct integration. **(6)**

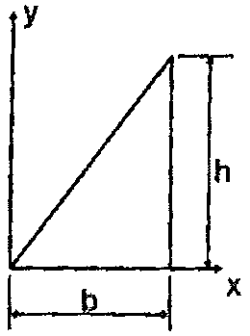

Fig. Q.13(a)(i)

ii) Locate the centroid of the plane area shown in figure below. **(10)**

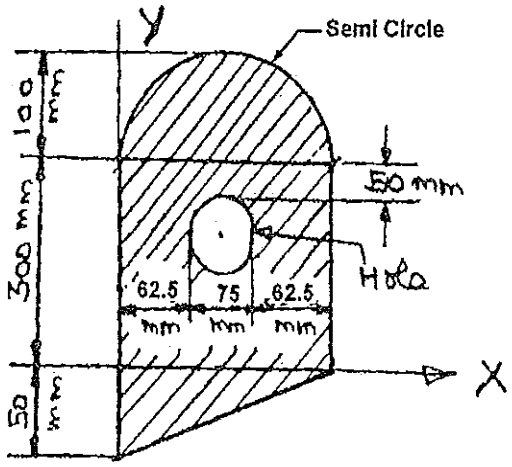

Fig. Q.13(a)(ii)

(OR)

b) An area in the form of L section is shown in figure.

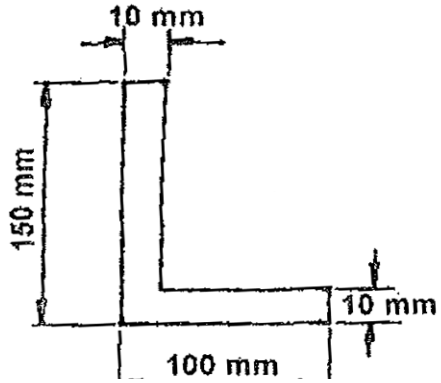

Fig. Q.13(b)

i) Find the moments of inertia I_{xx}, I_{yy} and I_{xy} about its centroidal axes. **(11)**

ii) Also determine the principal moments of inertia. **(5)**

14. a) The 50 kg block shown in Fig. 7 rests on a horizontal plane for which the coefficient of kinetic friction is 0.3. If the block is pulled by a 350 N force as shown, determine the velocity of the block after it has moved 65 m starting from rest. Use the principle of work and energy.

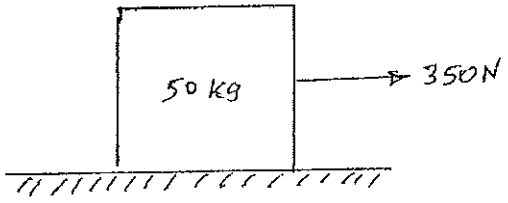

Fig. 7

(OR)

b) The 50 kg block shown in Fig. 8 is originally at rest on the smooth horizontal surface. Determine the time needed for the block to attain a velocity of 30 m/s if a force of 300 (N) is acting on the block as shown. Use principle of impulse and momentum.

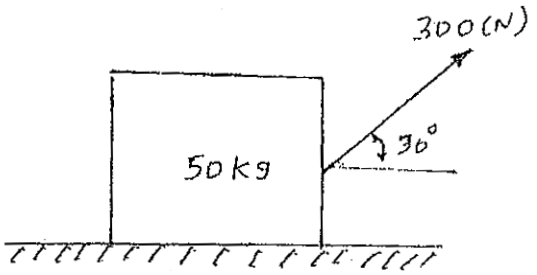

Fig. 8

15. a) Two blocks of weight W_1 and W_2 rest on a rough inclined plane (Fig. Q.15(a)) and are connected by a short piece of string as shown in Fig. If the coefficients of friction are μ_1 = 0.2 and μ_2 = 0.3, respectively, find the angle of inclination of the plane for which sliding will impend. Given : $W_1 = W_2 = 22.25$ N.

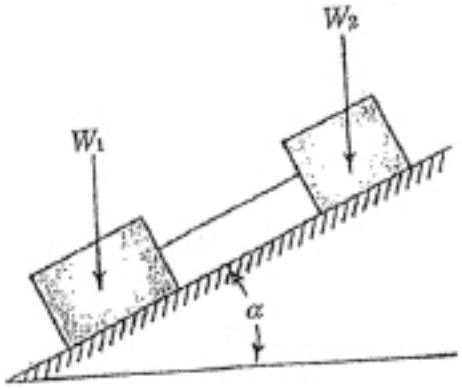

Fig. Q. 15(a)

(OR)

b) i) Determine the distance s to which the 90 kg painter can climb without causing the 4-m ladder to slip at its lower end A (Fig. Q.15(b)(i)). The top of the 15-kg ladder has a small roller, and at the ground the coefficient of static friction is 0.25. The mass center of the painter is directly above her feet. **(8)**

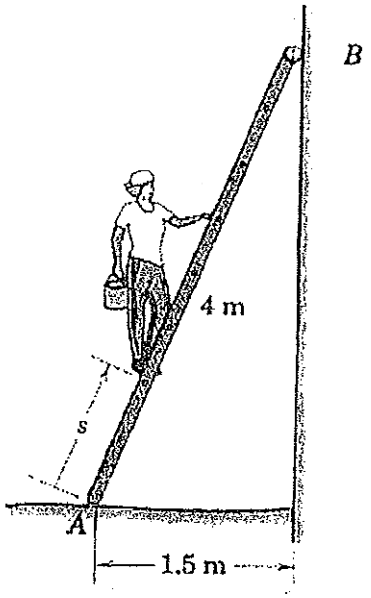

Fig. Q.15(b)(i)

ii) A 120 kg block (Fig.Q.15(b)(ii)) is supported by a rope that is wrapped 1½ times around a horizontal rod. Knowing that the coefficient of static friction between the rope and the rod is 0.15, determine the range of values of P for which equilibrium is maintained. **(8)**

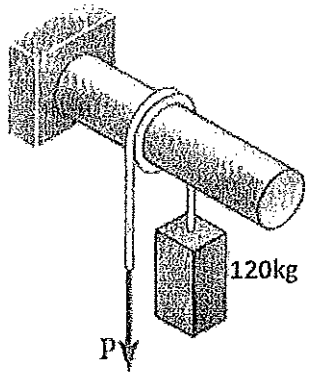

Fig. Q.15(b)(ii)