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

Question Paper Code: 51735

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Third Semester

Mechanical Engineering

15UME305 - ENGINEERING MECHANICS

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A force which combines with two or more forces to produce equilibrium is called

   (a) resultant (b) equilibrant (c) couple (d) moment

2. A system of three forces acts on a body and keeps it in equilibrium. The forces need to be

   (a) coplanar only
   (b) concurrent only
   (c) coplanar as well as concurrent
   (d) coplanar but may or may not be concurrent

3. The free body diagram of a body shows the body

   (a) with its surroundings and external forces acting on it
   (b) isolated from all external effects
   (c) isolated from its surroundings
   (d) isolated from its surroundings and external forces acting upon it

4. Consider the following statements: The effect of couple in a body remains unchanged if the couple is

   (1) rotated through an angle

   (2) shifted to any other position

   (3) replaced by another pair of forces whose rotation effect is same

   Which of the following statements are correct?

   (a) 1 and 2 (b) 1 and 3 (c) 2 and 3 (d) 1, 2 and 3

5. For a solid cone of height h the center of gravity lies on the axis at a distance above the base

   (a) $h/4$ (b) $h/3$ (c) $2h/3$ (d) $3h/8$

6. The moment of inertia of a solid sphere of mass m and radius r with respect to any diameter is

   (a) $1/2\ mr^2$ (b) mr^2 (c) $2/3\ mr^2$ (d) $5/4\ mr^2$

7. A stationary object of $10kg$ mass is acted upon by $20N$ force for 5 *seconds*. The object will attain a final velocity of

   (a) 1 *m/sec* (b) 10 *m/sec* (c) 20 *m/sec* (d) 30 *m/sec*

8. When a bullet is fired from a gun, it is recoiled in the backward direction. It is due to

   (a) impulse (b) inertia
   (c) conservation of momentum (d) conservation of energy

9. Which one of the following surfaces in contact has minimum coefficient of friction?

   (a) wood on wood (b) steel on steel
   (c) rubber tyre on dry concrete (d) rubber tyre on wet concrete

10. A zero angle of friction implies that

   (a) frictional force is infinite
   (b) frictional force is zero
   (c) frictional force acts normal to the plane
   (d) frictional force acts along the direction of motion

PART - B (5 x 2 = 10 Marks)

11. State parallelogram law.

12. Distinguish between moment and a couple.

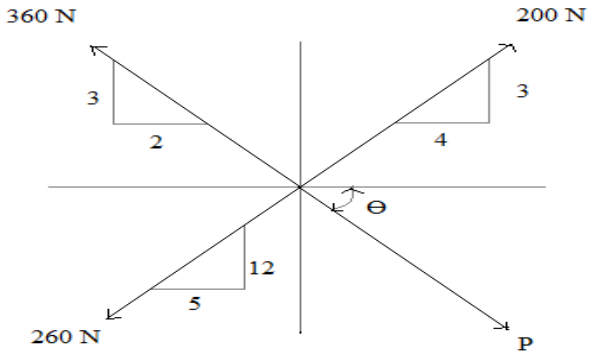
13. Define radius of gyration.

14. Write the equation of motion of a particle on a straight line.

15. State the Newton's law of collision of elastic bodies.

PART - C (5 x 16 = 80 Marks)

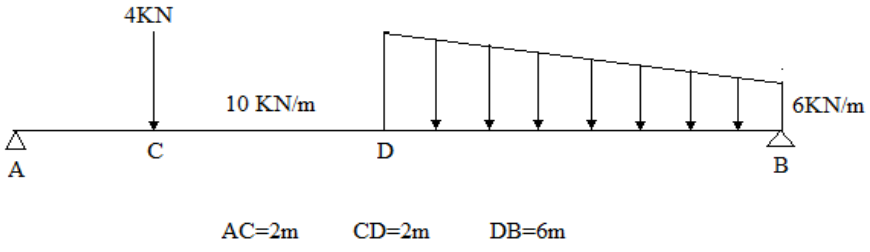
16. (a) The resultant of the force system shown in figure is 520*N* along the negative direction of *Y* – axis. Determine *P* and θ. (16)



Or

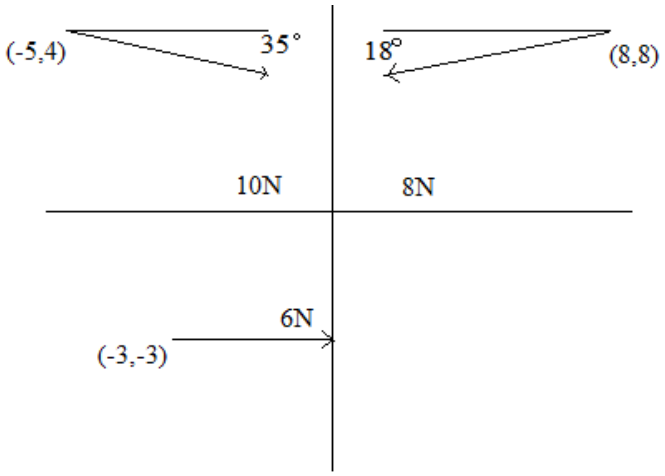
(b) The lines of action of three forces are concurrent at the origin *O* passes through points *A*, *B* and *C* having co-ordinates (3, 0, -3) (2, -2, -4) and (-1, 2, 4) respectively. If magnitude of the forces are 10*N*, 30*N* and 40*N*, find the magnitude and direction of their resultant. (16)

17. (a) Determine the support reactions of a simply supported beam subjected to the loads as shown in figure. (16)

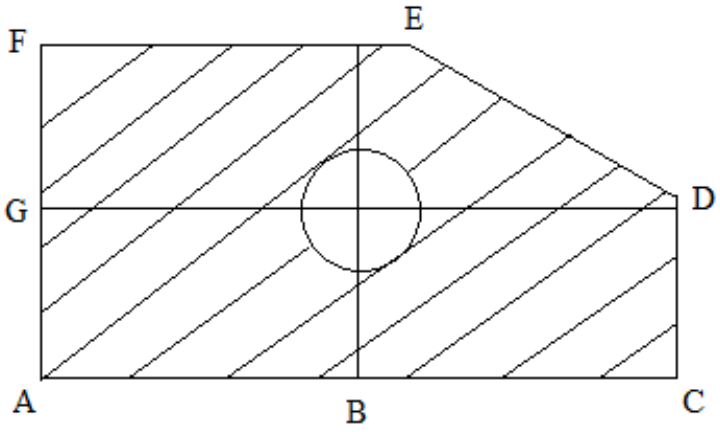


Or

(b) For the force system shown in figure: (i) Determine the resultant force (ii) Reduce to an equivalent force couple system at origin *O*. Assume the co-ordinates are in meter. (16)

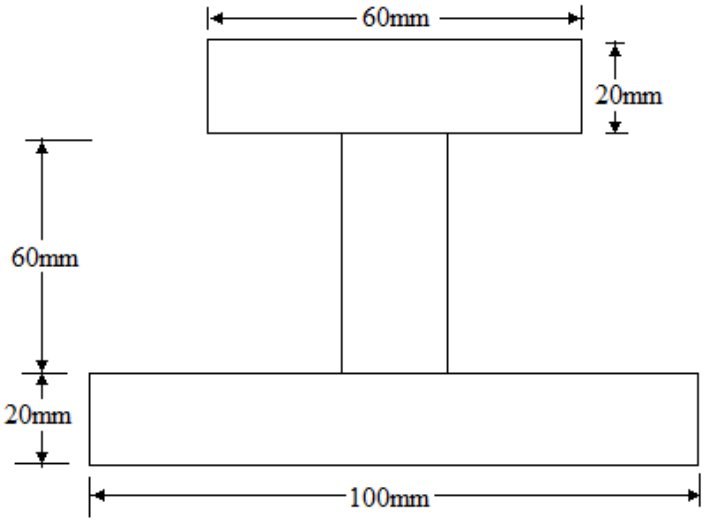


18. (a) Locate the centroid of the sectioned area shown in figure. *AB* = 80*mm*, *AC* = 140*mm* , *CD* = 80*mm*, *EF* = 100*mm* , *AF* = 140*mm* , *GA* = 80*mm*, Hole = 60*mm* diameter. (16)



Or

(b) Find the moment of inertia of an unsymmetrical *I* section shown in figure about its centroidal axis.



(16)

19. (a) The motion of a particle along a curved path is given by the equation

$X = t^2 + 8t + 4$ and $Y = t^3 + 3t^2 + 8t + 4$

Determine: (i) Initial velocity of the particle

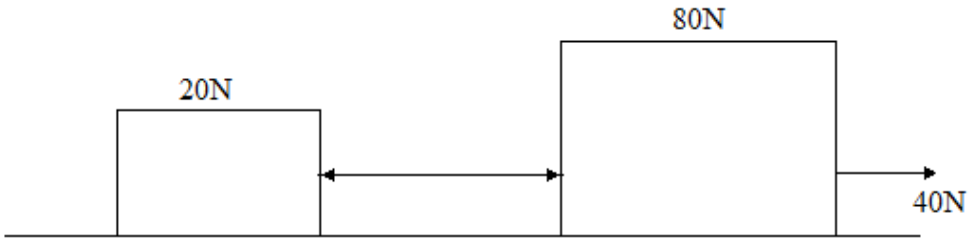
(ii) Velocity of the particle at $t = 2sec$

(iii) Acceleration of the particle at $t = 0$

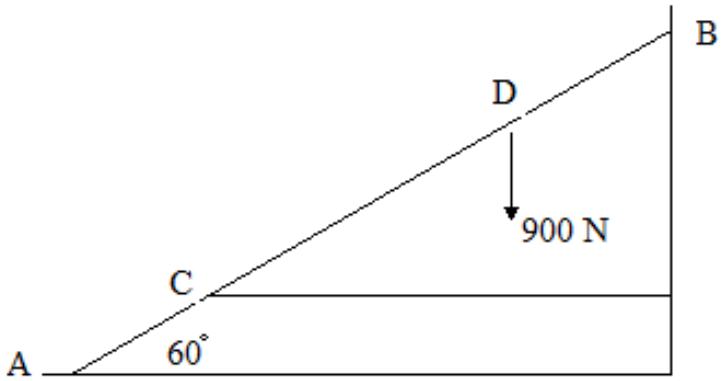
(iv) Acceleration of the particle at $t = 2sec$. (16)

Or

(b) Two weights $80N$ and $20N$ are connected by a thread and move along a rough horizontal plane under the action of a force $40N$ applied to the first weight of $80N$ as shown in figure. The coefficient of friction between the sliding surfaces of the weight and the plane is 0.3. Determine the acceleration of the weight and tension in the thread using D-Alembert's principle. (16)



20. (a) A ladder *AB* of weight 900*N* is held in impending motion towards the right by a rope tied to the wall as shown in figure. The coefficient of friction between the floor and ladder is 0.25 and that between the wall and ladder is 0.4. Calculate the tension in rope. *AB* = 10*m*, *AC* = 2.5*m*, *AD* = 5*m*. (16)



Or

(b) What should be the value of the angle Θ so that motion of the 390*N* block impends down the plane. The coefficient of friction for all the surfaces is 1/3. (16)