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**Question Paper Code: 43705**

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2022

Third Semester

Mechanical Engineering

14UME305 - ENGINEERING MECHANICS

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. If the resultant of two equal forces has the same magnitude as either of the forces, then the angle between the two forces is  
(a)  $30^\circ$                       (b)  $60^\circ$                       (c)  $90^\circ$                       (d)  $120^\circ$
2. Concurrent forces are those forces whose lines of action  
(a) lie on the same line                      (b) meet at one point  
(c) meet on the same plane                      (d) none of these
3. The resultant of the two forces  $P$  and  $Q$  is  $R$ . If  $Q$  is doubled, the new resultant is perpendicular to  $P$ . Then  
(a)  $P = Q$                       (b)  $Q = R$                       (c)  $Q = 2R$                       (d) none of these
4. Three forces acting on a rigid body are represented in magnitude, direction and line of action by the three sides of a triangle taken in order. The forces are equivalent to a couple whose moment is equal to  
(a) Area of triangle                      (b) Twice the area of triangle  
(c) Half the area of triangle                      (d) None of these
5. The centre of gravity of a quarter-circle lies at a distance of ..... from the base measured along the horizontal radius  
(a)  $\frac{3\pi}{4r}$                       (b)  $\frac{4r}{3\pi}$                       (c)  $\frac{3r}{8}$                       (d)  $\frac{8}{3r}$

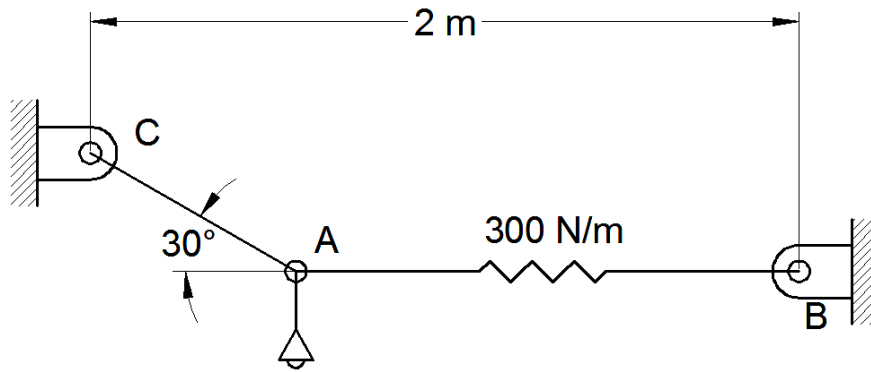
6. Moment of inertia of a circular section about an axis perpendicular to the section is  
 (a)  $\pi d^3/16$                       (b)  $\pi d^3/32$                       (c)  $\pi d^4/32$                       (d)  $\pi d^4/64$
7. The range of a projectile is maximum, when the angle of projection is  
 (a)  $30^\circ$                       (b)  $45^\circ$                       (c)  $60^\circ$                       (d)  $75^\circ$
8. During elastic impact, the relative velocity of the two bodies after impact is \_\_\_\_\_ the relative velocity of the two bodies before impact.  
 (a) equal to    (b) less than  
 (c) equal and opposite to    (d) greater than
9. The maximum frictional force, which comes into play, when a body just begins to slide over the surface of the other body, is known as  
 (a) static friction    (b) dynamic friction  
 (c) limiting friction    (d) coefficient of friction
10. The bodies which rebound after impact are called  
 (a) inelastic bodies    (b) elastic bodies  
 (c) neither elastic or inelastic bodies    (d) None of these

PART - B (5 x 2 = 10 Marks)

11. What is the difference between a resultant force and equilibrant force?
12. Distinguish between statics and dynamics with examples.
13. Explain polar moment of inertia.
14. What is Impulse of force?
15. Explain limiting friction.

PART - C (5 x 16 = 80 Marks)

16. (a) Determine the length of the cord  $AC$  in figure below so that the 8 kg lamp is suspended in the position shown. The undeformed length of the spring  $AB$  is 0.4 m and the spring has a stiffness of 300 N/m. (16)



Or

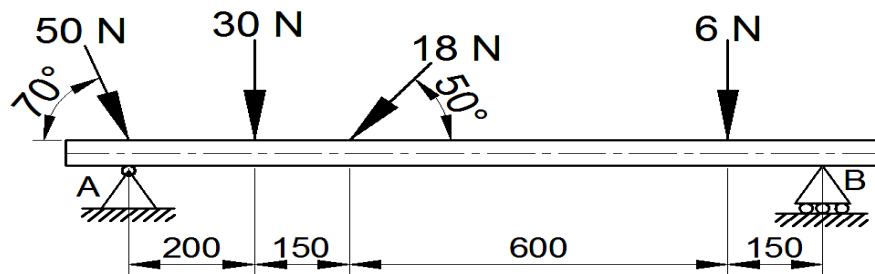
(b) Particle 'O' is acted on by the following forces. Determine the resultant force.

- (i) 20 N inclined  $30^\circ$  North of East
- (ii) 25 N towards North
- (iii) 30 N towards North West
- (iv) 35 N inclined  $40^\circ$  to South of West, Find the resultant. (K2) (16)

17. (a) Two beams AB and CD are shown in figure. A and D are hinged supports. B and C are roller supports. (i) Sketch the free body diagram of the beam AB and determine the reactions at the supports A and B. (ii) Sketch the free body diagram of the beam CD and determine reactions at the supports C and D. (16)

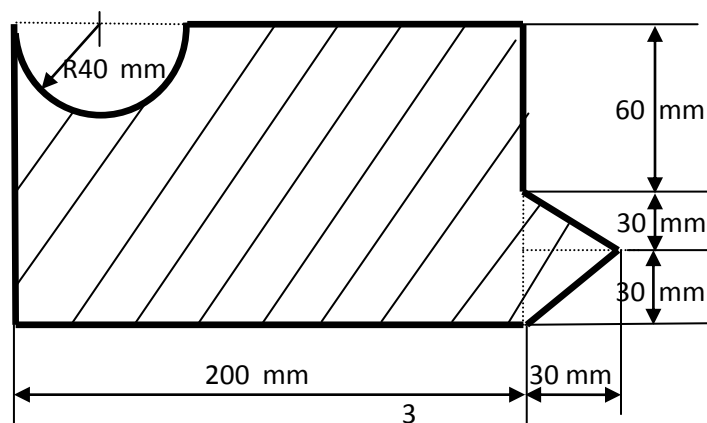
Or

(b) Find the pin reaction at A and the knife-edge reaction at B. (16)



All Dimensions are in 'mm'

18. (a) Determine the coordinates of the centroid of the plane area shown in below figure. (16)



Or

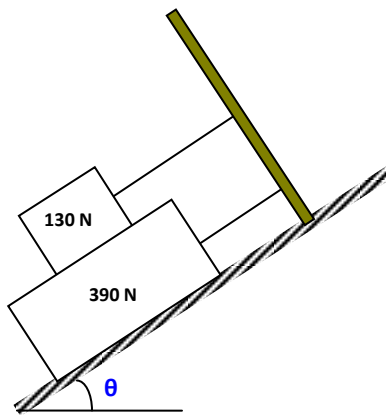
- (b) Find the moment of inertia of a T section of flange 100 mm x 30 mm and web 20 mm x 80 mm about its centroidal axes. (16)

19. (a) (i) A car starts from rest with a constant acceleration of  $4 \text{ m/s}^2$ . Determine the distance traveled in the 7th second. (8)
- (ii) A body was thrown vertically down from a tower and travels a distance of 3 m in the 5th second of its flight. Find the initial velocity of the body. (8)

Or

- (b) A car of mass 300 kg is traveling at 36 km/h on level road. It is brought to rest, after traveling a distance of 5m. What is the average force of resistance acting on the car? Find it by applying. (16)
- (i) Law of conservation of Energy
- (ii) Work-Energy method
- (iii) D-Alembert's principle

20. (a) What should be the value of the angle  $\theta$  so that motion of the 390 N block impends down the plane? The co-efficient of friction  $\mu$  for all surfaces is  $1/3$ . (16)



Or

- (b) A pull of 250N inclined at  $30^\circ$  in the horizontal plane is required just to move a body kept on a rough horizontal plane. But the push required just to move the body is 300N. If the push is inclined at  $30^\circ$  to the horizontal, find the weight of the body and the coefficient of friction. (16)