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

Question Paper Code : 11516

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Second Semester

ME 2151/113201/ME 25/10122 ME 205/080120002/CE 1151 — ENGINEERING MECHANICS

(Common to Civil, Aeronautical, Automobile, Marine, Mechanical, Production, Chemical, Petroleum Engineering, Biotechnology, Polymer, Textile, Textile (Fashion), Rubber and Plastics Technology, Materials Science and Engineering, Manufacturing Engineering, Mechatronics Engineering, Industrial Engineering, Industrial Engineering and Management, Environmental Engineering, Geoinformatics, Mechanical and Automation Engineering, Petrochemical Engineering, Chemical and Electrochemical Engineering, Petrochemical Technology, Pharmaceutical Technology and Textile Chemistry)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the angle between the forces A and B given as

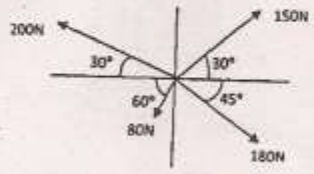
   $\vec{A} = 3i - 2j + 4k$

   $\vec{B} = 5i + 3j - 4k$

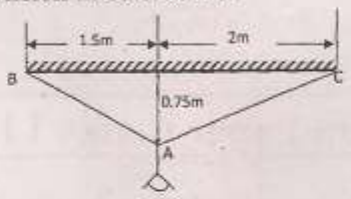
2. How will you find the direction cosine in the Z-direction of the resultant force of a concurrent spatial force system?
3. Distinguish between a couple and a moment.
4. State Varignon's theorem.
5. Distinguish between centroid and centre of gravity.
6. Define principal axes and principal moment of inertia.
7. A car moves on a circular path of radius 25 m, with a uniform speed of 9 m/s. Determine the total acceleration on the car.
8. What is D' Alembert's principle?
9. When do we say that the motion of a body is impending?
10. A wheel of radius 50 cm is moving on rails, with a speed of 12 m/s. Find the angular speed of the wheel.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine the resultant of the concurrent force system shown in figure. (8)



(ii) Figure shows a 10 kg lamp supported by two cables AB and AC. Find the tension in each cable. (8)

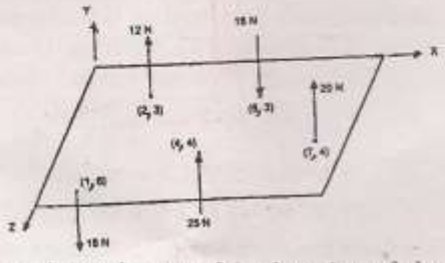


Or

(b) Forces 32 kN, 24 kN, 24 kN and 120 kN are concurrent at origin and are respectively directed through the points whose coordinates are A (2, 1, 6), B (4, -2, 5), C (-3, -2, 1) and D (5, 1, -2). Determine the magnitude of the resultant and the angles it makes with coordinate axes. (16)

12. (a) (i) Distinguish between '**Moment of a force about a point**' and '**Moment of a force about an axis**'. (4)

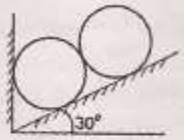
(ii)



Find the resultant force and its location of the force system shown in figure. The (x, z) coordinates of the points of application of the forces are given in metres. (12)

Or

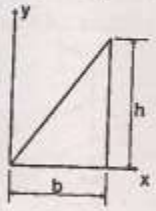
(b) Two identical rollers, each of weight 500 N, are supported by an inclined plane making an angle of 30° to the horizontal and a vertical wall as shown in the figure.



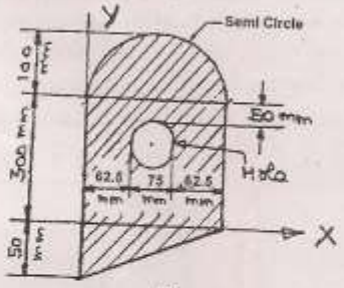
(i) Sketch the free body diagrams of the two rollers. (4)

(ii) Assuming smooth surfaces, find the reactions at the support points. (12)

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

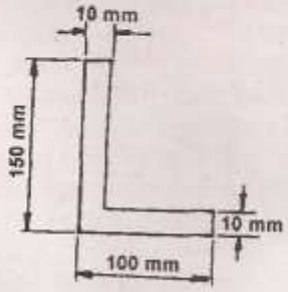


(ii) Locate the centroid of the plane area shown in figure below. (10)



Or

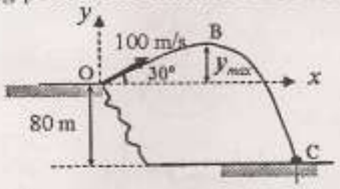
(b) (i) An area in the form of L section is shown in figure.



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) A Bullet is fired making an angle 30° to the horizontal from a hill which strikes the target which is 80 m lower than the horizontal passing through the firing point. The initial bullet velocity is 100 m/s.



Find the following :

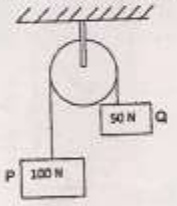
(i) The maximum height above horizontal to which the bullet will rise. (4)

(ii) The velocity of bullet when it strikes the target. (6)

(iii) The total time required for the bullet when it strikes the target. (6)

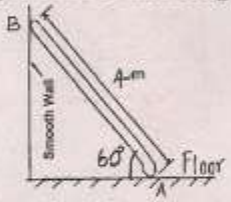
Or

(b) (i) Block P of weight 100 N and block Q of weight 50 N are connected by a rope that passes over a smooth pulley as shown in figure. Find the acceleration of the blocks and the tension in the rope, when the system is released from rest. Neglect the mass of the pulley. (8)



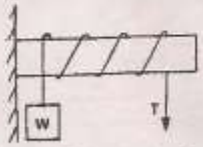
(ii) A 2000 kg automobile is driven down a 5° inclined plane at a speed of 100 km/h when the brakes are applied causing a constant total breaking force (applied by the road on the tires) of 7 kN. Determine the distance traveled by the automobile as it comes to a stop. (8)

15. (a) (i) A ladder of weight 1000 N and length 4 m rests as shown in figure.



If a 750 N weight is applied at a distance of 3 m from the top of ladder, it is at the point of sliding. Determine the coefficient of friction between ladder and the floor. (10)

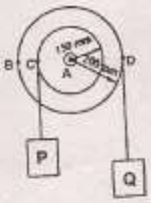
(ii) A rope is wrapped three times around a rod as shown in figure.



Determine the force T required on the free end of the rope, to support a load of W = 20 kN. Take μ as 0.30. (6)

Or

(b) Figure shows a stepped pulley. The smaller radius is 150 mm and the bigger radius is 200 mm. Two loads P and Q are connected by inextensible taut cords.



Load P moves with an initial velocity of 0.2 m/s and has a constant acceleration of 0.25 m/s^2 both downwards. Determine

(i) The number of revolutions turned by the pulley in 4 seconds. (6)

(ii) Velocity and the distance traveled by load Q after 4 seconds. (5)

(iii) Acceleration of point B located on the rim of the pulley at $t = 0$. Give both magnitude and direction. (5)