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

Question Paper Code : 77163

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Second Semester

Civil Engineering

GE 6253 — ENGINEERING MECHANICS

(Common to all branches except Electrical and Electronics Engineering, Electronics and Instrumentation Engineering, Instrumentation and Control Engineering, Biomedical Engineering, Computer and Communication Engineering, Computer Science and Engineering, Electronics and Communication Engineering, Medical Electronics and Information Technology)

(Regulation 2013)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A vector $\vec{F}$ starts at point (2, –1, 2) and passes through the point (–1, 3, 5). Find its unit vector.

2. State the principle of transmissibility.

3. List the different supports used to support structural components.

4. Find the magnitude and location of the single equivalent force for a beam *AB* of length 8 m having a point *C* at 3 m from *A* subjected to the following forces :

   (a) An upward force of 10 N at *A*

   (b) A downward force of 10 N at *C*

   (c) An upward force of 40 N at *B*

5. Find the radius of gyration of a rectangular area of MI about its base 9×10^4 cm^4 and cross sectional area 300 cm^2.

6. State perpendicular axis theorem.

7. A particle is projected into space at an angle of 30° to the horizontal at a velocity of 40 m/s. Find the maximum height reached by the projectile.

8. Distinguish between perfectly plastic impact and perfectly elastic impact.

9. What is angle of repose?

10. A wheel of radius 50 cm subjected to a load of 300 N rolls on a level ground at constant speed. If the wheel is pushed by a tractive force of 60 N applied horizontally at the centre of the wheel, find the coefficient of rolling resistance.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) The magnitude of the resultant of two concurrent forces including an angle of 90° between them is $\sqrt{13}$ kN. When this included angle is changed to 60°, the magnitude of the resultant becomes $\sqrt{19}$ kN. Find the magnitude of the two forces. (12)

(ii) A force of magnitude 3.5 kN makes 30°, 50° and 100° with x, y and z axes respectively. Find the force vector and determine its components along x, y, z axes. (4)

Or

(b) A weight of 8 kN is suspended by three cables PA, PB and PC. The co-ordinates of the points are :

P (1.5, 1, 5, –2) A (0, 3, 4)

B (2.5, 3, 2.5) C (1, 3, 0) (16)

Determine the tensions in the cables.

12. (a) A roller of radius 30 cm weighs 2.5 kN. It is to be pulled over a rectangular obstruction of height 10 cm by a horizontal force F passing through the centre of the roller. Find the magnitude if the force F passing through the centre of the roller. Find the magnitude if the force F required just to turn the roller over the corner of the obstruction. Also find the magnitude and direction of the minimum force required for the same. (16)

Or

(b) (i) A body of mass 900 kg is suspended by two cables PR and PQ making an angle of 40° and 50° respectively with the ceiling. Find the tension in the cables PQ and PR. (8)

(ii) A father and his son carry a block of mass 50 kg by using a uniform bar of length 3 m and mass 16 kg. The son can bear only half the load carried by the father. Find the location of the block on the bar. (8)

13. (a) (i) A solid hemisphere of density 2ρ is attached centrally to a solid cylinder of density ρ. Find the height of the cylindrical portion to have the CG of the solid combination on the axis of symmetry at the junction between the hemisphere and the cylinder. Take the cylinder diameter as 100 mm. (12)

(ii) Find the polar moment of inertia of a hollow circular section of outer diameter 80 mm and inner diameter 40 mm about an axis through its centroid. (4)

Or

(b) Find the MI of an I section about XX and YY axes through its centroid. Dimensions are : Top flange: 150 mm × 12 mm Web : 200 mm × 10 mm, Bottom flange : 150 mm × 12 mm. (16)

14. (a) (i) A particle is projected into space at an angle of 40° to the horizontal reaches the highest point in 3 seconds. Find the projection velocity and range. (6)

(ii) A block of mass 8 kg is dragged up an inclined plane by a rope inclined at 15° to the plane while the plane is inclined at 30° to the horizontal. Find the velocity of the block after 4 seconds if dragged from rest. Take the co-efficient of kinetic friction between the block and the plane as 0.2. Also assume that a force of 100 N is applied through the rope for dragging the block upwards the plane. Apply impulse momentum equation. (10)

Or

(b) (i) A boy drops a stone from the top of well vertically downwards into it. The splash is heard by him after 6 seconds. Find the well depth taking sound velocity as 400 m/s. (10)

(ii) A car of mass 500 kg moving at a speed of 80 km/hr to the right collides with a lorry of mass 1,500 kg which is at rest. After the impact, the lorry moves at a speed of 36 km/hr to the right. Find the velocity of the car after impact. Also find the coefficient of restitution. (6)

15. (a) Two rough planes are joined together one of them is horizontal and the other is inclined at 45° to the horizontal. A 100 kg block is on the inclined plane and is connected to a 60 kg block on the horizontal plane through a cable passing over a smooth pulley at the junction of the planes. A dragging force of A is applied on 60 kg block at an angle of θ to the horizontal. Find the magnitude of the force and the value of θ for the motion is about to start. Assume $\mu = 0.25$. (16)

Or

(b) A homogeneous sphere of mass m_1 and radius r_1 and a homogeneous cylinder of mass m_2 and radius r_2 roll along an incline without slipping. They start from rest at the top and reach the bottom at different times which of the two reaches the bottom earlier? (16)