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

S 4821

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Annual Pattern — First Year

Civil Engineering

GEIX 04 — ENGINEERING MECHANICS

(Common to Food Technology/Bio-Technology/Chemical Engineering/ Petroleum Engineering/Polymer Technology/Textile Technology/ Textile Technology (Textile Chemistry))

(Regulation 2004)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State the conditions that are to be satisfied for Lami's theorem to be applied.

2. In a polygon corresponding to a system of forces, if the closing side has a magnitude of zero, what can you say about the system?

3. Locate the point where the system of forces given in Fig. 3 is converted into a single force and zero couple. Also find the magnitude of the single force.

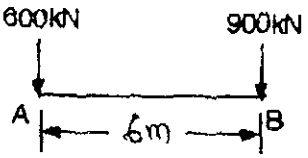

Fig. 3

4. State the assumptions made in the analysis of truss.

5. Say true or false and justify your answer. Friction is always developed in the direction opposite to the direction in which the external force is applied.

6. The coefficient of friction between a body and the inclined surface on which it is resting is $1/\sqrt{3}$. For the body to be in equilibrium, find the maximum angle made by the surface with respect to horizontal.

7. State perpendicular axis theorem.

8. Find the moment of inertia of a circular section of diameter 'D' about an axis tangential to the circle.

9. When a body of weight 'W' climbs up a plane inclined at angle of θ with respect to horizontal, find the component of weight opposite the motion.

10. A ball is dropped on a smooth floor from a height of 1 m. If the first rebound height is 81 cm, find the coefficient of restitution.

PART B — (5 × 16 = 80 marks)

11. (a) A spherical ball of weight 500 N is suspended vertically by a string 500 mm long. Find the magnitude and direction of the least force that can hold the ball 100 mm above the lowest point. Find also the tension in the string. Ignore the size of the ball.

Or

(b) Two forces P and Q are acting at the origin. The force P whose magnitude is 70 N is directed towards (3, –6, 2). The force Q is inclined at 45°, 60° and 60° respectively to X, Y and Z-axes. Determine the magnitude of Q so that the resultant of P and Q will be in XZ plane. Also determine the magnitude and direction cosines of the resultant.

12. (a) A system of three forces 10N, 10N and 5N act at A, B and C respectively in the direction of AB, BC and CA. If A, B and C form an equilateral triangle, find an equivalent force system consisting of three forces acting at the points A, B and C and parallel to the opposite sides.

Or

(b) Find the magnitude and nature of force in each member of the trusses given in Fig. 12 (b).

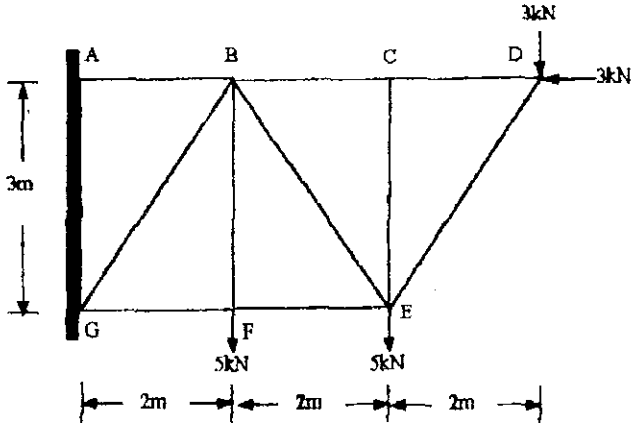

Fig. Q. No. 12 (b)

13. (a) A ladder 3 m long and weighing 200 N is resting on the horizontal floor and leaning against a vertical wall, making 30° with the wall. The friction coefficients at the ground and wall contact surfaces are 0.35 and 0.25 respectively. It has to support a weight of 100 N at the top. To prevent slipping, a string is tied to the foot of the ladder and attached to the wall in the horizontal position. Determine the minimum tension required in the string for this condition.

Find also the minimum angle with the floor at which the above ladder with the weight at the top could be placed without slipping in the absence of the string.

Or

(b) In Fig. 13 (b), calculate α so that the motion of lower block can just occur down the plane. The weight A and B are 30 N and 90 N respectively. The coefficient of friction for all contact surfaces is 1/3.

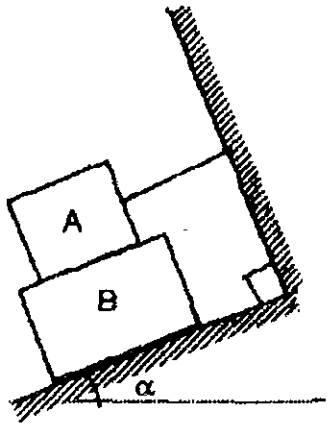

Fig. Q. No. 13 (b)

14. (a) Find the moments of inertia of the section given in the Fig. 14 (a) about the horizontal and vertical centroidal axes. Also find the polar moment or inertia and minimum radius of gyration. (All the dimensions are in mm).

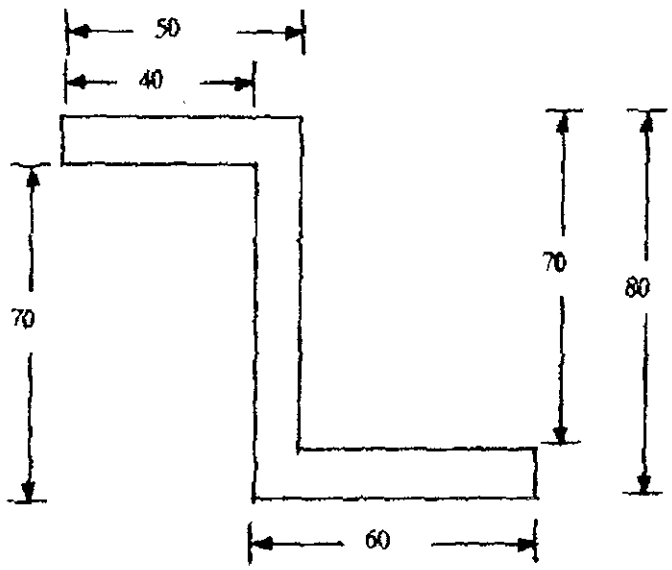

Fig. Q. No. 14 (a)

Or

(b) Derive the expression for mass moment of inertia of circular plate about any axis passing through centre and (i) lying on the plate (ii) perpendicular to plate and hence find mass moment of inertia of a steel plate of radius 100 mm and thickness 1 mm about each of the above axes. Take specific gravity of steel as 7.8.

15. (a) (i) A stone falls past a window 2 m high in 0.5s. Find the height above the window from where the stone is dropped. (8)

(ii) A shot is fired with a velocity of 30 m/s from a point 15 m in front of a vertical wall 6 m high. Find the angle of projection with the horizontal to enable the shot to just clear the wall. Explain the double answer. (8)

Or

(b) Two identical balls of radius 150 mm are moving with velocities of 5 m/s and 8 m/s along parallel lines 200 mm apart. If the coefficient of restitution is 0.6, determine the magnitude and direction of their velocities after they collide.