53 (ME 201) ENMC

2018

ENGINEERING MECHANICS

Paper : ME 201

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Define the Law of parallelogram of forces. What is the use of this law? 3+2=5

   (b) What is the effect of force and moment on a body? 4

   (c) What do you mean by resolution of force? 2

   (d) What is the difference between collinear and concurrent forces? 3

   (e) Explain in detail the metod of finding resultant in magnitude and direction of three or more forces acting at a point by analytical and graphical method. 6

2. *(a)* Explain and define the term 'free body diagram'. Draw the free body diagram of a ball of weight W, placed on a horizontal surface. 2+2=4

(b) State and explain the Lami's theorem. 6

(c) The resultant of the two forces, when they act at an angle of 60° is 14 N. If the same forces are acting at right angles, their resultant is $\sqrt{136}N$. Determine the magnitude of the two forces. 6

(d) The resultant of two concurrent forces is 1500 N and the angle between the forces is 90°. The resultant makes an angle of 36° with one of the force. Find the magnitude of each force. 4

3. *(a)* Four forces of magnitudes 10 N, 20 N, 30 N and 40 N are respectively acting along the four sides of a square taken in order. Determine the magnitude, direction and position of the resultant force. 7

(b) The five forces F_1, F_2, F_3, F_4 and F_5 are acting at a point on a body as shown in *fig* (i) and the body is in

equilibrium. If $F_1 = 10N$, $F_2 = 225N$, $F_3 = 15N$ and $F_4 = 30N$, find the force F_5 in magnitude and direction.

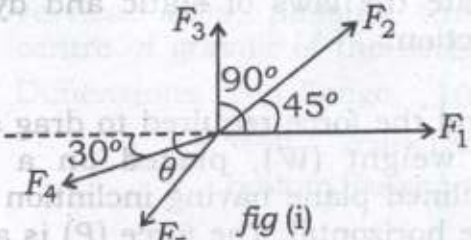

fig (i) 7

(c) A lamp weighing 10N is suspended from the ceiling by a chain. It is pulled aside by a horizontal cord until the chain makes an angle of 60° with the ceiling. Find the tensions in the chain and the cord by applying Lami's theorem. 6

4. *(a)* A truss of span 5 m is loaded as shown in *fig* (ii). Find the reactions and forces in the members of the truss. 10

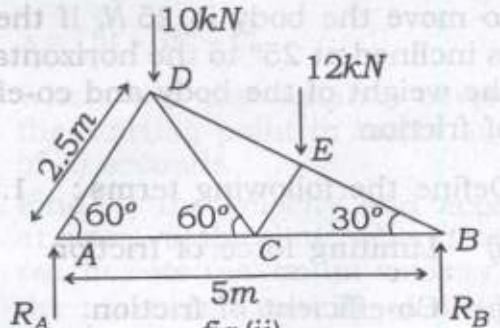

fig (ii)

(b) What is a frame? State the difference between a perfect frame and an imperfect frame. 4

(c) State the laws of static and dynamic friction. 6

5. (a) Find the force required to drag a body of weight (W), placed on a rough inclined plane having inclintion (α) to the horizontal. The force (P) is applied to the body horizontally and the body is

(i) on the point of motion up the plane

(ii) on the point of motion down the plane. 10

(b) A pull of 20 N, inclined at 25° to the horizontal plane, is required just to move a body placed on a rough horizontal plane. But the push required to move the body is 25 N. If the push is inclined at 25° to the horizontal, find the weight of the body and co-efficient of friction. 7

(c) Define the following terms: 1.5×2=3

(i) Limiting force of friction

(ii) Co-efficient of friction.

6. (a) Find the centre of gravity of the I-section of the following dimensions. Also determine the moment of inertia of the section about the horizontal and vertical axes, passing through the centre of gravity of the section.

Dimensions: Top flange : $10cm \times 2cm$

Web : $2cm \times 15cm$

bottom flange : $20cm \times 2cm$

5+7=12

(b) Prove that the moment of inertia of a triangular section about its base is

$$I_{Base} = \frac{bh^3}{12}$$

where, b = base of triangular section

h = height of triangular section. 8

7. (a) The equation of motion of a particle moving in a straight line is given by

$$s = 15t + 3t^2 - t^3$$ 7

Where s = the distance covered from the starting point in metre at the end of (t) seconds.

Find: (i) the velocity and acceleration at start, (ii) the time, when the particle reaches its maximum velocity and (iii) the maximum velocity of the particle.

(b) A particle moves along a straight line with an acceleration described by the equation, $a = t^3 + 2t^2 + 4t + 5$, where 'a' is in m/s^2 and *(t)* is in second, when $t = 1$ second, $s = 10m$ and $v = 10m/s$ Determine the velocity and displacement when $t = 2$ second. 8

(c) A car is moving with a velocity of $20m/s$. The car is brought to rest by applying brakes in 4 seconds. Determine :

(i) the retardation and *(ii)* distance travelled by the car after applying brakes. 5
