Total No. of printed pages = 8

END SEMESTER REGULAR

EXAMINATION, MAY/JUNE-2025

Semester : 2nd (NEP)

Course Code : ES-206

ENGINEERING MECHANICS

Full Marks – 60

Pass Mark – 24

Time –Three hours

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

Instructions :

(i) Question Nos.1, 2, 3 and 4 are compulsory.

(ii) Answer any *six* from the rest.

1. Fill in the blanks : 1×5=5

(a) The magnitude of the resultant will be maximum and minimum when angle between the two forces shall be _____ and _____.

[Turn over

(b) If a body in equilibrium is acted upon by four forces, then the resultant of any two forces must be _____, _____ and _____ with the resultant of the other two forces.

(c) A redundant frame is an imperfect frame, in which the number of members is more than _____.

(d) Moment of inertia of the triangular section about an axis through its centre of gravity and parallel to X-axis is _____.

(e) The angle of friction can not be more than the angle _____ degree.

- **Multiple Choice Questions**

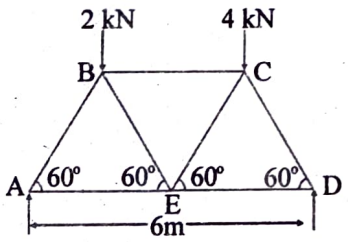
2. Choose the correct answer : 1×5=5

(a) The moment of a force, about any point, is _____, when the area of the triangle is 48 unit, whose base is the line to some scale representing the force and whose vertex is the point about which the moment is taken.

(i) 94 (ii) 24

(iii) 12 (iv) None of these

(b)



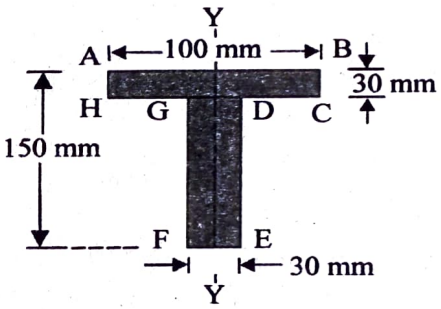
(i) Perfect frame

(ii) Deficient frame

(iii) Redundant frame

(iv) None of the above

(c)

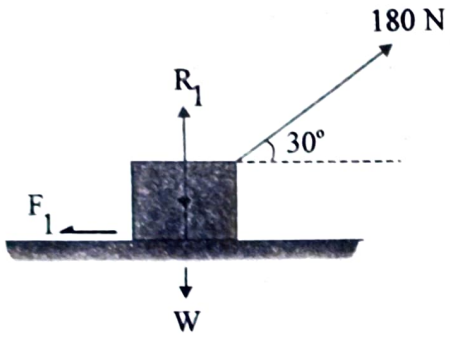


The distance of the centre of gravity of the section ABCH from the bottom of the flange FE, is :

(i) 135 mm (ii) 75 mm

(iii) 15 mm (iv) None of these

(d)



When the body is at the verge of motion, the value of R_1 is equal to :

(i) W–180 sin30°

(ii) W+180 sin30°

(iii) W

(iv) None of the above

(e) In a differential wheel and axle, the diameter of the effort wheel is 410 mm. The Diameters of the axles are 310 mm and 210 mm respectively. The Velocity ratio is :

(i) 8.2 (ii) 6.2

(iii) 2 (iv) None of these.

3. **Write True or False :** 1×5=5

(a) The Lami's Theorem is applicable only for non-coplanar concurrent forces.

(b) A load, which is spread over a beam, in such a manner that its extent varies uniformly on each unit length is known as uniformly distributed load.

(c) If the area of a section is in mm^2 and the distance of the centre of area from a line is in mm, then units of the moment of inertia of the section about the line is expressed in mm^3.

(d) A weight of 1000 N can be lifted by an effort of 50 N. If the velocity ratio of the machine is 20, then the machine is non-reversible.

(e) In a simple screw jack, with (l) as the length of the effort wheel and (p) as pitch of the screw, its velocity ratio is $\frac{2\pi l}{p}$.

4. (a) What are the various types of loadings ?1

(b) Define Mechanical advantages and Velocity ratio of a machine. 2

5. (a) Distinguish clearly between resolution of forces and composition of forces. 2

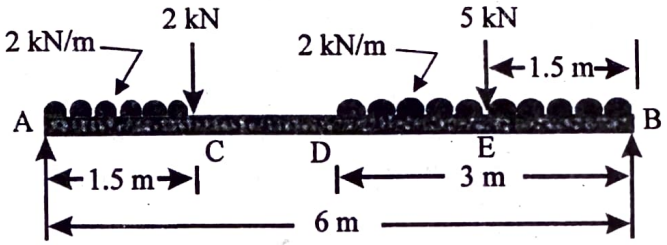
(b) Find magnitude and direction of the resultant force, if 35N, 56N, 42N and 63 N forces are acting along the lines joining the centre of a square to its vertices. 3+2=5

6. (a) State the Lami's Theorem and also mention the conditions of equilibrium. 2+1=3

(b) Three forces acting on a particle are in equilibrium. The angles between the first and second is 90° and that between the second and third is 120°. Find the ratio of the forces. 4

7 (a) What is a 'Frame' ? How would you distinguish between a Deficient frame and a Redundant frame ? 1+2=3

(b) A simply supported beam AB of span 6 m is loaded as shown in Fig. below :



Determine the reactions at A and B. 4

8. (a) State the theorem of perpendicular axis and parallel axis theorem applied to moment of inertia. 3

(b) A body consists of a right circular solid cone of height 40 mm and radius 30 mm placed on a solid hemisphere of radius 30 mm of the same material. Find the position of centre of gravity of the body. 4

9. (a) Explain the following terms : 3

(i) Angle of friction

(ii) Coefficient of friction

(iii) Limiting friction.

(b) A force of 250N pulls a body of weight 500N up an inclined plane, the force being applied parallel to the plane. If the inclination of the plane to the horizontal is 15°, find the Coefficient of friction. 4

10. (a) Obtain an equation for the maximum Mechanical Advantage and maximum Efficiency of a machine. 3

(b) In a certain weight lifting machine, an effort of 150N can lift a load of 3 kN and an effort of 200N can lift a load of 5 kN. Find the law of the machine. Also find the effort required to lift a load of 9 kN. 4

11. (a) State the Laws of Friction. 3

(b) State the Law of Parallelogram. 2

(c) Explain the difference between a Reversible machine and a Self-locking machine. 2