Total No. of printed pages = 8

END SEMESTER EXAMINATION–2022

Semester : 2nd

Subject Code : Me-201

ENGINEERING MECHANICS

Full Marks – 70

Time – Three hours

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

Instructions :

(i) *All* questions of PART–A are compulsory.

(ii) Answer any *five* questions from PART–B.

PART–A

Marks–25

1. Fill in the blanks with appropriate words :

$1 \times 10 = 10$

(a) The forces which are having common lines of action are called _____ forces.

(b) The resultant of two forces P and Q acting at an angle θ is equal to _____.

[Turn over

(c) The centre of gravity of a semicircle is at a distance of _____ from its base measured along the vertical radius 'r'.

(d) Efficiency is 100% for _____ machine.

(e) A body of mass 7.5 kg is moving with a velocity of 1.2 m/s. If a force of 15N is applied on the body, its velocity after 2 sec is _____ m/s.

(f) The unit of moment of force in S.I system is _____.

(g) In a couple, the lines of action of the forces are _____.

(h) Center of gravity is the point of a body through which the _____ of the body acts.

(i) If 'mgh' is the energy stored in a body of mass 'm' after lifting it to a height 'h' from ground, then the term 'mgh' is _____ energy.

(j) The power of an engine which can do a work of 1200 joules in 8 seconds is _____ W.

2. Write True or False :   1×5=5

   (a) The vector method for the resultant force is also called polygon law of forces.

   (b) The unit of work done is Joule.

   (c) All body has one and only one centre of gravity.

   (d) One of the characteristics of a couple is that is can cause a body to move in the direction of a greater force.

   (e) The force of friction always acts opposite to the direction of motion.

3. Choose the correct answer :   1×5=5

   (a) The Lami's Theorem is applicable only for _____. (Fill in the blank)

   (b) The centre of gravity of an equilateral triangle with each side (a) is _____ from any of the three sides. (Fill in the blank)

   (c) The efficiency of a lifting machine is the ratio of _____. (Fill in the blank)

   (d) A person is carrying a bag on his head of mass 5 kg. The person covered a distance of 5m. The work-done is

      (i) 25 Joule   (ii) 0 Joule

      (iii) 10 Joule   (iv) 25 Kilo-Joule

(e) What is the distance of the centre of gravity of a cube from every face, if the length of each side is 6m ?

(i) 2m

(ii) 3m

(iii) 6m

(iv) 4m.

4. Answer in *one* sentence each :　　　　1×5=5

(a) What are vector quantities ?

(b) Define resultant force.

(c) Define law of machine.

(d) Define coefficient of friction.

(e) What do mean by Workdone ?

PART–B

Marks–45

5. (a) Write about Parallelogram Law of Forces along with its formula and diagram.　　5

(b) Two forces act at an angle of 150°. The smaller force is 30N and the resultant is perpendicular to the smaller one. Find the bigger force.　　4

6. (a) A force of 15 N is applied perpendicular to the edge of a door 0.8 m wide as shown in Figure below. Find the moment of the force about the hinge. **3**

0.8m
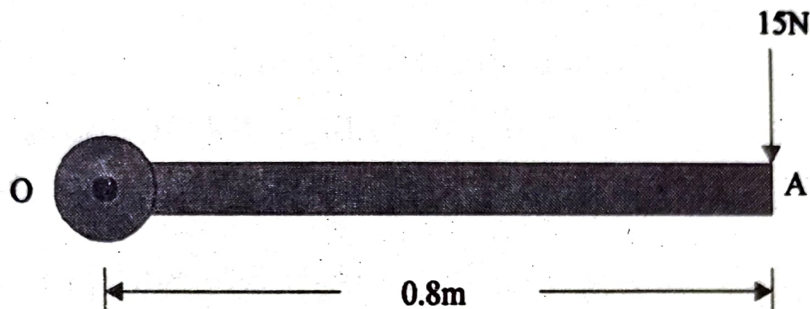
(b) A rod AB 2·5 m long is supported at A and B. The rod is carrying a point load of 5 kN at a distance of 1 m from A. What are the reactions at A and B? **4**

(c) State Varignon's principle of moments. **2**

7. (a) An I-section has the following dimensions in mm units. Determine mathematically the position of the centre of gravity of the section. **5**

Bottom flange = 300×100

Top flange = 150×50

Web = 300×50

(b) If the diameter of a hemisphere is 10 mm, then calculate the distance of C.G from the base.   2

(c) A hollow circular section has an external diameter of 80 mm and internal diameter of 60 mm. Find its moment of inertia about the horizontal axis passing through its centre.   2

8 (a) A body of weight 300 N is lying on a rough horizontal plane having a coefficient of friction as 0.3. Find the magnitude of the force, which can move the body, while acting at an angle of 25° with the horizontal. 5

(b) A body of weight 500 N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by an effort (P) parallel to the plane as shown in Figure. Determine the minimum and maximum values of P, for which the equilibrium can exist, if the angle of friction is 20°.   4

25°   500N
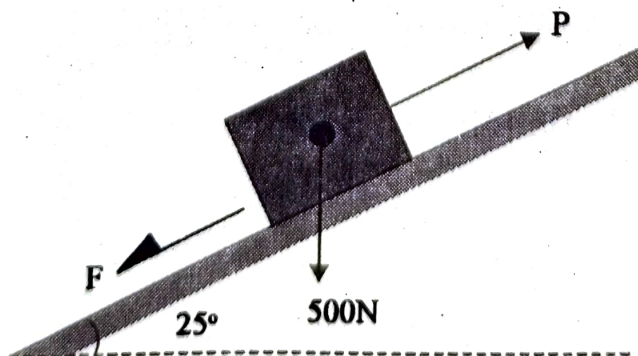
9. (a) A particle, starting from rest, moves in a straight line, whose equation of motion is given by : s = −2 + 3. Find the velocity and acceleration of the particle after 5 seconds.

4

(b) A stone of mass 1 kg is revolving in a circle of radius 1m with a linear velocity of 10 m/s. Find the centrifugal force acting on the stone.

2

(c) The distance between the rails of the track is 1·67m. How much the outer rail be elevated for a curve of 500m radius, in order that the resultant force may be normal at a speed of 45 km.p.h.

3

10. (a) Write a short note on reversible machine and self-locking machine.

3

(b) What load can be lifted by an effort of 120N, if the velocity ratio is 18 and efficiency of the machine at this load is 60% ? Determine the law of the machine, if it is observed that an effort of 200N is required to lift a load of 2600N and find the effort required to run the machine at a load of 3.5 kN.

6

11. (a) Derive the relation between mechanical advantage, velocity ratio and efficiency of a machine. 3

(b) With a differential wheel and axle, an effort of 6N raised a load of 60N. If the efficiency at this load is 80%, find the velocity ratio of the machine.

If the diameter of the effort wheel is 300 mm, determine the differences between the diameters of the axles. If the sum of the diameters of the axles is 280 mm, determine the diameter of each axle. 6