Total No. of printed pages = 8

RETEST EXAMINATION -2019

Semester : 2nd (Old Syllabus)

Subject Code : Me - 201

ENGINEERING MECHANICS

Full Marks –70

Time – Three hours

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

PART – A

Marks – 25

Answer *all* the questions from PART–A.

1. Choose the correct answer from the following : $1 \times 5 = 5$

   (i) The efficiency of a lifting machine is the ratio of

   (a) its output to input

   (b) work done by it to the work done on it

   (c) its mechanical advantage to its velocity ratio

   (d) All of the above.

[Turn over

(ii) Distance travelled by a body in the n^{th} second is given by which of the formula following ? (where u = initial velocity, a = acceleration, n = number of second)

(a) $u + a(2n - 1)/2$

(b) $u/2 + a(2n - 1)$

(c) $u + a\{(2n - 1)/3\}/2$

(d) None of the above

(iii) 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

(a) 5.2 m/s (b) 4 m/s

(c) 2 m/s (d) 1 m/s

(iv) The velocity ratio of a simple wheel and axle is given by _____. (where D = Diameter of effort wheel, d = Diameter of load axle)

(a) 2D/d (b) D/d

(c) D/2d (d) None of these

(v) A weight of 1000 N can be lifted by an effort of 80 N. If the velocity ratio of the machine is 20, then the machine is

(a) Reversible

(b) Non-reversible or self locking.

(c) Idle

(d) None of the above

2. Fill in the blanks : $1 \times 10 = 10$

(i) Forces whose line of action passes through a common point are called _____ forces.

(ii) The splitting of a force into two perpendicular directions without changing its effect is called _____.

(iii) Two forces 'P' and 'Q' have angle of inclination 'θ' between them. If 'α' is the angle which their resultant makes with the direction of P, then $\tan\alpha =$ _____.

(iv) Equations of equilibrium of a particle subjected to co-planar force system are _____ and _____.

(v) A body isolated from all other members which are connected to it is called the _____ body.

(vi) Newton's first law of motion gives the concept of _____.

(vii) One kilogram force is equal to _____ Newton.

(viii) Efficiency is 100% for _____ machine.

(ix) The capacity for doing work is called _____.

(x) One horsepower is equal to _____watt.

3. State true or false : 1×5=5

(i) Static friction has a value ranging from 0 to limiting friction.

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

(iii) The unit of angular velocity is m/s.

(iv) The distance through which a screw thread advances axially in one revolution is called lead or pitch.

(v) Two equal and unlike parallel forces whose lines of action are different are said to form couple.

4. Match the following : 1×5=5

A	B
(i) Acceleration	(a) Nm
(ii) Force	(b) rad./s^2
(iii) Moment	(c) m^4
(iv) Moment of inertia	(d) m/s^2
(v) Angular acceleration	(e) Newton (N)

PART – B

Marks – 45

Answer any *five* questions from PART – B.

5. (a) Two forces act at an angle of 120°. The bigger force is of 40N and the resultant is perpendicular to the smaller one. Find the smaller force. 4

(b) Three forces equal to 3P, 5P and 7P act simultaneously along the three sides AB, BC and CA of an equilateral triangle ABC of side 'a'. Find the magnitude, direction and position of the resultant. 2+1+2=5

6. (a) A simply supported beam AM of span 4m is carrying a point loads of 5 kN, 2 kN and W kN. Loads of 5 kN and 2 kN are at a distance of 1m and 2m respectively from the end A of the beam. If the support reaction at the end B is 4.5 kN, find the distance of load 'W' from the end A of the beam. 5

(b) A body of weight 500 N is pulled up an inclined plane by a force of 250 N. The inclination of the plane is 25° to the horizontal and the force is applied parallel to the plane. Determine the co-efficient of friction. 4

7. (a) Find the Centre of Gravity of the following I - section : 5

Top Flange : 8 cm × 2 cm

Web : 2 cm × 10 cm

Bottom flange : 12 cm × 2 cm

(b) Two equal heavy spheres of 50 mm radius are in equilibrium within a smooth cup of 150 mm radius. Show that the reaction between the cup and one sphere is double than that between the two spheres. 4

8. (a) Find analytically the resultant force and also the position of the resultant force for the following like parallel forces :

$P_1 = 20$ N; $P_2 = 50$ N; $P_3 = 60$ N; $P_4 = 70$ N

Take distances between P_1 and P_2 as 40 mm, between P_2 and P_3 as 30 mm and between P_3 and P_4 as 20 mm. 1+4=5

(b) A body of mass 40 kg is moving with a constant velocity of 2.5 m/s. Now a force of 100 N is applied on the body in its direction of motion. What will be its velocity after 2 seconds. 4

9. (a) What load will be lifted by an effort of 12 N if the velocity ratio is 18 and efficiency of the machine at this load is 60% ? If the machine has a constant frictional resistance, determine the law of the machine and find the effort required to run this machine at

(i) no load

(ii) a load of 900 N. 1+2+1+1=5

(b) A simple screw jack has a thread of pitch 12 mm. Find the load that can be lifted by an effort of 20 N applied at the end of the handle 500 m long. Take efficiency of the machine as 50%. 4

10. Answer the following questions :

(i) State theorem of Perpendicular Axis. 2

(ii) Prove Lami's theorem. 3

(iii) Derive the relation among mechanical advantage, velocity ratio and efficiency of a simple lifting machine. 2

(iv) State principle of Resolution of Forces. 2