13-06-19

Total No. of printed pages = 7

**ME 181104**



Roll No. of candidate | | | | | | | | | | |

**2019**

**B.Tech. 2nd Semester End-Term Examination**

**ENGINEERING MECHANICS**

**(New Regulation)**

**(w.e.f 2017-18) and New Syllabus (Group – A)**
**(w.e.f 2018-2019)**

Full Marks – 70 Time – Three hours

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

Answer question No. 1 and any *four* from the rest.

1. Choose the right answer(s) from the MCQ $(10 \times 1 = 10)$

   (i) If the scalar triple product of three vectors equal to zero, then the vectors are

   (a) Coplaner

   (b) Non-coplaner

   (c) Either coplanar or non coplanar

   (d) None of the above

**[Turn over**

(ii) According to principle of transmissibility of forces, the effect of force upon a body is

(a) Maximum when it acts the centre of gravity of the body

(b) Same at every point in its line of action

(c) Minimum when it acts at the centre of gravity of the body

(d) Different at different points in its line of action

(iii) Reactive components of a hinge joint supported on a horizontal plane

(a) Only vertical force

(b) Only horizontal force

(c) Both vertical and horizontal force

(d) None of these

(iv) For two unlike and parallel forces, there exists.

(a) A resultant force

(b) A resultant moment

(c) A resultant force and the moment

(d) None of the above

(v) In truss structure, the nature of reactive force is in the nature of

(a) Axial

(b) Bending

(c) Both axial and bending

(d) None of the above

(vi) Method of section of truss analysis is generally found useful to determine

(a) Forces in all members

(b) Forces in selective members

(c) Weights of the members

(d) Bending of the members

(vii) Rolling friction is a variety of

(a) Static friction

(b) Belt friction

(c) Kinetic friction

(d) Surface tension



(viii) Centre of gravity and centre of mass identical in case of

(a) Object involving effect of large height

(b) Very large object

(c) Object having no effect of large height and space

(d) None of the above

(ix) The efficiency of a self locking lifting machine should be

(a) Less than 50%

(b) More than 100%

(c) Within the range of 80-90%

(d) None of the above

(x) In virtual work principle, the displacement of rotation should necessarily be

(a) Real

(b) Imaginary

(c) Real and imaginary both are possible

(d) None of the above

2. (a) State and Prove Varignon's theorem (8)

(b) Two identical iron spheres each of radius 5 cm and weight 150 N is connected with a string of length 16 cm, and rests on a horizontal smooth floor. Another sphere of radius 6cm and weight 200 N test over them. Determine the tension in the string and reaction at all contact surfaces.(7)

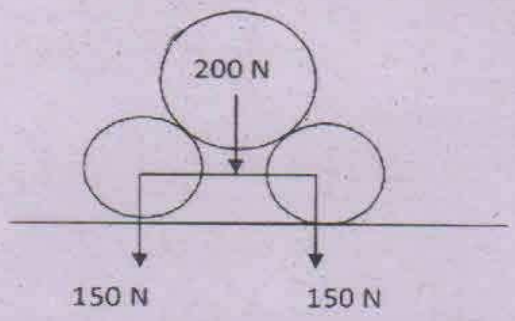


Figure 1

3. (a) For the plane truss AEDCB as shown in the figure determine the induced axial forces in the member AE, BE, BC (7)

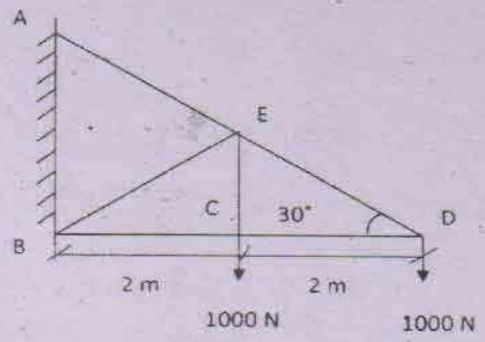


Figure 2

(b) A ladder as shown in the figure is 4m long and supported by a horizontal floor and vertical wall. The coefficient of friction at the wall is 0.25 and that at the floor is 0.5.the weight of the ladder is 30 N and is considered to be concentrated at C. The ladder also supports a vertical load of 150 N at C



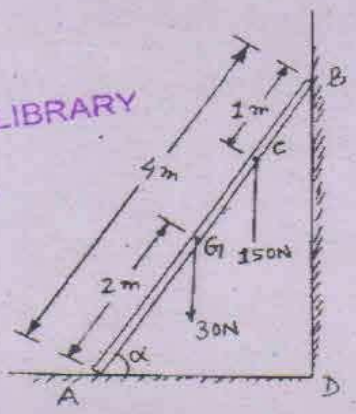


Figure 3

Determine the reactions at A and B and compute the least value of (a) at which the ladder may be placed without slipping to the left. (8)

4. (a) What do you mean by parallel axis theorem of moment of inertia? Find the moment of inertia of a circular section about its X-X axis (7)

(b) A semi circular area is removed from a trapezium as shown in the figure. Determine the centroid of the remaining area. (all Dim, are in mm) (8)

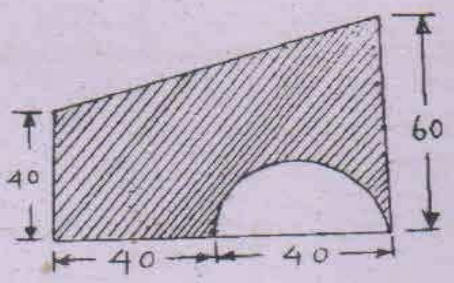


Figure 4

5. (a) Define velocity ratio and mechanical advantage of a machine. Derive a relation among mechanical advantage velocity ratio and efficiency of a machine. (5)

(b) What do you understand by the term Reversibility of a machine? Explain the difference between a reversible machine and self locking machine (5)

(c) In a certain machine, an effort of 10 N is just able to lift a load of 84 N. Calculate the efficiency and the friction both on effort and load side if the velocity ratio of the machine is 10. (5)

6. (a) What do you mean by principle of virtual work? Using the principle of virtual work determine the reaction of a beam AB of span 10 m carries two point loads 15 kN and 20 kN at 4 m and 6 in from the end A respectively. (7)

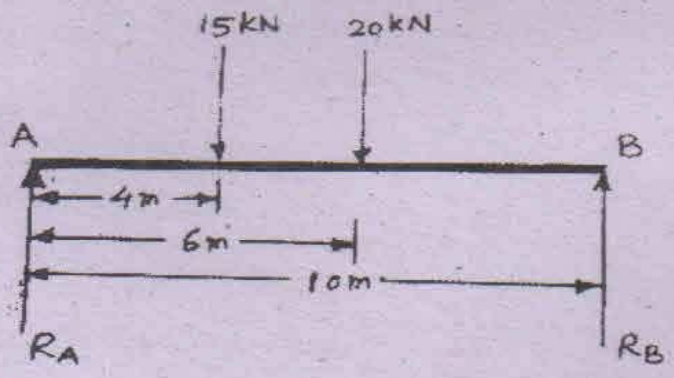


Figure 5

5. (a) Define velocity ratio and mechanical advantage of a machine. Derive a relation among mechanical advantage velocity ratio and efficiency of a machine. (5)

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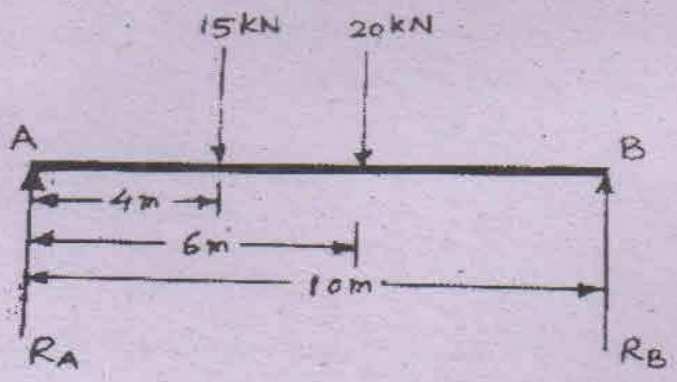


Figure 5

(b) A load W is lifted up using a pulley device shown in the figure. Determine the effort required to raise the load if R =11 cm r =2.1 cm. Neglect the friction in the movable pulley and take co-efficient of friction in the journals supporting the pulleys is $\mu$=1/3. Use method of virtual work and find the efficiency of the system. (8)

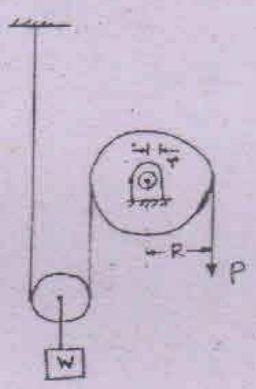


Figure 6

7. (a) Derive the expression for work done and kinetic energy of a rigid body when it is subjected to both translational and rotational motion. (8)

(b) A locomotive draws a train of mass 400 tonnes, including its own mass, on a level ground with a uniform acceleration, until it acquires a velocity of 54 km/h in 5 minutes.

If the frictional resistance is 40 N per tonne of mass and the air resistance varies with the square of the velocity. Find the power of the engine. Take air resistance as 500 N at 18km/h. (7)