53 (ME 201) ENMC

2017

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)* What do you mean by resultant force ? Distinguish between the composition of force and resolution of force. Explain briefly the triangular and polygon law of forces with example. 2+2+6=10

   (b) The following forces act at a point : 6+4=10

   (i) 50*N* towards North-East

   (ii) 40*N* towards East

(iii) $25N$ inclined at 30° West of North

(iv) $30N$ inclined at 60° South of West

Determine the resultant of the above force system using

(A) Method of resolution of force

(B) Polygon law of force.

2. (a) What is the physical meaning of moment of force ? State Varignon's principle of moment. 1+2=3

(b) State and prove the Lami's theorem. What is the limitation of Lami's theorem ? 2+4+1=7

(c) A system of loads acting on a beam is shown in *figure-1*. Determine the magnitude direction (α) and the distance (x) of the resultant along the horizontal axis. 10

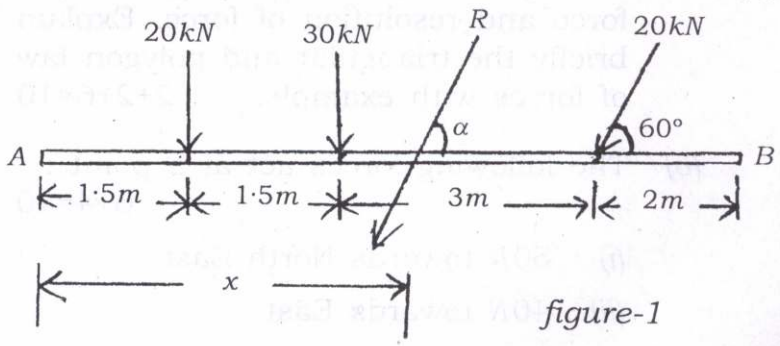

figure-1

3. *(a)* What do you mean by free body diagram ? Write the necessary and sufficient condition of equilibrium of a body. 1+2=3

(b) Two identical rollers, each weighing $Q = 50N$, are supported by an inclined plane and a vertical wall as shown in *figure*-2. Assuming smooth surfaces, find the reactions induced at the points of support *A*, *B* and *C*. 7

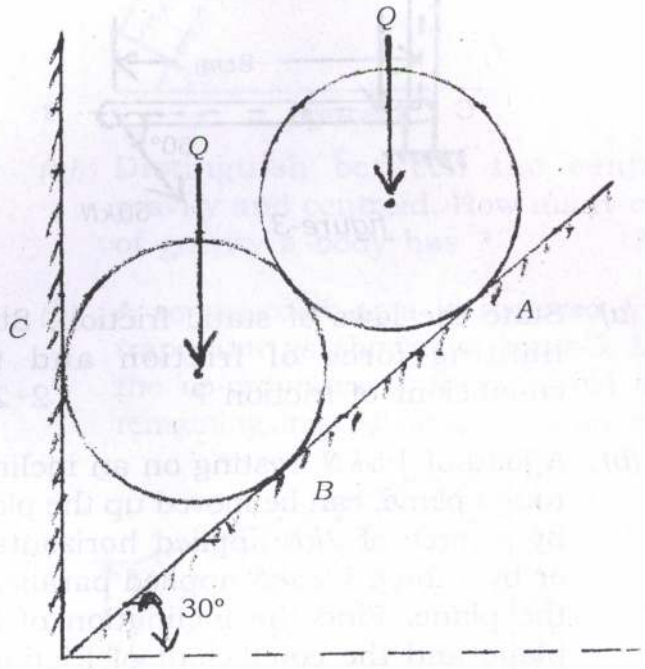

figure-2

(c) The forces acting on a bell-crank lever are shown in *figure-3*. Determine the force (F) if the lever is in equilibrium. Also find the reactions at C. 10

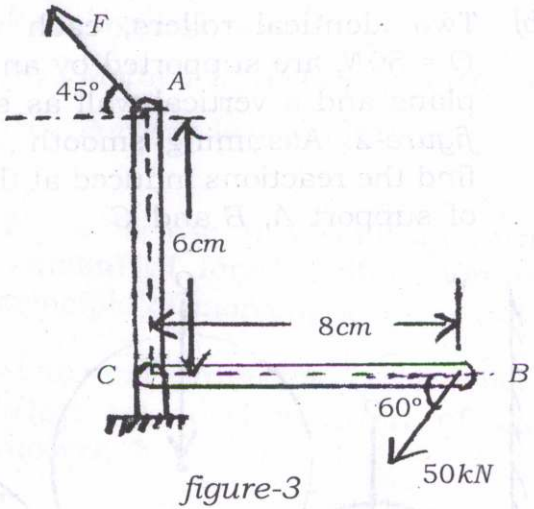

figure-3

4. (a) State the laws of static friction. State limiting force of friction and the co-efficient of friction ? 2+2=4

(b) A load of $1{\cdot}5kN$, resting on an inclined rough plane, can be moved up the plane by a force of $2kN$ applied horizontally or by a force $1{\cdot}25kN$ applied parallel to the plane. Find the inclination of the plane and the co-efficient of friction. 6

(c) What is the value of force (P) in the system shown in *figure 4* to cause the motion of $500N$ block to the right side ? Assume the pulley is smooth and the co-efficient of friction between other contact surfaces is 0·20. 10

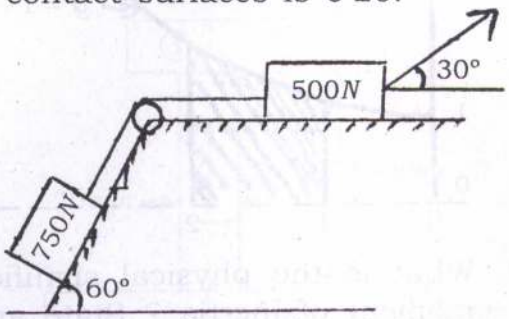

figure-4

5. (a) Distinguish between the centre of gravity and centroid. How many centre of gravity a body has ? 2+1=3

(b) A semicircular area is removed from a trapezium as shown in *figure-5*. Locate the co-ordinates of the centroid of the remaining area. All dimensions are in *mm*. 7

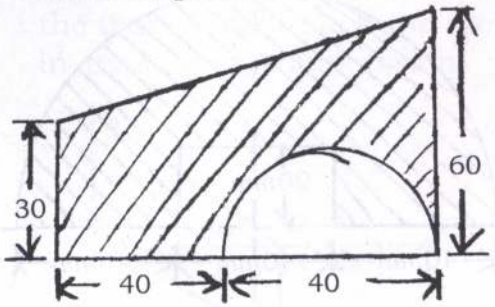

figure-5

(c) Determine the co-ordinates of the centroid of the shaded area of *figure-6*. 10

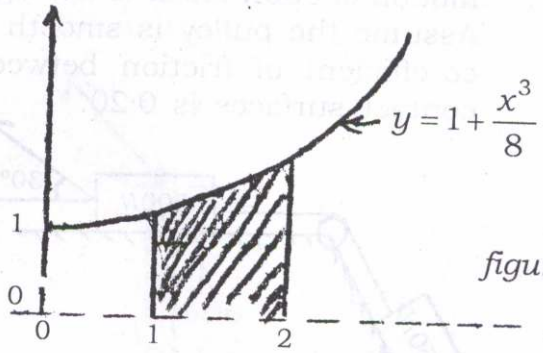

figure-6

6. (a) What is the physical significance of moment of inertia ? State and prove the parallel axis theorem of moment of inertia. 1+2+3=6

(b) The cross-section of a beam is shown in *figure-7*. Find the moment of inertia of the section about the horizontal centroidal axis. 4

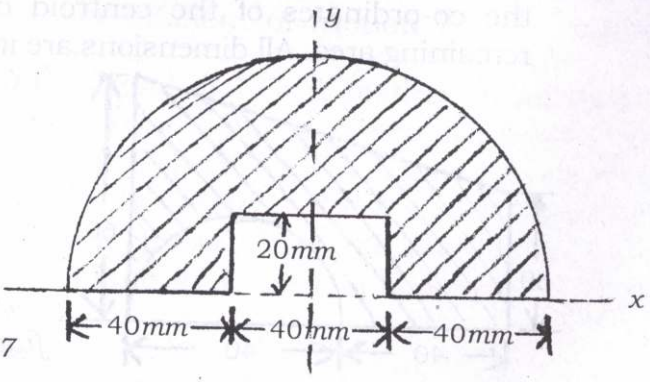

figure-7

(c) Using parallel axis theorem, find the moment of inertia of the following *figure-8*. 10

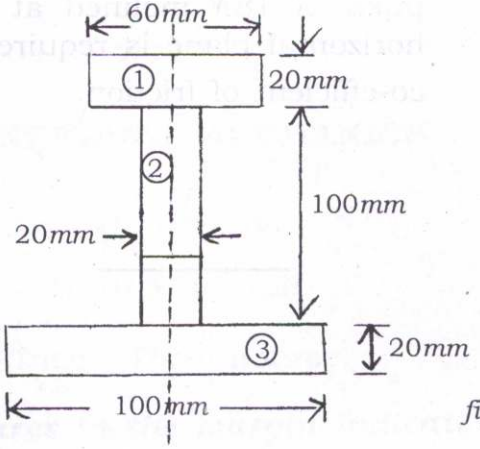

figure-8

7. (a) Distinguish between a truss and a frame. What do you mean by deficient and redundant plane trusses ? 2+2=4

(b) Determine the force in each member of the truss, and state if the members are in tension or compression. 10

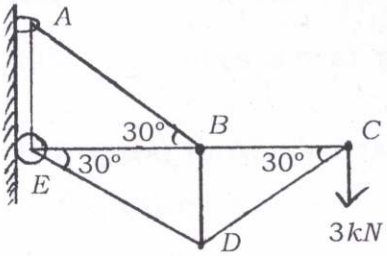

figure-9

(c) A body of weight $60N$ is placed on a rough horizontal plane. To just move the body on the horizontal plane, a push of $18N$ inclined at 20° to the horizontal plane is required. Find the co-efficient of friction. 6
