Code : 100310

B.Tech 3rd Semester Exam., 2020
(New Course)

ENGINEERING MECHANICS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct alternative from any *seven* of the following : 2×7=14

(a) Which of the following is a vector quantity?

(i) Energy

(ii) Mass

(iii) Momentum

(iv) Angle

(b) Kinetic friction is the

(i) tangent of angle between normal reaction and the resultant of normal reaction and the limiting friction

(ii) ratio of limiting friction and normal reaction

(iii) friction force acting when the body is just about to move

(iv) friction force acting when the body is in motion

(c) The angular velocity (in rad/s) of a body rotating at N revolutions per minute is

(i) $\pi N/60$

(ii) $\pi N/180$

(iii) $2\pi N/60$

(iv) $2\pi N/18$

(d) D'Alembert's principle is used for

(i) reducing the problem of kinetics to equivalent static problem

(ii) determining stresses in the truss

(iii) stability of floating bodies

(iv) designing safe structures

(e) If rain is falling in the opposite direction of the movement of a pedestrian, he has to hold his umbrella

(i) more inclined when moving

(ii) less inclined when moving

(iii) more inclined when standing

(iv) less inclined when standing

(f) A flywheel on a motor goes from rest to 1000 r.p.m. in 6 sec. The number of revolutions made is nearly equal to

(i) 25

(ii) 50

(iii) 100

(iv) 250

(g) Bending moment is zero in axial thrust diagram at

(i) point of contra-flexure

(ii) point of inflection

(iii) Both (i) and (ii)

(iv) None of the above

(h) The moment of inertia of hollow circular section about a central axis perpendicular to section as compared to its moment of inertia about horizontal axis is

(i) same

(ii) double

(iii) half

(iv) four times

(i) Mass moment of inertia of a uniform thin rod of mass M and length l about its mid-point and perpendicular to its length is

(i) $(2/3)\ Ml^2$

(ii) $(1/3)\ Ml^2$

(iii) $(3/4)\ Ml^2$

(iv) $(1/12)\ Ml^2$

(j) A particle is moving with a constant velocity along a line parallel to positive x-axis. The magnitude of its angular momentum with respect to the origin is

(i) zero

(ii) increasing with x

(iii) decreasing with x

(iv) remaining constant

2. Find the moment of a force 5 N directed along one side of a cube of side length 2 m with respect to—

   (a) all vertices of the cube;

   (b) all axes going through the sides. 14

3. Draw the free-body diagram of the 50 kg paper roll which has a center of mass at *G* and rests on the smooth blade of the paper hauler (in Fig 1) :

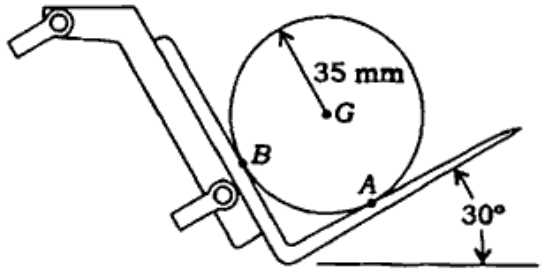

Fig. 1

Explain the significance of each force acting on the diagram. 14

4. Explain, with due mathematical expression, the mass moment of inertia for an object. Derive the mass moment of inertia about the centroidal axes of a solid sphere, a solid cylinder, and a solid right circular cone. 14

5. At the instant shown (in Fig. 2), the disk is rotating with an angular velocity of ω and has an angular acceleration of α :

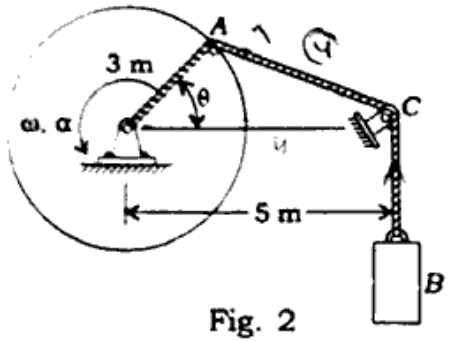

Fig. 2

Determine the velocity and acceleration of cylinder *B* at this instant. Neglect the size of the pulley at *C*. 14

6. The hollow circular shaft is subjected to an internal torque of $T = 10$ kN-m (in Fig. 3) :

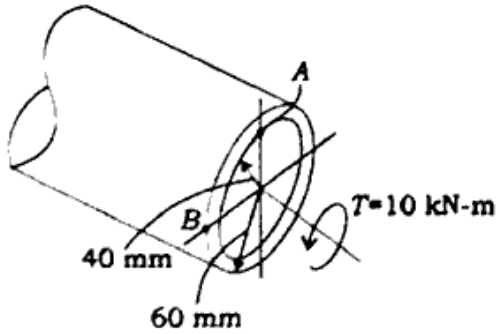

Fig. 3

Determine the shear stress developed at points *A* and *B*. Represent each state of stress on an element. 14

7. Draw shear force and bending moment diagrams for the beam shown (in Fig. 4) :

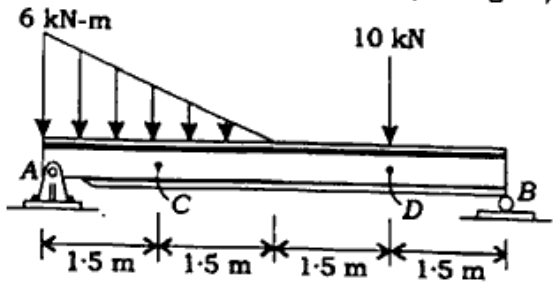

Fig. 4

Determine the internal normal force, shear force, and moment at points C and D in the simply supported beam. Point D is located just to the left of the 10 kN concentrated load. 14

8. If the coefficient of static friction at all contacting surfaces is μ_s (in Fig. 5), determine the inclination θ at which the identical blocks, each of weight W, begin to slide : 14

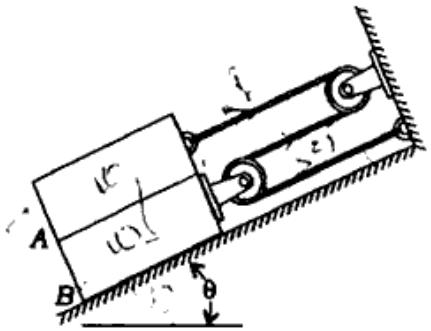

Fig. 5

9. Write short notes on the following with suitable mathematical expressions : 3+4+3+4=14

(a) Angle of repose

(b) Types of supports and their reactions

(c) Polar moment of inertia

(d) General planar motion

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