Code : 011201

2013

ENGINEERING MECHANICS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

*(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 (any *seven*) :

(a) Which of the following system of forces can not be reduced to a single force?

(i) Non-concurrent forces in space

(ii) Non-concurrent forces in a plane

(iii) Parallel forces in space

(iv) Parallel forces in a plane

(b) If a body is at rest, it implies that

(i) the forces acting on it are always zero

(ii) the resultants of the forces acting on it are zero

(iii) the moments of the forces acting on it are zero

(iv) both the resultant force and moment are zero

(c) At the point of impending motion, the static frictional force is

(i) zero

(ii) maximum

(iii) minimum

(iv) infinite

(d) Mass moment of inertia of a thin hoop of mass M and radius R about an axis perpendicular to its plane is

(i) MR^2

(ii) $\frac{MR^2}{2}$

(iii) $\frac{MR^2}{3}$

(iv) $\frac{MR^2}{4}$

(e) A rigid body can be idealized as a particle

(i) only when its size is very minute

(ii) only when the body is at rest

(iii) when there is no translational motion involved

(iv) when there is no rotational motion involved

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(h) If a lift is accelerating when moving upwards, the weight of a man standing on the floor of the lift is

(i) same as that when on ground

(ii) zero

(iii) greater than that on ground

(iv) less than that on ground

(g) In a perfectly elastic collision

(i) momentum is conserved

(ii) kinetic energy is conserved

(iii) both momentum and kinetic energy are conserved

(iv) neither momentum nor kinetic energy is conserved

(h) Which of the following is not a vector?

(i) Angular displacement

(ii) Angular velocity

(iii) Angular acceleration

(iv) Linear velocity

(i) Instantaneous power in fixed axis rotation is expressed mathematically as

(i) $I\alpha$

(ii) $I\omega$

(iii) $M\alpha$

(iv) $M\omega$

where I = moment of inertia, M = mass, α = angular acceleration, ω = angular velocity

(j) Impulse of a force acting on a body is equal to

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(i) momentum of the body

(ii) change in momentum of the body

(iii) rate of change in momentum of the body

(iv) product of momentum and time

2. (a) Explain how a system of non-concurrent forces can be reduced to an equivalent force couple system.

(b) Two beams AB and CD are supported as shown in Fig. 1. Determine the reactions at the supports B, A and D.

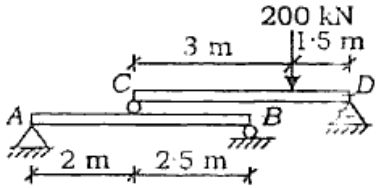

Fig. 1

3 (c) State the conditions of equilibrium for different force systems.

(d) Three smooth cylinders are placed as shown in Fig. 2. Determine the reactions at all contact surfaces. Weight of cylinders B

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and D is W and of C is $2W$. The corresponding radii are respectively, r and $2r$.

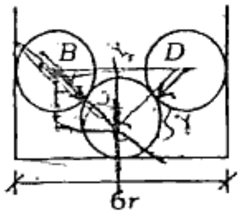

Fig. 2

4. (a) Define free body and free body diagram.

(b) Define two-force equilibrium.

(c) Determine the value of the force W which would produce a force of magnitude 150 kN in the member AB (Fig. 3).

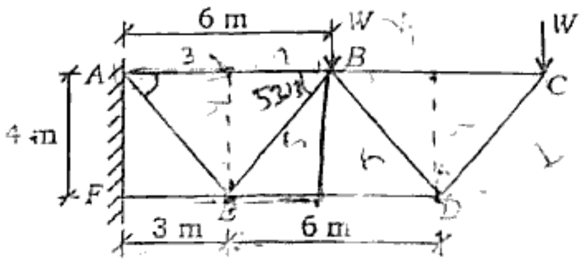

Fig. 3

5. (a) Define radius of gyration for mass moment of inertia. akubihar.com

(b) Determine the centroid of the composite section and also compute the second moment of inertia about the axis XX (Fig. 4).

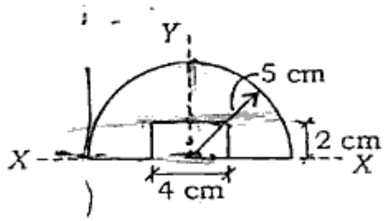

Fig. 4

6. A particle moving in a straight line is subjected to a resistance which produces a retardation of kv^3, where v is the velocity and k is constant. Show that v and the time t are given in terms of s by the equation, $v = \frac{u}{1+ksu}$ and $t = \frac{1}{2}ks^2 + \frac{s}{u}$, where u is the initial velocity. akubihar.com

Two [illegible] A and B weighing 100 N and [illegible] vely are allowed to roll [illegible] from [illegible] inclined [illegible] 30° [illegible] Fig [illegible] A [illegible]

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$V_A = 100$ mm and $V_B = 150$ mm. The radii of gyration are 80 mm and 130 mm. Assuming rolling without slipping, find when and where the two rims come into contact on the inclined plane.

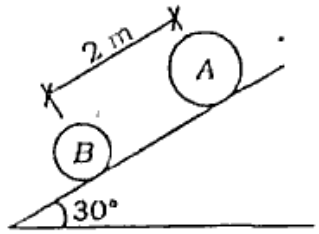

Fig. 5

8. A smooth sphere moving at 10 m/s in the direction shown collides with another sphere of double its mass and moving with 5 m/s in the direction as shown in Fig. 6. If the coefficient of restitution is 2/3, determine their velocities after collision.

Fig. 6

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9. The stepped pulley arrangement shown in Fig. 7, when released from rest, determine the acceleration of the blocks, angular acceleration of the pulley and tension in the strings connecting the blocks. The mass of the pulley is 50 kg and its radius of gyration is 18 cm and the coefficient of friction between the horizontal plane and the block resting on it is 0·2.

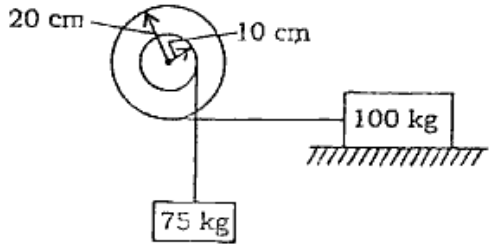

Fig. 7

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