b) Two steel cylinders [illegible] rest on a right angled wedge support as shown in Fig 9. The side of wedge makes an angle of 30° with the horizontal. The diameters of the cylinders A and B are 200 mm and 500 mm and their weights being 100N and 400N respectively. Determine the reactions R between all contact points.

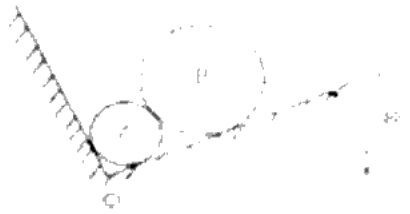

Fig 9

11 a) Find the decrease in length of the steel bar loaded as shown in Fig 10. Take $E = 2 \times 10^5$ N/mm².

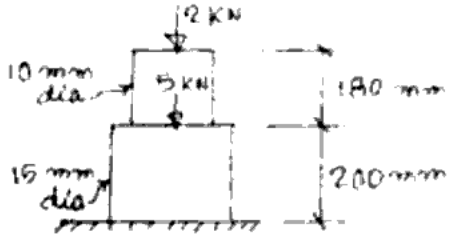

Fig 10

b) If t_1 is the time in which a projectile reaches a point P_1 along its path and t_2 is the time taken by the projectile from P_1 till it hits the horizontal plane passing through point P_2 as shown in Fig 11. Show that the height of point P_1 above the plane is $\frac{1}{2}gt_1t_2$.

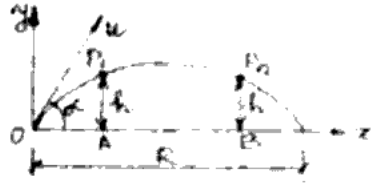

Fig 11

Candidate's Signature .....

CS/B.TECH (NEW)/SEM-1/ME-101/2013-14

2013

ENGINEERING MECHANICS

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1 Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) Lami's theorem is applicable to

a) Equilibrium of two coplanar, concurrent forces

b) Equilibrium of three coplanar, concurrent forces

c) Equilibrium of three coplanar, non-concurrent forces

d) None of these

iii) Angle between the vectors $\hat{i} + \hat{j}$ and $\hat{j} + \hat{k}$ is

a) 90° b) 45°

c) 0° d) none of these

iii) When a body slides down an inclined surface inclination θ with the horizontal the acceleration a the body is given by

a) $a = g$ b) $a = g\cos\theta$

c) $a = g\sin\theta$ d) $a = \dfrac{g}{\cos\theta}$

iv) The values of $\hat{i}\cdot\hat{i}$ and $\hat{i}\times\hat{i}$ are

a) 1 and 0 b) 1 and 1

c) 0 and 0 d) 0 and 1

v) Moment of inertia of a circle with its centroidal x-axis

a) $\pi d^4/32$ b) $\pi d^4/256$

c) $\pi d^4/64$ d) $\pi d^4/128$.

vi) A particle moves along horizontal direction and position at any instance is prescribed by the relat $x = 3t^3 - 5t^2$ where x is in metres and t is in secon Which of the following distance will be covered by particle during $t = 2$ sec to 5 sec ?

a) 246 m b) 146 m

c) 200 m d) [illegible] m

vii) A rectangular bar of length l breadth b and thickness t is subjected to an axial pull of P the linear strain is given by

a) btE/P b) P/btE

c) bt/PE d) $e = PE/bt$

viii) Given $\vec{F}_1 = 5\hat{j} + 4\hat{k}$ and $\vec{F}_2 = 3\hat{i} + 6\hat{k}$. The magnitude of the scalar product of these vectors is

a) 15 b) 30

c) 24 d) 12

ix) Equation of motion of a particle is $s = 2t^3 - t^2 - 2$, where s is displacement in metres and t is time in seconds. Acceleration of the particle after 1 second will be

a) 8 m/s² b) 9 m/s²

c) 10 m/s² d) 5 m/s²

x) If $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$ and $\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$ then $\vec{A}\cdot\vec{B}$ is given by

a) $A_x B_x + B_x A_y + A_z B_z$

b) $A_x A_y + A_z B_x + B_z A_x$

c) $A_x A_y + B_x B_y + B_y A_x$

d) $A_x B_x + A_y B_y + A_z B_z$

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xi) D' Alembert's principle

a) is based upon the presence of inertia force

b) provides advantage over Newton's law

c) is purely a hypothetical law

d) allows a dynamic problem to be treated as a st[illegible] one.

xii) A single force and couple action in the same plane u[illegible] a rigid body

a) balance each other

b) cannot balance each other

c) produce moment of a couple

d) are equivalent

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 [illegible]

2. A member is shown in Fig. 1. Replace the force (100N) ac[illegible] at point D, into equivalent force-couple system at poin[illegible]. Find the reaction forces at points A and B.

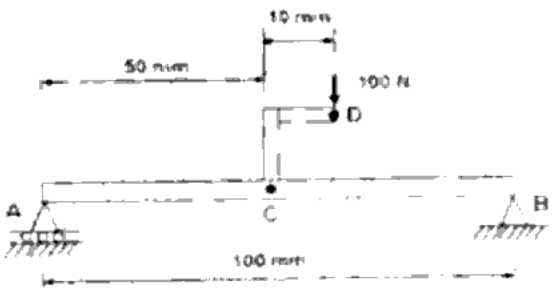

Fig. 1

A load [illegible] [illegible] [illegible] from A. The spring AB [illegible] [illegible] by [illegible] [illegible] and is [illegible] in the equilibrium position according to Fig. 2. Determine the stiffness of the spring.

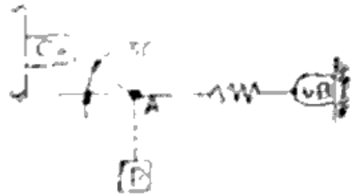

Fig. 2

[illegible] A bar of uniform cross-section A and length L is vertically hung subjected to its own weight. Prove that strain energy within the bar U = [illegible]/6E, where [illegible] = sp. weight, E = modulus of elasticity.

[illegible] a) State the parallel axes theorem of moment of inertia of lamina.

b) Calculate the location of the centroid of the L-section as shown in Fig. 3.

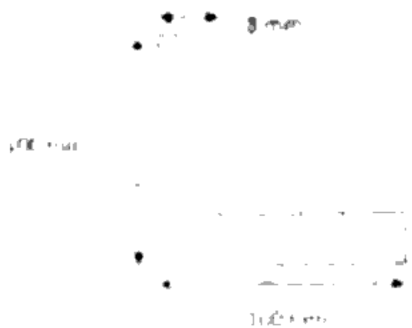

Fig. 3

[illegible] A force [illegible] (3[illegible] [illegible] + 2k[illegible]) N acts at a point A whose coordinates are (1, [illegible] 2, 3) m. Compute

a) moment of force about origin

b) moment of force about the point B (2, 1, 2) m.

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GROUP – C

(Long Answer Type Questions)

Answer any three of the following

7 a) A ball of weight W is resting upon a smooth plane and attached at its centre to the strings which pass over smooth pulley and carry load P and Q as shown Fig. 4. Find the angle θ and pressure between the b and the plane

b) A uniform wheel of 60 cm diameter rests against a r rectangular block of 15 cm height as shown in Fig Find the magnitude and direction of the least p through the centre of the wheel that will just turn t wheel over the corner of the block. All surfaces a smooth. Determine the reaction of the block at the po C. Weight of wheel is 5 kN 6

Fig. 4

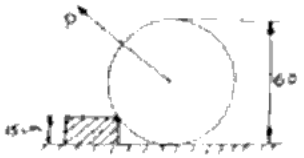

Fig. 5

8 a) State D'Alembert principle

b) Two blocks weighing 600N and 1200N are placed on 3 and 60° planes respectively as shown in Fig. 6. T blocks are connected by an extensible string which passing over a friction pulley. If $\mu = 0.25$ for both t plane, find the tension in the string and the accelerati of blocks

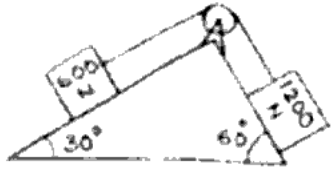

Fig. 6

9 a) A gun is fired, so that, the initial velocity of its bullet is 980m/s and can hit the target located 500 m above the level of gun point and at horizontal distance of 3000 m. Neglecting the air resistance, determine the firing angle 6

b) Determine the centroid of the shaded area as shown in the following Fig. 7 5

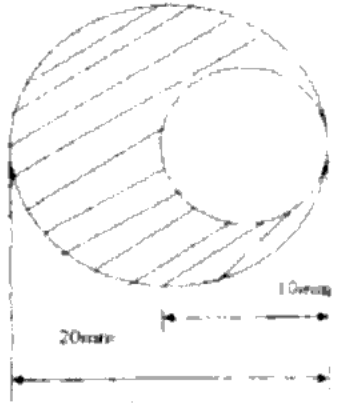

Fig. 7

c) Draw the stress-strain curve for ductile material and show various regions and points on it 4

10 a) A force $F = 50\,i + 75\,j - 100\,k$, acts through E as shown in Fig.-8. Determine the moment of force about x, y and z axes respectively 8

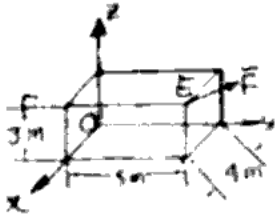

Fig. 8