Printed Pages : 8 **EME-102**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4301 Roll No.

B. Tech.

(Only for the candidates admitted/Readmitted in the session 2008-09)

(SEM. I) EXAMINATION, 2008-09

ENGG. MECHANICS

Time : 3 Hours] *[Total Marks : 100*

Note : *(i) This paper is in **three** sections. Section **A** carries **20** marks, Section **B** carries **30** marks and Section **C** carries **50** marks.*

*(ii) Attempt **all** questions. Marks are indicated against each question/part.*

*(iii) Assume missing **data suitably**, if any.*

SECTION - A

1 You are required to answer **all** the parts : **2×10=20**

Choose correct answer for the following two parts :

(a) Mass moment of inertia of a thin circular disc about its polar axis is

(i) $MR^2/2$ (ii) $MR^2/4$

(iii) $MR^4/2$ (iv) $MR^4/4$

(b) When a body slides down an inclined surface (making angle θ with horizontal), the acceleration of the body is

(i) g (ii) $g \cos\theta$

(iii) $g \sin\theta$ (iv) none of the above.

Fill in the blanks for the following three parts :
You will be awarded full marks, if all the entries in a part are correct (otherwise will be awarded zero).

(c) In method of sections (truss), the section must pass through not more than _____ members; and the equations of equilibrium are given as _____.

(d) A body of mass 2.5 kg is moving with a constant velocity of 5 m/s In order to bring it to rest at a distance of 4 m, the work done is _____ and force required is _____.

(e) Maximum possible value (theoretical) for the poisson's ratio is _____ and the actual value for the cork is approximately _____.

Match the columns for the following three parts :
You will be awarded full marks, if all the matches in a part are correct (otherwise will be awarded zero).

(f) Match the following columns :

	Column I		**Column II**
(i)	Non uniform straight line motion	(P)	$a_n=0$ and $a_t=0$
(ii)	Non uniform curvilinear motion	(Q)	$a_n \neq 0$ and $a_t \neq 0$
(iii)	Uniform straight line motion	(R)	$a_n \neq 0$ and $a_t=0$
(iv)	Uniform curvilinear motion	(S)	$a_n=0$ and $a_t \neq 0$

Where a_n is radial acceleration and a_t is linear acceleration.

(g) Match the following columns :

	Column I		**Column II**
(i)	Uniformly distributed load	(P)	Shear force remains constant
(ii)	Uniformly varying load	(Q)	Shear force varies suddenly
(iii)	Concentrated load	(R)	Shear force varies linearly
(iv)	No load	(S)	Bending moment varies linearly

(h) Match the following columns :

	Column I		**Column II**
(i)	Rectangle	(P)	$\pi D^4 / 64$
(ii)	Triangle	(Q)	$bh^3 / 12$
(iii)	Circle	(R)	$\pi R^4 / 8$
(iv)	Semicircle	(S)	$bh^3 / 36$

Column II gives the value of moment of inertia about a centroidal axis.

Choose correct answer for the following two parts :

(i) STATEMENT-1

As compared to a solid shaft of outer diameter D, a hollow shaft of same outer diameter will have smaller angle of twist per unit length when subjected to same torque.

and

STATEMENT-2

For the same cross sectional area a hollow shaft has larger polar moment of inertia as compared to solid shaft.

(i) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1.

(ii) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1.

(iii) STATEMENT-1 is True, STATEMENT-2 is False.

(iv) STATEMENT-1 is False, STATEMENT-2 is True.

(j) STATEMENT-1

In the case of pure bending the radius of curvature of neutral axis varies linearly.

and

STATEMENT-2

In pure bending the magnitude of banding moment remains constant.

(i) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1.

(ii) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1.

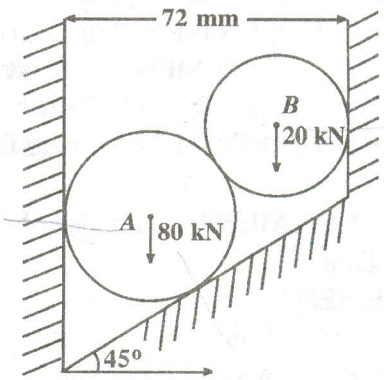
(iii) STATEMENT-1 is True, STATEMENT-2 is False.

(iv) STATEMENT-1 is False, STATEMENT-2 is True.

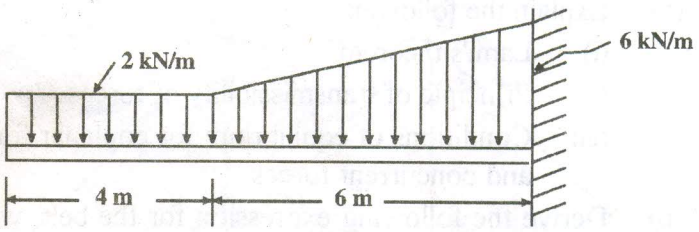
SECTION - B

2 Answer any **three** parts of the following : **10×3=30**

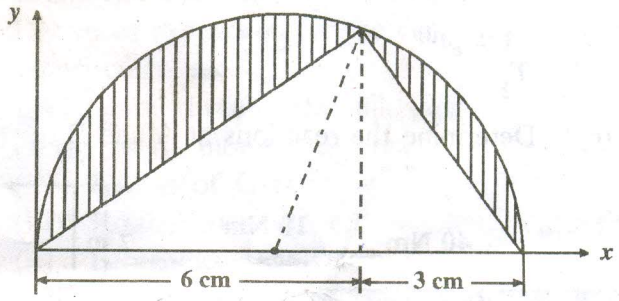
(a) Two cylinders A and B of diameters 3cm and 6cm weighing 20 kN and 80 kN respectively are placed as shown in figure. Assuming all the contact surfaces to be smooth, find the reactions at the walls.



(b) Find the shear force and moment equation for the cantilever beam shown in figure. Also sketch the shear force and bending moment diagram.



(c) A triangle is removed from a semicircle as shown in figure. Locate the centroid of the remaining object.



(d) A vehicle weighing 50 kN moves with a velocity of 60 km/hr along x-direction. Another vehicle weighing 25 kN moving along y-direction with a velocity of 90 km/hr, collides with it. If two vehicles get entangled after collision, determine their common velocity.

(e) Why I-section beam is preferred over a rectangular-section beam ? A simply supported beam, 2 cm wide by 4 cm high and 1.5 m long is subjected to a concentrated load of 2 kN (perpendicular to beam) at a point 0.5m from one of the supports. Determine : (i) the maximum fiber stress and (ii) the stress in a fiber located 1 cm from the top of the beam at mid-span.

SECTION - C

3 Answer any **two** parts of the following : 5×2=10

(a) Explain the following :

(i) Lami's theorem

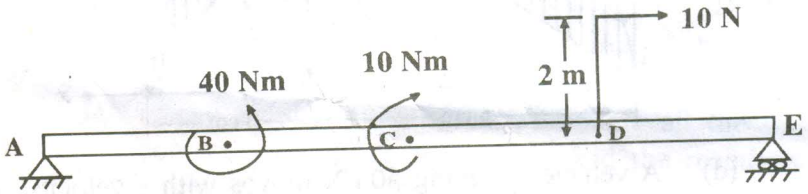
(ii) Principle of transmissibility of forces

(iii) Conditions of equilibrium for coplanar forces and concurrent forces.

(b) Derive the following expression for the belt, where all symbols have their usual meaning, $T_1 > T_2$, in belt-pully arrangement for power transmition.

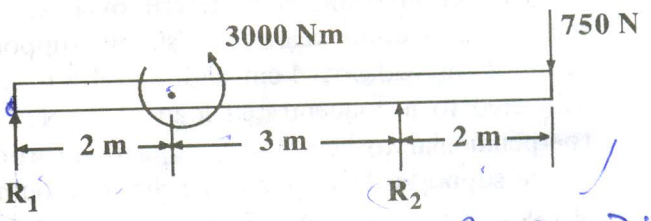
$$\frac{T_1}{T_2} = e^{\mu\theta}$$

(c) Determine the reactions at A and B.



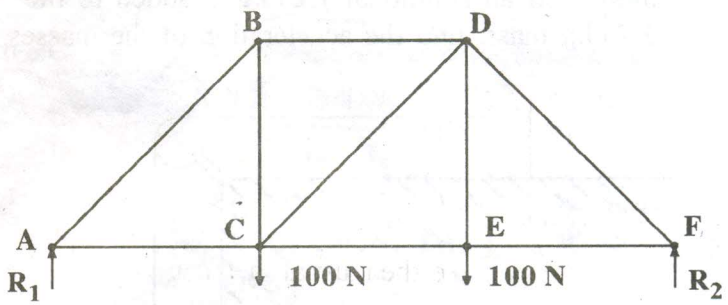
4 Answer any **one** part of the following : 10

(a) Draw the shear force and bending moment diagram for the beam shown in figure.



$R_1 + R_2 = 750$

(b) For the truss shown in figure, **find** the force in the members.



5 Answer any **two** parts of the following : **5×2=10**

(a) Derive an expression for the centroid of semicircular arc.

(b) Explain any **three** of the following :

(i) Second moment of area

(ii) Radius of Gyration

(iii) Parallel axis theorem

(iv) Perpendicular axis theorem.

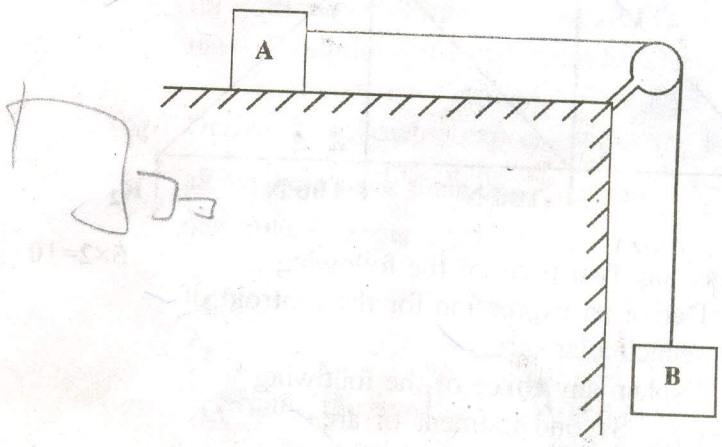
(c) Derive an expression for mass moment of inertia of solid sphere about axis passing through its center.

6 Answer any **one** part of the following : **10**

(a) A sphere, a cylinder and a hoop, each having the same mass and radius are released from rest on an incline. Determine the velocity of each body after it has rolled through a distance corresponding to a change in elevation *h*.

(b) A body of mass 25 kg resting on a horizontal table is connected by a string passing over a smooth pulley at the edge of the table to another body of mass 3.75 kg and hanging vertically as

shown in **fig.** Initially, the friction between 25 kg mass and the table is just sufficient to prevent the motion. If an additional 1.25 kg is added to the 3.75 kg mass, find the acceleration of the masses.



7 Answer any **two** parts of the following : **5×2=10**

(a) Derive the following expression for the elastic constants :

$$K = \frac{E}{3(1-2\mu)}$$

(b) Plot tensile test diagram for Mild Steel and explain all salient points. Derive an expression for strain energy in terms of strain and Young's modulus.

(c) Calculate the minimum diameter of a solid steel shaft which is not allowed to twist more than 3^{o} in a 6 m length when subjected to a torque of 12 kN-m. Also calculate the maximum shearing stress developed. Take G = 83 GPa.
