Printed Pages : 8 EME102

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

PAPER ID : 4301 Roll No.

B.Tech

(SEM I) ODD SEMESTER THEORY EXAMINATION 2009-10

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 parts :

(a) If number of forces act simultaneously on a particle, it is possible :

(i) not to replace them by a single force

(ii) to replace them by a single force

(iii) to replace them by a single couple

(iv) to replace them by a force and couple

(b) Moment of intertia of a circular area, about an axis perpendicular to the area passing through its centre is given by :

(i) $\pi d^4/8$ (ii) $\pi d^4/16$

(iii) $\pi d^4/32$ (iv) $\pi d^4/64$

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 truss analysis, the weight of truss member is assumed to be _____ and stress induced on application of force in truss members is _____.

(d) Centripetal component of acceleration is measured _____ to the direction of velocity and acts along a line _____ to the path of rotation and towards the centre of curvature of path

(e) The value of shear stress which is induced in the shaft due to the applied torque is _____ at the centre and _____ at the circumference.

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)	Statics	(P)	Study of forces that causes motion
(ii)	Dynamics	(Q)	Study of forces in rigid bodies
(iii)	Kinetics	(R)	Study of displacement, velocity and acceleration
(iv)	Kinematics	(S)	Study of forces in moving bodies

(g) Match the following columns :

Column I		**Column II**	
(i)	Lami's theorem	(P)	Dynamic equilibrium of particle
(ii)	Maxwell theorem	(Q)	Principle of moments
(iii)	D'Alembert's principle	(R)	Equilibrium of three concurrent forces
(iv)	Varignon's theorem	(S)	Force analysis of trusses

(h) Match the following columns :

Column I	Column II
(i) Torsional rigidity	(P) EI
(ii) Section modulus	(Q) GJ
(iii) Torsional stiffness	(R) I/y
(iv) Flexural rigidity	(S) T/θ

Choose the correct answer for the following two parts :

(i) Two forces can be in equilibrium only if they are :

(I) equal in magnitude

(II) opposite in direction

(III) collinear in action

(i) Only I and II are correct

(ii) Only I and III are correct

(iii) Only II and III are correct

(iv) All are correct

(j) For the same power transmitted

(I) the weight of solid shaft is less than that of the hollow shaft

(II) the weight of hollow shaft is less than that of the solid shaft

(III) No relation exists between power transmitted and the weight of solid and hollow shaft

(i) Only I and III are correct

(ii) Only II and III are correct

(iii) II alone is correct

(iv) I alone is correct

SECTION - B

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

(a) Three cylinders A, B and C each weighing 100 N and diameter 80 mm are placed in a channel of 180 mm width as shown in **Fig. 1.** Determine the pressure exerted by the cylinder A and B at the point of contact.

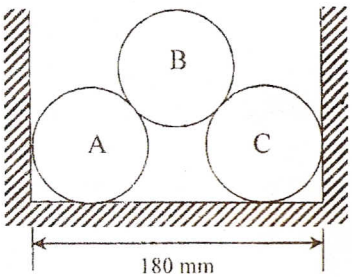

Fig. 1.

(b) Calculate the values of shear force and bending moments for the cantilever beam shown in **Fig. 2**. Also draw the shear force and bending moment diagrams.

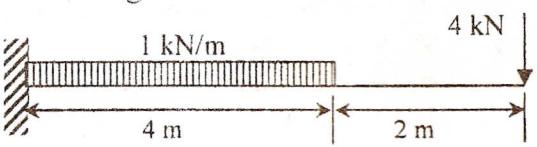

Fig. 2.

(c) For the z-section as shown in **Fig. 3**, the moment of inertia with respect to x and y axes are given as $I_x = 1548\ cm^4$ and $I_y = 2668\ cm^4$. Determine the principal axes of the section about O (centroid of vertical section and point O coincides) and values of the principal moments of inertia.

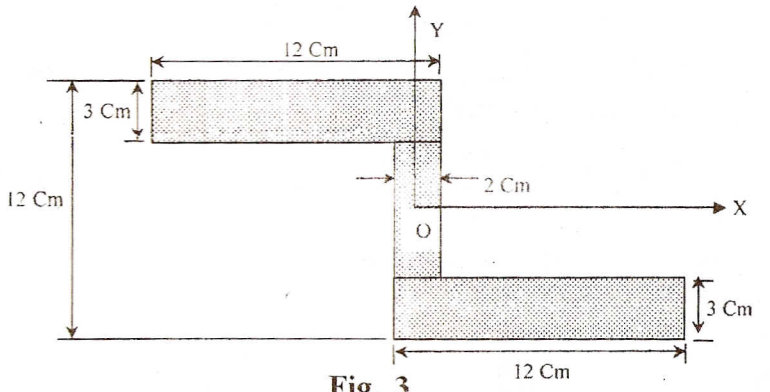

Fig. 3

(d) A horizontal bar 1.5 m long and of small cross-section rotates about vertical axis through one end. It accelerates uniformly from 1200 rpm to 1500 rpm in an interval of 5 seconds. What is the linear velocity at the beginning and end of the interval ? What are the normal and tangential components of acceleration of the mid point of the bar after 5 seconds after the acceleration begins?

(e) A cast iron test beam 20 mm × 20 mm in section and 1 m long and supported at the ends fails when a central load of 640 N is applied. What uniformly distributed load will break a cantilever of the same material 50 mm wide, 100 mm deep and 2 m long?

SECTION - C

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

(a) Explain the theorem of transmissibility of a force. What are its limitations ?

(b) Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between belt and pulley is 0.25, angle of lap 160° and maximum tension in the belt is 2.5 kN.

(c) **Fig. 4** shows a system of levers supporting a load of 500 N. Determine the reactions at the supports A and B.

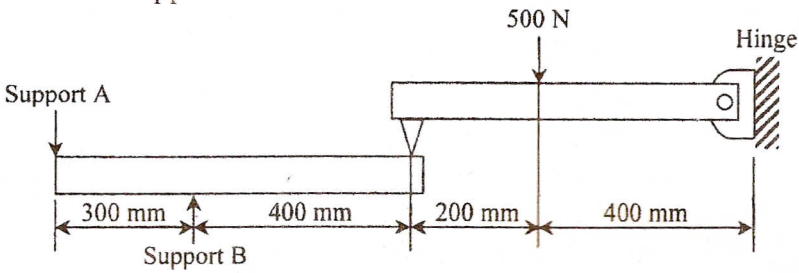

Fig. 4

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

(a) Find the forces in all members of a truss as shown in **Fig. 5** which carries a horizontal load of 12 kN at point D and vertical load of 18 kN at point C.

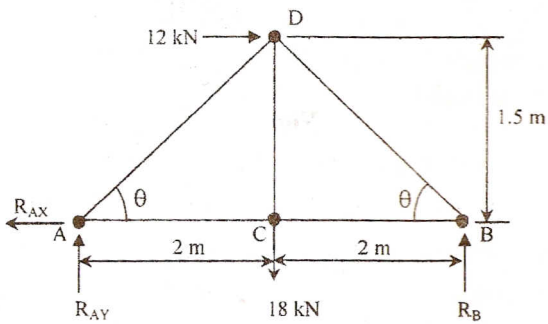

Fig. 5

(b) A beam is loaded as shown in **Fig. 6**. Draw its shear force and bending moment diagram.

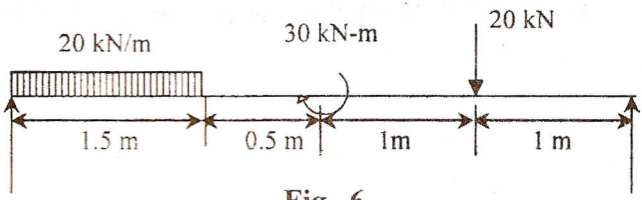

Fig. 6

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

(a) Explain the following :

(i) Product of inertia

(ii) Principal moment of inertia.

(b) A semicircular area is removed from the trapezoid as shown in **Fig. 7**. Determine the centroid of remaining area :

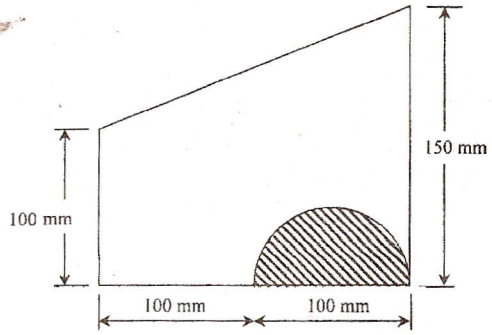

Fig. 7

(c) Derive an expression of mass moment of inertia of a circular lamina about the central axis.

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

(a) A cord is wrapped around a wheel of radius 0.2 m, which is initially at rest as shown in **Fig. 8**. If a force is applied to the cord and gives it an acceleration $a = (4t)\ m/sec^2$, where t is in second. Determine the angular velocity of the wheel and the angular position of line OP both as a function of time.

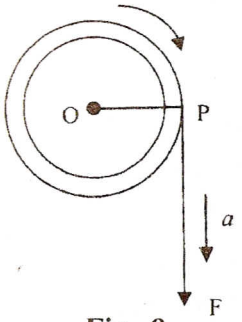

Fig. 8

(b) A road roller has a total mass of 12000 kg. The front roller has a mass of 2000 kg, a radius of gyration of 0.4 m and a diameter of 1.2 m. The rear axle, together with its wheels, has a mass of 2500 kg, a radius of gyration of 0.6 m and a diameter of 1.5 m. Calculate kinetic energy of rotation of the wheels and axles at a speed of 9 km/h and total kinetic energy of road roller.

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

(a) Write the assumptions made in the theory of simple bending.

A beam of I-section is 250 mm deep. The flanges are 15 mm thick, 100 mm wide while the web is 8 mm thick. Compare the flexural strength of this beam section with a rectangular section of the same material and area whose width is two-third depth

(b) Prove that shear stress due to pure torsion is directly proportional to the radius of the shaft. The average torque transmitted by a shaft is 2255 Nm. The maximum torque is 146% of average torque. If the allowable shear stress in the shaft material is 45 N/mm^2, determine the suitable diameter of the shaft.