Printed Pages : 12 EME-202/EME-102

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

PAPER ID : 4303 Roll No. | M | T | | | | | | | | U |

B. Tech.

(Second Semester)Theory Examination, 2010-11

ENGINEERING 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 two forces P and Q acting at a point are represented in magnitude and direction by the two adjacent sides of the parallelogram and θ is the angle between the forces, then :

(i) if $\theta = 90°, R = 2P\cos(\theta/2)$

(ii) if $P = Q, R = 2P\cos(\theta/2)$

(iii) if $\theta = 0°, R = P - Q$

(iv) if $\theta = 180°, R = P + Q$.

(b) The bending equation is :

(i) $\frac{M}{I} = \frac{\sigma}{R} = \frac{E}{y}$

(ii) $\frac{M}{y} = \frac{\sigma}{I} = \frac{E}{R}$

(iii) $\frac{M}{y} = \frac{\sigma}{R} = \frac{E}{I}$

(iv) $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$.

(c) Moment of inertia 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) $\pi d^4/64$.

(d) In UDL loading (w N/m), the maximum bending moment in case of simple supported beam is given as :

(i) wL (ii) $\frac{wL^2}{2}$

(iii) $\frac{wL^2}{4}$ (iv) $\frac{wL^2}{8}$.

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.

(e) In a cantilever beam carrying a concentrated load at the free end, the bending moment will be maximum at ..... and minimum at .....

(f) A body will be in rotational equilibrium if resultant force ..... and resultant moment.....

(g) Theory of simple bending assumes the material of beam to be ..... and perfectly .....

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.

(h) Match the following columns :

Column I	Column II
(i) Principle of superposition	(P) Dynamic equilibrium of particle
(ii) Maxwell theorem	(Q) Principle of moments
(iii) D'Alembert's principle	(R) Sum of deformation in individual section
(iv) Varignon's theorem	(S) Force analysis of trusses

(i) Column II gives the mass moment of inertia of various solids about the central axis. Match the following columns :

Column I	Column II
(i) Cylinder	(P) $2mr^2/3$
(ii) Sphere	(Q) $3mr^2/10$
(iii) Cone	(R) $2mr^2/5$
(iv) Thin spherical shell	(S) $mr^2/2$

(j) Match the following dimensional formula :

Column I	Column II
(i) Work	(P) $ML^{-1}T$
(ii) Power	(Q) $ML^{2}T^{2}$
(iii) Momentum	(R) $ML^{2}T^{3}$
(iv) Pressure	(S) MLT^{-1}

Section-B

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

2. (a) A roller shown in Fig. 1 is of mass 20 kN. What force P is necessary to start the roller over the block *A* and reaction at the contact point *C*.

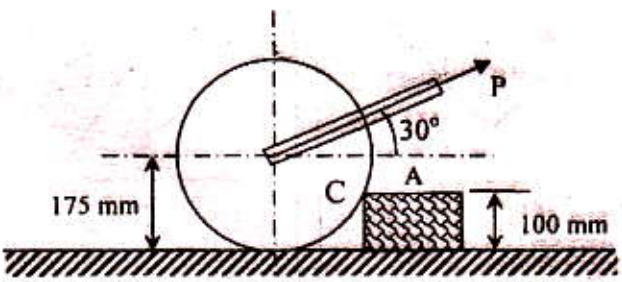

Fig. 1

(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.

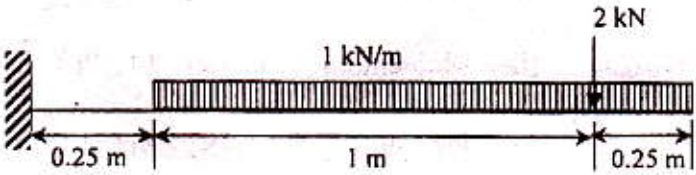

Fig. 2

(c) Calculate the moment of inertia of the composite area shown in Fig. 3 about the centroidal axis.

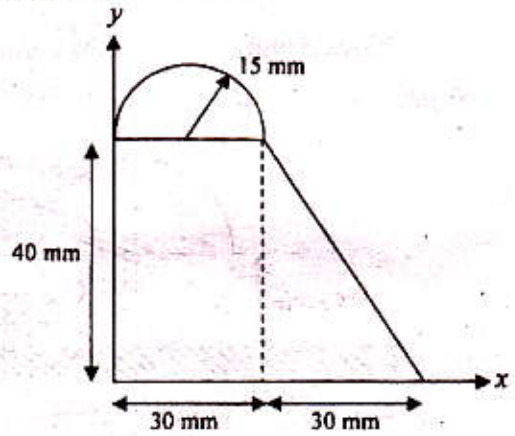

Fig. 3

(d) Two equal weights of 1000 N each are lying on two inclined planes connected by a string passing over a frictionless pulley as shown in Fig. 4. Using D' Alemberts principle, find the acceleration of weights and tension in the string. The coefficient of friction between the plane and weights is 0.2.

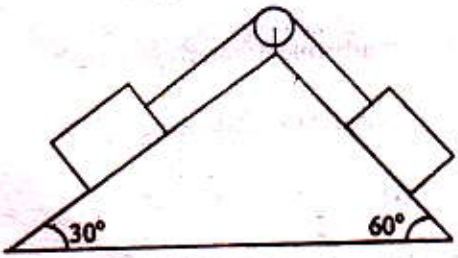

Fig. 4

(e) Three beams have the same length, same allowable stress and the same bending moment. The cross-sections of the beam are square, a rectangle with depth twice the width, and a circle. Find the ratios of weights of rectangular and circular cross-section beams with respect to the square beam.

Section-C

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

(a) Explain the following :

(i) Laws of friction

(ii) Varignon's theorem

(iii) Types of force systems.

(b) What is a free body diagram ? Explain with suitable example. Two smooth balls each of radius 15 cm and weighing 400 N are lying in a vertical cylinder of diameter 50 cm (Figure. 5). Determine the pressure exerted on the balls and base of the cylinder by the balls.

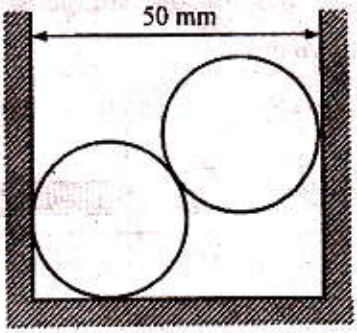

Fig. 5

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

(a) A truss is loaded as shown in Fig. 6. Find the reactions and forces in the members of truss.

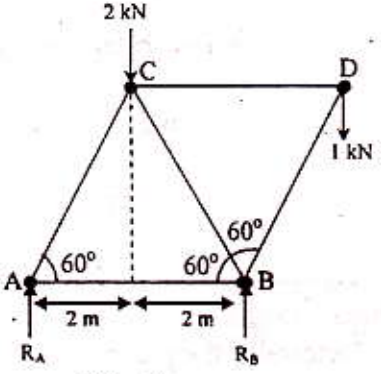

Fig. 6

(b) Draw the shear force and bending moment diagrams for the simple supported beam as shown in Fig. 7.

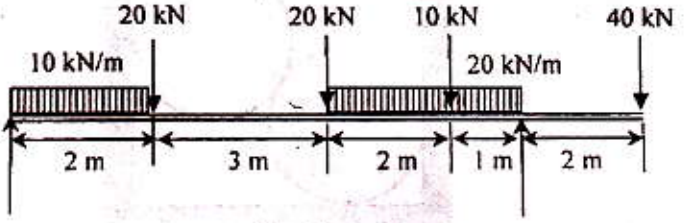

Fig. 7

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

(a) (i) State and prove the theorems of parallel and perpendicular axis with suitable example.

(ii) Derive an expression for the mass moment of inertia of a circular disc of radius R and thickness t about its centroidal axis.

(b) A semicircular area is removed from the trapezoid as shown in Fig.. 8. Determine the centroid of the remaining area.

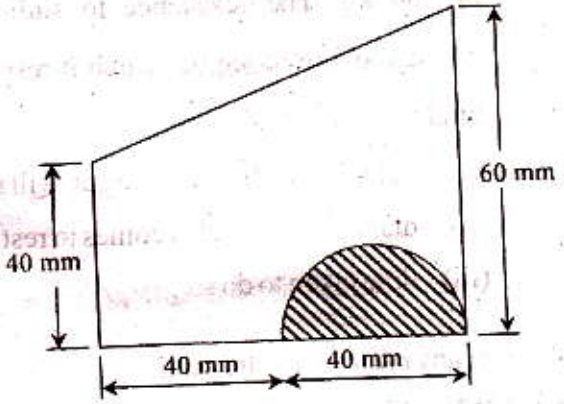

Fig. 8

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

(a) (i) What do you understand by the term kinema- tics ? Explain different types of plane motion of rigid bodies with suitable examples.

(ii) What is energy ? Explain the various forms of mechanical energies.

(b) A bullet of mass 20 g is fired horizontally with a velocity of 300 m/sec., from a gun carried in a carriage; which together with the gun has a mass of 100 kg. The resistance to sliding of the carriage over the ice on which it rests is 20 N. Find :

(i) velocity, with which the gun will recoil

(ii) distance, in which it comes to rest, and

(iii) time taken to do so.

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

(a) What do you understand by the term neutral axis and neutral surface ? A rectangular beam 300 mm deep is simply supported over a span of 4m. Determine the uniformly distributed load per meter, which the beam can carry, if the bending stress does not exceed 120 N/mm^2.

Take $I = 8 \times 10^6 mm^4$.

(b) State the assumptions made in the theory of pure torsion. Derive the torsion formula :

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{l}.$$