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

PAPER ID : 4303 Roll No. | | | | | | | | | | |

# B. Tech.

## (SEM. II) THEORY EXAMINATION 2010-11

## ENGINEERING MECHANICS

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

**Note :** (1) This paper is in three sections. Section A carries 20 marks, Section B carries 30 marks and Section C carries 50 marks.

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

(3) 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 four parts :**

(a) The instantaneous centre of rotation of a body in plane motion :

(i) can exist within the body.

(ii) can exist outside the body.

(iii) can exist anywhere in the space.

(iv) all of the above.

(b) Proof Resilience of a body is the energy stored up to :

(i) Elastic limit

(ii) Proportionality limit

(iii) Ultimate point

(iv) Point of fracture

(c) In the flexure formula $\sigma = \frac{M_y}{I}$, y is the distance of fiber under consideration from :

(i) Neutral axis of beam

(ii) Neutral surface of the beam

(iii) Bottom surface of beam

(iv) Top surface of beam

(d) The gradient of Bending Moment Curve gives the idea about :

(i) Magnitude of loading

(ii) Magnitude of shear force

(iii) Rate of change of shear force

(iv) Rate of change of loading.

**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 belt pulley drive the tight tension side of the drive will act in a direction _____ to the direction of _____ for the belt.



(f) If an area is _____ about an axis its area product of inertia will always be _____ .

(g) Bending moment equation for a linearly varying loading is _____ degree polynomial.

**Choose correct answer for the following three parts :**

(h) A cycle stops when wheels are stopped rolling with the help of brake as :

(A) Rolling of the wheels decreases as the brakes are applied.

(B) Sliding friction is much higher than rolling friction which acts against motion.

(i) Both statement A and statement B are the correct explanation of the phenomena.

(ii) Neither of the statement A and statement B is the correct explanation of the phenomena.

(iii) Statement A is the correct explanation of the phenomena but statement B is incorrect.

(iv) Statement B is the correct explanation of the phenomena but statement A is incorrect.

(i) Assertion (A) : In dealing with the equilibrium of constrained bodies under the action of concurrent forces in one plane, we cannot determine definitely the magnitude of more than two reactive forces and the problem is said to be statically determinate.

Reason (R) : The resolution of a given force into more than two coplanar concurrent components is an indeterminate problem.

(i) A and R are true and R is the correct explanation of A.

(ii) A and R are true but R is not the correct explanation of A.

(iii) A is true and R is false.

(iv) Both A and R are false.

(j) A bullet is fired from a rifle. If the rifle recoils freely, the kinetic energy of the rifle in comparison to that of the bullet

(A) will be less as rifle is heavier than the bullet

(B) will be same because of the law of conservation of energy.

(i) Statement A is true and is a correct explanation of the phenomena.

(ii) Statement B is true and is a correct explanation of the phenomena.

(iii) Neither of the statement A and statement B is true.

(iv) Both the statements are true but they are not correct explanation of the phenomena.

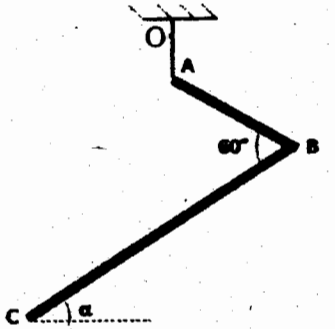
## SECTION—B

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

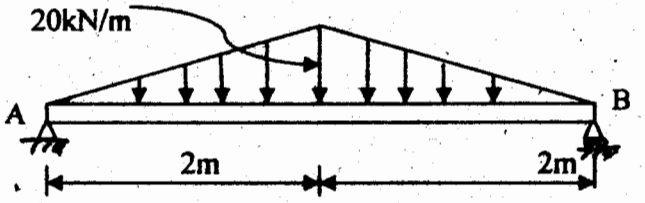
(a) Two prismatic bars AB and BC of length 0.5 m and 1.0 m



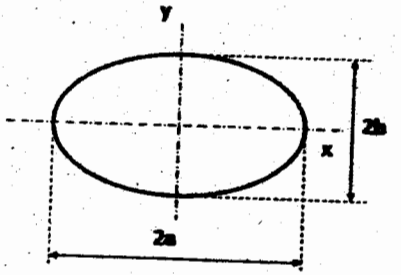
respectively, are joined rigidly at B and suspended by a string OA as shown. Determine the value of $\alpha$ for equilibrium of the arrangement.



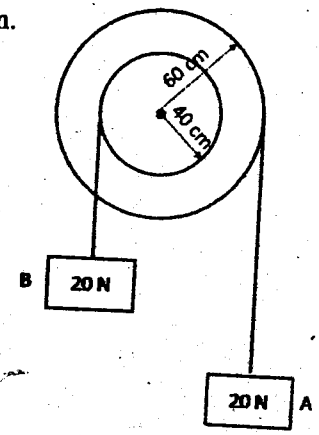

(b) Find the shear force and moment equation for the simply supported beam shown in figure. Also sketch the shear force and bending moment diagram.



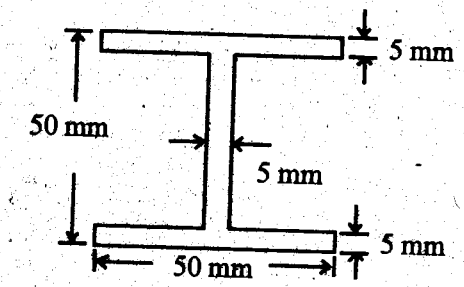

(c) Determine the area moment of inertia of an ellipse about its centroidal axes.



(d) Two weights, each of 20 N, are suspended from a two-step pulley as shown in figure. Find the acceleration of the weight A. The weight of the pulley is 200 N and its radius of gyration is 200 mm.




(e) A simply supported beam of I section (as shown in figure) caries a uniformly distributed load of 50 kN/m over its entire span. If the value of flexural stress is limited to $10^7$ Pa, find the maximum possible length of the beam.



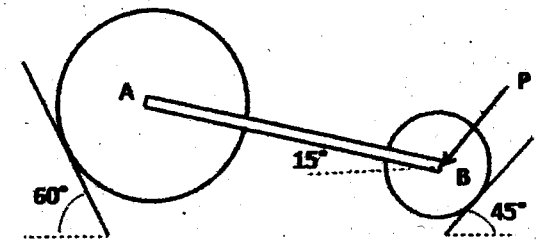

## SECTION—C

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

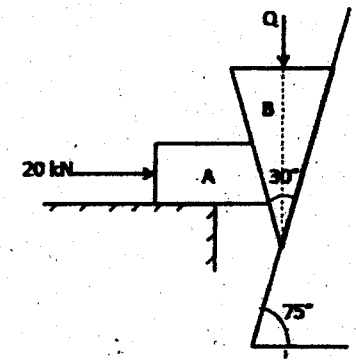
(a) Two cylinders of mass 100 kg and 500 kg are connected by a rigid bar of negligible weight hinged at each cylinder.



Determine the magnitude of force P, acting parallel to the 45° plane, for equilibrium :



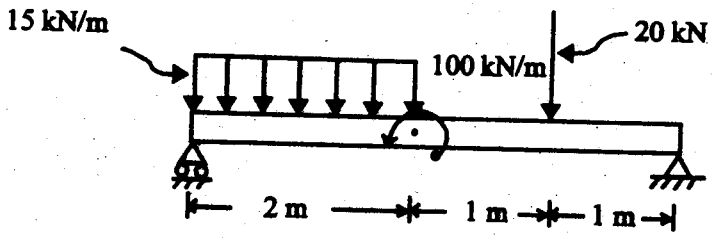

(b) Figure shows a wedge B held between the block A and the surface C. A horizontal push of 20 kN is acting on block A. Find the vertical force Q on the wedge B so as to just move it downward. Assume coefficient of friction as 0.3 for all contact surfaces of contact.




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

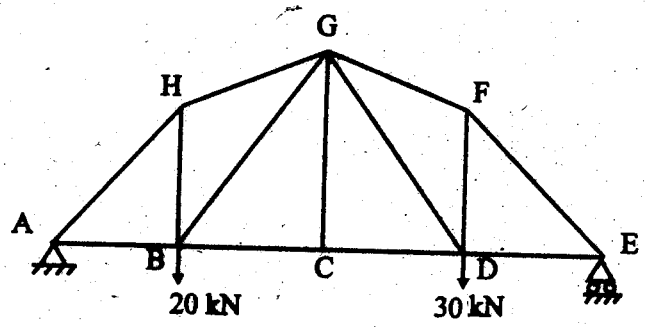
(a) Draw the shear force and bending moment diagram for

the simply supported beam shown in figure.



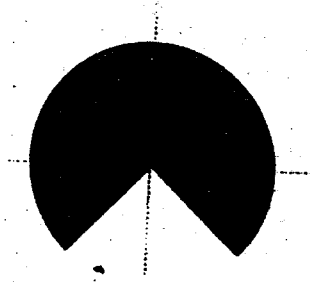

(b) For the truss shown in figure, find the force in the members :

AB = BC = CD = ED = BH = DF = 3 m, CG = 4 m




5. Answer any two parts of the following : (5×2=10)

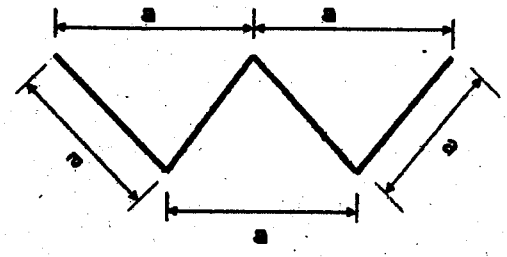
(a) Determine the centroid and moment of inertia of the area shown about centroidal x-axis.





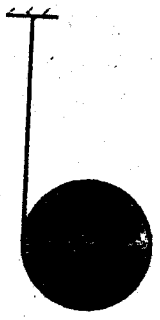
(b) Determine the mass moment of inertia of a solid cylinder of radius R and height h about its longitudinal axis.

(c) Determine the centroid of a thin wire bent in shape of 'W' as shown in figure.



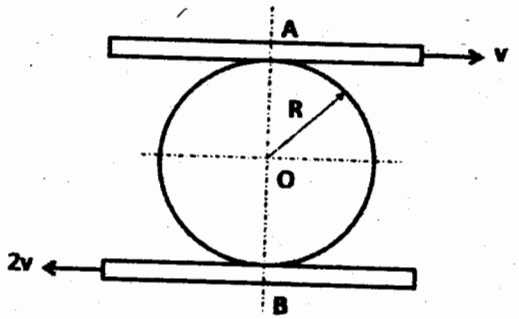

6. Answer any two parts of the following : (5×2=10)

(a) A cylinder of mass 5 kg and radius 50 mm is suspended from a cord that is wound around its circumference. If the cylinder is allowed to fall freely, find acceleration of its mass centre G and tension in the cord.



(b) A disc of radius R rolls without slipping between two plates A and B. If plates are having velocities v and 2v as shown

in figure, determine the angular velocity of disc and velocity of center.



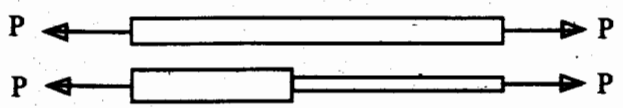

(c) A passenger train passes a certain station at 60 km/h and covers a distance of 20 km with this speed and then stops at the next station 30 km from the first with uniform deceleration. Another train starting from the first station covers the same distance in double this time and stops at the next station. The second train covers a part of the distance with uniform acceleration and remaining distance with uniform deceleration. Determine the maximum speed of local train.

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

(a) A tapered bar whose diameter reduces from $D_1$ to $D_2$ over its length L is subjected to a tensile load P. Derive an expression for elongation of this bar.



(b) A bar of length L and cross sectional area A is subjected to a tensile load P, find the strain energy ($U_0$) stored in the bar due to this load. If the cross sectional area of half of the above bar (length L/2) is doubled (2A) as shown in figure, determine the strain energy in this case in terms of $U_0$.




(c) A hollow shaft having outer diameter 1.2 times inner diameter is to replace a solid shaft transmitting the same power at the same speed. Determine the outer and inner diameters of the hollow shaft in terms of the diameter of solid shaft and percentage saving in the material (by using hollow shaft). Assume that the same material is used in both the cases.