Reg. No. | | | | | | | | | | |

# Question Paper Code: **66236**

**B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2011**
**Regulations 2008**

Second Semester

Common to Civil, Aeronautical, Automobile, Marine, Mechanical, Production, Chemical , Petroleum Engineering and to Biotechnology, Polymer, Textile, Textile(Fashion), Rubber and Plastics Technology

**ME2151 Engineering Mechanics**

Time: Three Hours | Maximum: 100 marks

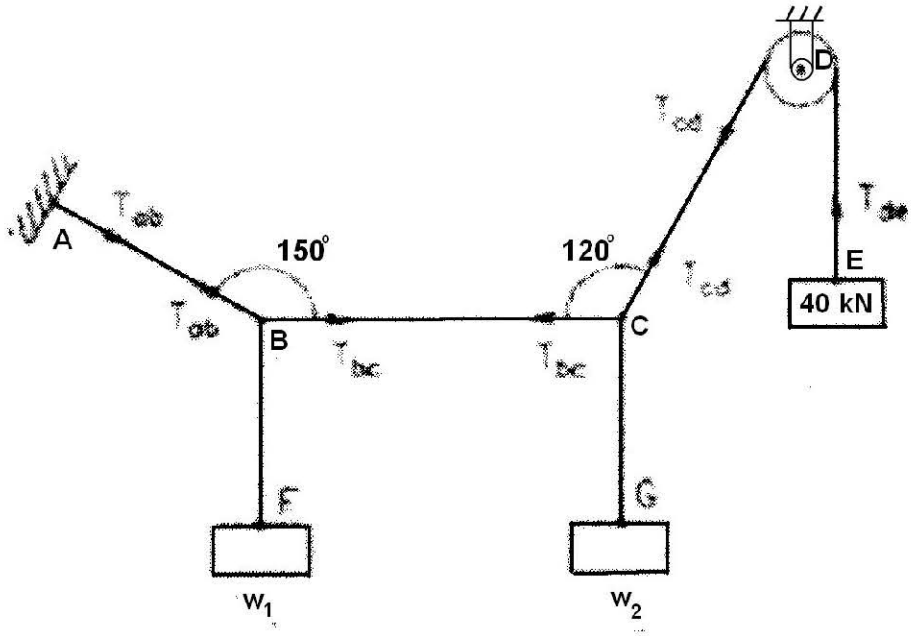
Answer ALL Questions

Part A - (10 x 2 = 20 marks)

1. Define non-coplanar concurrent forces.
2. State the necessary and sufficient conditions for static equilibrium of a particle in two dimensions.
3. List out the steps to be followed to draw the Free Body Diagram of a rigid body.
4. State the necessary and sufficient conditions for equilibrium of rigid bodies in two dimensions.
5. When will the product of inertia of a lamina become zero?
6. Define polar moment of inertia of a lamina.
7. A stone is dropped from the top of a tower. It strikes the ground after four seconds. Find the height of the tower.
8. State the principle of Work and Energy.
9. When do we say that the motion of a body is impending?
10. A rigid body rotates about a fixed axis. Write the expression for angular velocity when the rotation is uniformly accelerated.

Part B - (5 x 16 = 80 marks)

11. (a) ABCDE is a light string whose end A is fixed. The weights $W_1$ and $W_2$ are attached to the string at B and C and the string passes round a small smooth wheel at D carrying a weight 40 kN at the free end E. In the position of equilibrium, BC is horizontal and AB and CD make angles 150° and 120° with horizontal.



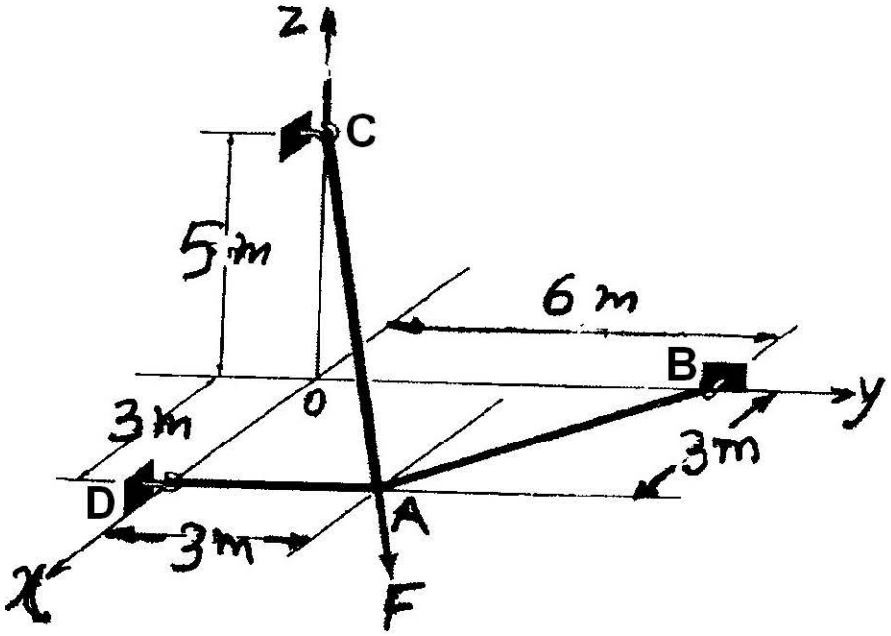

Find (i) the tensions in AB, BC and DE of the given string. (ii) magnitudes of $W_1$ and $W_2$. (16)

OR

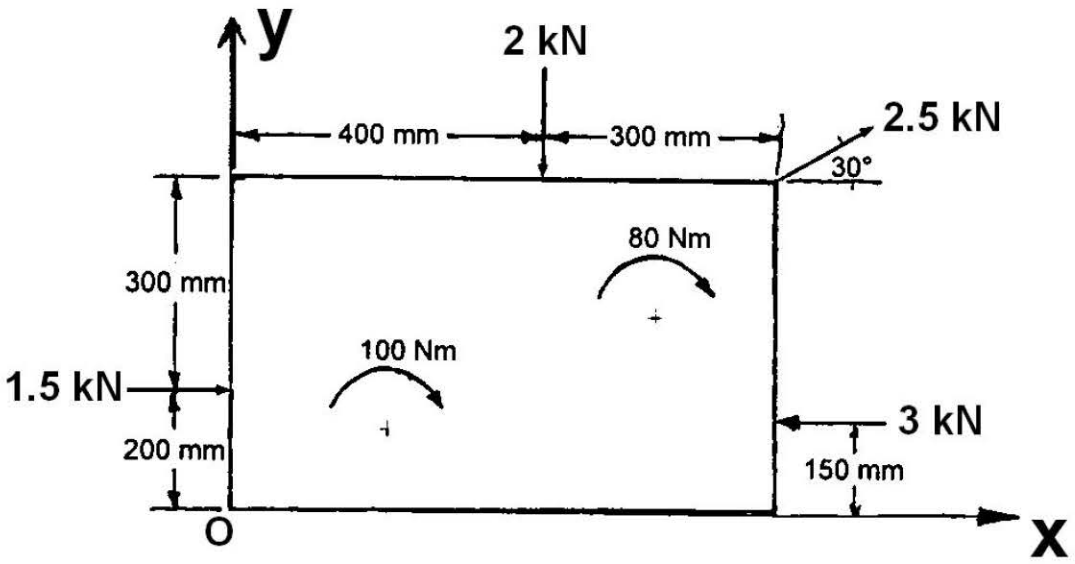
11. (b) Figure shows three cables AB, AC, AD that are used to support the end of a sign which exerts a force of

$$\vec{F} = \{250i + 450j - 150k\}N$$

at A. Determine the force developed in each cable. (16)




12. (a) A force couple system acting on a rectangular plate is shown in figure.

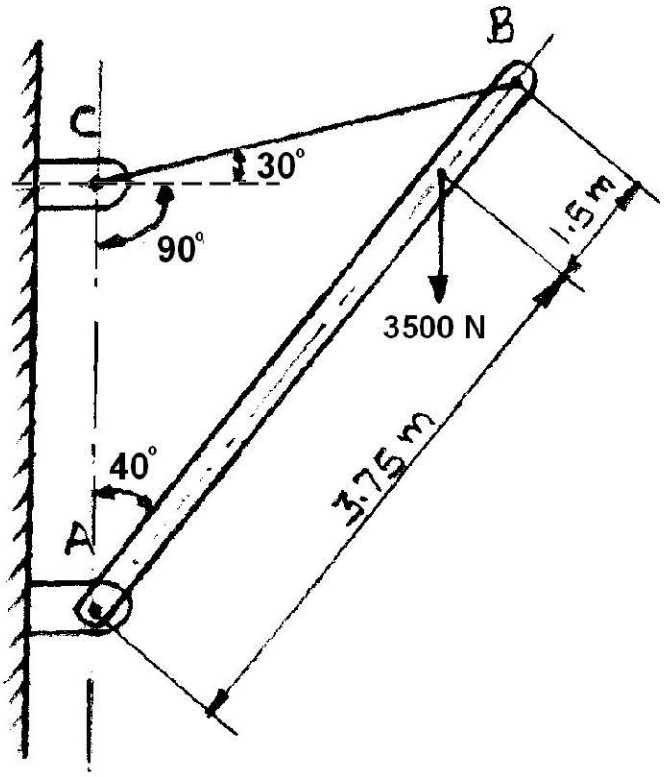



(i) Find the equivalent force-couple system at the origin O. (12)

(ii) Find the single resultant force and its location on the x-axis. (4)

OR

12. (b) A load of 3500 N is acting on the boom, which is held by a cable BC as shown in figure. The weight of the boom can be neglected.

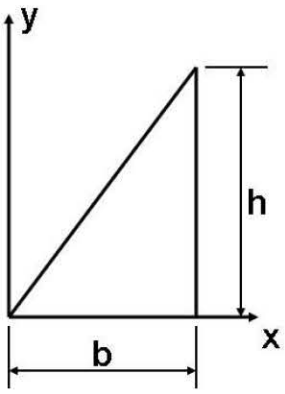



(i) Sketch the free body diagram of the boom. (4)

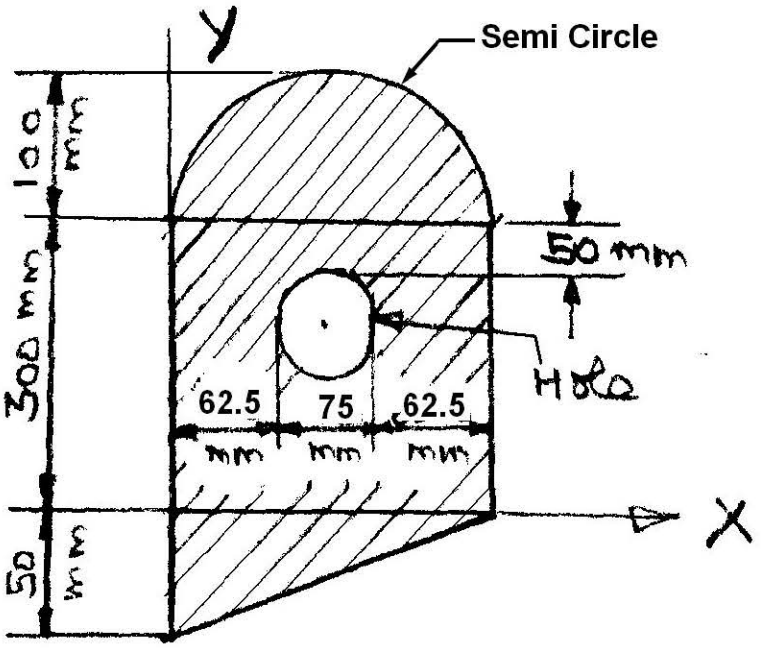
(ii) Determine the tension in the cable BC. (5)

(iii) Find the magnitude and direction of the reaction at A. (7)

13. (a) (i) Derive the expressions for the location of the centroid of a triangular area shown in figure, by direct integration. (6)

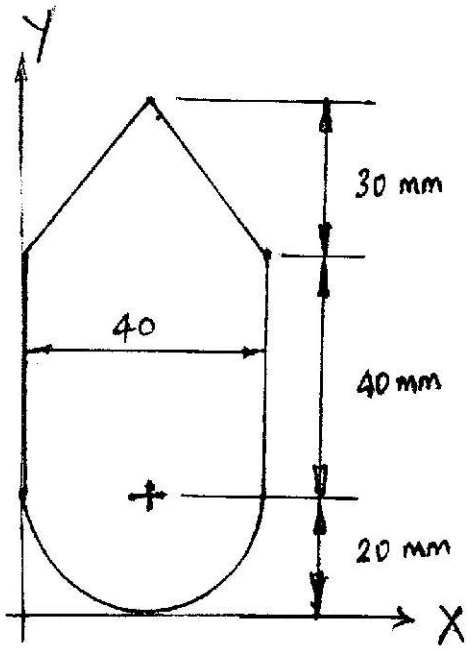



(ii) Locate the centroid of the plane area shown in figure below. (10)




OR

13. (b) Figure shows a composite area.



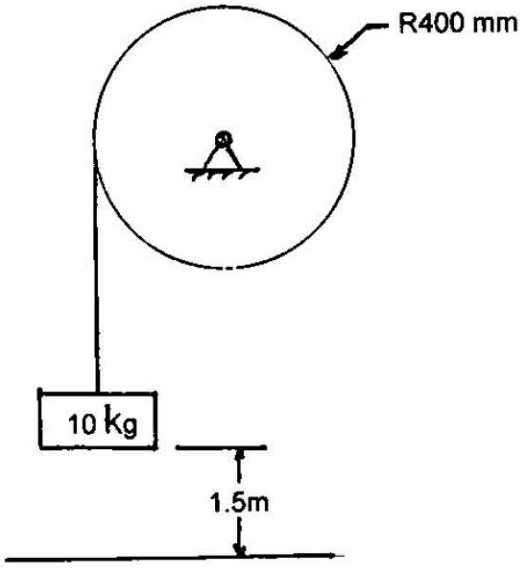

Find the moments of inertia (second moments of area) about both the centroidal axes. (16)

14. (a) Two trains **A** and **B** leave the same station on parallel lines. **A** starts with a uniform acceleration of 0.15 m/s$^2$ and attains the speed of 24 km/hour, after which, its speed

remains constant. **B** leaves 40 seconds later with uniform acceleration of 0.30 m/s$^2$ to attain a maximum speed of 48 km/hour. Its speed also becomes constant thereafter. When will **B** overtake **A**? (16)

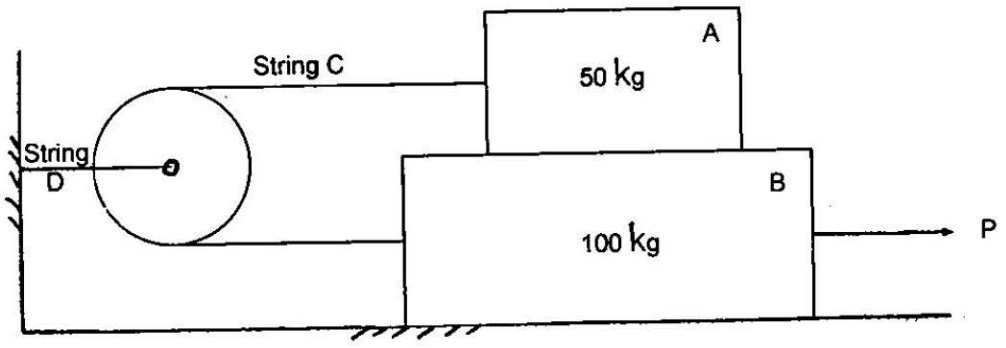
OR

14. (b) The 10 kg block shown in figure hangs from the end of a cable wrapped around the cylindrical drum of radius 400 mm.




The system starts from rest when the block is at 1.5 m above the floor. Determine the mass of the drum which will allow the block to hit the floor at $1/4^{th}$ the speed it would have attained if the block alone were simply dropped from the same height. (16)

15. (a) (i) Two blocks A and B of mass 50 kg and 100 kg respectively are connected by a string C which passes through a frictionless pulley connected with the fixed wall by another string D as shown in figure.

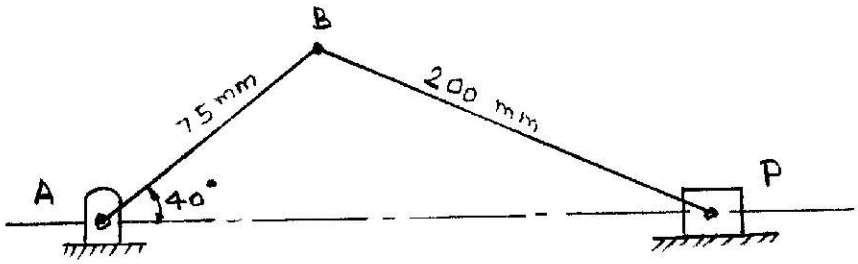



Find the force P required to pull the block B. Also find the tension in the string D. Take coefficient of friction at all contact surfaces as 0.3. (8)

(ii) In a belt drive, the smaller pulley is subjected to a tension $T_1$ on the tight side and a tension $T_2$ on the slack side. Derive a relation between these tensions in terms of the coefficient of friction and the angle of wrap. (8)

OR

15. (b) In the engine system shown in figure, the crank AB has a constant clockwise angular speed of 3000 r.p.m.




For the crank position indicated, find
(i) the angular velocity of the connecting rod BP
(ii) velocity of piston P.

(16)