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B.Tech.

FIRST SEMESTER EXAMINATION 2015-16

EME102

ENGINEERING MECHANICS

Time: 3 Hours **Max. Marks: 100**

Note: Attempts all Questions. All Questions carry equal marks.

1. Attempt **any four parts** of the followings. [4X5]
   a. State triangle law of forces and Lami's theorem.
   b. State and explain the principle of transmissibility of forces. What are its applications?
   c. The resultant of two forces, when they are acting at an angle 60° is 14 N. If the same forces are acting at right angles, their resultant is $\sqrt{136}$ N. Determine the magnitude of the two forces.
   d. For the frame shown in Fig. 1, determine the force supported by the roller at E.

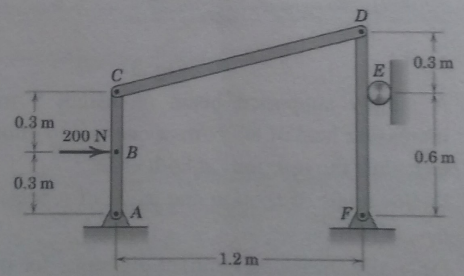

Fig. 1

   e. State the Varignon's principle. Also differentiate between concurrent and non-concurrent forces.
   f. A right circular roller of weight 5000N rest on a smooth inclined plane and is held in position by a cord AC as shown in fig.2. Find the tension in the cord if there is a horizontal force of magnitude 1000N acting at C.

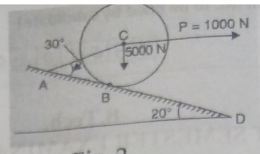

Fig. 2

2. Attempt **any four parts** of the followings. [4X5]
   a. Show that the resultant $R=\sqrt{P^2+Q^2}$ when the two forces P and Q are acting at right angles to each other. Find the value of R if the angle between the forces is zero.
   b. Determine the x and y scalar components of F1, F2, and F3 acting at point A of the bracket.

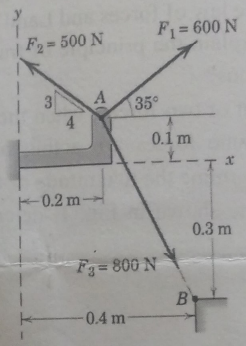

Fig. 3

   c. A simply supported beam of length 5 m carries a uniformly increasing load of 800N/m at one end to 1600N/m at the other end. Calculate the reactions at both ends.
   d. Define angle of friction and angle of repose. Also state Coulomb's law of friction.
   e. Draw the shear and moment diagrams for the diving board shown in Fig. 4, which supports the 80-kg man poised to dive. Specify the bending moment with the maximum magnitude.

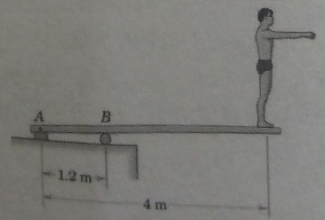

Fig 4.

f. State and prove the parallel axis and perpendicular axis theorems.

3. Attempt **any two parts** of the followings. [2X10]

a. Calculate the member forces (tension or compression) in members **BH, GH** and **BC** of the following truss systems (fig 5). Use method of consistent deformations and standard notations and signs. Take axial rigidity '**AE**' same for all members.

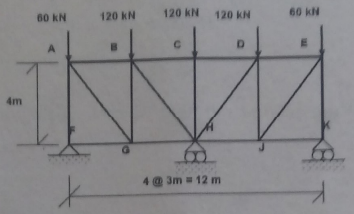

Fig. 5

b. Draw the S.F. and B.M. diagrams for the beam loaded as shown in Fig. 6, and determine (i) the position and magnitude of the maximum B.M., and (ii) the position of any point of contraflexure.

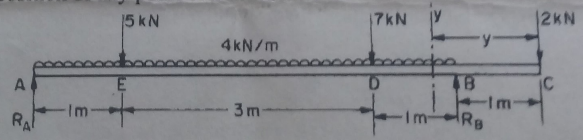

Fig. 6

c. The rotor of an electric motor uniformly accelerates to a speed of 1800 rpm from rest in 5 sec and then the rotor decelerates uniformly to stop. If the total time elapsed from start to stop is 12.3 sec, determine the number of revolutions made while acceleration and deceleration. What would be the reason for the longer time taken during stopping.

4. Attempt any two parts of the followings. [2X10]

a. Locate the centroid of the shaded area shown in fig. 7.

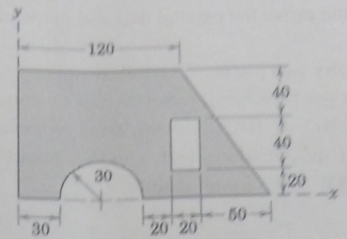

Fig. 7

b. Calculate the second moment of area of the shaded portion as shown in fig. 8.

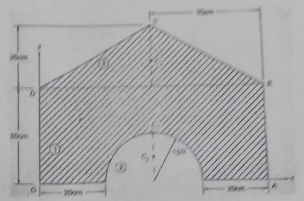

Fig. 8

c. Derive the relation for a circular shaft when subjected to torsion as given below $\frac{T}{J}=\frac{\tau}{R}=\frac{C\theta}{L}$.

5. Attempt **any two parts** of the followings. [2X10]

a. (i) State D'Alembert's principle with its applications.
(ii) Explain the stress strain diagram of mild steel.

b. (i) A rectangular beam 500 mm deep and 75 mm wide is simply supported over a span of 8 m. What uniformly distributed load per meter the beam may carry, if the bending stress is not to exceed 140 N/mm^2.
(ii) A steel bar 20 mm diameter is loaded as shown in fig.9. Determine the stresses in each part.

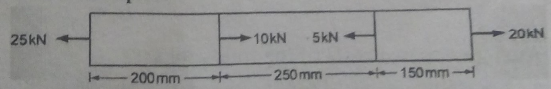

Fig. 9

c. A particle of mass 1 kg moves in a straight line under the influence of a force which increases linearly with time at the rate of 60 N/s. At time t=0, the initial force may be taken as 50N. Determine the acceleration and velocity of the particle 4 sec after it started from rest to the origin.