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Reg. No. : .....

Name : .....

Combined First and Second Semester B.Tech. Degree Examination, March 2018
(2013 Scheme)
13.105 : ENGINEERING MECHANICS (ABCEFHMNPRSTU)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** marks.

1. State and prove Varignon's theorem of moments.
2. Calculate the moment of inertia of a triangle about its centroidal axis.
3. Explain instantaneous centre.
4. A ball collides with another ball having twice its own mass moving with one-seventh of its velocity. If the coefficient of restitution between them is ¾, what is the velocity of the first ball after collision ?
5. Explain with suitable diagram centripetal and centrifugal forces. **(5×4=20 Marks)**

PART – B

Answer **one full** question from **each** Module. **Each** question carries **20** marks.

Module – I

6. A fine light string ABCDE whose extremity A is fixed has weights W1 and W2 attached to it at B and C and passes round a smooth peg at D carrying a weight of 40N at the free end E. If in the position of equilibrium, BC is horizontal and AB and CD makes angles of 150 and 120 respectively with BC, find (1) tension in portions AB, BC, CD and DE of the string, (2) the values of weights W1 and W2 and (3) the pressure on the peg at D. **20**

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7. Two smooth spheres each of radius 200 mm and weight 200 N rest in a horizontal channel of width 720 mm and having vertical walls as shown in Figure 1. Find the pressures at E, F and G. **20**

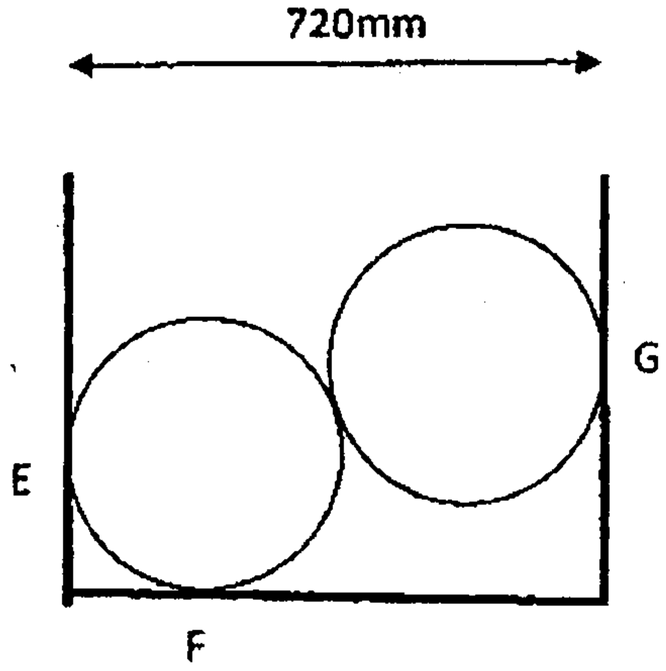

Figure 1

Module – II

8. A uniform ladder of length 15 m rests against a vertical wall making an angle of 60° with horizontal. Coefficient of friction between wall and ladder, and ground and ladder are 0.3 and 0.25. A man weighing 500 N ascends the ladder. How high will he be able to go before the ladder slips ? Find the weight necessary to be put at the bottom of the ladder so as to be just sufficient to permit the man to go to the top. Assume the weight of ladder as 850 N. **20**

9. Two beams AC and CD of lengths 9 m and 10 m respectively are hinged at C. These are supported on rollers at the left and right ends, A and D. A hinged support is provided at B 7m from A. Using principle of virtual work, determine the reactions at the hinge C and the support B when a load of 700 N acts at a point 6 m from D. **20**

Module – III

10. a) To determine the moment of inertia of a wheel about its axis, a string of length 6 m is wrapped round its shaft. The string is pulled with a constant force of 100 N. It is observed that when the string leaves the axle, the wheel is rotating 3 times a second. Calculate the moment of inertia of the wheel. **8**

    b) An archer pulls back his arrow with a force proportional to the displacement and must exert 50 N force to hold the 0.5 kg arrow in position ready to shoot. The string of the bow (assume inextensible) is 5 m long and the centre of the string is pulled back by 1 m. Compute : 1) the potential energy stored in the arrow, 2) the tension in the string and 3) the speed with which the arrow leaves the string. **12**

11. Find the acceleration of each weight in the system shown in Figure 2, if weights of blocks A, B and C are respectively 100 N, 300 N and 200 N. The pulleys are weightless and frictionless. Which block will strike the ground first ? **20**

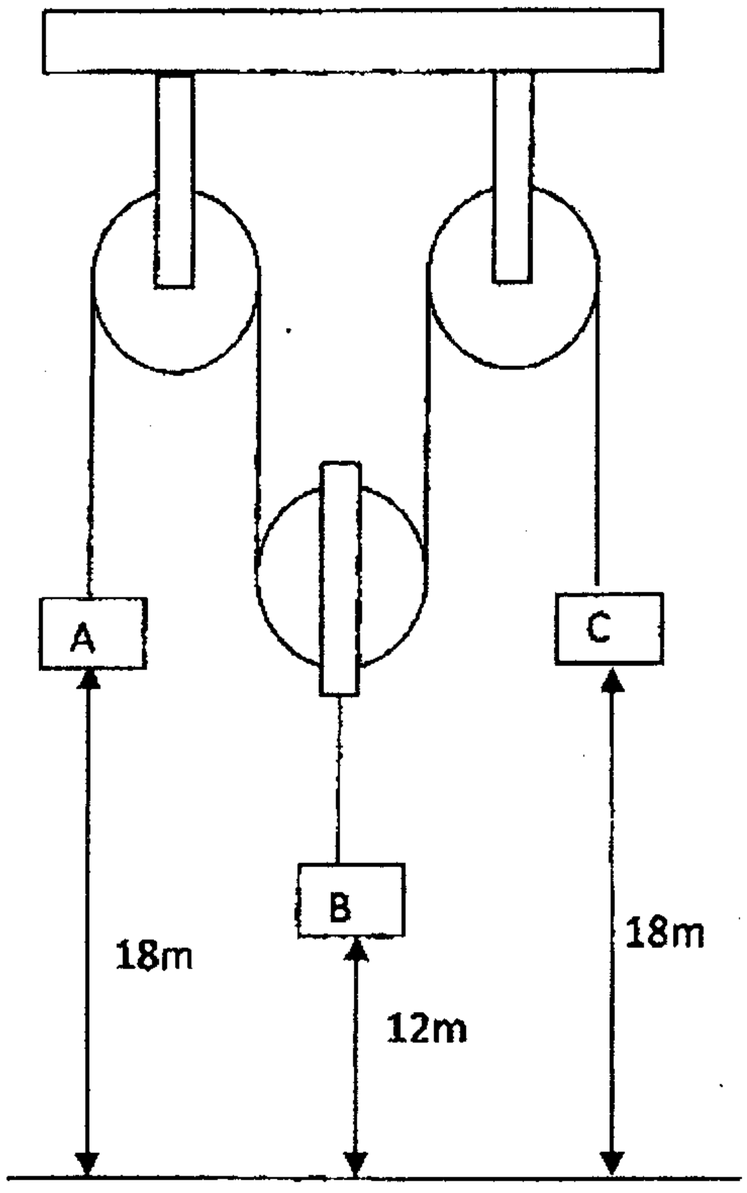

Figure 2

Module – IV

12. An elastic string AB of length 1 m is fixed at A and is such that if a weight of 200 N is attached at B, it will be stretched to double its length. A weight of 50 N is fastened at B. Find the period of oscillation when the weight is pulled down a distance of 0.4 m below its position of rest and released. **20**

13. When a cyclist is riding west at 12 km/h he finds the rain meeting him at an angle of 45° with vertical. When he rides at 8 km/h, he meets the rain at an angle of 30° with vertical. What is the actual velocity (magnitude and direction) of the rain ? **20**