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14CIV13

First Semester B.E. Degree Examination, Dec.2014/Jan.2015
Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least ONE question from each part.***

PART – 1

1 a. Briefly explain the role of civil engineers in the infrastructural development. **(10 Marks)**

b. In the triangle ABC, a force at 'A' produces a clockwise moment of 90 kN-m at B and an anticlockwise moment of 45 kN-m at C. Find the magnitude and direction of the force. **(06 Marks)**

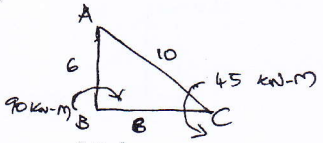

Fig. Q1 (b)

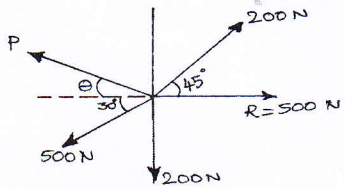

Fig. Q3 (a)

c. Define force and its characteristics. **(04 Marks)**

2 a. Explain the following with neat sketches: i) Principle of superposition of forces. ii) Principle of transmissibility of forces. iii) Couple and its characteristics. **(10 Marks)**

b. Draw typical cross section of a road and explain the parts. **(10 Marks)**

PART – 2

3 a. Four co-planar forces acting at a point are shown in Fig. Q3 (a). One of the forces is unknown and its magnitude is shown by 'P'. The resultant has a magnitude of 500 N and is acting along the x-axis. Determine the unknown force 'P' and its inclination with x-axis. **(08 Marks)**

b. State and prove Varignon's theorem of moments. **(06 Marks)**

c. State and prove parallelogram law of forces. **(06 Marks)**

4 a. Determine the magnitude, direction of the resultant force for the force system as shown in Fig. Q4 (a). Locate the resultant force with respect to point D. **(08 Marks)**

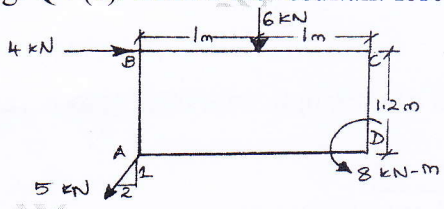

Fig. Q4 (a)

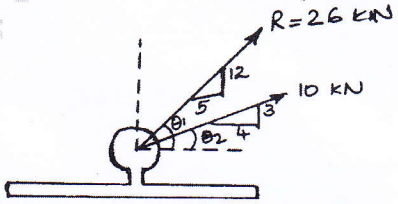

Fig. Q4 (b)

b. 26 kN force is the resultant of the two forces, one of which is as shown in Fig. Q4 (b). Determine the other force. **(08 Marks)**

c. Explain the principle of resolved parts. **(04 Marks)**

PART – 3

5 a. Determine the reactions at contact points for spheres A, B and C as shown in Fig. Q5 (a). It is given that $W_A = W_B = 4$ kN, $W_C = 6$ kN, $d_A = d_B = 500$ mm, $d_C = 800$ mm **(12 Marks)**

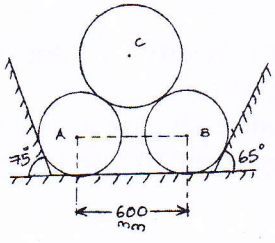

Fig. Q5 (a)

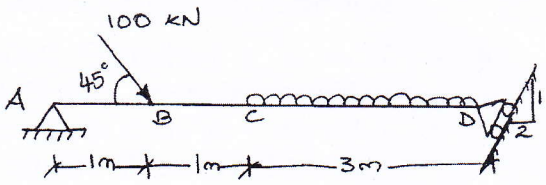

Fig. Q5 (b)

b. For the beam with loading shown in Fig. Q5 (b), determine the reactions at the supports. **(08 Marks)**

6 a. State and prove Lami's theorem. **(08 Marks)**

b. The ladder shown in Fig. Q6 (b) is 4 m long and is supported by a horizontal floor and vertical wall. The co-efficient of friction at the wall is 0.25 and at the floor is 0.50. The weight of the ladder is 200 N, considered concentrated at 'G'. The ladder supports a vertical load of 1000 N at 'C'. Determine the reactions 'A' and 'B' and compute the least value of 'α' at which, the ladder may be placed without slipping. **(08 Marks)**

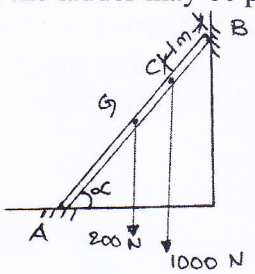

Fig. Q6 (b)

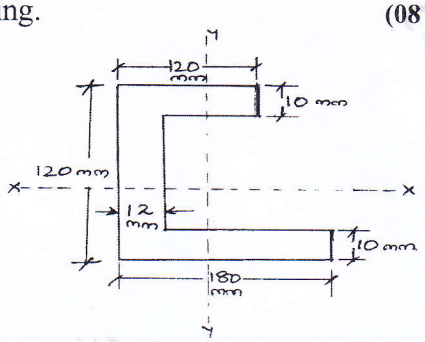

Fig. Q7 (b)

c. State laws of friction. **(04 Marks)**

PART – 4

7 a. Determine the centroid of a semi-circular lamina of radius 'R' by method of integration. **(08 Marks)**

b. Determine the moment of inertia of the section shown in Fig. Q7 (b) about its centroidal axes. Calculate the least radius of gyration for the section as well. **(12 Marks)**

8 a. State and prove parallel axis theorem. **(06 Marks)**

b. Locate the centroid of the shaded area as shown in Fig. Q8 (b). **(08 Marks)**

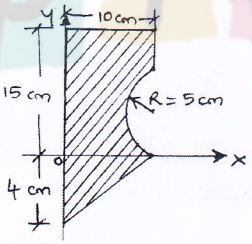

Fig. Q8 (b)

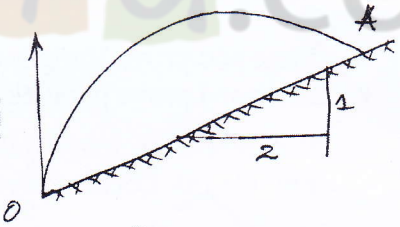

Fig. Q9 (b)

c. Derive an expression for moment of inertia of a triangle with respect to horizontal centroidal axis. **(06 Marks)**

PART – 5

9 a. What is centrifugal force? What is super elevation? **(04 Marks)**

b. Determine the position at which the ball is thrown up the plane will strike the inclined plane as shown in Fig. Q9 (b). The initial velocity is 30 m/s and angle of projection is $\tan^{-1}\left(\frac{4}{3}\right)$ with horizontal. **(08 Marks)**

c. A stone is dropped from the top of the tower 50 m high. At the same time another stone is thrown up from the tower with a velocity of 25 m/s. At what distance from the top and after how much time the two stones cross each other? **(08 Marks)**

10 a. What is a projectile? Define the following terms briefly: i) Angle of projection ii) Horizontal range iii) Vertical height iv) Time of flight. **(10 Marks)**

b. A burglar's car starts at an acceleration of 2 m/s^2. A police vigilant party came after 5 s and continued to chase the burglar's car with a uniform velocity of 20 m/s. Find the time taken in which the police van will overtake the car. **(10 Marks)**

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