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First/Second Semester B.E. Degree Examination, Dec.2016/Jan.2017
Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs.
Max. Marks:100

Note: *Answer FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Choose the correct answers for the following : (04 Marks)
   i) A branch of civil engineering that deals with testing soils and foundation design is called.
       A) structural engineering   B) geotechnical engineering
       C) environmental engineering   D) highway engineering
   ii) Highways which are superior to national highways and are provided wherever volume of traffic is very high are :
       A) airways   B) express ways   C) road ways   D) district roads
   iii) A bascule bridge is a
       A) floating bridge   B) arch bridge   C) suspension bridge   D) movable bridge
   iv) Shoulders are the components of
       A) bridges   B) buildings   C) roads   D) dams.

   b. Write a note on role of civil engineer in infrastructure development of a Nation.   (08 Marks)
   c. Explain any four types of dams with sketches.   (08 Marks)

2 a. Choose the correct answers for the following : (04 Marks)
   i) Forces whose line of action lie along the same line
       A) coplanar non-concurrent   B) coplanar parallel
       C) collinear   D) concurrent
   ii) An object with only mass but no size in mechanics is
       A) rigid body   B) point body   C) particle   D) deformable body
   iii) Effect of a force on a body depends on
       A) direction   B) magnitude   C) position   D) all of these
   iv) The translators effect of a couple on the rigid body is
       A) zero   B) maximum   C) minimum   D) none of these.

   b. State the law of transmissibility of force.   (02 Marks)
   c. A circular disc of radius 1 m is acted upon by four forces as shown in Fig. 2(c). Replace the forces by equivalent force couple system at 0.   (06 Marks)
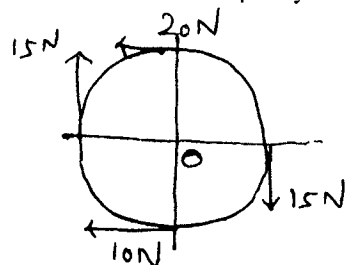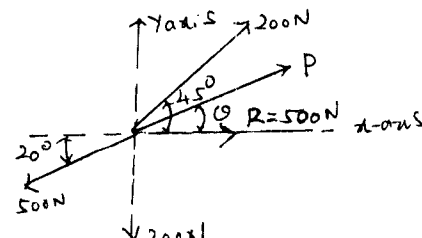

Fig. Q2(c)

Fig. Q2(d)

   d. The four coplanar forces acting at a point are as shown in Fig. Q2(d). One of the forces is unknown and its magnitude is shown by P. The resultant is 500 N and is along x-axis. Determine the forces P and its inclination θ with x-axis.   (08 Marks)

3 a. Choose the correct answers for the following : (04 Marks)
    i) The technique of finding the resultant of a system of forces is called
        A) resultant   B) resolution   C) composition   D) equilibrium
    ii) If two concurrent forces each P act at right angles to each other, their resultant will be equal to
        A) $2\sqrt{P}$ B) $P\sqrt{2}$ C) 4 P   D) P
    iii) Varignon's is theorem is applicable to
        A) only coplanar force system   B) only concurrent force system
        C) only non concurrent force system D) coplanar, concurrent and non-concurrent systems
    iv) In a coplanar concurrent system if $\Sigma H = 0$ then the resultant is
        A) horizontal   B) vertical   C) moment   D) none of these.
  b. State and prove Varignon's theorem of moments. (08 Marks)
  c. Find the magnitude, direction and distance of the resultant from the point A for the system of forces shown in Fig. Q3(c). (08 Marks)

Fig. Q3(c)
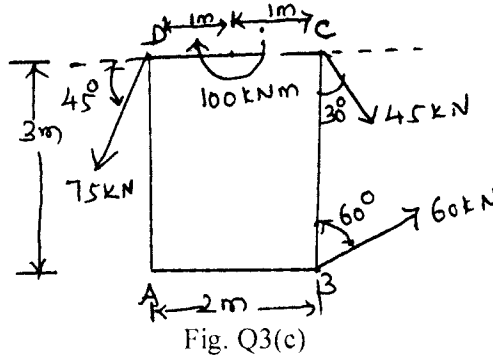
4 a. Choose the correct answers for the following : (04 Marks)
    i) Moment of total area about its cenroidal axis
        A) twice the area   B) three times the area   C) zero   D) none of these
    ii) Centroid of plane is the point at which
        A) weight of the body is concentrated
        B) Mass of the body is concentrated
        C) surface area of the body is concentrated
        D) all of these
    iii) Centroid of a rectangle of base width b and depth d is
        A) b/3 and d/3   B) b/2 and d/2   C) b/4 and d/4   D) none of these
    iv) Centroid of a quarter of a circular lamina lies from diameter line at a distance of
        A) $4R/3\pi$ B) $R\pi/3$ C) $2R/3\pi$ D) none of these.
  b. Show that the centroid of a semi circle is at a distance of $4R/3\pi$ from the diametral axis. (06 Marks)
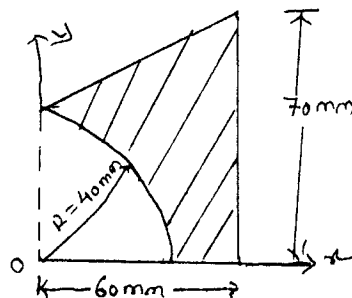 c. Locate the centroid for the Fig.Q4(c) with respect to point 0. (10 Marks)

Fig. Q4(c)

PART – B

5 a. Choose the correct answers for the following : **(04 Marks)**
   i) A free body diagram is a diagram
      A) drawn by free hand
      B) separating the body from its surrounding and replacing with force vector
      C) represents of a floating body
      D) all of these
   ii) If a body is in equilibrium it is concluded that
      A) no force is acting   B) resultant is zero
      C) moment about any pant is zero   D) both B and C
   iii) The Lami's theorem can be applied only when number of unknown forces are
      A) two   B) three   C) five   D) none of these
   iv) The force which is equal and opposite to the resultant is
      A) resultant force   B) force   C) equilibrant   D) none of these.

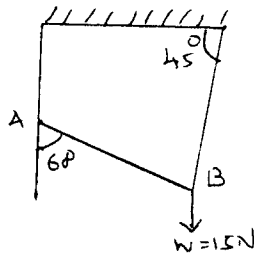**b.** Find the tension in the strings for the Fig. Q5(b). **(06 Marks)**

Fig. Q5(b)   Fig. Q5(c)
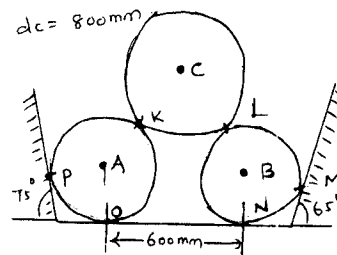
c. Determine the reaction at contact points for spheres A, B and C shown in Fig. Q5(c). Take $W_A = W_B = 4$ kN, $W_C = 6$ kN. $d_A = d_B = 500$ mm, $d_C = 800$ mm. **(10 Marks)**

6 a. Choose the correct answers for the following : **(04 Marks)**
   i) Statically determinate beams are
      A) The beams which can be analyzed completecy, using static equations of equilibrium
      B) the beams which can be analyzed without using static equations of equilibrium
      C) fixed beams
      D) none of these
   ii) Water in a tank is an example of
      A) point load   B) UDL   C) UVL   D) none of these
   iii) Reaction line at roller support with respect to plane of contact is
      A) oblique   B) perpendicular   C) inclined   D) none of these
   iv) At fixed end of cantilever, the number of unknown reaction components are
      A) 1   B) 2   C) 3   D) 4

b. Explain different types of supports with sketches. **(06 Marks)**
c. Determine the support reactions for the beam shown in Fig. 6(c). **(10 Marks)**

Fig. Q6(c)
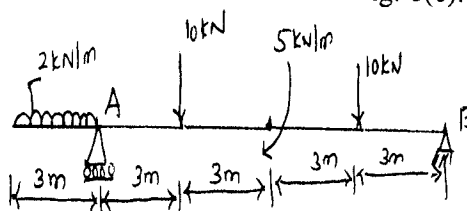
7   a.   Choose the correct answers for the following :   (04 Marks)
         i)   The coefficient of friction depends on
              A) area of contact   B) roughness of contact surface ;
              C) both A and B   D) none of these
         ii) The maximum frictional force developed when the body just begins to slide is called
              A) limiting friction   B) roiling friction   C) static friction   D) none of these
         iii) Angle of friction is angle between
              A) normal reaction and frictional force   B) normal reaction and resultant
              C) weight of the body and friction force   D) normal reaction and weight of the body
         iv) Compared to static friction, dynamic friction is
              A) larger   B) equal   C) smaller   D) none of these
    b.   Explain with sketches : i) cone of friction ii) angle of repose.   (06 Marks)
    c.   An 8 m long uniform ladder weighing 500 N is resting on a rough horizontal floor and
         inclined at angle of 30° with the vertical wall Fig. Q7(c). A man weighing 750 N climbs the
         ladder. At what position will he induce slipping? The coefficient of friction between the
         ladder and the wall is 0.3 and that between the ladder and floor is 0.2.   (10 Marks)
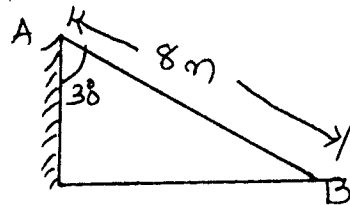

Fig. Q7(c)

8   a.   Choose the correct answers for the following :   (04 Marks)
         i)   The moment of inertia of an area about an axis which is perpendicular to the plane is called
              A) radius of Gyration   B) polar moment of inertia
              C) second moment of area   D) none of the above
         ii) If I_a is moment of inertia of a rectangle about its centriodal axis and I_{AB} is moment of
              inertia about its base, then
              A) $I_G > I_{AB}$ B) $I_G < I_{AB}$ C) $I_G = I_{AB}$ D) none of the above
         iii) Moment of inertia of a square of side 'B' about its centriodal axis is
              A) $B^4/8$ B) $B^4/12$ C) $B^4/36$ D) $B^4/48$
         iv) M.I of hollow circular section whose external diameter is 8 mm and internal diameter is
              4 mm and internal diameter is 4 mm about centriodal axis is
              A) 437.5 mm^4 B) 337.5 mm^4 C) 237.5 mm^4 D) 188.4 mm^4.
    b.   State and prove parallel axis theorem.   (06 Marks)
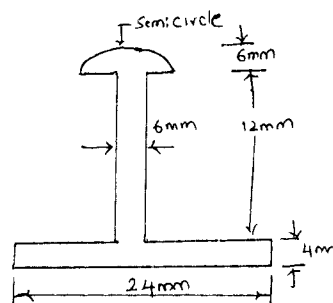   c.   Find the polar radius of gyration for the area shown in Fig.Q8(c) through the centriod. (10 Marks)

Fig. Q8(c)

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