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10CIV13

First Semester B.E. Degree Examination, January 2011
Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, choosing at least two from each part.***
2. ***Answer all objective type questions only on OMR sheet page 5 of the answer booklet.***
3. ***Answer to objective type questions on sheets other than OMR will not be valued.***

PART – A

1 a. Choose the correct answer :

i) Geotechnical engineering involves the study of
A) Water B) Soil C) Air D) All of these.

ii) Shoulders are the components of
A) Roads B) Bridges C) Buildings D) Dams

iii) A bridge constructed at some angle to the river flow is
A) Skew bridge B) Square bridge C) Steel bridge D) Lift bridge

iv) A bascule bridge is a
A) Floating bridge B) Arch bridge C) Suspension bridge D) Movable bridge

(04 Marks)

b. Explain the types of roads as per the Nagpur-road plan. **(06 Marks)**

c. Draw a neat cross-section of the gravity dam and mark important features on it. **(04 Marks)**

d. Explain the following bridges, with neat sketches:
i) Suspension bridge ii) Arch bridge **(06 Marks)**

2 a. Choose the correct answer :

i) Effect of a force on a body depends in
A) Magnitude B) Direction C) Position or line of action D) All of these.

ii) When trying to turn a key into a lock, following is applied.
A) Coplanar forces B) Moment C) Lever D) Couple.

iii) A single force and a couple acting in the same plane upon a rigid body
A) Balance each other B) Can not balance each other
C) Produce moment of a couple D) One equivalent.

iv) Moment of a force
A) occurs about a point B) measures the capacity to do useful work
C)occurs when bodies are in motion D)measures the ability to produce turning about axes

(04 Marks)

b. State the law of transmissibility of force. **(02 Marks)**

c. Differentiate between the resultant and the equilibrant. **(04 Marks)**

d. Determine the angle α for which the moment of the 500 N force shown in Fig.Q2(d), is maximum about 'O'. Also, find the maximum moment. **(10 Marks)**

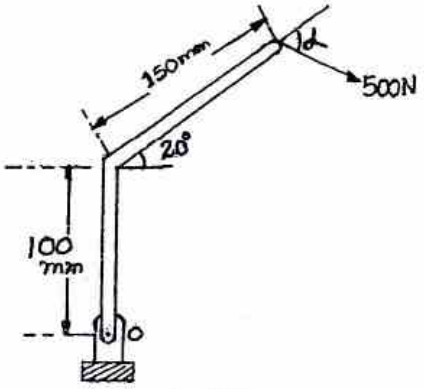

Fig.Q2(d)

3 a. Choose the correct answer :

i) Two forces each equal to P/2 act at right angles. Their effect may be neutralized by the third force, acting along their bisector in the opposite direction, with a magnitude of

A) P B) $\sqrt{2}P$ C) $-P/2$ D) $P/\sqrt{2}$

ii) In a coplanar concurrent forces system, if $\Sigma V = 0$, then the resultant is

A) Horizontal B) Vertical C) Moment D) None of these

iii) The Varignon's theorem is not applicable for the forces, which are

A) coplanar non-cocurrent B) non-coplanar, non-concurrent
C) concurrent D) parallel.

iv) The magnitude of the resultant of two forces of magnitudes P and $\sqrt{2}$ P is "P". Then the angle between the two forces is

A) 135° B) 90° C) 45° D) 30° **(04 Marks)**

b. The sum of the two concurrent forces P and Q is 500 N and their resultant is 400N. If the resultant is perpendicular to "P", find P, Q and the angle between P and Q. **(06 Marks)**

c. The forces acting on 1m length of a dam are shown in Fig.Q3(c). Determine the resultant force acting on the dam. Calculate the point of intersection of the resultant with the base. **(10 Marks)**

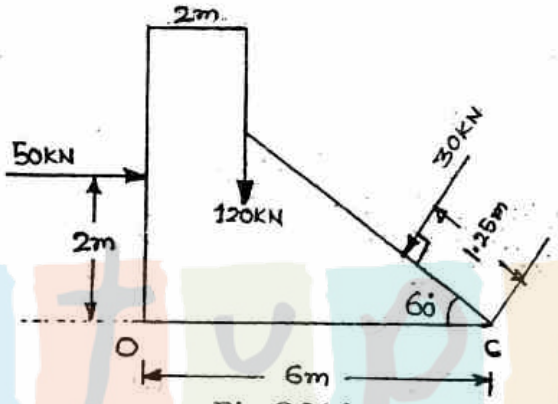

Fig.Q3(c)

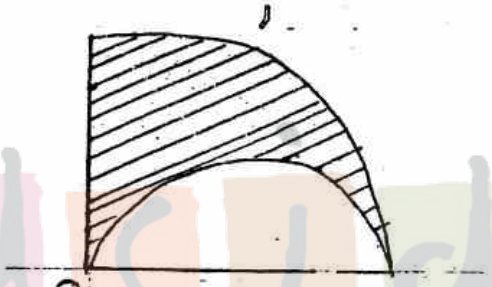

Fig.Q4(c)

4 a. Choose the correct answer :

i) The centre of gravity of a plane lamina will not be its geometrical centre if it is a

A) Square B) Rectangle C) Right angled triangle D) Equilateral triangle

ii) The centroid of an equilateral triangle of side 'a' is ____ from any of the three sides,

A) $\frac{a\sqrt{3}}{2}$ B) $\frac{a\sqrt{2}}{3}$ C) $\frac{a}{2\sqrt{3}}$ D) $\frac{a}{3\sqrt{2}}$

iii) The centroid of a semicircle of radius (r), with respect to its base is

A) $3r/3\pi$ B) $3r/8\pi$ C) $4r/3\pi$ D) $4r/\pi$.

iv) Moment of the total area about its centroidal axis is

A) Twice the area B) Three times the area C) Zero D) None of these. **(04 Marks)**

b. Determine the centroid of a sector of radius r by the method of integration. **(06 Marks)**

c. Find the centroid of the shaded area shown in Fig.Q4(c), obtained by cutting a semicircle of diameter 100m from the quadrant of a circle of radius 100mm. **(10 Marks)**

PART – B

5 a. Choose the correct answer :

i) A free body diagram is a diagram

A) drawn by free hand B) of a body suspended freely in air
C) of a body in vacuum, free from any influence from the surroundings
D) drawn by detaching the body from its attachments with surroundings and replacing the attachments with force vector.

ii) A particle acted upon by the two forces of equal magnitude is in equilibrium. The angle between the forces is

A) 0° B) 90° C) 180° D) 45°

iii) If a body is in equilibrium, it is concluded that
A) no force is acting on the body B) the resultant of all the forces acting on it is zero
C) the moment of the forces about any point is zero D) Both (B) and (C).

iv) Three forces of magnitudes F_1=100N, F_2=100N and $F_3=100\sqrt{3}$ N act on a particle in a plane. The particle remains in equilibrium, only if the angle between F_1 and F_2 is
A) 30° B) 45° C) 60° D) 90° **(04 Marks)**

b. A 3 kN crate is to be supported by a rope and pulley arrangements shown in Fig.Q5(b). Determine the magnitude and direction of the force 'F', which should be exerted at the free end of the rope. **(06 Marks)**

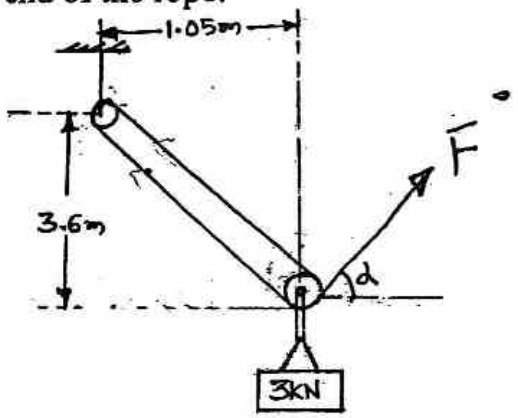

Fig.Q5(b)

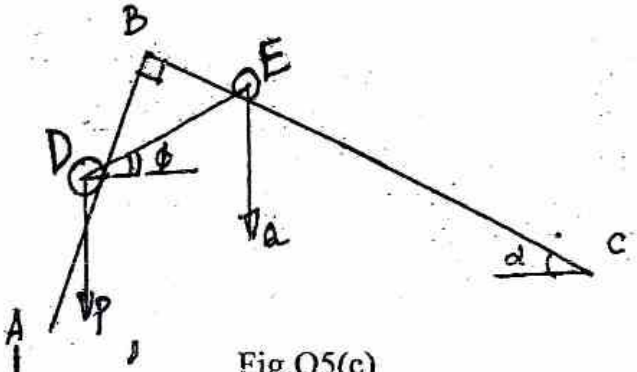

Fig.Q5(c)

c. Two rollers of weights "P" and "Q" are connected by a flexible string DE and rest on two mutually perpendicular planes AB and BC as shown in Fig.Q5(c). Find the tension (T) in the string and angle "ϕ", that it makes, with the horizontal, when system is in equilibrium. Given P = 600N, Q = 1000N, $\alpha = 30°$. Assume that the string is inextensible and passes freely through the slots in the smooth inclined planes AB and BC. **(10 Marks)**

6 a. Choose the correct answer :

i) Fixed beams have
A) one end fixed & other end simply supported B) both ends fixed
C) both ends roller supported D) one end fixed & other end free.

ii) GVL stands for
A) General varying load B) Gradually vertical load
C) Gradually varying load D) General variable load.

iii) A truss is perfect when
A) m = 2J – 3 B) 2J = m + 3 C) m = 3J – 2 D) 2J = m – 3

iv) The minimum number of members to form a perfect truss is
A) 1 B) 2 C) 3 D) 4 **(04 Marks)**

b. Determine the reactions at the supports A and B, for the beam shown in Fig.Q6(b). **(06 Marks)**

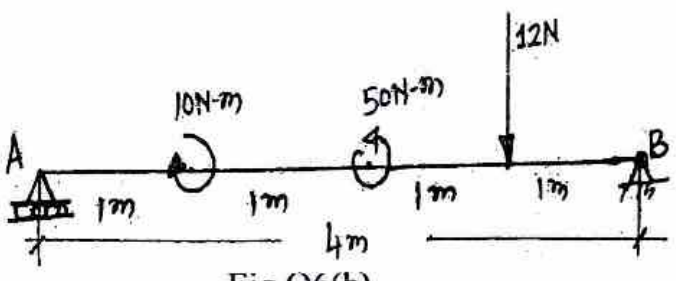

Fig.Q6(b)

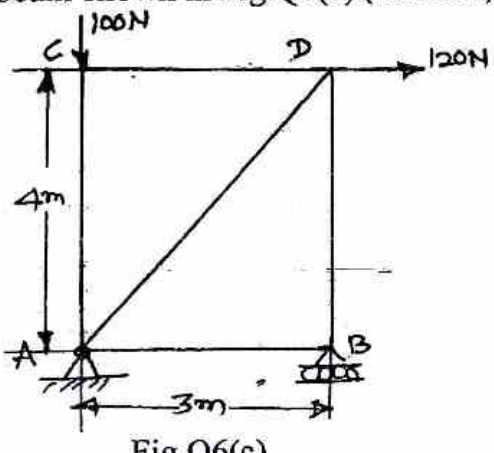

Fig.Q6(c)

c. Find the support reactions and member forces for the pin-jointed plane truss shown in Fig.Q6(c), by method of joints. **(10 Marks)**

7 a. Choose the correct answer :

i) The angle which an inclined surface makes with the horizontal, when a body placed on it is on the point of moving down, is known as,
A) angle of friction B) angle of limiting friction
C) angle of inclination D) angle of repose.

ii) If the angle of friction is zero, a body will experience
A) infinite friction B) zero friction
C) the force of friction normal to the plane
D) the force of friction in the direction of motion.

iii) The coefficient of friction depends on
A) area of contact B) shape of the surface C) strength of the surface D) All of these.

iv) The tangent of the angle of friction is of
A) angle of repose B) coefficient of friction C) cone of friction D) limiting friction.

(04 Marks)

b. i) Define : A) Angle of friction (ϕ), B) Coefficient of friction (μ). **(02 Marks)**

ii) Determine the value of "θ" for impending motion of the blocks. Take coefficient of friction (μ) for all contaet surfaces as 0.25. [Refer Fig.Q7(b)(ii)]. **(06 Marks)**

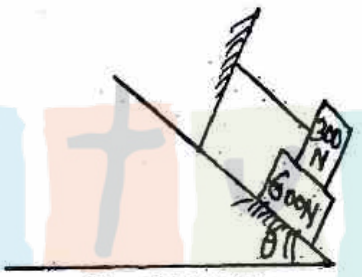

Fig.Q7(b)(ii)

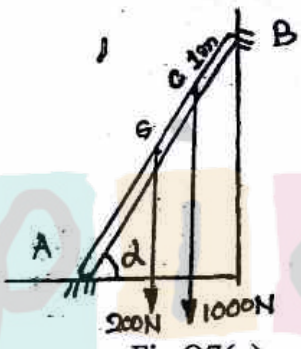

Fig.Q7(c)

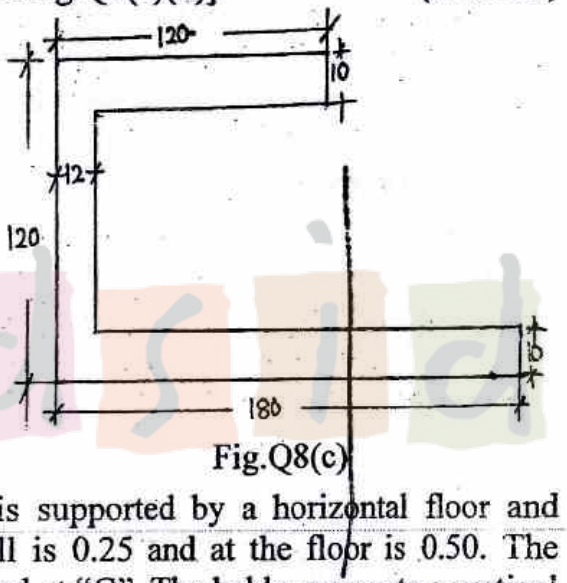

Fig.Q8(c)

c. The ladder shown in Fig.Q7(c), is 4m long and is supported by a horizontal floor and vertical wall. The coefficient 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 1000N at "C". Determine the reactions at A and B and compute the least value of "α" at which, the ladder may be placed without slipping. **(08 Marks)**

8 a. Choose the correct answer :

i) The ratio of the moment of inertia for triangle (b×h) coinciding with its base to a centroidal axis parallel to the base is
A) $bh^3/2$ B) $bh^3/4$ C) $bh^3/8$ D) $bh^3/12$

ii) The radius of gyration of a circular area of radius "r" is
A) r/2 B) r/4 C) 2r/3 D) 3r/4

iii) The unit of moment of inertia of an area is
A) kg.m B) $kg.m^2$ C) $kg.m^4$ D) m^4

iv) If I_G is the moment of inertia of a rectangle about its centroidal axis and I_{AB} is the 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 these. **(04 Marks)**

b. Derive the expression for the moment of inertia of a semicircular lamina of radius (r) about its centroidal axis parallel to the diameter. **(04 Marks)**

c. Determine the radius of gyration about the centroidal axes for the lamina shown in Fig.Q8(c). All dimensions are in mm. **(12 Marks)**

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