

First/Second Semester B.E. Degree Examination, June/July 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 in 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 your answers for the following :
- i) Geotechnical engineering involves the study of
 A) Building B) Soil C) Air D) All the above
 - ii) Building tanks and dams and carrying stored water to field is known as
 A) Structural engineering. B) Environmental engineering.
 C) Water resources and irrigation engg. D) Construction technology.
 - iii) The structure which provides passage over the obstacles like valley, river without closing the way underneath is:
 A) Dam B) Bridge C) Harbour D) Airport
 - iv) Highways which are superior to National Highways and are provided wherever volume of traffic is very high are:
 A) State highways B) High volume roads C) Air ways D) Expressways
 (04 Marks)
- b. Explain briefly the scope of civil engineering in:
 i) Water resources engineering; ii) Geotechnical engineering (10 Marks)
- c. Explain different types of roads. (06 Marks)
- 2 a. Choose your answers for the following :
- i) Which of the following is the basic concept of mechanics?
 A) Charge B) Power C) Force D) Energy
 - ii) When more than three concurrent forces are in equilibrium, select the condition that is satisfied.
 A) All the forces must have equal magnitude.
 B) Polygon representing the forces will not close.
 C) The last side of the polygon will represent the resultant.
 D) Polygon representing the forces will close.
 - iii) Effect of a force on a body depends upon its:
 A) Direction B) Position C) Magnitude D) All the above
 - iv) Forces coexist on a plane and all the forces act helter-skelter over the body. These are
 A) Coplanar non-concurrent forces B) Coplanar concurrent forces
 C) Coplanar parallel forces D) Non-coplanar non-concurrent forces
 (04 Marks)
- b. State and explain basic idealization in mechanics. (06 Marks)
- c. Define a couple. Mention its characteristics. (04 Marks)
- d. A 100N vertical force is applied to the end of a lever which is attached to a shaft as shown in Fig. Q2 (d), determine
- i) The moment of force about O.
 - ii) The horizontal force applied at 'A' which creates same moment about 'O'.
 - iii) The smallest force applied at 'A' which creates same moment about 'O'. (06 Marks)

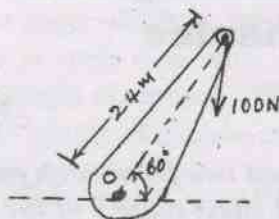


Fig. Q2(d)

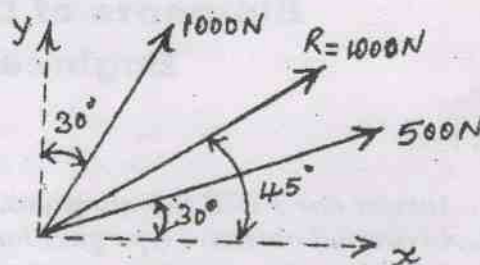


Fig. Q3(c)

- 3 a. Choose your answers for the following :
- If two equal forces of magnitude 'p' act at an angle ' θ ', their resultant will be
 A) $2p \cos \theta/2$ B) $P \tan \theta/2$ C) $2p \sin \theta/2$ D) $p \cos \theta/2$
 - The simplest resultant of a plane force system is always
 A) A single force B) A wrench C) A single moment
 D) A single force or a single moment.
 - The angle between two forces to make their resultant a minimum and a maximum respectively are:
 A) 0° and 90° B) 180° and 90° C) 90° and 180° D) 180° and 0°
 - The moment of a force about any point is numerically equal to times the area of the triangle whose base is the line representing the force and vertex is the point about which the moment is taken.
 A) Half B) Same C) Twice D) Thrice
- b. State and prove Varignon's theorem of moments. (04 Marks)
- c. Two forces acting on a body are 500N and 1000N as shown in Fig. Q3 (c). Determine the third force F such that the resultant of all the three forces is 1000N directed at 45° to the x-axis. (10 Marks)
- (06 Marks)
- 4 a. Choose your answers for the following :
- The first moment of area of a semicircular area about its diameter d is given by
 A) $\frac{d^3}{12}$ B) $\frac{d^3}{24}$ C) $\frac{d^3}{6}$ D) $\frac{d^3}{36}$
 - Centroid of a triangular area of base 'b' and height 'h' taken about an axis coincident with the base is given by
 A) $\frac{bh^3}{12}$ B) $\frac{b^2h}{6}$ C) $\frac{bh^2}{6}$ D) $\frac{h}{3}$
 - Moment of total area about its centroidal axis is
 A) Twice the area B) Three times the area
 C) Zero D) none of the above
 - Centroid conveys some clue about
 A) The orientation of a surface B) Centre of a body
 C) Shape and disposition of the area D) Area of cross-section
- (04 Marks)
- b. Determine the centroid of semicircle by the method of integration. (06 Marks)
- c. With reference to the co-ordinate axis x and y, locate the centroid of the area shown in Fig. Q4 (c). (10 Marks)

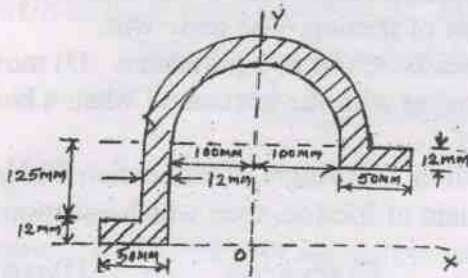


Fig. Q4(c)

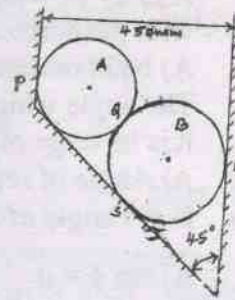


Fig. Q5(c)

PART - B

- 5 a. Choose your answers for the following :
- The force that cancels the effects of the force system acting on the body is known as
A) Resultant B) Neutral force C) Balancing force D) Equilibrant
 - If the sum of all the forces acting on a body is zero it may be concluded that the body
A) Must be in equilibrium B) cannot be in equilibrium
C) May be equilibrium provided the forces are concurrent.
D) May be in equilibrium provided the forces are parallel.
 - For a smooth spherical surface reaction acts
A) Horizontal to the plane of contact B) Inclined to the plane of contact
C) Perpendicular to the plane of contact D) None of the above.
 - A system that possesses a resultant:
A) Will be equilibrium B) Will be under rest
C) Will not be in equilibrium D) None of these
- b. Define free body diagram. Describe types of forces acting on a body. Explain them briefly. (04 Marks)
- c. Cylinder 'A' of diameter 200mm and cylinder B of diameter 300mm are placed in a trough shown in Fig. Q5 (c). If cylinder A weighs 800N and cylinder B weighs 1200N, determine the reactions developed at contact surfaces P, Q, R and S. Assume all contact surfaces are smooth. (06 Marks)
- (10 Marks)
- 6 a. Choose your answers for the following :
- Minimum number of members required to form a simple truss
A) 2 B) 3 C) 4 D) 5
 - In the method of joints for the analysis of forces in the member of truss, the number of equilibrium equations available at each joint are
A) 2 B) 3 C) 4 D) 5
 - For a system of coplanar parallel forces to be in equilibrium
A) The resultant force must vanish alone is sufficient
B) The resultant couple must vanish alone is sufficient
C) Both resultant force and the resultant couple must vanish
D) None of the above
 - The beam is neither permitted to move in any direction nor allowed to rotate in the case of
A) Hinged support B) Fixed support C) Roller support D) Simple support
- b. Briefly explain the method of joints and method of sections used in the analysis of simple trusses. (04 Marks)
- c. Determine the reactions at the support for the beam loaded shown in Fig. Q6(c). (10 Marks)

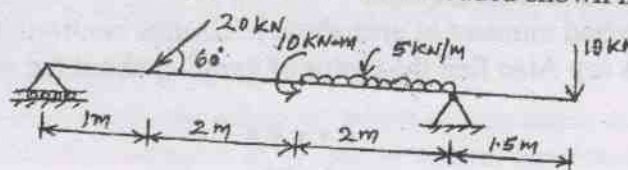


Fig. Q6(c)

7 a. Choose your answers for the following :

- i) A body of weight Q is placed on an inclined rough plane. The inclination of the plane with the horizontal is less than the angle of friction. The body will.
 - A) be in motion
 - B) move downwards
 - C) be in equilibrium
 - D) move upwards
- ii) The angle which an inclined surface makes with the horizontal when a body placed on it is in verge of moving down, is called
 - A) Angle of repose
 - B) Angle of friction
 - C) Angle of inclination
 - D) None
- iii) If ϕ = angle of friction and μ = coefficient of friction, then which equation is valid?
 - A) $\tan \phi = \mu$
 - B) $\tan \phi = \frac{1}{\mu}$
 - C) $\sin \phi = \mu$
 - D) $\cos \phi = \mu$
- iv) Angle of friction is the angle between
 - A) The incline and horizontal
 - B) The normal reaction and frictional force.
 - C) The weight of the body and the friction force.
 - D) Normal reaction and the resultant.

(04 Marks)

b. Explain limiting friction, angle of repose and cone of friction.

(06 Marks)

c. A uniform ladder of 4m length rests against a vertical wall with which it makes an angle of 45° as shown in Fig. Q7 (c). The coefficient of friction between the ladder and the floor is 0.5. If the man whose weight is one-half of that of ladder ascends it, how high will he be when the ladder slips?

(10 Marks)

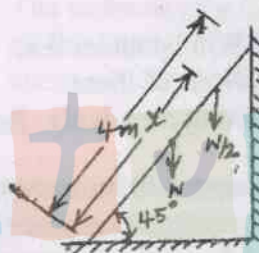


Fig. Q7(c)

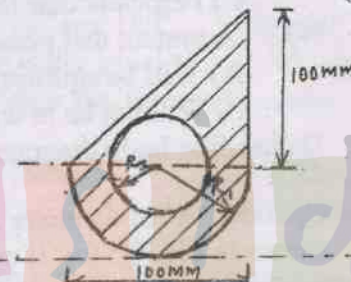


Fig. Q8(c)

8 a. Choose your answers for the following :

- i) The moment of inertia of a body is
 - A) Moment of its inertia
 - B) The rotational moment acting on the body
 - C) The rotational analogue of mass
 - D) The inertial moment acting on the body
- ii) The second moment of a plane area about any axis as compared to its second moment about the neutral axis
 - A) Is always more
 - B) Is always less
 - C) Is equal
 - D) Not equal
- iii) Moment of inertia of a square of side 'a' about an axis through its centre of gravity is
 - A) $\frac{a^4}{4}$
 - B) $\frac{a^4}{8}$
 - C) $\frac{a^4}{12}$
 - D) $\frac{a^4}{36}$
- iv) The value of moment of inertia depends on
 - A) Type of material
 - B) Weight of material
 - C) Density of material
 - D) Cross-sectional dimensions. (04 Marks)

b. State and prove parallel axis theorem.

(06 Marks)

c. Determine the second moment of area about horizontal centroidal axis for shaded area shown in Fig. Q8 (c). Also find the radius of gyration about the same axis. Take $R_1 = 50\text{mm}$ and $R_2 = 20\text{mm}$.

(10 Marks)
