21314

17204

3 Hours/100 Marks

Seat No. | | | | | | | |

Instructions *: (1)* ***All*** *questions are* ***compulsory****.*

(2) Answer ***each*** *next main question on a* ***new*** *page.*

(3) ***Illustrate*** *your answers with neat sketches* ***wherever*** *necessary.*

(4) Figures to the ***right*** *indicate* ***full*** *marks.*

(5) ***Assume*** *suitable data, if* ***necessary****.*

(6) ***Use*** *of Non-programmable Electronic Pocket Calculator is* ***permissible****.*

(7) Mobile Phone, Pager and any other Electronic Communication devices are ***not*** *permissible in Examination Hall.*

MARKS

1. Attempt **any ten** of the following : **20**

   a) State 'Compound machine' with one example.

   b) Define ideal load.

   c) What is self locking machine ?

   d) Define kinematics.

   e) How is force represented by Bow's notation ?

MARKS

f) State the principle of transmissibility of force.

g) Define funicular polygon.

h) Define equilibrant.

i) State graphical conditions of equilibrium for non-concurrent forces.

j) Define angle of repose.

k) For a worm and worm wheel, the number of teeth on the worm wheel is 78. The diameter of effort wheel is 400 mm and that of load drum is 300 mm. Calculate its velocity ratio.

l) State any two advantages and any two disadvantages of friction.

2. Attempt **any four** of the following : **16**

a) A machine requires an effort of 9 N to lift a load of 45 N. The velocity ratio of machine is 25. Find the load lost due to friction and efficiency of the machine at this load.

b) In a simple axle and wheel, the diameter of wheel is 180 mm and that of axle 30 mm. If the efficiency of the machine is 80%, find the effort required to lift a load of 100 N.

c) In a single purchase crab, number of teeth on pinion and main gear are 25 and 100 respectively. The length of effort handle is 0.5 m and the diameter of the load drum is 0.25 m. A load of 2500 N is lifted by applying an effort of 200 N. Find the efficiency of the machine.

d) Resolve the force 19 MN along 22° and 32° on either side of it.

MARKS

e) A force of 95 kN is acting at point C as shown in Fig. No. 1. Find the moment of this force at point A.

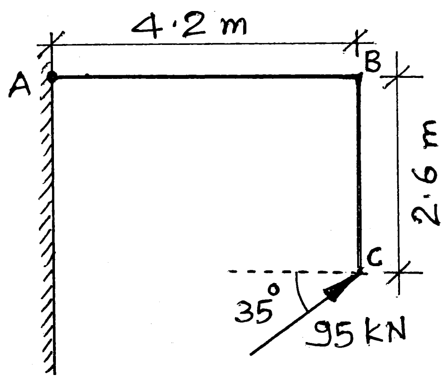

Fig. No. 1 (Q. No. 2. e))

f) State any four properties of a couple.

3. Attempt **any four** of the following : **16**

a) Two forces 120 kN and 400 kN act on a particle and the included angle between their lines of action is 109°. Find their resultant and its angle of inclination with 120 kN force. Use analytical method.

b) Find the resultant of the concurrent force system shown in Fig. No. 2 in magnitude and direction by analytical method.

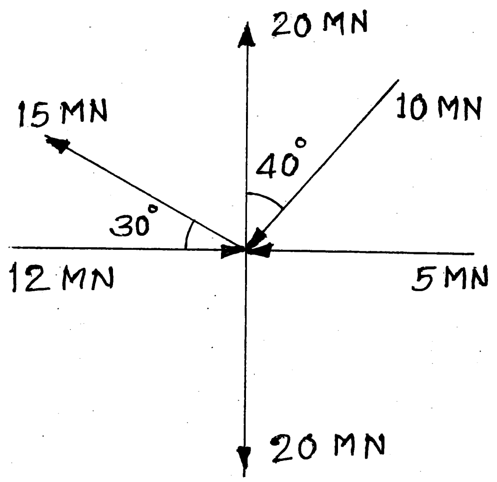

Fig. No. 2 (Q. No. 3. b))

MARKS

c) Four forces of 200 N, 300 N, 400 N and 200 N are acting at an angles of 0°, 90°, 180° and 225° in anticlockwise direction from the x-axis at a point, all acting away from the point. Find the resultant force in magnitude and direction using graphical method only.

d) ABCD is a rectangle such that AB = 3 m and BC = 2 m. Along sides AB, CB, CD and AD, the forces of 100 kN, 200 kN, 250 kN and 150 kN are acting respectively. Find the magnitude, direction and position of the resultant of the forces from C. Use analytical method only.

e) Three parallel forces of magnitude of 50 kN, 100 kN and 200 kN are acting vertically upwards at A, B and C such that AB = 3 m and BC = 4.5 m. Determine the resultant force using graphical method only. Locate it with respect to 100 kN force.

f) Five parallel forces of magnitude 2 MN, 6 MN, 12 MN, 8 MN and 10 MN are acting at 2 m, 4 m, 5 m and 7 m from the first force. Among these forces 1^{st}, 2^{nd} and 5^{th} force are acting upwards while other acting downwards. Find their resultant analytically and locate it with respect to 6 MN force.

4. Attempt **any four** of the following : **16**

a) Find the magnitude of the forces A and B for the force system which is in equilibrium as shown in Fig. No. 3.

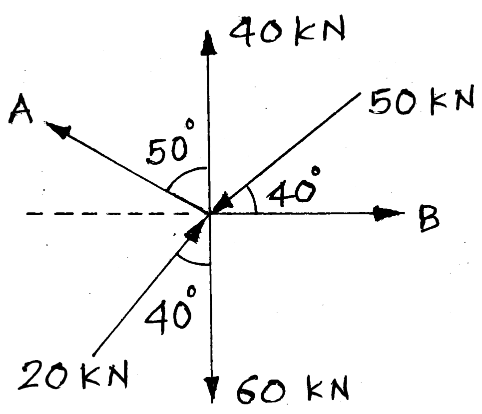

Fig. No. 3 (Q. No. 4. a))

MARKS

b) A sphere weighing 100 kN is resting in a smooth channel. The sides of a channel are inclined at 65° and 78° to the horizontal. Find the reactions offered by the channel surfaces at contact points.

c) A simply supported beam of 9 m span has a u.d.l. of 19 kN/m on 3.5 m length from L.H.S. Three downward point loads of 5 kN, 15 kN and 11 kN are also acting on the beam at 3.5 m, 4.5 m and 7 m from L.H.S. Find the support reactions using analytical method only.

d) Find the reactions at roller and hinge supports of a beam loaded as shown in Fig. No. 4. Use graphical method only.

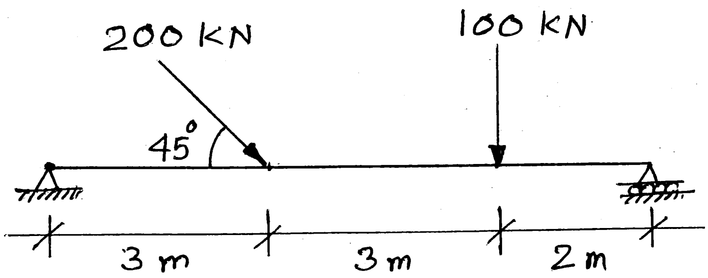

Fig. No. 4 (Q. No. 4. d))

e) A beam ABC is hinged at A and placed on rollers at B such that AB = 6 m and an overhang BC = 2 m. The beam carries a u.d.l. of 1.8 MN/m over its entire length along with downward point loads of 10 MN and 5 MN at point C and at the centre of AB respectively. Using analytical method, find support reactions.

f) Two men carry a weight 670 N by means of ropes fixed to the weight. One rope is inclined at 40° and other at 50° with the vertical. Find the tension in each rope analytically.

Marks

5. Attempt **any four** of the following : **16**

a) A body weighing 25 kN is placed on a horizontal plane for which coefficient of friction is 0.68. Calculate normal reaction, limiting force of friction, horizontal force required to move it and angle of friction.

b) A block weighing 40 kN resting on a rough horizontal plane can be moved by a force of 20 kN applied at an angle of 40° with horizontal. Find coefficient of friction.

c) A body of weight 500 N is placed on an inclined plane at an angle of 22° with the horizontal. If the coefficient of friction is 0.25, find the value of force to be applied parallel to the plane just to move the body up the plane.

d) A heavy stone of mass 450 kg is on a hill slope of 40° incline. If the μ between the ground and the stone is 0.65, is the stone stable ?

e) In a lifting machine a load of 25 kN is lifted by an effort of 250 N. If the efficiency of the machine is 80%, calculate its V.R. If the same machine lifts 10 kN load by an effort of 125 N, find the law of machine.

f) A screw jack lifts a load of 35 kN by an effort of 480 N at the end of a lever arm of 1 m. If the pitch of the screw is 6 mm, calculate the efficiency of the screw jack at this load.

6. Attempt **any four** of the following : **16**

a) Find the centroid of an area which consists of a square and equilateral triangle constructed on it having base of triangle as side of square. The side of square is 2.5 m. The combination is symmetrical about y-y axis.

b) A T-section has a flange 300 mm × 30 mm and a web of 20 mm × 350 mm. Overall depth is 380 mm. Find the position of its centroid and locate it on the sketch.

c) A wall of height 6 m has one side vertical and other inclined. The top thickness is 1 m and bottom thickness is 4 m. Find its centroid.

d) A hemisphere of radius 100 mm is removed from a cube of 400 mm side from the top face of cube. Remainder remains symmetrical about y-y axis. Find the centre of gravity of the remainder. Show it on the sketch.

e) The frustum of a solid cone has a top diameter of 300 mm and that of its base is 450 mm. Locate the c.g. of this frustum of cone, if its height is 650 mm.

f) A solid sphere of 200 mm in diameter is placed on the top of a cylinder 300 mm in diameter and 500 mm high such that their axes concides. Find the c.g. of combination and show it on the sketch.