

17204

15116

3 Hours / 100 Marks

Seat No.

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- 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) What is efficiency of machine?
 - b) Define mechanical advantage along with its expression.
 - c) What is law of machine?
 - d) Enlist four coplaner force system.
 - e) State four effects of forces on rigid body.
 - f) Define resolution of force.
 - g) Define Lami's theorem.
 - h) Define free body diagram with one example.

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- i) Define angle of repose with diagram.
- j) State any two types of beams with diagram of each.
- k) Define polar diagram with one example.
- l) Define centroid and centre of gravity.

2. Attempt any FOUR of the following:

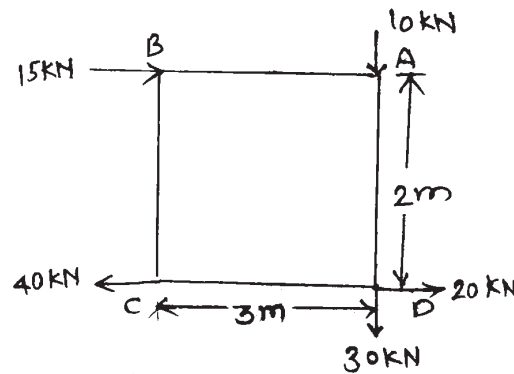
16

- a) For a certain machine the law is $P = (0.08W + 5)$ N. Calculate the effort required to lift a load of 5 kN. Also calculate the maximum M.A. and identify the type of machine V.R. of machine is 20.
- b) In a machine an effort of 2 N lifted a load of 30 N. If the effort lost due to friction is 0.5 N. Find the velocity ratio and efficiency of machine.
- c) A Weston's differential pulley block is used to lift a load of 8 kN. The diameter of pulleys are 26 cm and 24 cm. Calculate the effort required if the efficiency is 45%. Also calculate the load lost in friction.
- d) A geared pulley block is used to lift a load by an effort of 1000 N with 60% efficiency. Calculate the load lifted by the effort:
 - (i) cogs on effort wheel = 120,
 - (ii) cogs on load wheel = 12,
 - (iii) No. of teeth on pinion = 10,
 - (iv) No. of teeth of spur = 20
- e) A screw jack has an effort wheel diameter of 20 cm and pitch is 5 mm. Find velocity ratio. If a load of 1000 N is lifted by an effort of 150 N. Find the efficiency of the machine.
- f) A machine has a V.R. = 50. A load of 3 kN is lifted by an effort of 150 N. Calculate M.A., efficiency and effort lost in friction and ideal effort.

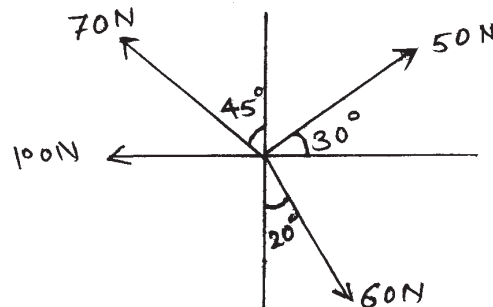
3. Attempt any FOUR of the following:

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- Resolve a force of 12 kN into two directions at 30° and 40° on either side of it.
- Find the orthogonal components of each of the following forces, all acting away from the points:
 - 350 N acting 40° West of South.
 - 400 N acting due South
 - 200 N acting North-East
 - 40 N acting due East
- Calculate the moment about point 'B' for the force system as shown in Figure No. 1.

Fig. No. 1

- Two forces of 12 N and 9 N are acting at a point such that their resultant is 15 N. Find the angle between them. Also find angle between resultant and one of the force.
- Calculate the magnitude and direction of resultant for concurrent force system as shown in Figure No. 2. Use analytical method.

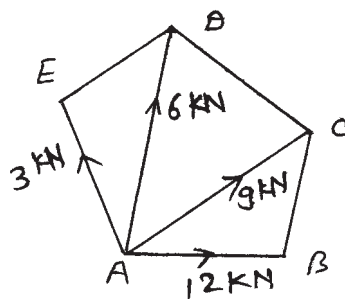
Fig. No. 2

- Four forces of 20 N, 15 N, 30 N and 25 N are acting at 0° , 60° , 90° and 150° from X-axis taken in order. Find resultant by graphical method.

4. Attempt any FOUR of the following:

16

- a) Five parallel forces of 20, 40, 60, 80 and 100 N are acting on beam. Distances of forces from 20 N force are 1 m, 2 m, 3 m and 4 m. Forces of 40 N and 80 N are acting vertically downwards. Other pointing upwards. Find resultant in magnitude and direction and locate it's position with respect to 20 N force.
- b) Forces of 3, 6, 9 and 12 kN respectively acts on a regular pentagon as shown in Figure No. 3. Find the resultant in magnitude and direction. Use analytical method only.

Fig. No. 3

- c) Solve Q 4 (a) graphically.
- d) An electric bulb of 30 N weight is hanging from ceiling. It's wire is pulled by a force acting at 40° to the horizontal such that the wire makes an angle of 60° with the ceiling. Find the magnitude of force and tension in the wire.
- e) A sphere weights 1200 N. It is supported by two planes at 35° and 50° to the horizontal respectively. Calculate the support reactions.
- f) A simply supported beam is of 10 m span. It has a u.d.l. of 25 kN/m throughout it's length and point loads of 80 kN and 120 kN at 3 m and 8 m from left support. Calculate the reactions at support using analytical method.

5. Attempt any FOUR of the following:

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- a) Calculate the reactions of beam at the support as shown in Figure No. 4 using analytical method.

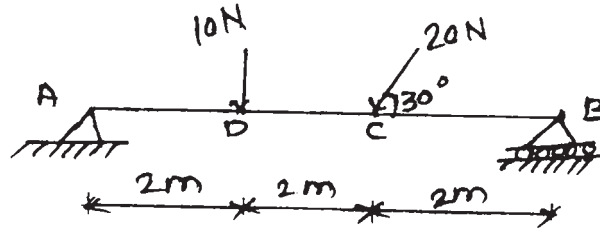


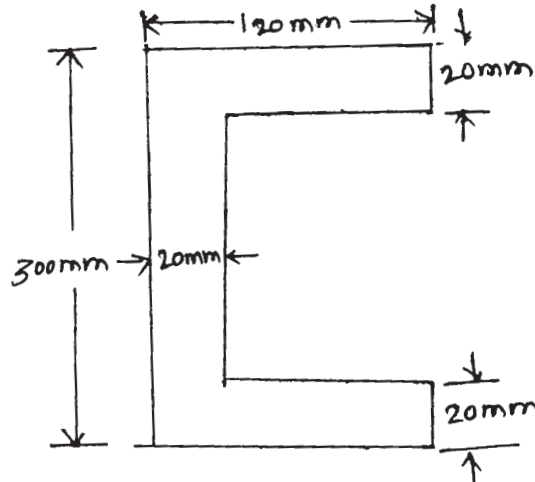
Fig. No. 4

- b) A beam of 6m span simply supported at ends. It carries three loads 12 kN, 18kN, 24kN at 1m, 3m and 4m respectively from left hand support. Calculate reactions at the end of the beam graphically.
- c) A beam ABC is hinged at A and placed rollers at B. The distance between two supports AB is 5m and overhanging BC is 1 m. The beam carries a u.d.l. of 10 kN/m over its entire length along with a point load of 5 kN at C. Calculate support reactions by analytical method.
- d) A block weighing 100 N can be just moved by applying a pull of 'p' N being applied horizontally. Find 'p' if coefficient of friction between block and surface is 0.50.
- e) A body of weight 400 N resting on an inclined plane inclined at an angle of 30° with the horizontal just started to move down the plane. Calculate:
- Coefficient of friction
 - Angle of friction
 - Angle of repose
- f) A body weighing 350 kN is resting on a horizontal plane and can be just moved by a force of 125 kN applied horizontally. Find coefficient of friction. Also find magnitude and direction of resultant reaction.

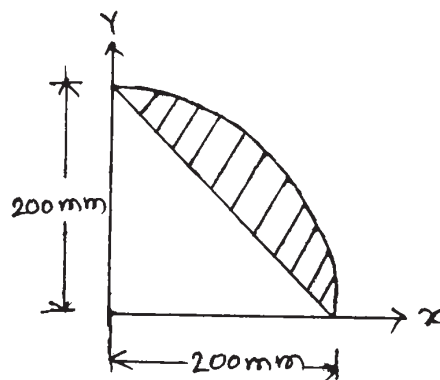
6. Attempt any FOUR of the following:

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- a) Find the centroid for a channel section as shown in Figure No. 5

Fig. No. 5

- b) Find the centroid of an inverted T-section with flange $200 \text{ mm} \times 10 \text{ mm}$ and a web of $300 \text{ mm} \times 10 \text{ mm}$.
- c) Find the centroid of the shaded area of a lamina as shown in Figure No. 6

Fig. No. 6

- d) A right circular cone of 5 cm radius and 50 cm height is placed co-axially on a solid cylinder of 5 cm radius and 100 cm height. Find center of gravity of the composite solid.
- e) A cone has base 120 mm and height 200 mm. In to it a hole of diameter 60 mm is drilled upto a depth of 50 mm. Find center of gravity of remaining volume of cone.
- f) Draw the sketch of solid cylinder and solid cone and show the position of C.G. on it.