11819

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 :   **20**

(a)   Define efficiency of machine.

(b)   Define Reversible & Non-reversible machine with it's condition.

(c)   What is law of machine ?

(d)   State principle of transmissibility of force.

(e)   Define statics & dynamics.

(f)   Define a force & state it's SI unit.

(g)   Explain space diagram & vector diagram.

(h)   Define lami's theorem.

(i)   State different types of beams with sketch.

(j)   Define cone of friction.

(k)   State the factors on which frictional resistance depends.

(l)   State Varignon's theorem of moment.

2.   Attempt any FOUR :   **16**

(a)   In a certain machine a load of 100 N is lifted by an effect of 8 N at an efficiency of 60%. Find effort lost, lost in friction & load lost in friction.

(b)   In a certain lifting machine, the effort has to move through 1 m in order to lift the load through 10 mm. If the efficiency of the machine is 60%, find the load that can be lifted by an effort of 25 N.

(c) A machine lifts a load of 400 N & 600 N by efforts of 60 N & 80 N respectively. Find law of machine & efficiency at a load of 800 N if VR is 22.

(d) A screw jack of pitch 8 mm has a lever of 250 cm length. If the efficiency of the machine is 30%, find the effort required to lift a load of 1500 N.

(e) A single purchase crab has following details –
No. of teeth of spur = 125, No. of teeth on pinion = 25, Dia. of effort wheel = 40 cm & Dia. of load drum = 16 cm. A load of 250 N is lifted by an effort of 32 N. Find efficiency.

(f) In a differential axle & wheel, the dia. of wheel is 40 cm & that of axles are 10 cm & 8 cms. If the efficiency of m/c is 90%, determine the load lifted by an effort of 200 N.

3. **Attempt any FOUR :** 16

(a) Resolve each of the following forces into orthogonal components :
(i) 20 N acting 30° North of East
(ii) 25 N acting due North
(iii) 30 N acting North-West
(iv) 35 N acting 40° South of West

(b) Resolve a force of 100 N into two directions 40° & 50° on either side of it acting on $+^{ve}$ X axis.

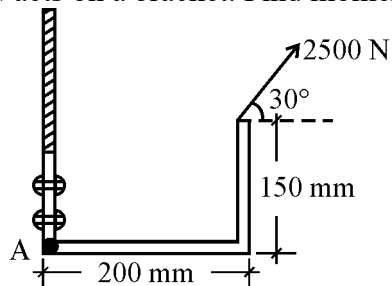(c) A force of 2500 N acts on a bracket. Find moment of this force at 'A' (Fig. 1).

Fig. 1

(d) Find the angle between the two forces of magnitude 120 N each, such that their resultant is 60 N.

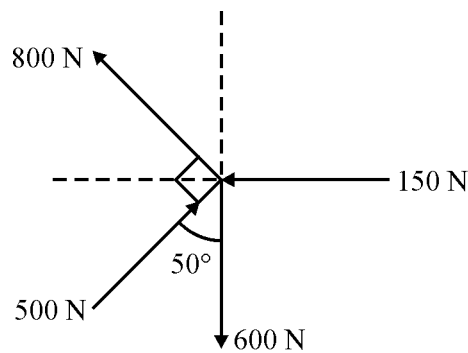(e) Find the resultant of all forces shown in Fig. 2. Mark it's position & direction on sketch.

Fig. 2

(f) Five parallel forces of 10, 20, 30, 50 & 80 kN are acting on a beam. Distances of forces from 10 kN force are 1m, 2m, 3m & 5m. Forces 20 & 50 kN are acting downward & other acting upward. Find resultant in magnitude, direction & position w.r. to 10 kN force graphically.

4. Attempt any FOUR : 16

(a) A sphere weighing 500 N is supported by two planes. One plane is vertical & other is inclined at 60° to the horizontal. Calculate the reactions at the planes.

(b) Two men carry a weight 400 N by means of ropes fixed to the weight. One rope is inclined at 45° & other at 30° with vertical. Find tension in each rope.

(c) 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 magnitude of force & tension in the wire.

(d) A simply supported beam is of 10 m span. It has a udl of 25 kN/m throughout it's length & point loads of 80 kN & 120 kN at 3 m & 8 m from left support. Calculate support reactions by analytical method.

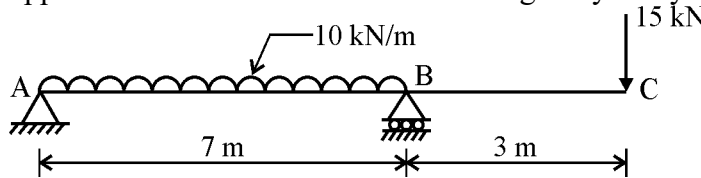(e) Find support reactions for a beam shown in Fig. 3 by analytical method.

Fig. 3

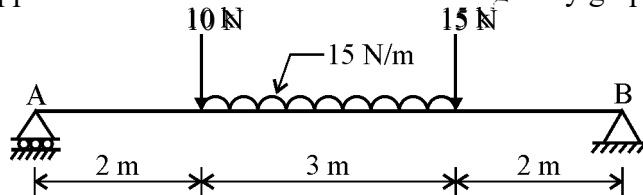(f) Find support reactions for a beam shown in Fig. 4 by graphical method.

Fig. 4

5. Attempt any FOUR : 16

(a) A body weighing 12 kN is lying on a horizontal plane for which μ = 0.70. Determine normal reaction, limiting force of friction, horizontal force required to move it & angle of friction.

(b) A block of 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force at 30° upto the horizontal to just move the block.

(c) A body of weight 400 N is placed on an inclined plane at an angle of 15° with the horizontal. If coefficient of friction is 0.14, find the value of force to be applied parallel to plane just to prevent the body from sliding down.

(d) Find the horizontal force required to drag a body of weight 100 N along a horizontal plane. If the plane is raised gradually upto 15°, the body will begin to slide.

(e) Forces of 1, 2, 3 & 4 kN respectively act at one of the angular points of a regular pentagon towards the other four angular points taken in order. Find the resultant in magnitude & direction.

(f) Determine analytically the resultant of the coplanar parallel forces acting vertically upwards –
   (i) 40 N
   (ii) 20 N at 30 cm
   (iii) 30 N at 50 cm &
   (iv) 60 N at 70 cm. All distances are measured from the first force towards right.

6. **Attempt any FOUR :** 16

   (a) Find centroid of an inverted T-section with flange 60 × 10 mm & web 50 × 10 mm.

   (b) A retaining wall of height 5.2 m has one side vertical. The top width is 0.8 m & bottom width is 3.2 m, find centroid.

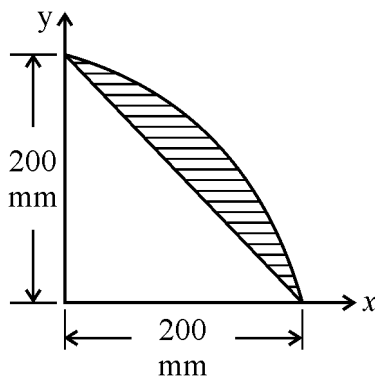   (c) Find the centroid of shaded area of a lamina shown in Fig. 5.

   Fig. 5

   (d) A right circular cone of base diameter 100 mm & height 200 mm is placed on the base of hemisphere of same dia. Find C.G.

   (e) A frustum of a solid circular cone is of top dia. 30 cm & bottom dia. 60 cm of height 50 cm. Find C.G. of the frustum.

   (f) Define – Centroid & centre of Gravity. Locate C.G. of a solid cone of height 900 mm & show it on sketch.

   _____