

**1<sup>ST</sup> SEM./ COMMON TO ALL ./ 2023(W) NEW**

**TH-4 Engineering Mechanics**

**Full Marks: 80**

**Time- 3 Hrs**

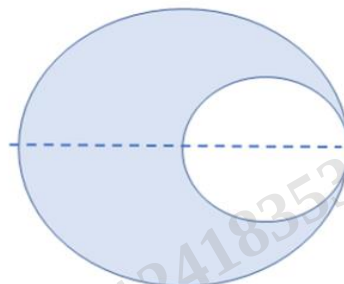
**Answer any five Questions including Q No.1& 2**  
**Figures in the right hand margin indicates marks**

1. Answer **All** questions 2 x 10

- a. What do you mean by coplanar forces?
- b. Define “Friction” and co-efficient of the friction.
- c. State the Perpendicular Axis Theorem.
- d. What is the condition of reversibility of a lifting machine?
- e. State the Newton’s 1<sup>st</sup> law of motion.
- f. Differentiate between couple and moment of a force.
- g. State and explain the Polygon law of forces.
- h. Differentiate between simple gear train and compound gear train.
- i. Define co-efficient of Restitution.
- j. What do you mean by Centroid?

2. Answer **Any Six** Questions 6 x 5

- a. State and prove the Lami’s Theorem.
- b. What are the laws of friction? Explain in details.
- c. In a simple axle and wheel arrangement, radii of effort wheel and axle is 240 mm and 40mm respectively. Find the efficiency of the machine, if a load of 600N can be lifted by an effort of 120N.
- d. A circular hole of 50mm diameter is cut out from a circular plate of 100mm diameter as shown in figure. Find the centroid of the section.



- e. The resultant of two concurrent forces is perpendicular to the smaller force and angle between the forces is 120°. If the bigger force is 60N, find the smaller one.
- f. A bullet of 10gm mass is fired horizontally with a velocity of 1000m/s from a gun of mass 50kg. Find (a) velocity with which the gun will recoil and (b) force necessary to bring the gun to rest in 250mm.
- g. Define simple lifting machine. Explain and establish the relation between efficiency, mechanical advantage and velocity ratio of a simple machine

### Answer Any Three Questions

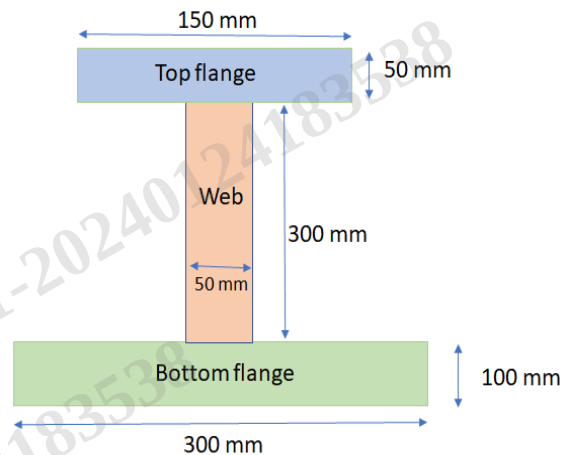
- 3 For a weight lifting machine, an effort of 40N can lift a load of 1kN and an effort of 55N can lift a load of 1.5 kN. Find the law of the machine. Also find maximum mechanical advantage and maximum efficiency of the machine. Take velocity ratio of the machine as 48. 10

- 4 The following forces act at a point 10
- i) 20N inclined at  $30^\circ$  towards north of east
  - ii) 25N towards north
  - iii) 30N towards north-west
  - iv) 35N inclined at  $40^\circ$  towards south of west

Find the magnitude and direction of the resultant force.

- 5 A body of weight 450 N is pulled up an inclined plane by a force of 300N. The inclination of the plane is  $30^\circ$  to the horizontal and the force is applied parallel to the plane. Determine the co-efficient of friction. 10

- 6 Find the moment of inertia of the given figure about the Centroidal YY axis 10



- 7 The value of greatest resultant and least resultant of two forces are 17N and 3N respectively. Determine the resultant force if the angle between the forces is  $120^\circ$ . 10
- 8 Prove that the moment of inertia of a rectangular section having width 'b' and depth 'd' about x-x axis is  $bd^3/12$ . 10