

**B TECH**  
**(SEM I) THEORY EXAMINATION 2017-18**  
**ELEMENTS OF MECHANICAL ENGINEERING**

Time: 3 Hours

Total Marks: 70

**Note:** Attempt all Sections. If require any missing data; then choose suitably.

**SECTION - A**

1. Attempt all questions in brief.

2 x 7 = 14

- a. Differentiate centroid and center of gravity.
- b. Write down the equations of equilibrium for a body subjected to coplanar concurrent force system.
- c. What do you mean by statically determinate beams?
- d. Differentiate perfect and imperfect truss?
- e. Write down the statement of Zeroth law of thermodynamics.
- f. Define the COP of a refrigerator.
- g. What do you mean by dryness fraction?

**SECTION - B**

2. Attempt any three of the following:

7 x 3 = 21

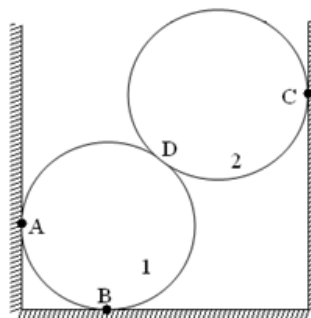
- a. State and prove parallel axis theorem.
- b. Define truss. Write down the assumptions taken while analyzing a truss.
- c. Explain polar modulus and section modulus with the help of suitable example.
- d. Show that energy is a property of the system.
- e. Explain all the processes involved in Rankine cycle with the help of its T-S diagram.

**SECTION - C**

3. Attempt any one part of the following:

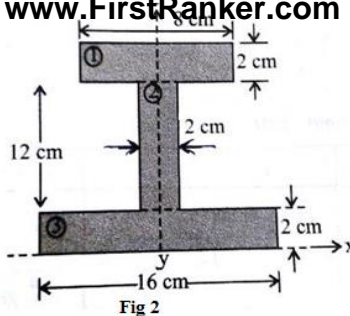
7 x 1 = 7

- (a) Two spheres, each of weight 1000N and of radius 25 cm rest in a horizontal channel of width 90 cm as shown in Fig-1. Find the reaction on the points of contacts A, B and C.



**Fig 1**

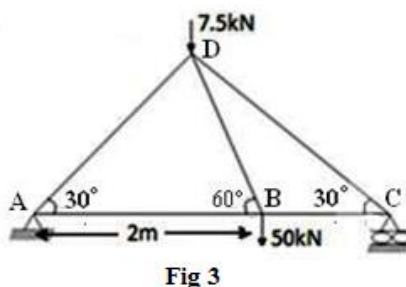
- (b) Find the moment of inertia of I section as shown in Fig2 about its centroidal x and y axes.



4. Attempt any *one* part of the following:

7 x 1 = 7

- (a) Determine the forces in each member of the truss as shown in Fig 3.



- (b) Draw SFD and BMD of the beam as shown in Fig 4.

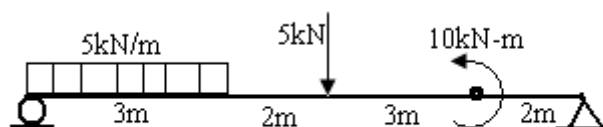


Fig 4

5. Attempt any *one* part of the following:

7 x 1 = 7

- (a) Derive the following equation. Also mention the assumptions made in the derivation.

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

Where M is bending moment, I is moment of inertia,  $\sigma$  is bending stress on a fiber at a distance of y from neutral axis, E is elastic modulus and R is the radius of curvature.

- (b) A solid circular shaft transmits 75 kW power at 180 rpm. Calculate the shaft diameter if the twist in the shaft is not to exceed 1 degree in 2 m length and shear stress is limited to 50 MN/m<sup>2</sup>. Take modulus of rigidity G = 100 GN/m<sup>2</sup>.

6. Attempt any *one* part of the following:

7 x 1 = 7

- (a) Define the following terms-

- Thermodynamic equilibrium
- Quasi static process
- Concept of continuum

- (b) Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kPa pressure and 0.95 m<sup>3</sup>/kg volume, and leaving at 5 m/s, 700 kPa and 0.19 m<sup>3</sup>/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. Compute the rate of shaft work input to the air in kW.

- (a) A domestic food freezer maintains a temperature of  $-15^{\circ}\text{C}$ . The ambient air temperature is  $30^{\circ}\text{C}$ . If heat leaks into the freezer at the continuous rate of 1.75 kJ/s what is the least power necessary to pump this heat out continuously.
- (b) Explain the working of 4 stroke diesel engine with the help of neat and clean diagrams with proper labelling showing all the major components of engine.

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