

**B.TECH
(SEM I) THEORY EXAMINATION 2018-19
ELEMENTS OF MECHANICAL ENGINEERING**

Time: 3 Hours

Total Marks: 70

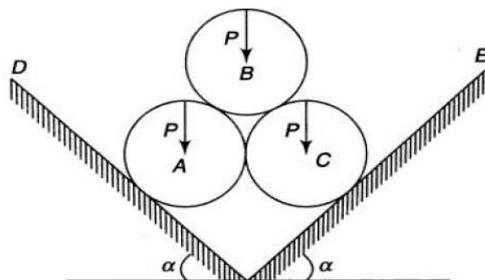
Note: 1. Attempt all Sections.

SECTION A

1. Attempt all questions in brief. 2 x 7 = 14
- a) Explain the term moment and couple of forces.
 - b) What are the assumptions in analysis of truss?
 - c) State parallel axis theorem.
 - d) Define neutral axis and neutral layer.
 - e) State superposition theorem.
 - f) Explain reversible and irreversible process.
 - g) Define second law of thermodynamics with the help of Kelvin Planks and Classius statements.

SECTION B

2. Attempt any three of the following: 7 x 3 = 21
- a) Three smooth right circular cylinders each of radius 'r' and weight 'P' are arranged in smooth inclined surfaces as shown in fig below determine the least value of angle α that will prevent the arrangement from slipping.



- b) Draw the shear force and bending moment diagram for the beam as shown in Figure 2 below. Also find the point of contraflexure if any.

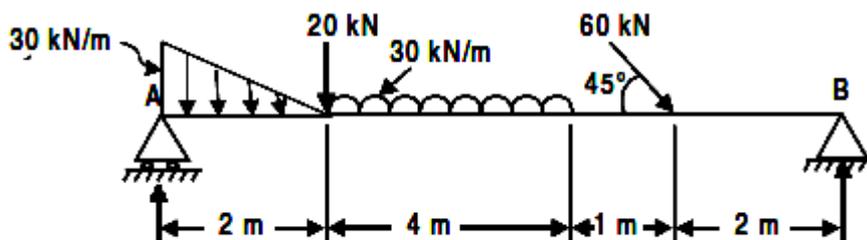


Figure 2

- c) Determine the co-ordinates of centroid of the shaded area shown in figure 3.

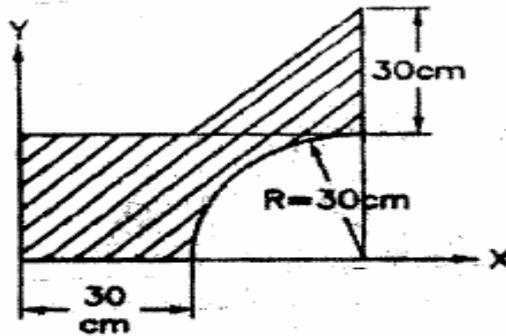


Figure 3

- d) 2.0 m long steel bar is having uniform diameter of 40 mm for a length of 1 m and in the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm as shown in Fig. 4 Determine the elongation of this bar when subjected to an axial tensile load of 200 kN. Given $E = 200 \text{ GN/m}^2$.

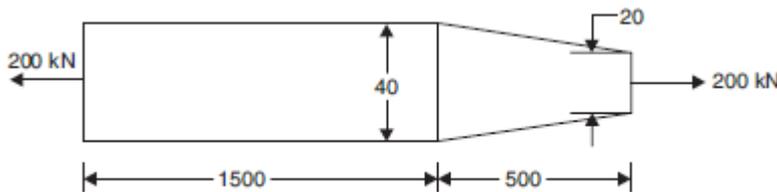


Fig. 8.21

Figure 4

- e) The minimum pressure and temperature in an Otto cycle are 120 kPa and 30°C . The amount of heat added to the air per cycle is 1700 kJ/kg. Determine pressure and temperature at all points. Also calculate efficiency if compression ratio is 8.

SECTION C

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

7 x 1 = 7

- a) Determine the area Moment of inertia and radius of gyration of the shaded area about centroidal X-axis. (figure 5)

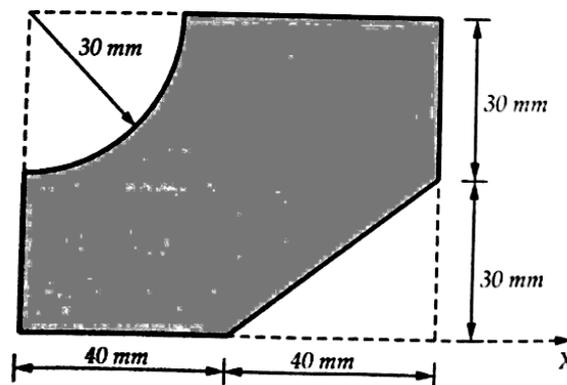


Figure 5

- a) A wire is fixed at two points A & D as shown in following figure 6. Two weights 20 N, 25 N are supported at B & C, respectively, when equilibrium is reached it is found that inclination of AB is 30° and that of CD is 60° to the vertical. Determine the tension in the segments AB, BC and CD of the rope and also the inclination of BC to the vertical

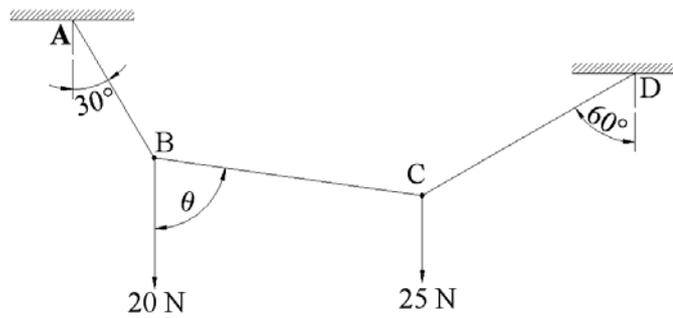


Figure 6

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

7 x 1 = 7

- a) Find the axial forces in all members of the truss as shown in fig.7.

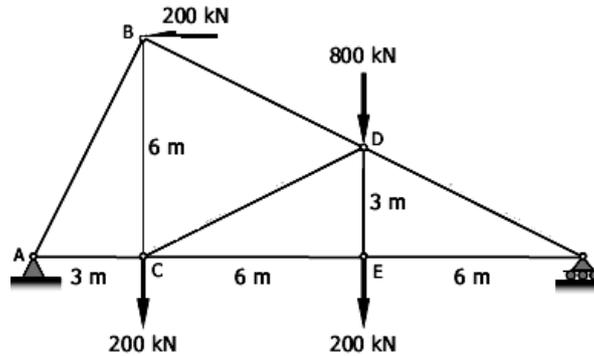


Figure-7

- b) What is steel? Classify it on the basis of percentage of carbon. Write down its applications.

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

7 x 1 = 7

- a) A simply supported rectangular beam with symmetrical section 200 mm in depth has a moment of inertia of $2.5 \times 10^5 \text{ m}^4$ about its neutral axis. Determine the largest span over which the beam would carry a uniformly distributed load of 4 kN/m run such that the stress due to bending does not exceed 125 MN/m^2 .

- b) Write down the assumption taken during SFEE. Also write the SFEE equation for turbine and compressor with neat sketch.

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

7 x 1 = 7

- a) 5 kg/s air fuel mixture enters in a steady flow gas turbine at 45 bar and 1000°C with a velocity of 250 m/s. The mixture leaves the turbine at 2 bar with a velocity of 150 m/s. The turbine is well insulated so that the process may be assumed adiabatic. Calculate the work output of turbine. Assume $C_p = 1.05 \text{ kJ/kg}$, $\gamma = 1.4$ and $R = 300 \text{ Nm/kgK}$.

- b) Determine diesel cycle efficiency with help of P-V and T-S diagram and discuss all processes of cycle.

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

7 x 1 = 7

- a) What is the heat engine and heat pump? The efficiency of a Carnot engine rejecting heat to a cooling pond at 280°C is 30%. If the cooling pond receives 1050 kJ/min. What is the power developed by the cycle in kW. Also find the temperature of source.

- b) Explain the working of two stroke petrol engine with neat sketch and sequence of events.