

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4039 Roll No. **B. Tech.**

(SEM. II) EXAMINATION, 2007-08

MECHANICAL ENGINEERING

Time : 3 Hours]

[Total Marks : 100

- Note :**
- (1) Answer all questions.
 - (2) Use of steam table and Mollier's chart is permitted.
 - (3) Assume missing data suitably if any.

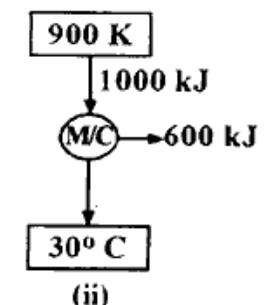
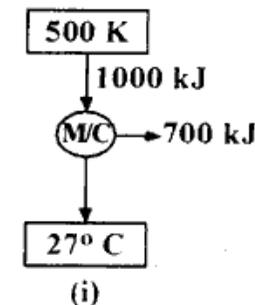
1 Attempt any **four** parts of the following : **4×5=20**

- (a) Explain with examples, what are microscopic and macroscopic point of views to study the subject of thermodynamics.
- (b) How will you define temperature? A metal block of 5 kg and temperature 200°C is submerged into water whose mass is 8 kg and temperature is 30°C. If the specific heat of metal is 0.2 kJ/kgK, what will be the final temperature of the system?
- (c) Air during a reversible process is compressed from initial pressure 12 kN/m² to 6 times the

initial pressure. Due to this compression volume of air decreases from initial volume 4 m³ to 1.8 m³.

Calculate:

- (i) Law of the process
 - (ii) Work done in compressing the air
- (d) Two carnot refrigerators A and B are arranged in series. Obtain the COP of thin composit system in terms of COP of refrigerator A and B only.
 - (e) What is Carnot theorems? What are its different corrolaries? Explain.
 - (f) Block diagrams of two systems are given below : Giving proper reasons indicate



- (i) Name of the system (i.e. HE, RE or HP)
- (ii) Type of cycle is possible or impossible and reversible or inversible.

2 Attempt any **two** parts : 10×2=20

- (a) (i) What are different types of IC engine?
Why the compression ratio in a CI engine is greater than that for a SI engine, explain?
- (ii) Sketch a Carnot cycle for water-steam system. Why is Carnot cycle not used as thermodynamic cycle for the steam power plant?
- (b) In a steam power plant, steam is supplied to the turbine at 36 bar and 410°C. The condenser pressure is 0.075 bar. If the turbine develops a power of 12 MW calculate for a theoretical cycle :
- (i) Mass flow rate of steam
(ii) Heat addition and heat rejection
(iii) Pump work
(iv) Thermal efficiency
- (c) For a diesel cycle following data were observed.
Air inlet pressure and temperature = 1.01 bar and 300 K
Compression ratio = 20
Cut off ratio = 2
Calculate the temperatures at all points of the cycle, net power output and thermal efficiency of the cycle.

3 Attempt any **two** of the following : 10×2=20

- (a) Explain the following :
- (i) General condition of equilibrium of a system of coplanar concurrent forces.
- (ii) Moment of a couple. Show that a force acting at a point is equivalent to a force - couple system at another point.
- (iii) Laws of dry friction.
- (iv) Belt friction and its applications.
- (b) Forces 7, 1, 1 and 3 kN act at one of the angular points of a regular pentagon towards four other angular points taken in order. Obtain the resultant of this force system. What is its direction?
- (c) A block of stone weighing 50 kN rests on a horizontal floor. If the coefficient of friction between floor and block is 0.3 and if a man pulls the block through a string which makes an angle α with the horizontal, find for what value of the force necessary to move the block will be minimum. Find this force also. <https://www.aktuonline.com>

4 Attempt any **two** parts of the following : 10×2=20

- (a) (i) Define a beam. Explain how shear force and bending moments are developed at different sections of the beam.
- (ii) How are the trusses classified? What are the assumptions taken while analysing a plane truss ?

- (b) Determine the forces and their nature in each member of the truss loaded as shown in Fig 1.

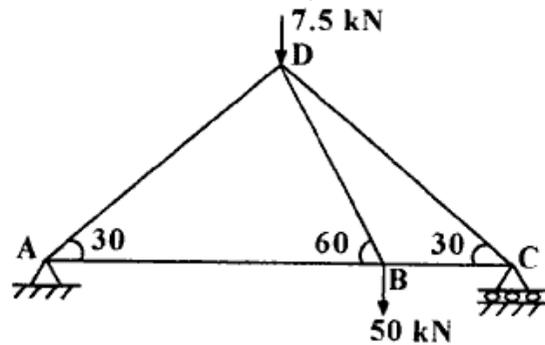


Fig. 1

- (c) Draw the shear force and bending moment diagrams for the beam shown in figure 2.

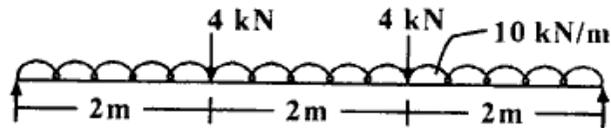


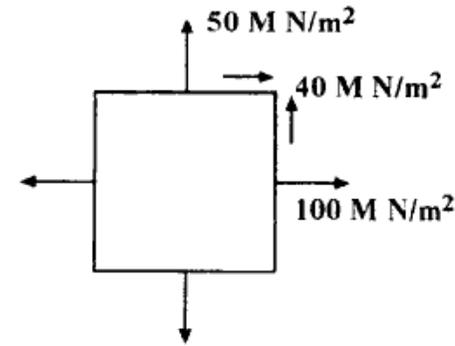
Fig. 2

- 5 Attempt any **four** parts of the following : $5 \times 4 = 20$

- (a) Draw stress-strain diagram for a ductile material and define different points shown on it.
- (b) A round bar 40 cm long has 5 cm diameter for middle half of its length and a reduced diameter at the two ends (ends are equal in diameter and length-wise). Bar carries axial load of 10 kN. Find the diameter and end section if the total allowable extension is 0.03 cm

$$E = 200 \text{ GN/m}^2.$$

- (c) Calculate the value of principal stresses and the planes on which they occur for the stresses shown in Figure 3.



Also calculate the plane on which maximum shear stresses are occurring. What are the values of normal stresses on these plans ?

- (d) Derive the simple bending equation.

$$\frac{N}{I} = \frac{T_b}{Y} = \frac{E}{R}$$

Also mention the assumptions made in the derivation.

- (e) Determine the dimensions of a rectangular Simply supported steel beam 5 m long to carry an UDL of 10 kN/m, if the maximum permissible bending stress is 1000 N/cm². The depth of the beam is 1.5 times its width.

- (f) Design a circular solid shaft to transmit 80 kW power at 200 rpm, if the twist in the shaft is not to exceed 2° in 3m length of the shaft and maximum shear stress is limited to 70 MN/m^2 . Take mod. of rigidity $G = 90 \text{ GN/m}^2$.
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