



Printed Pages : 4

ME – 201

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

PAPER ID : 4033

Roll No.

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B. Tech.

(SEM. II) EXAMINATION, 2006-07

Mechanical Engg.

Time : 3 Hours]

[Total Marks : 100

- Note :**
- (1) Attempt *all* the questions.
 - (2) Assume missing data if any.
 - (3) Use of steam table and Nollierts chart is permissible.

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

- (a) Define : Thermodynamic state, process, quasistatic process.
- (b) Explain : continuum, thermodynamic equilibrium
- (c) Differentiate between characteristic gas constant and universal gas constant. Using ideal gas equation, find the characteristic gas constant for oxygen gas.
- (d) Explain the principle of thermo metry and explain a scheme of temperature measurement using a thermometric property,
- (e) What are fixed points in thermometry? Derive the relation between the numerical values on absolute and centigrade scales.
- (f) How a real gas behaviour deviates from that of an ideal gas behaviours. Explain the vander Waal's equation.

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

- (a) Show that the internal energy of a system is a state property. A closed system undergoes a reversible process at a constant pressure of 4 bar. Its volume changes from 0.2m^3 to 0.1m^3 . Determine the change in internal energy of the system if net heat added to the system during the process is 40 kJ.
- (b) Define (i) heat engine (ii) Refrigerator (iii) Heat Pump. A heat engine operates between a source at 900°C and the sink at 30°C . It develops a power of 10 kW. Determine the rate of Heat rejection to the sink.
- (c) What do you understand by steady state? Derive steady state energy equation. A compressor of a gas turbine receives air at 1 bar and 27°C . Inlet air enters at a speed of 15 m/s and leaves at speed of 100 m/s. The pressure and the temperature at outlet are 20 bar and 500°C . If the mass flow rate is 6.5 kg/s, find the input power required to operate the compressor. Take $C_p = 1 \text{ kJ/kgK}$

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

- (a) 3 kg of saturated liquid water is contained in a constant pressure system at 5 bar. Energy is added to the system until it has a quality of 60% Determine.
 - (i) The saturation temperature
 - (ii) Final temperature and pressure
 - (iii) Change in volume and
 - (iv) Change in enthalpy of the system.

- (b) With the help of neat sketches, explain the working of a four stroke compression ignition. Engine show the processes on P-V diagram and obtain the work done by the engine in one cycle.
- (c) In an otto cycle, the air at the beginning of compression is at 1 bar and 40°C. The ratio of compression is 8. The heat added during the constant volume process is 1000 kJ. Determine :
- The max. temp in the cycle.
 - The air standard efficiency
 - The work done /kg of Air and
 - The heat rejected per kg.
- Take $C_v = 0.718 \text{ kJ/kgK}$ and $\gamma = 1.4$

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

- (a) In **fig. 1** the rods A and B are of same length. The cross sections of A and B are 4 cm^2 and 6 cm^2 respectively. Plate C is rigid and remains horizontal before and after a pull of 5000 N is applied. Find the displacement of the plate and the stresses in rods A and B. Given that the Youngs' modulus of material of rod A is 200 kN/mm^2 and that of B is 100 kN/mm^2 .

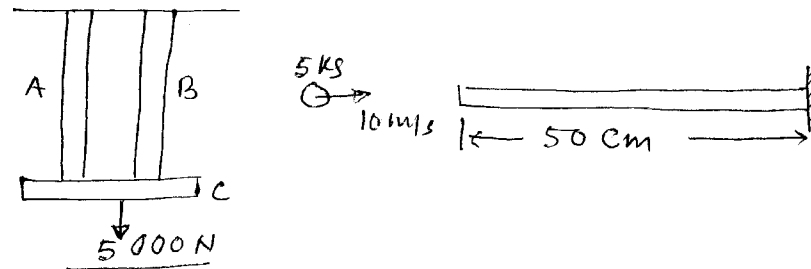


Fig. 1 & 2

- (b) Differentiate between brittle and ductile materials. Draw stress-strain diagram for a ductile materials and show and explain the different points coming on it.
- (c) (i) Explain the concept of complementary shear stress.
(ii) Find the principle stresses and principal directions for the state of stress shown in **fig. 3.** below :

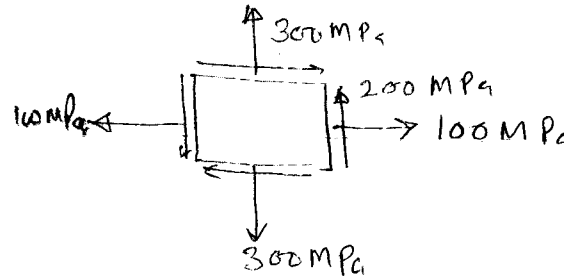


Fig. 3

- 5** Attempt any **two** of the following : **10×2**
- (a) A cantilever beam has a rectangular cross section 50 mm wide and 150 mm deep. The cantilever is 2 m long and carries a concentrated force of 10^4 N at the free end. Calculate the maximum bending stress in the beam.
- (b) A solid shaft of diameter 10 cm, transmits 10 kW power at 1500 R.P.M. Find the maximum shear stress in the shaft. If the diameter is increased by 10%, how much power may be transmitted by the shaft without changing the maximum shear stress in the shaft ?
- (c) Define the following terms :
- | | |
|-----------------------|-----------------------|
| (i) Shear strain | (ii) Principal stress |
| (iii) Section modulus | (iv) Pure bending |
| (v) Poisson's Ratio. | |