* V – 4 0 3 3 *

Printed Pages : 4 **ME – 201**

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

PAPER ID : 4033 Roll No. | | | | | | | | | | |

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 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.

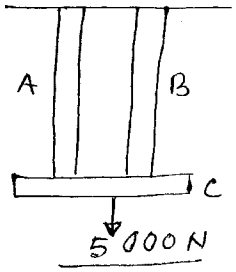
(c) In an otto cycle, the air at the beginning of compression is at 1 bar and 40°C. The ratio of compression is 8. The heat added during the constant volume process is 1000 kJ. Determine :

i) The max. temp in the cycle.
ii) The air standard efficiency
iii) The work done /kg of Air and
iv) The heat rejected per kg.

Take C_v = 0.718 kj/kgK and γ = 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.



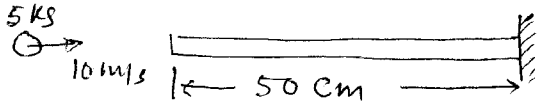


Fig. 1 & 2

(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 :

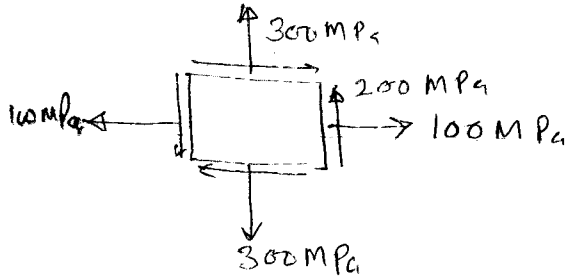


Fig. 3

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 cantelever 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, transmitts 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 charging 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.