01874

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

December, 2012

BIME-002 : THERMAL ENGINEERING - I

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any Seven** questions. Use of calculator is allowed*

1. A certain power plant uses coal with the following analysis by weight ; 78% C, 6%H_2, 98% O_2,1.2%N2 and 5%ash and an analysis of the refuge collected from the ash pit shows that it contains 30% carbon by weight. An orsat analysis of the flue gases give 12.5% CO_2, 0.9%CO and 5.6% O_2 and the rest Nitrogen Find : 10
   (a) Theoretical airfuel ratio
   (b) Actual air fuel ratio
   (c) Dilution coefficient
   (d) Percentage of excess air.

2. 10 kg of air at 100°C is stored in a rigid cylinder of volume 0.05 m^3. Calculate the pressure using Vander Waals equation of state. The properties of air at critical point are $P_c = 38.467$ bar $T_c = 137.24K$ and $V_c = 0.093 m^3/kg$ mole 10

3. Find the height of chimney necessary to produce a draught of 30mm of water column. The atmospheric air temp is 27°C and gas temp in chimney is 217°C. Air fuel ratio is 13.5. What will be the power required if induced draught fan is used for producing the above draught? Fuel consumption is 1500 kg/h. **10**

4. In a condenser, vacuum gauge reads 715 mm of Hg while barometer reads 755mm of Hg. The temperature of condenser be 25°C. Determine the pressure of steam and air and mass of air per kg of steam. Also determine the vacuum efficiency. **10**

5. Find the dimension of a single cylinder double acting non-condensing steam engine to satisfy the following requirements. **10**

   B.P. = 50 kW, steam chest pressure = 11 bar back pressure = 1.1 bar, cut off at 5.8 of the stroke, clearance 5% of the stroke, piston speed = 125.m/min RPM = 300, Piston rod diameter = 4.5cm, diagram factor = 0.8. mechanical efficiency = 90%

6. The nozzle of a De Laval steam turbine are supplied with dry saturated steam at a pressure of 7 bar abs. The pressure at outlet is 1 bar. The turbine has two nozzles with a throat diameter of 3mm. Assuming that the nozzle efficiency is 95% and that of turbine rotor 30%, find the quantity of steam used per hour and power developed. **10**

7. Steam at 6 bar abs and 108°C is supplied to a single stage turbine where it is exhausted into a condenser at a pressure of 0.2 bar abs.The blade speed is 300 m/s and nozzle angle is 20°and nozzle efficiency is 85%. Blade velocity co-efficient of 0.7 and blades are equi-angular. Calculate the following for steam flow rate of 1kg/s **10**

(a) Axial thrust on blade

(b) Steam consumption per break power if mech efficiency is 90%

(c) blade efficiency

(d) Stage efficiency

(e) heat equivalent of the friction of blade.

8. In a reheat cycle steam enters the H.P.turbine at 100 bar and 500°C. The expasion is continued to a pressure of 8.5 bar with isentropic efficiency of 80%. There is a pressure drop of 1.5 bar in the reheater and then this steam enters the L.P. turbine at 7 bar and 500°C in which expansion is continued to a back pressure of 0.04 bar with isentropic efficiency of 85%. Find. **10**

(a) Thermal efficiency

(b) S.S.C. Air at 15°C and atmospheric pressure is taken in an open cycle gas turbine.

9. Power plant. In the compressor the pressure rises to 5 times. The compressed air is then heated to 800°C and then expanded in the turbine to the atmospheric pressure. Find the power developed per kg of fuel and the air standard efficiency. **10**

10. Write short notes on *any two* of the following. **5x2=10**

(a) Sources of heat loss in boilers

(b) compounding of steam turbines

(c) Effect of friction on nozzle performance.