01745

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2012

BIME-002 : THERMAL ENGG - I

Time : 3 Hours *Maximum Marks : 70*

Note : *Attempt **any Seven** questions.*

1. Two Kg of air at 6.86 bar abs. and 90°C pass through a reversible non flow polytropic process represented by $PV^{1.1}$ = constant till the pressure falls to 1.37 bar. Find **10**
   (i) The final temperature, specific volume and change in entropy.
   (ii) Work and heat transfer.
   (iii) What will be the answer if the process was irreversible and adiabatic between the same end states ?

2. Find the draught produced in mm of water by a chimney of 40 m height. Assume the diameter of chimney as 150 cm and 30% of the theoretical draught is lost in friction. Consider that the mass of flue gas be 20 kg of fuel burnt in the combustion chamber and the temp of flue gases and the ambient air as 270°C and 23°C. Find the mass of flue gases passing through the chimney per minute. **10**

3. The fuel supplied to a petrol engine is assumed to have the composition C_2H_{16}. Calculate **10**

(i) The stoichiometric air - fuel ratio by mass

(ii) The percentage volumetric composition of the products of combustion if 50% excess air is supplied and the combustion is complete. Assume air contains 21% O_2 by volume.

4. Super heated steam at 10 bar abs and 300°C admitted into the cylinder of a steam engine expands isentropically to a pressure of 0.7 bar. The pressure then falls at constant volume to a back pressure of 0.28 bar. Determine : **10**

(i) modified Rankine cycle efficiency

(ii) steam consumption per kW hour

(iii) mean effective pressure

(iv) heat removed in the condenser/kg steam

(v) loss of work due to incomplete combustion

(vi) if the cylinder diameter and stroke are 30 cm and 58 cm respectively, what would be the new stroke if the steam is allowed to expand without any restriction up to the condenser pressure.

5. Sketch a schematic diagram of a steam power plant and explain the various process of Rankine cycle on T - S and P - V diagram. **10**

6. Calculate the throat and exit diameter of a convergent - divergent nozzle which will discharge 820 Kg of steam/hr from a pressure of 8 bar superheated to 220°C into a chamber having a pressure of 1.05 bar. Friction loss in the divergent part of the nozzle may be taken as 0.15 of the total enthalpy drop. **10**

7. A single row impulse turbine developed 135 kW at a blade speed of 175 m/s using 2 kg of steam/s. Steam leaves the nozzle at 400 m/s. Velocity coefficient of the blade is 0.9. steam leaves the turbine blade axially. Determine the Nozzle angle, blade angle at entry and exit assuming no shock. **10**

8. A steam power plant equipped with regenerative as well as reheat arrangement is supplied with steam to the H.P turbine at 80 bar and 470°C. For feed heating a part of steam is extracted at 7 bar and the remainder of steam is reheated to 350°C in a reheater and then expanded in L.P. turbine down to 0.035 bar. Determine **10**

   (i) Amount of steam bled off for feed heating.

   (ii) Amount of steam in L.P turbine

   (iii) Heat supplied in boiler and reheater

   (iv) Output of turbine

   (v) Cycle efficiency

9. Air at 15°C and atmospheric pressure is taken in an open cycle gas turbine power plant. In the compressor the pressure rises five times. The compressed air is then heated to 800°C and the expanded in the turbine to the atmospheric pressure. Find the power developed by per Kg of fuel and the air standard efficiency. **10**

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

(i) Describe the advantages of water tube boiler over fire tube boiler

(ii) Critical pressure ratio of a nozzle

(iii) Enthalpy and internal energy of combustion.