B.Tech. MECHANICAL ENGINEERING (BTMEVI)

00342

Term-End Examination

December, 2011

BIME-002 : THERMAL ENGG - I

Time : 3 hours   *Maximum Marks : 70*

Note : Attempt **any five**. Use of **steam tables** and **Mollier's chart** is allowed. Use of scientific non-programmable calculator is **permitted**.

1. (a) Using Maxwell relation derive the Clausius clapeyron equation.   **7**

   (b) Show that for a perfect gas Joule-Thomson coefficient is equal to zero.   **7**

2. (a) Define and differentiate between internal energy of reaction and enthalpy of reaction.   **7**

   (b) The dry products of combustion of hydrocarbon fuel have the following or sat analysis 8% CO_2, 1% CO, 8.8% O_2 and 82.2% N_2. Determine the actual as well as theoretical air-fuel ratio.   **7**

      The formula for hydrocarbon is of the form $C_x H_y$. Take molecular weight of air as 28.95.

3. (a) Explain the working of Babcock- Wilcox **7**
boiler with neat sketch.

(b) The absolute pressure in the condenser is **7**
11.56 kPa when the barometer reads
1.0×10^2 kPa. The temperature is 40°C.
Determine the partial pressure of air,
vacuum efficiency and mass of air present
in the condenser per kg of steam.

4. (a) What are the basic components of a steam **7**
power plant ? Enumerate the function of
each component.

(b) Steam at a pressure of 10 bar, dry-saturated **7**
enters the nozzle and the exit pressure is
maintained at 0.3 bar. The nozzle efficiency
for the convergent portion is 96% and for
the divergent portion is 92%. The throat
diameter for each nozzle is 6mm. Find the
mass flow rate of steam and the exit
diameter of the nozzle required.

5. (a) Explain Regenerative Rankine Cycle. **7**

(b) A simple impulse turbine has a blade speed **7**
of 350 m/s and blade speed to steam
velocity (inlet) ratio is 0.45. Nozzles are
inclined at 20° to plane of rotation and steam
leaves the stage at an angle of 70° to the
plane of rotation.
Determine,

(i) Blade inlet angle (θ)

(ii) Kinetic energy of steam at outlet.

6. (a) Compare gas turbines with I.C engines. 7

(b) In a gas turbine cycle, air at 270°C and 7
0.98 bar is compressed to 6 bar. The
temperature of air is increased to 750°C as
it passes through the combustion chamber.
The isentropic efficiencies of compressor
and turbine are 0.8 and 0.85 respectively.
Determine the efficiency of the plant.

7. Write short notes on : $4 \times 3\frac{1}{2} = 14$
   (a) Turbojet Engine
   (b) Turboprop Engine
   (c) Combined power and heating cycle
   (d) Carnot vapour cycle.

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