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BIME-002

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

December, 2015

BIME-002 : THERMAL ENGINEERING – I

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. Assume missing data suitably, if any. Use of steam tables is permitted. Use of calculator is permitted.*

1. Explain the Joule Thompson coefficient and Inversion curve. *10*

2. The percentage of composition by mass of a solid fuel used in boiler is given below :

   C = 90%, H_2 = 3·5%, O_2 = 3%, N_2 = 1%, S = 1% and remainder being ash.

   Determine the mass of air per kg of fuel for complete combustion and mass of dry products formed per kg of fuel. *10*

3. Explain why safety valves are needed in a boiler. Draw the neat sketch of a spring loaded safety valve and explain its working. *10*

4. Find the mass of flue gases flowing through a chimney when draught produced is equal to 2 cm of water. Temperature of flue gases is 297°C and the ambient temperature is 27°C. The flue gases formed per kg of fuel burnt is 20 kg. Diameter of the chimney is 2 m. Neglect the losses. *10*

5. State the methods of governing of steam engines and discuss any one method in detail. *10*

6. Steam at a pressure of 15 bar and with 50°C of superheat is allowed to expand in a convergent-divergent nozzle. The exit pressure is 1 bar. If the nozzle is required to supply 2 kg/s of steam, then find the (a) velocity at throat and exit, (b) areas at throat and exit. *10*

7. Discuss with the help of T-s diagram the effect of the following variables on efficiency and power output of a Rankine cycle : *10*

   (a) Inlet pressure

   (b) Condenser pressure

   (c) Inlet temperature with inlet pressure maintained constant

8. Steam enters the blade row of an impulse turbine with a velocity of 600 m/s at an angle of 25°C to the plane of rotation of blades. The mean blade speed is 255 m/s and the blade angle at exit is 30°. The blade friction coefficient is 10%. Determine the

(a) blade angle at inlet,

(b) work done/kg of steam,

(c) axial thrust, and

(d) diagram efficiency. *10*

9. Show that the optimum pressure ratio for the maximum specific work output of a gas turbine cycle is

$$r_p = \left(\frac{T_{max}}{T_{min}}\right)^{r/2(r-1)},$$

where T_{max} and T_{min} are the maximum and minimum temperatures of the cycle. *10*

10. Write short notes on the following : *2×5=10*

(a) Principle of rocket propulsion

(b) Effects of air leakage on condenser