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

□□6551 **Term-End Examination**

June, 2019

BIME-002 : THERMAL ENGINEERING – I

Time : 3 hours *Maximum Marks : 70*

*Note : Attempt any **seven** questions. Use of calculator is allowed. Use of steam tables is permitted.*

1. (a) Define a boiler. How are boilers classified ? 5

    (b) Enumerate the factors which should be considered while selecting a boiler. 5

2. The percentage composition of sample of liquid fuel by weight is,

    $C = 84.8\%$, and $H_2 = 15.2\%$.

    Calculate :

    (i) The weight of air needed for the combustion of 1 kg of fuel.

    (ii) The volumetric composition of the products of combustion if 15% excess air is supplied. 10

3. **(a)** 1 kg of steam at 120 bar and 400°C expands reversibly in a perfectly thermally insulated cylinder behind a piston until the pressure is 38 bar and the steam is then dry saturated. Calculate the work done by the steam. *5*

(b) A certain perfect gas is compressed reversibly from 1 bar, 17°C to a pressure of 5 bar in a perfectly thermally insulated cylinder, the final temperature being 77°C. The work done on the gas during the compression is 45 kJ/kg. Calculate γ, C_v and R of the gas. *5*

4. **(a)** What is the function of a boiler chimney ? *5*

(b) Define the chimney efficiency and elicit expression for the same. *5*

5. In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0·4 bar. Calculate the Carnot and Rankine efficiency of the cycle. Neglect pump work. *10*

6. **(a)** Explain the various operations of a Carnot cycle. Also represent in a T-s diagram. *5*

(b) Explain "Regenerative Cycle" with the help of a neat diagram. Also derive an expression for its thermal efficiency. *5*

7. (a) What is a pass-out turbine ? When is it used ? 5

(b) What is a cogeneration plant ? What are the thermodynamic advantages of such a plant ? 5

8. (a) Define steam nozzle. Explain various types of nozzles. 5

(b) A single-stage steam turbine is supplied with steam at 5 bar, 200°C at the rate of 50 kg/min. It expands into a condenser at a pressure of 0·2 bar. The blade speed is 400 m/sec. The nozzles are inclined at an angle of 20° to the plane of the wheel and the outlet blade angle is 30°. Neglecting friction losses, determine the

(i) power developed,

(ii) blade efficiency, and

(iii) stage efficiency. 5

9. (a) Define a steam turbine and state its field of application. 5

(b) Explain with a neat sketch the details of a simple gas turbine power plant. 5

10. (a) Explain the principle of jet propulsion and mention how jet propulsion engines are classified. *5*

(b) What are the advantages and disadvantages of a 'ramjet' engine ? What are its applications ? *5*