| BIME-002 |

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)
Term-End Examination
December, 2016

⊔⊔⊔⊔⅃⅄

BIME-002 : THERMAL ENGINEERING – I

Time : 3 hours   *Maximum Marks : 70*

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

1. (a) What are secondary fuels ? List some important secondary fuels.

   (b) What is the function of a safety valve in a boiler ? State the minimum number of safety valves to be used on a boiler.   *5+5*

2. (a) Define the following as related to steam turbines (any *two*) :
   (i) Speed ratio
   (ii) Blade velocity coefficient
   (iii) Diagram efficiency
   (iv) Stage efficiency

   (b) Explain the difference between an impulse turbine and a reaction turbine.   *5+5*

3. The following readings were obtained during a boiler trial of 6 hours duration :

Mean steam pressure = 12 bar

Mass of steam generated = 40000 kg

Mean dryness fraction = 0·85

Mean feed water temperature = 30°C

Coal used = 4000 kg

Calorific value of coal = 33400 kJ/kg

Calculate : *10*

(a) Factor of equivalent evaporation

(b) Efficiency of the boiler

4. In a stage of an impulse turbine provided with single row wheel, the mean diameter of the blades is 1 m. It runs at 3000 rpm. The steam issues from the nozzle at a velocity of 350 m/sec and the nozzle angle is 20°. The rotor blades are equiangular. The blade friction is 0·86. Calculate the mean blade speed, if the axial thrust on the end bearing of a rotor is 120 N. Also calculate the mass flow rate in the turbine. *10*

5. A turbojet engine consumes air at the rate of 60·2 kg/s when flying at a speed of 1000 km/hr. Calculate : *10*

(a) Exit velocity of the jet when the enthalpy change for the nozzle is 230 kJ/kg and the velocity coefficient is 0·96.

(b)   Fuel flow rate in kg/s when the air-fuel ratio is 70 : 1.

(c)   Thrust specific fuel consumption.

(d)   Thermal efficiency of the plant when the combustion efficiency is 92% and the calorific value of the fuel used is 42000 kJ/kg.

(e)   Propulsive efficiency.

6.   At a stage in a reaction turbine, the mean blade ring diameter is 1 m and the turbine runs at a speed of 50 rev/sec. The blades are designed for 50% reaction with exit angle 30° and inlet angle 50°. The turbine is supplied with steam at the rate of 600000 kg/hr and the stage efficiency is 85%. Determine the power output of the stage.   *10*

7.   A surface condenser deals with 13625 kg of steam per hour at a pressure of 0·09 bar. The steam enters 0·85 dry and the temperature at the condensate and air extraction pipes is 36°C. The air leakage amounts to 7·26 kg/hour.

Determine

(a)   the surface required, if the average heat transmission rate is 3·97 kJ/cm^2 per second;

(b)   the cylinder diameter for the dry air pump, if it is to be single acting at 60 rpm with a stroke to bore ratio of 1·25 and volumetric efficiency of 0·85.   *10*

8. A single-cylinder, compression ignition engine with a brake thermal efficiency of 30% uses high speed diesel oil having a calorific value of 42000 kJ/kg ? Determine BSFC in kg/kWh. *10*

9. (a) Explain the working differences between propeller-jet, turbojet and turbo-prop.

   (b) State the fundamental differences between jet propulsion and rocket propulsion. *5+5*

10. A closed cycle ideal gas turbine operates between temperature limits of 800°C and 30°C, and produces a power of 100 kW. The plant is designed such that there is no need for a regenerator. A fuel of CV 45000 kJ/kg is used. Determine

   (a) the mass flow rate of air through the plant, and

   (b) the rate of fuel consumption.

   Assume $C_p = 1$ kJ/kg-K, $\gamma = 1.4$. *10*