CBCS SCHEME

USN | | | | | | | | | | |

18SM33

# Third Semester B.Tech. Degree Examination, Feb./Mar. 2022
## Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

***Note:* 1. *Answer any FIVE full questions, choosing ONE full question from each module.***
***2. Use of thermodynamic data hand book is permitted.***





### Module-1

1 a. Explain with examples how thermodynamics play an important role in engineering and science. **(08 Marks)**

b. Define the following with example:
(i) Control volume
(ii) Intensive and extensive property **(06 Marks)**

c. The e.m.f. in a thermocouple with the test junction at t°C on gas thermometer scale and reference junction at ice point is given by $e = 0.20\ t - 5 \times 10^{-4}\ t^2$ mV. The voltmeter is calibrated at ice and steam points. What will this thermometer read in a place where the gas thermometer reads 50°C? **(06 Marks)**

**OR**

2 a. With P-T diagram, explain different regions of water that takes place. **(06 Marks)**

b. Explain the following: (i) Compressability factor (ii) Compressability chart **(06 Marks)**

c. A gas mixture consists 3 mole $O_2$, 5 mole $N_2$ and 2 mole $CO_2$. Determine:
(i) The mole fraction
(ii) The mass fraction of each component
(iii) Apparent molecular weight of mixture
(iv) Apparent gas constant **(08 Marks)**

### Module-2

3 a. Differentiate between thermodynamic work and heat. **(06 Marks)**

b. With a diagram, explain pdv-work. **(06 Marks)**

c. If a gas of volume 6000 $cm^3$ and at a pressure of 100 kPa is compressed quasistatically according to $PV^2 = C$ until the volume becomes 2000 $cm^3$. Determine final pressure and work transfer. **(08 Marks)**

**OR**

4 a. State Joules experiment 1st law of thermodynamics. **(06 Marks)**

b. Define specific heat at constant pressure and constant volume. **(06 Marks)**

c. Steam is supplied to a 73.6 KW turbine with an enthalpy of 2800 kJ/kg velocity of 110 m/s. The steam leaves the turbine with a velocity of 300 m/s and an enthalpy of 2000 kJ/kg. Heat lost from the turbine to the surroundings is 20 kJ/kg. The change in potential energy is negligible. Determine: (i) The shaft work output (ii) Steam flow rate in kg/hr **(08 Marks)**

### Module-3

5 a. Define Kelvin Planck and Clausius statements. **(06 Marks)**

b. Explain about the thermodynamic temperature scale. **(06 Marks)**

c. A domestic refrigerator maintains a temperature of –12°C. The ambient air temperature is 35°C if heat leaks to the freezer at the continuous rate of 2 kJ/sec, determine the maximum COP of the refrigerator and least power required to drive the refrigerant. **(08 Marks)**

**OR**

6 a. State and prove Clausius of inequality. **(06 Marks)**

b. Using Tds relation, find the entropy change for an ideal gas. **(08 Marks)**

c. Find the entropy change of 5 kg of a perfect gas whose temperature varies from 150°C to 200°C during constant volume process the specific heat varies linearly with absolute temperature and is represented by the relation $C_V = 0.45 + 0.009\ T$ kJ/kg°K. **(06 Marks)**

## Module-4

7 a. With P-V and T-S diagram, derive efficiency of a diesel cycle in terms of compression ratio and cut-off ratio. **(08 Marks)**

b. Differentiate between open cycle and closed cycle gas turbine. **(06 Marks)**

c. A certain quantity of air at a pressure of 1 bar and temperature 70°C is compressed adiabatically to 7 bar in Otto cycle and 460 kJ of heat is added per kg of air, calculate:

(i) Compression ratio

(ii) Temperature at the end of compression

(iii) Temperature at the end of heat addition **(06 Marks)**

**OR**

8 a. With line and T-S diagram, explain Reheat Rankine Cycle and deduce the formula for efficiency. **(06 Marks)**

b. What are the effects of temperature and pressure on Rankine cycle? **(06 Marks)**

c. Steam at 20 bar, 360°C is expanded in a steam turbine to a pressure of 0.08 bar. It then enters a condenser. Where it is condensed to saturated liquid water. Assuming the turbine and feed pump efficiency as 60% and 90% respectively, determine per kg of steam, the net work, the heat transferred to working fluid and the Rankine cycle efficiency. **(08 Marks)**

## Module-5

9 a. With a neat sketch, explain vapour compression refrigeration system. **(10 Marks)**

b. Define the following:

(i) COP (ii) Refrigeration effect (iii) Capacity of refrigerator

(iv) Mass flow rate of refrigerant (v) Power required **(10 Marks)**

**OR**

10 a. With a neat sketch, explain Summer Air Conditioning Systems. **(08 Marks)**

b. Define the following: (i) DBT (ii) WBT (iii) Specific humidity **(06 Marks)**

c. It is required to design an air conditioning plant for a office room with the following conditions:

Outdoor conditions: 14°C DBT and 10°C WBT

Required conditions : 20°C DBT and 60% RH

Air circulation : 0.3 $m^3$/min/person

Seating capacity : 60

Condition is achieved first by heating and then by adiabatic humidifying. Determine:

(i) Heating capacity of coil in KW

(ii) Capacity of humidifier **(06 Marks)**

* * * * *