CBCS SCHEME

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

18AU32

Third Semester B.E. 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, steam tables, Psychrometry charts are permitted.*

Module-1

1 a. Define :
(i) Intensive and Extensive properties.
(ii) Thermodynamic cycle.
(iii) Thermodynamic equilibrium.
(iv) Quasi-static process.
(v) Zeroth law of thermodynamics **(10 Marks)**

b. The mercury column of a mercury in glass thermometer reads 50 mm, when the thermometer is at the ice point and 250 mm, when the thermometer is at steam point. The length of the mercury column 'x' and the temperature 't' are related as $t = ax^2 + b$,where $t = 0$ at ice point and $t = 100$ at steam point. Compare this scale with Celsius scale, where 't' is linearly defined in terms of 'x' with the same values of 't' at the ice and steam points. **(10 Marks)**

OR

2 a. Enumerate the similarities between heat and work. Explain an example to illustrate the difference between heat and work. **(05 Marks)**

b. In a closed system air is compressed from 0.5 m^3 to 0.1 m^3 by a piston. The pressure and volume are related by $P = 5 - 3\ V$, where P is in bar and V in m^3. Determine the work done on the system. **(05 Marks)**

c. A closed system containing a gas expands slowly in a piston cylinder from 600 KPa and 0.1 m^3 to a final volume 0.5 m^3. Determine the work done for the following processes:
(i) $P = C$ (ii) $PV = C$
(iii) $PV^{1.4} = C$ (iv) $P = -300V + 630$
where P is in KPa and V is in m^3. Sketch all processes on a PV diagram with a common starting state point. **(10 Marks)**

Module-2

3 a. Prove that internal energy is a property of the system. **(05 Marks)**

b. From first law of thermodynamics, write the general steady flow energy equation for a flow system. Apply the same equation for a throttling process. **(05 Marks)**

c. A steam turbine receives steam with flow rate of 54000 kg/h and experiences a heat loss of 50.4 MJ/h. The exit pipe is 3 m below the level of inlet pipe. Find the power developed by the turbine if the pressure decreases from 6.2 MPa and 9.86 KPa. Velocity increases from 30.5 m/s to 274.3 m/s, internal energy decreases by 938.5 KJ/kg and specific volume from 0.058 m^3/kg to 13.36 m^3/kg. **(10 Marks)**

OR

4 a. State Kelvin-Plancks and Clausius statement of second law of thermodynamics and prove that they are equivalent. **(10 Marks)**

b. A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and −20° C. The heat transfer to the heat engine is 2000 KJ and the net work output of the combined engine refrigerator plant is 360 KJ. Determine the heat transfer of the refrigerator and net heat transfer of the refrigerator and net heat transfer to the reservoir at 40°C. Sketch the process. **(10 Marks)**

Module-3

5 a. Derive Clausius inequality and hence prove that entropy is a property. **(10 Marks)**

b. Explain briefly available and unavailable energies referred to a cyclic heat engine. **(10 Marks)**

OR

6 a. Explain with neat sketch, the method of determining the quality of steam by throttling calorimeter. **(10 Marks)**

b. Steam is available at a pressure of 8 bar. Determine the enthalpy and specific volume if it is,
   (i) Dry saturated.
   (ii) Wet, with a dryness fraction of 0.85.
   (iii) Superheated upto 300°C. **(10 Marks)**

Module-4

7 a. With the help of a schematic diagram, explain the working of a vapour absorption system. **(10 Marks)**

b. Explain steam jet refrigeration with neat sketch. **(10 Marks)**

OR

8 a. Define the following terms and write the expressions for the same:
   (i) Relative humidity
   (ii) Specific humidity.
   (iii) Degree of saturation.
   (iv) Total pressure of moist air and
   (v) Enthalpy of moist air. **(10 Marks)**

b. With a neat sketch, explain the working of the air conditioning system for hot and dry weather. Show the process on psychrometric chart. **(10 Marks)**

Module-5

9 a. Derive the expression for the isothermal workdone by a single stage reciprocating compressor with and without clearance volume. **(10 Marks)**

b. Explain multistage compression with sketch. Mention its advantages. **(10 Marks)**

OR

10 a. Classify gas turbines. Sketch the gas turbine cycle on T-S diagram, showing all the processes. Consider both ideal and actual cases and explain. **(10 Marks)**

b. Write short notes on:
   (i) Turbojet engine.
   (ii) Rocket propulsion. **(10 Marks)**

* * * * *