March 2022
B.Tech - 3rd Sem
Thermodynamics (PCC-ME-301/21)

Duration: 90 Minutes **Max. Marks: 25**

Instructions:

- It is compulsory to answer all the questions (1 mark each) of Part-A in short.
- Answer any four questions from Part-B in detail.
- Different sub-parts of a question are to be attempted adjacent to each other.

PART A

Q1 (a) What is a quasi-static process? (1)

(b) What do you understand by a thermodynamic equilibrium? (1)

(c) Define perpetual motion of the first kind (PMM1). (1)

(d) Define Zeroth law of thermodynamics. (1)

(e) What is a free expansion process (1)

(f) What will be loss of available energy associated with the transfer of 1000 kJ of heat from constant temperature system at 600 K to another at 400 K when the environment temperature is 300 K? (1)

(g) What are the causes of irreversibility of a process? (1)

(h) What do you understand by the degree of superheat and the degree of subcooling? (1)

(i) Define the term dryness fraction of steam. (1)

(j) In Brayton cycle, the turbine output is 600 KJ/kg, the compressor work is 400 kJ/kg and the heat supplied is 1000 kJ/kg, determine the thermal efficiency of Brayton cycle. (1)

PART B

Q2 (a) Show that heat transfer is a path function. (2)

(b) Derive the expression for work transfer for isothermal and adiabatic process in a closed system. (3)

Q3 An adiabatic cylinder of 10 m^3 volume is divided into two compartment A and B, each of volume 6 m^3 and 4 m^3 by a thin partition. Initially the compartment A is filled with air at 6 bar, 600 K while there is vacuum in compartment B. Suddenly the partition is removed and fluid in compartment A expands freely and fills both the compartment. Treating air as an ideal gas. Find the irreversibility in kJ of the process. Take atmospheric pressure as 1 bar and atmospheric temperature as 300 K. (5)

Q4 At the inlet to a certain nozzle the enthalpy of fluid passing is 2800 kJ/kg, and the velocity is 50 m/s. At the discharge end the enthalpy is 2600 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it.

(i) Find the velocity at exit of the nozzle.

(ii) If the inlet area is 900 cm^2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate.

(iii) If the specific volume at the nozzle exit is 0.498 m^3/kg, find the exit area of nozzle.

(5)

Q5 (a) Describe the process of formation of steam and give its graphical representation also. (3)

(b) Write a short note on Mollier chart. (2)

Q6 Derive the expression for air standard thermal efficiency of diesel cycle. Also write all the assumption made while deriving air standard thermal efficiency. (5)