CBCS SCHEME

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18IM34

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of steam table is permitted.***

Module-1

1 a. Explain microscopic and macroscopic approaches of thermodynamics. **(04 Marks)**

b. Explain mechanical, chemical and thermal equilibrium with an example. **(06 Marks)**

c. Define the following with an example:
(i) Open and closed systems.
(ii) Point function and path function.
(iii) Intensive and extensive properties. **(06 Marks)**

d. Explain zeroth law of thermodynamics. **(04 Marks)**

OR

2 a. Distinguish between heat and work. **(04 Marks)**

b. Develop the expression for the polytropic process. **(06 Marks)**

c. Explain thermometric properties of thermometers. **(05 Marks)**

d. Consider a two part process with expansion from 0.1 m^3 to 0.2 m^3 at a constant pressure of 150 KPa followed by an expansion from 0.2 m^3 to 0.4 m^3 with linearily increasing pressure from 150 KPa to 300 KPa. Sketch P-V diagram and solve for the total work done. **(05 Marks)**

Module-2

3 a. Show that energy is a property of the system. Define specific heats at constant volume and constant pressure. **(10 Marks)**

b. Develop steady state steady flow energy equation with neat diagram. **(10 Marks)**

OR

4 a. Explain Joules Experiment with neat sketch. **(08 Marks)**

b. Define first law of thermodynamics and state its limitations. **(04 Marks)**

c. During a steady flow process 5000 kg/h of fluid pass through a system in which the exit pipe is 2 m below the level of the inlet pipe. Find the power developed by the system if pressure decreases from 7 to 1.2 KPa, velocity decreases from 400 to 60 m/s, internal energy decreases by 5 KJ, specific volume increases from 0.03 to 0.2 m^3/kg and heat lost by the system is 12 KJ. **(08 Marks)**

Module-3

5 a. Explain the Kelvin-Planck statement of second law.
Show that COP of Heat Pump = 1+COP of refrigerator. **(06 Marks)**

b. Explain Reversible and Irreversible cyclic processes. **(06 Marks)**

c. A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine? **(08 Marks)**

OR

6 a. Prove the equivalence of Kelvin-Plank and clausius statements. **(08 Marks)**

b. Define entropy and prove that it is a property of the system. **(08 Marks)**

c. A fluid system at 60°C and 1 bar undergoes a reversible process during which the temperature remains constant. If the heat transfer to the system during the process is 120 KJ, find the increase in the entropy of the system. **(04 Marks)**

Module-4

7 a. Define pure substance and state two property rule. **(04 Marks)**

b. With neat sketches, explain phase equilibrium diagram on T-S and h-S coordinates. **(06 Marks)**

c. Define : (i) Compressed liquid (ii) Saturated liquid (iii) Super heated vapour (iv) Boiling pressure and temperature (v) Critical point. **(10 Marks)**

OR

8 a. Sketch and explain separating and throttling calorimeter to find out the dryness fraction of pure substance. **(10 Marks)**

b. Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam. **(10 Marks)**

Module-5

9 a. Define Avogadro's law and specific heats of ideal gases. **(06 Marks)**

b. Explain : (i) Universal gas constant and particular gas constant (ii) Perfect gas and semi perfect gas. **(06 Marks)**

c. The methane gas cylinder is about 25 cm in diameter and 80 cm in height. It is dischanged to 12 MPa at room temperature of 27°C. (i) Assuming ideal gas law, find the mass of the gas filled in the cylinder, (ii) If the cylinder is to be protected against excessive pressure by means of a fusible pulg, at what temperature the plug has to melt to limit the maximum pressure to 15 MPa? Assume the molecular weight of methane to be 16.043 kg/kg mole. **(08 Marks)**

OR

10 a. Define the following:

(i) Partial pressure and partial volume of a gas in a mixture.

(ii) Mass fraction and mole fraction of a gas. **(08 Marks)**

b. Define Dalton's law of partial pressure. **(04 Marks)**

c. Find the increase in entropy when 2 kg of oxygen at 60°C are mixed with 6 kg of nitrogen at the same temperature. The initial pressure of each constituent is 103 KPa and is the same as that of the mixture. **(08 Marks)**

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