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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 22AS3ESTDN **Max Marks: 100**
Course: Thermodynamics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Scientific calculator and steam data handbook are permitted to use.

UNIT - I

1	a)	Identify the following as open/closed/isolated system. (i) Lithium ion Battery (ii) Thermoflask (iii) IC engine during compression (iv) Evaporator (v) Refrigerant in the refrigerator (vi) Universe.		**6**
	b)	With a suitable P-V diagram, derive an expression for the work done for an adiabatic process.		**6**
	c)	Two Celsius thermometer A & B agree at ice point and steam point but elsewhere are related by equation $t_A = L+Mt_B+Nt^2_B$ where t_A & t_B are temperatures of A & B. When both thermometers are immersed in the fluid A register 51^0C, while B register 50^0C.Compute the reading on thermometer B when A reads 25^0C.		**8**

UNIT - II

2	a)	A closed system undergoes a process 1-2 in which it absorbs 200kJ of energy as heat while it does 100 kJ of work. Then it follows the path 2-3 in which it rejects 50kJ of energy as heat when 80kJ work is done on it. If it is required to restore the system to state 1 through an adiabatic path, find the work and heat interactions along the adiabatic path. Also find the net work and heat interactions.		**6**
	b)	Prove that Internal energy is a property of the system		**6**
	c)	A gas turbine receives gas at an enthalpy of 800 kJ/kg and a velocity of 100m/s.The gas leaves the turbine at an enthalpy of 380 kJ/kg and a velocity of 150m/s. Heat lost to surroundings from the gas is 36 kJ/s. If the gas flow rate is 10kg/s. Find the power developed by the turbine.		**8**

UNIT - III

3	a)	Establish the equivalence between Kelvin-Planck and Clausius statement of second law of thermodynamics.	**7**
	b)	Define: i) Heat engine ii) Kelvin statement of II law iii) Perpetual motion machine-II iv) Carnot Theorem-I v) COP	**5**
	c)	There are three reservoirs at temperatures of 827°C, 127°C and 27°C parallel. A reversible heat engine operates between 827°C and 127°C and a reversible refrigerator operates between 27°C and 127°C respectively 502 kJ of heat are extracted from the reservoir at 827°C by the heat engine and 251 kJ of heat are abstracted by the refrigerator from the reservoir at 27°C. Find the net amount of heat delivered to the reservoir at 127°C.	**8**

OR

4	a)	State and prove Clausius Inequality.	**7**
	b)	Define Entropy and prove it is a property of the system.	**5**
	c)	A lump of steel of mass 10 kg at 627^0C is dropped in 100kg of oil at 30^0C. The specific heats of steel and oil are 0.5 kJ/kg-K and 3.5 kJ/kg-K respectively. Calculate the entropy change of the steel the oil and the universe. Comment whether the process is reversible of irreversible	**8**

UNIT - IV

5	a)	Explain i) Daltons law ii) Amagat's law	**6**
	b)	Sketch the P-T Phase diagram for water. Mark on it the following: Solid region, Liquid region, Vapor phase, Triple point.	**8**
	c)	A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find the quantity of heat which must be rejected so as to reduce the quality to 40% wet. Determine the pressure and temperature of the new state.	**6**

OR

6	a)	Explain the Compressibility chart with neat sketch.	**6**
	b)	Obtain the expressions for First and second Tds equations.	**8**
	c)	Determine the pressure of air at 205°C having a specific volume of 0.00315 m^3/kg using i) Ideal gas equation (ii) Van der Waals' equation.	**6**

UNIT - V

7	a)	With a suitable P-V and T-S diagram, derive an expression for the efficiency of the Ideal Brayton cycle. State the assumptions made.	**10**
	b)	In an engine working on Otto cycle, the compression ratio is 8. The temperature of air at the beginning of compression is 300K and the temperature after expansion is 700K. Calculate i) heat supplied per kg of air ii) cycle efficiency.	**10**

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