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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2019

Thermodynamics

Time: 3 hrs *Max. Marks: 100*

Note: i) PART - A is compulsory. **Two** marks for each question.
ii) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	Differentiate between Intensive and Extensive property.	2
b.	Define Zeroth law of thermodynamics.	2
c.	Define first law of thermodynamics for closed system and non cyclic process.	2
d.	Differentiate between reversible and irreversible process.	2
e.	Enlist the properties of refrigerant.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	Differentiate between: i) Microscope and Macroscopic approach ii) Open system and Closed system iii) Thermodynamic and Thermometric property	9
b.	The temperature't' on the thermometric scale is defined as property 'p' and with the relation $P = e^{(t-B)/A}$ where 'A 'and 'B' are constants. The temperature of ice and steam points is assigned with number '0' and '100' respectively. Experiments provide value of 'P' is 1.786 and 8.31 at ice and steam points respectively. Determine the temperature corresponding to a reading where $P = 3.5$ on the thermodynamics scale.	9
c.	A piston and cylinder arrangement contains a gas is at pressure of 1.5 MPa. The gas expands according to a process which is represented by a straight line on a Pressure-Volume diagram. The final pressure is 0.15 MPa. Determine the work done by the gas on the piston, if the stroke is 0.3 m.	9
	UNIT - II	**18**
2 a.	State first law of the thermodynamics for a closed system undergoing cyclic process. Prove that energy is a property of a system.	9
b.	In a gas turbine unit, the gasses flow through the turbine at 20 kg/s and the power developed by the turbine is 15000 kW. The enthalpies of gasses at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively and the velocities of gas at the inlet and outlet are 40 m/s and 100 m/s respectively. Determine; i) The rate of which heat is rejected from the turbine ii) The diameter of inlet pipe given that the specific volume of the gasses at inlet is $0.35 m^3/kg$.	9

Contd…2

c. The working fluid in a steady flow process flows at a rate of 220 kg/min. The fluid rejects 100 kJ/s of heat when passing through the system. The condition of the fluid at the inlet are P_1 = 6 bar; V_1 = 320 m/s; U_1 = 2000 kJ/kg, V_1 = 0.36 m^3/kg. At the exit, are P_2 = 1.2 bar, V_2= 140 m/s; U_2 = 1400 kJ/kg, V_2 = 1.3 m^3/kg. Determine the power capacity of the system in MW. The change in potential energy may be reflected. 9

UNIT - III **18**

3 a. State Kelvin-Plank and Clausius statements of second law of thermodynamics and illustrate violating Clausius statement results in violation of Kelvin-Plank statement. 9

b. A reversible heat engine operating between two reservoirs at temperature 600°C and 40°C. The engine drives a refrigerator which operates between reservoirs at temperatures, 40°C and 20°C. The net work output of the combined engine and refrigerator plant is 360 kJ. Determine the heat transfer to the refrigerator and the net heat transfer to the reservoir at 40°C. 9

c. Two reversible heat engines A and B are arranged in series, 'A' rejecting heat to 'B' through an intermediate reservoir. The engine an 'A' receives 200 kJ at a temperature of 421°C from a hot source while the engine 'B' is a communication with a cold sink at a temperature 4.4°C. If the work output of 'A' is twice that of 'B', determine; 9

i) The intermediate temperature between 'A' and 'B'

ii) Efficiency of each engine iii) Heat rejected to cold sink

UNIT - IV **18**

4 a. Develop an expression for air standard efficiency of a diesel cycle and design its mean effective pressure. 9

b. Develop an expression for standard Otto-cycle, the compression ratio is 7:1 and the compression begins at 35°C and 0.1 MPa. The minimum temperature of the cycle is 1100°C. Determine; 9

i) Temperature and pressure at each end of process ii) The heat supplied per kg of air

iii) Cycle efficiency iv) Mean effective pressure

c. A two stage compressor with perfect intercooling takes in air at 1 bar pressure and 27°C. The compression path follows $PV^{1.3}$ = C. The compressed air delivered at 10 bar front the high pressure cylinder to an air receiver. Determine per kg of air, i) The minimum work done, ii) Minimum work done in 3 stage compression working under same condition. 9

UNIT - V **18**

5 a. With neat sketch, explain the vapour absorption refrigeration system. 9

b. In a refrigerator working on Bell-Coleman cycle, the air is drowning in to the cylinder of the compressor from the cold chamber at a pressure of 1 bar and temperature 10°C. After Isentropic compression to 5 bar, the air is cooled at constant pressure to temperature of 20°C. The polytrophic expansion, $PV^{1.2}$ = C follow and air expanded to 1 bar, is passed to cold chamber. Determine; 9

i) Work done per kg of air ii) Refrigeration effect per kg air flow iii) C.O.P

c. Atmospheric air at 101.325 kPa has 30°C DBT and 15°C. Using psychomotor chart, and property values from table, Determine; 9

i) Partial pressure of air and water vapour ii) Specific humidity

iii) Relative humidity iv) Vapour density v) Enthalpy of moist air

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