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Third Semester B.E. Degree Examination, Dec.2019/Jan.2020 Engineering Thermodynamics

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamics Data Hand Book is allowed.

Module-1

- 1 a. Define :
- Intensive and extensive properties
 - Thermodynamics cycle
 - Thermodynamics equilibrium
 - Microscopic and macroscopic view points
 - Zenith law of thermodynamics
- (10 Marks)
- b. Fahrenheit and centigrade thermometers are both immersed in a fluid. Fahrenheit reading is numerically twice that of the centigrade reading. What is the temperature of the fluid expressed as R and K. Note $T_F = T_C + 459.17$.
- (10 Marks)

OR

- 2 a. Define work and heat and differentiate between them. (06 Marks)
- b. 'Heat may not cause a temperature rise, substantiate this statement with suitable example. (06 Marks)
- c. If perfect gas is undergoing a process according to $T \propto V^{-2/5}$. Calculate the workdone by the gas from state 1 at 100 bar and 4m^3 volume to the state 2 in which volume is 2m^3 . Also calculate the final pressure. (08 Marks)

Module-2

- 3 a. Derive an expression for SFEE (Steady Flow Energy Equation) and modify it to a steam nozzle. (10 Marks)
- b. Steam enters a nozzle with an enthalpy of 3025kJ/kg and exits at 2790kJ/kg . Assume the nozzle is horizontal with a heat loss of 100kJ/kg . If the inlet velocity is 60m/s , specific volume is $0.19\text{m}^3/\text{kg}$ and inlet area is 0.1m^2 , determine the exit velocity and mass flow rate. (10 Marks)

OR

- 4 a. Explain PMM I and PMM II and state why they violate thermodynamics laws. (10 Marks)
- b. A heat engine working on a Carnot cycle converts one fifth of the heat input into work. When the temperature of the sink is reduced by 80°C , the efficiency doubles, calculate the temperature of the source and sink. (10 Marks)

Module-3

- 5 a. Define the following terms :
- Critical point
 - Triple point
 - Dryness fraction
 - Enthalpy of vaporization
 - Degree of superheat.

Consider water as a pure substance and represents all the above point except triple point on a T-S diagram. (12 Marks)

- b. A throttling calorimeter is connected to the desuperheated steam line with the pressure measuring 3.0MPa. The calorimeter pressure is 200Kpa and the temperature is 250°C. Determine the line steam quality and the enthalpy (of the line). (08 Marks)

OR

- 6 a. Derive an expression for principle of increase of entropy and show that for an adiabatic process $S_2 - S_1 \geq 0$. (08 Marks)
- b. Define available and unavailable energy. (04 Marks)
- c. A heat engine receives reversibly 450kJ/cycle from a source at 327°C and rejects heat reversibly to a sink at 27°C. There are no other heat transfers for each of the three hypothetical cases, amount of heat rejected are i) 210kJ/cycle ii) 105 kJ/cycle iii) 315 kJ/cycle. Compute the cyclic integral of $\delta Q/T$ and from these results show that which process is reversible, irreversible and impossible. (08 Marks)

Module-4

- 7 a. With the help of a schematic diagram explain the working of a vapour absorption system. (10 Marks)
- b. A 10 tonne ammonia ice plant operates between evaporator temperature of 15°C and a condenser temperature of 35°C. The ammonia enters the compressor as dry saturated vapour. Assuming isentropic compression determine:
- Mass flow rate NH_3
 - COP of the plant
 - Power input in kW
 - Tones of ice produced at 10°C from water at 25°C in a day.
- Take enthalpy of fusion of ice = 334kJ/kg, C_p for water = 4.187 kJ/kg°C, C_p for ice = 2.1 kJ/kg°C. (10 Marks)

OR

- 8 a. Define the following terms and write the expression for the same.
- Specific humidity
 - Relative humidity
 - Degree of saturation
 - Sensible heating
- b. If sling psychrometer reads 40°C DBT and 28°C WBT. Calculate :
- Specific humidity
 - Relative humidity
 - Vapour density in air
 - Dew Point Temperature
- ii) Enthalpy of mixture per kg of dry air.
- Take total pr, $p = 101.325\text{KPa}$ and $R_v = 0.461 \text{ kJ/kg K}$, $R_a = 0.287 \text{ kJ/kg K}$. (12 Marks)

Module-5

- 9 a. Derive an expression for minimum work for a reciprocating compressor. Based on the P-V diagram define isothermal efficiency of a reciprocating compressor. (10 Marks)
- b. 7.5 kW of power is delivered by a single stage single cylinder double acting compressor. Determine the cylinder dimensions if stroke to diameter ratio is 1.25 : 1. The following data may be assumed. Suction pressure = 0.9bar, delivery pressure = 6 bar, average piston speed as 120m/s, law of compression $PV^{1.25} = C$. Neglect clearance. (10 Marks)

OR

- 10 a. With a neat sketch, explain the principle of Rocket propulsion. (07 Marks)
- b. Classify Gas turbines, sketch the Gas turbine cycle on a T-S diagram showing all the processes. Consider both ideal and actual cases and explain. (06 Marks)
- c. With suitable sketches, explain the principle of working of a Gas turbine with all major components. (07 Marks)
