

CBCS SCHEME

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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 $T_{\text{of}} = T_{\text{(R)}} - 459.17$. (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 $T\alpha V^{-2/5}$. 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)

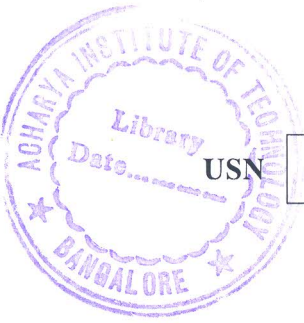
OR

- 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:
 i) Mass flow rate NH_3 ii) COP of the plant iii) Power input in kW
 iv) 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.
 i) Specific humidity ii) Relative humidity
 iii) Degree of saturation iv) Sensible heating (08 Marks)
 b. If sling psychrometer reads 40°C DBT and 28°C WBT. Calculate :
 i) Specific humidity ii) Relative humidity
 iii) Vapour density in air iv) 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)
