CBCS SCHEME

USN | | | | | | | | | | |

18AU32

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 :
i) Intensive and extensive properties
ii) Thermodynamics cycle
iii) Thermodynamics equilibrium
iv) Microscopic and macroscopic view points
v) 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 ToF = T (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 2790 kJ/kg. Assume the nozzle is horizontal with a heat loss of 100kJ/kg. if the inlet velocity is 60m/s, specific volume is $0.19m^3/kg$ 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 an 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 :
i) Critical point
ii) Triple point
iii) Dryness fraction
iv) Enthalpy of vaporization
v) 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 receivers 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 = 101.325KPa and R_v = 0.461 kJ/kg K, R_a = 0.287 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)**

* * * * *