CBCS SCHEME

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17AE33

Third Semester B.E. Degree Examination, July/August 2022
Aero Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Classify the following into intensive and extensive properties :
i) Color ii) Concentration iii) Enthalpy iv) Entropy v) Density vi) Internal energy vii) Specific enthalpy viii) Hardness ix) Pressore x) Volume. **(10 Marks)**

b. The emf in a thermocouple with the test junction at f'c on gas thermometer scale and reference junction at the pint is given by
$\varepsilon = 0.20t - 5 \times 10^{-4} t^2$ mV
The milliroltmeter is calibrated at ice point and steam point. What will this thermometer read in a place where the gas thermometer reads 50°C.? **(10 Marks)**

OR

2 a. Obtain displacement work for following quasi static process
i) Isobaric process
ii) Isothermal process
iii) Adiabatic process. **(10 Marks)**

b. Gas from a bottle of compressed helium is used to inflate an inelastic flexible balloon, originally folded completely flat to a volume of $0.5m^3$. If the barometer reads 760mm of Hg. What is the amount of work done upon the atmosphere by the balloon? Sketch the system before and after the process. **(10 Marks)**

Module-2

3 a. Show that energy of system is a property of the system. **(10 Marks)**

b. A fluid is confined in a cylinder by a spring loaded, frictionless piton so that pressure in the fluid is a linear function of the volume (P = a + bV). The internal energy of the fluid is given by
$U = 34 + 3.15pV$
$U \rightarrow kJ$
$P \rightarrow KPa$
$V \rightarrow m^3$
If the fluid changes from an initial state of 170KPa, $0.03m^3$ to final state of 400KPa, $0.06m^3$, with no work other tan piston, find the direction and magnitude of the work and heat transfer. **(10 Marks)**

OR

4 a. Apply mass balance and energy balance equation to steady flow process and obtain steady flow energy equation. **(10 Marks)**

b. In a stream power station, stream flows steady through a 0.2m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be 4MPa, 400°C and h = 3213.6kJ/kg, v = $0.073m^3$/kg. At the turbine end 3.5MPa, 392°C and h = 3202.6 kJ/kg, v = $0.084m^2$/kg. There is a heat loss of 8.5kJ/kg from the pipeline. Calculate the steam flow rate. **(10 Marks)**

Module-3

5 a. Prove that the violation of Kelvin – Planck statement implies the violation of clausius statement, for second law of thermodynamics. **(10 Marks)**

b. A cycle heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. what is the least rate of heat rejection per KW net output of the engine. **(10 Marks)**

OR

6 a. Obtain the equation for inequality of Clausius and given the criterion of the reversibility of a cycle. **(10 Marks)**

b. A system has a heat capacity at constant volume. $C_v = AT^2$; $A = 0.042 J/k^3$.
The system is originally at 200°K and thermal reservoir at 100°K is available. What is the maximum amount of work that can be recovered as the system is cooled down to the temperature of the reservoir? **(10 Marks)**

Module-4

7 a. State and explain the following :
i) Gibb's Dalton's law of partial pressure
ii) Amagots law of partial volume. **(10 Marks)**

b. A vessel of volume $0.04m^3$ contained a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9kg. Find the pressure, the mass, the specific volume, enthalpy and internal energy. **(10 Marks)**

OR

8 a. Determine the pressure in a steel vessel having a volume of 15 liter and containing 3.4kg nitrogen at 400°C by using :
i) Ideal gas equation
ii) Vander Waals equation
Also calculate the compressibility factor by using the answer obtained from the Vander Waals equation. **(10 Marks)**

b. Using maxwell's equation obtain :
i) First Tds equation
ii) Second Tds equation. **(10 Marks)**

Module-5

9 a. With a neat PV and TS diagram obtain air standard efficiency for otto cycle. **(10 Marks)**

b. A Carnot engine working between 400°C and 40°C produces 130kJ of work determine :
i) The engine thermal efficiency
ii) The heat added
iii) The entropy change during heat rejection process. **(10 Marks)**

OR

10 a. With neat sketch explain simple Rankine cycle. **(10 Marks)**

b. A Carnot cycle works on steam between the pressure limits of 7MPa and 7 KPa. Determine thermal efficiency, turbine work and compression work per kg of steam. **(10 Marks)**

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