12/06/2025 SE MECHANICAL SEM-III C-SCHEME THERMODYNAMICS QP CODE: 10083837

Duration: 3hrs **Marks:80**

N.B: (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.
(5) Use Steam Table.

1 Attempt any Five [20]

a) Define a thermodynamic system. Distinguish between open and closed systems with examples.

b) Define Thermal Reservoir. Difference between Heat Engine, Heat pump, Refrigerator Drive the COP of heat pump is greater than one

c) Define Joule Thomson coefficient and state its significance

d) Prove that Entropy is property of the system

e) Define a) Mach number b) Stagnation temperature c) Stagnation Pressure d) Sonic flow.

f) A gas undergoes a reversible non-flow process according to the relation p = (-3v +15) where V is the volume in $m^3$and p is the pressure in bar. Determine work done when the volume changes from 3 to 6 m^3.

2 a) Write two major statements of second law of thermodynamics and explain how the concept of thermal efficiency and coefficient of performance are generated by this law. [08]

b) 2 kg of an ideal gas occupies a volume of 0.3m^3 at 10 bar pressure and 500K temperature when this gas expands polytropically $PV^{1.2}$ =C the internal energy decreases by 300KJ. and γ = 1.4 Determine a) Specific gas constant b) Final temperature, pressure and volume c) Heat and work interaction across the system boundary. [12]

3 a) What do you mean by availability? A system at 450 K receives 225 kJ/s of heat energy from a source at 1500K, and the temperature of both the system and source remain constant during the heat transfer process. Determine net change in entropy, available energy of heat sources and system, and decrease in available energy Take atmospheric temperature equal to 300 K. [10]

	b)	Explain various components of a simple steam power plant with sketch.	[06]
	c)	Define and explain the terms Available energy, Un-available energy, irreversibility and Dead state.	[04]
4	a)	Sketch and explain the Rankine cycle on p-v and T-s plots.	[08]
	b)	Define a) wet steam b) Superheated steam c) Dryness fraction d) Saturation temperature. Steam initially at 0.95 dry and 12 bar expands isentropic ally in a non-flow process in a final dryness fraction of 0.8. What is the final pressure of steam and enthalpy change during the process?	[12]
5	a)	In a thermal power plant operating on an ideal Rankine cycle, superheated steam produced at 5MPa and 500°C is fed to a turbine where it expands to the condenser pressure of 10kPa. If the net power output of the plant is to be 20MW, evaluate: i) Heat added in the boiler in kJ/k ii) The thermal efficiency. iii) The mass flow rate of steam in kg/sec	[12]
	b)	What is cut off ratio? What are assumptions of air standard cycle? For same compression ratio and heat supplied, compare Otto and Diesel cycle with the help of P-V and T-S Diagram.	[08]
6	a)	An oil engine takes in air at 1.01 bar. 20°C and the maximum cycle pressure is 69 bar. The compression ratio is 18. Calculate the air standard thermal efficiency based on the dual combustion cycle. Assume that the heat added at constant volume is equal to the heat added at constant pressure.	[12]
	b)	Explain the effect of variation in back pressure on C-D nozzle performance	[08]

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