Gandhi Institute of Engineering and Technology University, Odisha, Gunupur (GIET University)

B. Tech (Third Semester - Regular) Examinations, November 2025

23BMEPC10001– Engineering Thermodynamics

(Mechanical Engineering)

Time: 3 hrs Maximum: 60 Marks

Use of Steam Table is Permitted in the Examination Hall
Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions

		CO #	Blooms Level
a.	State and explain briefly about principle of increase of entropy.	CO1	K1
b.	Define an irreversible process. State the causes of irreversibility.	CO2	K1
c.	Define dryness fraction. Write the dryness fraction value for saturated vapour.	CO4	K1
d.	Explain briefly about mean effective pressure (m.e.p).	CO5	K1
e.	Define free air delivery (F.A.D.) of a reciprocating air compressor.	CO6	K1

PART – B **(10 x 5 = 50 Marks)**

<u>Answer ***ALL*** the questions</u>

		Marks	CO #	Blooms Level
2. a.	0.05 m^3 of air at a pressure of 8 bar and temperature of 250°C expands to 7.5 times its original volume and the final temperature after expansion is 25°C. Calculate change of entropy of air during the process. Take c_p = 1.005 kJ/kgK and c_v = 0.72 kJ/kgK.	6	CO1	K3
b.	Define available energy (A.E.). Write the expression for A.E. from a finite source at temperature T when the environment temperature is T_o.	4	CO2	K3
	(OR)			
c.	Derive the expression for work done (W_{1-2}) in a non-flow isentropic process.	4	CO1	K3
d.	Calculate the decrease in available energy when 25 kg of water at 90°C mix with 35 kg of water at 36°C, the pressure being taken as constant and the temperature of surroundings being 18°C.	6	CO2	K3
3.a.	The rate of heat received by a heat engine from a source at 1200 K is 800 kW. The engine rejects heat to the sink of 300 K. If the heat engine produces a power of 200 kW, calculate the rate of irreversibility in kW.	6	CO2	K3
b.	Define entropy generation in a process. Explain that the expansion of a hot fluid in a turbine is an isentropic process.	4	CO3	K3
	(OR)			
c.	A metal piece of 1 kg mass with constant specific heat of 0.4 kJ/kgK is cooled from 210°C to 95°C by transferring heat to the surrounding air at 27°C. Determine the reversible work and the irreversibility for this process.	6	CO2	K3
d.	State and explain the Gouy-Stodola theorem in detail.	4	CO3	K3
4.a.	Describe the working principle of simple vapour power cycle in detail with neat sketch.	6	CO4	K3
b.	Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a	4	CO4	K3

	steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.			
	(OR)			
c.	Steam at 20 bar, 360°C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. (a) Assuming ideal processes, find net work per kg of steam and the cycle efficiency, (b) If the turbine and the pump have each 80% isentropic efficiency, find the % reduction in the net work and cycle efficiency.	6	CO4	K3
d.	Write short notes on the followings (draw T-s diagram for each case): a) Binary vapour cycle, b) Co-generation power plant	4	CO4	K3
5.a.	Draw p-V, T-s diagrams and derive the expression for air standard efficiency of Otto cycle.	6	CO5	K3
b.	An engine working on the Otto cycle is supplied with air at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum temperature and pressure of the cycle, the cycle efficiency, and the mean effective pressure. Take c_p = 1.005 kJ/kgK, c_v = 1.005 kJ/kgK, R = 0.287 kJ/kgK.	4	CO5	K3
	(OR)			
c.	In an air standard Diesel cycle, the compression ratio is 16, and the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate the followings: (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency and (d) the mean effective pressure.	6	CO5	K3
d.	Compare the Otto, Diesel and Dual combustion cycle performance on the basis of same compression ratio.	4	CO5	K3
6.a.	Describe the working principle of vapour compression refrigeration (VCR) system in detail with neat sketch.	6	CO6	K3
b.	Derive the expression for work done in isothermal process for a reciprocating air compressor without considering the clearance.	4	CO6	K3
	(OR)			
c.	Define tonne of refrigeration. Draw the T-s and p-h diagram of a VCR system and express its COP in terms of enthalpy.	4	CO6	K3
d.	A single acting reciprocating air compressor is required to compress 1 kg of air from 1 bar to 5 bar. The initial temperature is 27°C. Find the power required to drive the compressor in a polytropic process, i.e., $pV^{1.3} = C$, when the compressor runs at 150 rpm.	6	CO6	K3

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