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BTECH
(SEM III) THEORY EXAMINATION 2023-24
THERMODYNAMICS

TIME: 3HRS

M.MARKS: 70

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 7 = 14

Q no.	Question	Marks	CO
a.	State Zeroth law of thermodynamics.	2	1
b.	Explain Steady flow Process with the help of example.	2	2
c.	Why Carnot cycle is a theoretical cycle? Explain.	2	3
d.	Give the third law of thermodynamics.	2	3
e.	Define Available Energy and Unavailable Energy.	2	4
f.	Write short note on Clapeyron-Clausius equation.	2	4
g.	Draw Rankine cycle on T-s and p-V diagram.	2	5

SECTION B

2. Attempt any three of the following:

7 x 3 = 21

Q no.	Question	Marks	CO
a.	Define thermodynamic property. Classify it in detail with examples.	7	1
b.	Explain the 1 st law of thermodynamics applied to non-flow process. A gas at 65 kPa, 200°C is heated in a closed vessel till it reaches to 400°C. Determine the amount of heat required for 0.5 kg of this gas if internal energy at 200°C and 400°C are 26.6 kJ/kg and 37.8 kJ/kg respectively.	7	2
c.	Two reversible heat engines 'A' and 'B' are arranged in series, engine 'A' rejecting heat directly to engine 'B'. Engine 'A' receives 200 kJ at a temperature of 421°C from a hot source, while engine 'B' is in communication with a cold sink at a temperature of 4.4°C. If the work output of 'A' is twice that of 'B', find (i) The intermediate temperature between engine 'A' and engine 'B' (ii) The efficiency of each engine (iii) The heat rejected to the cold sink.	7	3
d.	Define the co-efficient of : (i) Volume expansion (ii) Isothermal compressibility (iii) Adiabatic compressibility	7	4
e.	Discuss Vapor Compression Refrigeration Cycle (VCR) with the help of T-s and p-h diagrams.	7	5

SECTION C

3. Attempt any one part of the following:

7 x 1 = 7

Q no.	Question	Marks	CO
a.	Explain Concept of Continuum in detail.	7	1
b.	A gas undergoes a thermodynamic cycle consisting of three processes Beginning at an initial state where $p_1 = 1$ bar, $V_1 = 1.5$ m ³ and $U_1 = 512$ kJ. The processes are as follows: (i) Process 1–2: Compression with $pV = \text{constant}$ to $p_2 = 2$ bar, $U_2 = 690$	7	1



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	kJ (ii) Process 2–3: $W_{2-3} = 0$, $Q_{2-3} = -150$ kJ, and (iii) Process 3–1: $W_{3-1} = +50$ kJ. Neglecting KE and PE changes, Determine the heat interactions Q_{1-2} and Q_{3-1} .		
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4. Attempt any one part of the following: 7 x 1 = 7

Q no.	Question	Marks	CO
a.	A freezing plant requires 40 tons of refrigeration. The freezing temperature is -35°C while the ambient temperature is 30°C . If the performance of the plant is 20% of the theoretical reversed Carnot cycle working within the same temperature limits, calculate the power required.	7	2
b.	State Kelvin Planck and Clausius statements of second law of thermodynamics. Also establish equivalence of these two statements.	7	2

5. Attempt any one part of the following: 7 x 1 = 7

Q no.	Question	Marks	CO
a.	Calculate the decrease in available energy when 25 kg of water at 95°C mix with 35 kg of water at 35°C , the pressure being taken as constant and the temperature of the surroundings being 15°C (C_p of water = 4.2 kJ/kgK).	7	3
b.	Write short notes on the following: (1) Available energy and unavailable energy. (2) Joule-Thompson coefficient and Inversion curve	7	3

6. Attempt any one part of the following: 7 x 1 = 7

Q no.	Question	Marks	CO
a.	Explain Simple Rankine Cycle of T-s and p-v diagrams.	7	4
b.	Explain following psychrometric properties: (1) Wet bulb temperature (2) Dew point temperature (3) Relative humidity	7	4

7. Attempt any one part of the following: 7 x 1 = 7

Q no.	Question	Marks	CO
a.	Explain reverse brayton cycle with the help of T-s and p-v diagrams.	7	5
b.	A refrigerator working on reverse brayton cycle operates between pressure limits of 1 bar and 6 bar. Air is drawn from the cold chamber at 15°C , Air coming out of compressor is cooled at 30°C before entering the expansion cylinder. Expansion and compression follow the $PV^{1.4}=C$. Determine C.O.P of the system.	7	5