Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III EXAMINATION – WINTER 2025

Subject Code:3131905 Date:15-12-2025

Subject Name: Engineering Thermodynamics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

3. **Attempt all questions.**
4. **Make suitable assumptions wherever necessary.**
5. **Figures to the right indicate full marks.**
6. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	State Zeroth law of thermodynamics.	**03**
	(b)	What is quasi-static process? Explain with neat sketch.	**04**
	(c)	Write short note on thermodynamic temperature scale.	**07**
Q.2	**(a)**	State and explain first law of thermodynamics.	**03**
	(b)	Write and explain steady flow energy equation for (i) Turbine (ii) Heat exchanger.	**04**
	(c)	Write short note on limitations of first law of thermodynamics.	**07**
		OR	
	(c)	10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid at the inlet are : p_1 = 1.5 bar, ρ_1 = 26 kg/m3, C_1 = 110 m/s and u_1 = 910 kJ/kg and at the exit are p_2 = 5.5 bar, ρ_2 = 5.5 kg/m3, C_2 = 190 m/s and u_2 = 710 kJ/kg. During the passage, the fluid rejects 55 kJ/s and rises through 55 metres. Determine : (i) The change in enthalpy (Δh) ; (ii) Work done during the process (W).	**07**
Q.3	**(a)**	Explain principle of increase of entropy.	**03**
	(b)	State and explain different causes of irreversibility.	**04**
	(c)	Write short note on entropy change for non-flow and flow processes.	**07**
		OR	
Q.3	**(a)**	State function of feed water heater.	**03**
	(b)	Explain in brief about reheat-regenerative cycle.	**04**
	(c)	Discuss in detail about different variables affecting efficiency of Rankine cycle.	**07**
Q.4	**(a)**	What is air standard efficiency?	**03**
	(b)	Explain simple Brayton cycle with neat sketch.	**04**
	(c)	Explain simple vapour compression refrigeration (VCR) cycle on P-h and T-s diagrams.	**07**
		OR	
Q.4	**(a)**	Explain term mean effective pressure.	**03**
	(b)	Enlist different factors affecting the performance of VCR cycle. Explain any one of them in detail.	**04**
	(c)	Write short note on Bell-Coleman cycle.	**07**
Q.5	**(a)**	What is stoichiometric air fuel ratio?	**03**
	(b)	Explain adiabatic flame temperature.	**04**
	(c)	Write short note on Bomb gas calorimeter.	**07**
		OR	
Q.5	**(a)**	What is calorific value of fuel?	**03**
	(b)	Explain in brief about reversed Carnot cycle and its limitations.	**04**
	(c)	A mixture of hydrogen (H_2) and oxygen (O_2) is to be made so that the ratio of H_2 to O_2 is 2 : 1 by volume. If the pressure and temperature are 1 bar and 25°C respectively, calculate : (i) The mass of O_2 required ; (ii) The volume of the container	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2024

Subject Code:3131905 Date:29-11-2024

Subject Name:Engineering Thermodynamics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of steam table is permitted.**

Q.1	**(a)**	What do you mean by thermodynamic equilibrium? Explain in detail.	**03**
	(b)	'Entropy is a property of the system.' Prove the statement.	**04**
	(c)	Write two major statements of second law of thermodynamics and show that violation of one statement leads to violation of other one.	**07**
Q.2	**(a)**	Explain in brief - PMM 1 and PMM 2.	**03**
	(b)	Define and explain: (i) Homogenous and Heterogeneous system (ii) Intensive and Extensive properties	**04**
	(c)	In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate: (i) The rate at which heat is rejected to the turbine and (ii) The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m^3/kg.	**07**
		OR	
	(c)	300 kJ/s of heat is supplied at a constant fixed temperature of 290°C to a heat engine. The heat rejection takes place at 8.5°C. The following results were obtained : (i) 215 kJ/s are rejected. (ii) 150 kJ/s are rejected. (iii) 75 kJ/s are rejected. Classify which of the result report a reversible cycle or irreversible cycle or impossible results.	**07**
Q.3	**(a)**	Give comparison of Carnot and Rankine cycle.	**03**
	(b)	A rigid cylinder containing 0.004 m^3 of nitrogen at 1 bar and 300 K is heated reversibly until temperature becomes 400 K. Determine : (i) The heat supplied. (ii) The entropy change. Assume nitrogen to be perfect gas (molecular mass = 28) and take $\gamma = 1.4$	**04**
	(c)	Write a short note on Bomb calorimeter.	**07**
		OR	
Q.3	**(a)**	Explain the concept of available and unavailable energy. When does the system become dead?	**03**
	(b)	Explain the terms irreversibility and effectiveness. State types of irreversibilities.	**04**

	(c)	5 kg of water at 0^0C is exposed to reservoir at 98^0C. Calculate the change of entropy of water, reservoir and universe. Assume that specific heat of water is 4.187 KJ/Kg-K.	**07**
Q.4	**(a)**	State advantages and disadvantages of regenerative feed heating.	**03**
	(b)	Derive an expression for thermal efficiency of an Otto cycle.	**04**
	(c)	In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work.	**07**

OR

Q.4	**(a)**	State the assumptions made for analysis of air standard cycles.	**03**
	(b)	Explain effect of regeneration on the performance of Rankine cycle using appropriate diagram.	**04**
	(c)	Explain principle of increase of entropy.	**07**
Q.5	**(a)**	An inventor claims that a new heat cycle will develop 0.4 kW for a heat addition of 32.5 kJ/min. The temperature of heat source is 1990 K and that of sink is 850 K. Is his claim possible?	**03**
	(b)	Compare Otto, Diesel and Dual cycles for (i) Same compression ratio and heat supplied (ii) Same maximum pressure and temperature	**04**
	(c)	Explain simple Vapour Compression Refrigeration (VCR) cycle with P-h and T-s diagrams.	**07**

OR

Q.5	**(a)**	Explain minimum air volume requirement for complete combustion of 1 m^3 Hydrogen fuel.	**03**
	(b)	Explain the following terms: (i) Adiabatic flame temperature (ii) Enthalpy of reaction (iii) Enthalpy of formation (iv) Stoichiometric air fuel ratio	**04**
	(c)	Discuss various factors affecting the performance of simple VCR cycle.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – WINTER 2023

Subject Code:3131905 Date:18-01-2024

Subject Name:Engineering Thermodynamics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of Steam table and Mollier Chart (h-s diagram) is permitted.**

			MARKS
Q.1	**(a)**	Define state, property, cycle.	**03**
	(b)	Explain Zeroth law of thermodynamics stating it's application.	**04**
	(c)	Explain First law of thermodynamics for the closed system i) undergoing a cycle and ii) change of state/process.	**07**
Q.2	**(a)**	Carnot cycle is practically impossible. Justify the statement	**03**
	(b)	Compare steady flow processes with unsteady flow processes.	**04**
	(c)	Write down Kelvin-Planck's and Clausius' statements for Second Law of thermodynamics. Prove equivalence between them.	**07**
		OR	
	(c)	At the inlet to an insulated nozzle, steam enters at 687 kPa and 205°C with 3000 m/min velocity and leaves at a pressure of 137 kPa and 30000 m/min velocity. Determine enthalpy of leaving steam. Mention the assumptions made.	**07**
Q.3	**(a)**	Explain the terms 'EXERGY' and 'ANERGY'.	**03**
	(b)	Prove that entropy is the property of system.	**04**
	(c)	Derive an expression for exergy of a closed system.	**07**
		OR	
Q.3	**(a)**	Explain the Third Law of Thermodynamics.	**03**
	(b)	State the types of irreversibility. Discuss their effects.	**04**
	(c)	A heat engine receives 1000 kW of heat from an infinite heat source at 559 K and rejects heat at 279 K to an infinite heat sink. Comment whether the cycle is possible or irreversible for following heat rejection amounts: i) 400 kW ii) 490 kW iii) 850 kW	**07**
Q.4	**(a)**	State the functions of the following components of V.C.R. system: (1) Condenser (2) Expansion Valve (3) Evaporator	**03**
	(b)	Compare Carnot and Rankine cycle.	**04**
	(c)	In an ideal Rankine cycle, steam at 20 bar and 350° C expands in steam turbine to 0.05 bar. The saturated water after condensation fed back to the boiler. Determine i) net work done per kg of steam ii) Rankine cycle efficiency.	**07**
		OR	
Q.4	**(a)**	Discuss with T-s diagram, the effect of superheat and condenser pressure variation on performance of Rankine cycle.	**03**
	(b)	Discuss any two factors affecting the performance of VCR cycle.	**04**
	(c)	In an engine operated on Otto cycle, the compression ratio is 6 and the compression starts at 30° C and 100 kPa. The maximum temperature of the cycle	**07**

is 1250°C. Determine; i) heat supplied pe kg of air ii) air standard efficiency of the cycle iii) Mean effective pressure of the cycle. Take Cv = 0.716 and $\gamma = 1.4$

Q.5	**(a)**	Explain effect of regeneration on the performance of Rankine cycle using appropriate diagram.	**03**
	(b)	Draw block diagram of Vapour Compression Refrigeration system. Write down all four processes and show these processes on p-h diagram.	**04**
	(c)	Explain Junker's gas calorimeter with neat sketch.	**07**

OR

Q.5	**(a)**	Explain effect of sub cooling in VCR cycle using p-h diagram.	**03**
	(b)	Derive an expression for thermal efficiency of an Otto cycle.	**04**
	(c)	Determine the mass of air required for the complete combustion of 1 kg of an Iso-Octane (C_8H_{18}) used as a fuel for an engine. Assume air contains 23% O_2 by mass.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III(NEW) EXAMINATION – WINTER 2022

Subject Code:3131905 Date:24-02-2023

Subject Name:Engineering Thermodynamics

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Discuss perpetual motion machines of first kind with neat sketch.	**03**
	(b)	Explain zeroth law of thermodynamics.	**04**
	(c)	Show the equivalence of Clausius and Kelvin Plank statement of second law of thermodynamics.	**07**
Q.2	**(a)**	Carnot cycle is not practical – Justify the statement.	**03**
	(b)	Briefly discuss about thermodynamic equilibrium.	**04**
	(c)	A cylinder contains 0.45 m^3 of gas at $1x10^5$ N/m^2 and 80°C. The gas is compressed to a volume of 0.13 m^3. The final pressure being $5x10^5$ N/m^2. Assume $\gamma = 1.4$, R = 294.2 J/kg °C. Calculate mass of gas, index of compression n, increase in internal energy of gas and heat rejected by gas during compression.	**07**
		OR	
	(c)	A reversible refrigerator is used to maintain a temperature of 0° C in a refrigerator space when it rejects heat to the atmosphere at 27° C. The heat removal rate from refrigerator space is 1500 kJ/min. Find out the COP and work input required. (ii) If the reversible heat engine used to run the above refrigerator, calculate overall COP of the system, heat engine receives heat from source at 400° C and rejects heat to atmosphere.	**07**
Q.3	**(a)**	Define the following terms: (i) Available energy (ii) Unavailable energy (iii) Dead state	**03**
	(b)	Prove that entropy is a property of system.	**04**
	(c)	5 kg of water at 30° C is mixed with 1 kg of ice at 0° C. The process of mixing is adiabatic and the system is open to atmosphere. Make calculations for the temperature of mixture and the change of entropy for the spontaneous mixing process. Take specific heat of water = 4.187 kJ/kg K and latent heat of ice = 335 kJ/kg.	**07**
		OR	
Q.3	**(a)**	Define and explain reversible process.	**03**
	(b)	State the types of irreversibility. What is their effect?	**04**
	(c)	Derive the relevant equation to get maximum work from a finite body and thermal energy reservoir.	**07**
Q.4	**(a)**	Show simple Vapour Compression Refrigeration (VCR) cycle on *P-h* and *T-s* diagram. State the processes involved.	**03**
	(b)	Explain variables affecting efficiency of Rankine cycle.	**04**

(c) In an engine working on Otto cycle, air has a pressure of 1 bar and temperature 30° C at the entry. Air is compressed with a compression ratio of 6. The heat is added at constant volume until the temperature rises to 1500 °C. Determine (i) air standard efficiency (ii) pressure and temperature at the end of compression (iii) heat supplied (iv) mean effective pressure. **07**

Take C_V= 0.718 kJ/kg K, R = 0.287 kJ/kg K.

OR

Q.4 **(a)** State the assumptions made for analysis air standard cycle. **03**

(b) Compare Otto, Diesel and Dual cycles for **04**

(i) Same compression ratio and heat supplied

(ii) Same maximum pressure and temperature

(c) An ammonia refrigerator works between – 6.7 °C and 26.7 °C. The vapour is dry-saturated at the end of compression. Calculate (i) theoretical COP (ii) Power required to drive the compressor if the cooling capacity of the refrigerator is 5 tons. **07**

Use of the following properties of NH_3.

Temp (°C)	Sp Enthalpy (kJ/kg)		Sp Entropy (kJ/kg-K)	
	Liquid (h_f)	Saturated Vapour (h_g)	Liquid (s_f)	Saturated Vapour (s_g)
-6.7	-29.26	1262.36	-0.1087	4.7401
26.7	124.56	1291.62	0.4264	4.3263

Q.5 **(a)** Efficiency of Carnot cycle is independent of working fluid – Justify. **03**

(b) State the factors affecting the performance of simple VCR cycle **04**

(c) Explain the minimum air requirement for incomplete combustion of carbon to carbon monoxide by mass and volume. **07**

OR

Q.5 **(a)** Compare Carnot and Rankine cycle. **03**

(b) Explain the following terms: **04**

(i) Adiabatic flame temperature

(ii) Enthalpy of reaction

(iii) Enthalpy of formation

(iv) Stoichiometric air fuel ratio

(c) Derive air standard efficiency of Diesel cycle. **07**

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