Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III EXAMINATION – SUMMER 2025

Subject Code:3131905 Date:31-05-2025

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.**
5. **Steam table, Gas table and Mollier chart is permitted.**

			Marks
Q.1	**(a)**	Define the terms: (1) Thermodynamics System (2) Property (3) Cycle	**03**
	(b)	Explain thermodynamic equilibriumbriefly.	**04**
	(c)	Derive S.F.E.E. clearly stating assumptions. Reduce it for turbine.	**07**
Q.2	**(a)**	Show that the COP of a heat pump is always greater than the COP of refrigerator.	**03**
	(b)	Explain PMM of kind I and II.	**04**
	(c)	Steam enters a nozzle at 7 bar pressure and 20º C (initial enthalpy = 2850 kJ/kg) and leaves at a pressure of 1.5 bar. The initial and final velocities of steam is 40 m/s nad 700 m/s respectively throught the nozzle. The mass flow rate is 1400 kg/hr and heat loss from the nozzle is 11705 kJ/hr. Specific volume at exit is 1.24 m^3/kg.Determine final enthalpy and exit area.	**07**
		OR	
	(c)	An inventor claims that his engine developes 75 kW of power while operating between 1023K and 298K temperature. The amount of fuel(C.V. of fuel = 74500 kJ/kg) burnt per hour is 3.9 kg. Comment about the validity of his claim and justify your comment.	**07**
Q.3	**(a)**	State and prove Clausius theorem.	**03**
	(b)	Show that efficiency of a reversible heat engine operating between two constant temperatures is maximum.	**04**
	(c)	A block of 100 kg of iron at temperature 100ºC is immersed in 50 kg of water at a temperature of 20ºC. Determine the entropy change for combined system of iron and water. Take Cp of iron and water as 0.42 kJ/kgK and 4.18 kJ/kgK respectively.	**07**
		OR	
Q.3	**(a)**	Define: (i) Availability (ii) Irreversibility and (iii) Dead state.	**03**
	(b)	Explain Guoy-Stodola theorem.	**04**
	(c)	Explain principle of increase of entropy. Apply it for the heat transfer through a finite temperature difference.	**07**
Q.4	**(a)**	Enlist desirable properties of good refrigerant.	**03**
	(b)	For the same compression ratio and heat rejection, compare Otto, Diesel and Dual cycle. Explain with p-v and T-s diagram.	**04**

	(c)	Draw Rankine cycle on P-v, T-s and h-s diagrams and derive an expression for its thermal efficiency with and without pump work.	**07**
		OR	
Q.4	**(a)**	State the assumptions made for the analysis of air standard cycle.	**03**
	(b)	Explain simple regenerative Rankine cycle.	**04**
	(c)	A diesel engine has compression ratio of 20. The compression begins at 0.1 MPa and 35ºC. The heat added is 1700 kJ/kg. Calculate maximum pressure and temperature of cycle, work done per kg of air and cycle efficiency.	**07**
Q.5	**(a)**	Define the following terms related to combustion process: (i) HCV (ii) LCV (iii)Enthalpy of formation	**03**
	(b)	Explain Bomb calorimeter with neat sketch.	**04**
	(c)	Discuss factors affecting performance of VCR cycle.	**07**
		OR	
Q.5	**(a)**	Explain Stoichiometric air fuel ratio in detail.	**03**
	(b)	Calculate the amount of theoretical air required for the combustion of 1 kg of acetylene (C_2H_2) to CO_2 and H_2O.	**04**
	(c)	In a steam power cycle, the dry saturated steam supplied at 15 bar. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131905 Date:29-06-2024

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 tables and Mollier diagrams is allowable.**

			Marks
Q.1	**(a)**	Define the terms: 1. Process 2. Cycle 3. Isolated system	**03**
	(b)	Explain in brief:1. Thermodynamic equilibrium 2. Zeroth law of thermodynamics	**04**
	(c)	Derive the steady flow energy equation for (1) Steam Nozzle (2) Centrifugal Pump	**07**
Q.2	**(a)**	What do you mean by PMM-1 and PMM-2 ?	**03**
	(b)	Differentiate between the Heat Pump and Refrigerator.	**04**
	(c)	A stream of gases at 750 kPa, 750°C and 140 m/s is passed through a gas turbine of a jet engine. The stream comes out of the turbine at 200 kPa, 550°C and 280 m/s. The enthalpies of gas at the entry and exit of the turbine are 950 kJ/kg and 650 kJ/kg of gas respectively. Determine the capacity of the turbine if the gas flow is 5 kg/s. Assume the process is adiabatic.	**07**
		OR	
	(c)	Determine the least rate of heat rejection per kW net output of the cyclic heat engine which operates between a source temperature of 1000°C and a sink temperature of 40°C.	**07**
Q.3	**(a)**	State the limitations of the Carnot Cycle.	**03**
	(b)	The air standard efficiency of an Otto cycle is 60% and γ = 1.4. Calculate the compression ratio.	**04**
	(c)	Derive the air standard efficiency equation of Otto cycle with usual notations.	**07**
		OR	
Q.3	**(a)**	Explain the terms: Brake thermal efficiency and Relative efficiency of the engine.	**03**
	(b)	An oil engine working on the dual combustion cycle has a compression ratio of 14 and the explosion ratio obtained from an indicator card is 1.4. If the cut-off occurs at 6 per cent of the stroke, find the ideal efficiency. Take γ for air = 1.4.	**04**
	(c)	Derive the air standard efficiency equation of Diesel cycle with usual notations.	**07**
Q.4	**(a)**	Explain in brief the term: EXERGY.	**03**
	(b)	Explain with neat schematic diagram the Reheat Rankine cycle.	**04**
	(c)	In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine: (i) The pump work, (ii) The turbine work, (iii) The Rankine efficiency, (iv) The condenser heat flow,(v) The dryness at the end of expansion. Assume the mass flow rate of steam equals to 9.5 kg/s.	**07**
		OR	

Q.4	**(a)**	Explain in brief the terms: Available energy and Unavailable energy.	**03**
	(b)	Draw the Simple Brayton cycle on p-v and T-s diagrams.	**04**
	(c)	Explain with neat schematic diagram the Simple Vapour Compression Refrigeration (VCR) cycle. Also draw P-h and T-s diagrams for it.	**07**
Q.5	**(a)**	Define the terms: Reversibility and Irreversibility.	**03**
	(b)	With usual notations prove that $\Phi\delta Q/T <= 0$.	**04**
	(c)	Describe the terms: (i) Enthalpy of formation, (ii) Enthalpy of reaction, (iii) Adiabatic flame temperature	**07**

OR

Q.5	**(a)**	What is irreversibility? State various types of irreversibility.	**03**
	(b)	What is entropy principle? With the help of it prove that adiabatic mixing of two fluids is irreversible.	**04**
	(c)	Describe with neat diagram the bomb calorimeter.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131905 Date:28-07-2023

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 the type of thermodynamic system by giving suitable example of it.	**03**
	(b)	Explain thermodynamic equilibrium and state the Zeroth law of thermodynamics.	**04**
	(c)	Derive the general energy equation and deduce it for steady flow energy equation.	**07**
Q.2	**(a)**	Discuss the Limitation of first law of thermodynamics.	**03**
	(b)	Explain the terms PMM – I and PMM – II with suitable diagram.	**04**
	(c)	Give comparison between Otto, diesel, and dual cycles based on same compression ratio and heat rejection.	**07**
		OR	
	(c)	Derive equation for efficiency for Diesel Cycle.	**07**
Q.3	**(a)**	Explain state and property also describe intensive and extensive property.	**03**
	(b)	Show that the COP of a heat pump is greater than the COP of refrigerator by unity.	**04**
	(c)	How actual Brayton cycle differs from the theoretical cycle? Explain with the help of T-S diagram.	**07**
		OR	
Q.3	**(a)**	Define: i) Enthalpy of formation, ii) Enthalpy of reaction, iii) Adiabatic flame temperature.	**03**
	(b)	Write down Kelvin-Planck and Clausius statements of 2 Law of thermodynamics.	**04**
	(c)	In a steam power station, steam flows steadily through a 0.2 m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be p= 4 MPa, t = 400°C, h = 3213.6 kJ/kg, and v = 0.073 m^3/kg. At the turbine end, the conditions are found to be p = 3.5 MPa, t = 392°C, h= 3202.6 kJ/kg and v=0.084 m^3/kg. There is a heat loss of 8.5 kJ/kg from the pipeline. Calculate the steam flow rate.	**07**
Q.4	**(a)**	Discuss causes of irreversibility for a thermodynamic system.	**03**
	(b)	Explain the Clausius inequality.	**04**
	(c)	An engine working on the otto cycle is supplied with air at 0.1MPa, 35°C. The compression ratio is 8. Heat supplied is 2100kJ/kg, Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and mean effective pressure (for air, Cp = 1.005, Cv = 0.718 and R = 0.287 kJ/kg K).	**07**

OR

Q.4	**(a)**	State first law of thermodynamics. Write the limitation of first law of thermodynamics.	**03**
	(b)	What is the mean temperature of heat addition? Explain its significance.	**04**
	(c)	Show that efficiency of a reversible heat engine operating between two constant temperatures is maximum.	**07**
Q.5	**(a)**	Draw the sketch of Rankine cycle p-V, T-s and h-s diagram (consider Inlet and exit to turbine is superheated and saturated steam respectively).	**03**
	(b)	Draw block diagram of Vapour Compression Refrigeration system. Write down all four processes only. Also show these processes on p-h diagram.	**04**
	(c)	Steam at 20 bar, 360^{o}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. Assuming ideal processes, find per kg steam the network and the cycle efficiency.	**07**

OR

Q.5	**(a)**	Define following terms: 1) dead state 2) high grade energy 3) irreversibility.	**03**
	(b)	Define cut-off ratio. How cut-off ratio affects the efficiency of diesel cycle?	**04**
	(c)	Explain the availability of steady flow process.	**07**

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