Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2021

Subject Code:3131905 Date:11/09/2021

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.**

			Marks
Q.1	**(a)**	Define the terms: (1) System (2) Process (3) State	**03**
	(b)	Explain thermodynamic equilibrium and state the Zeroth law of thermodynamics.	**04**
	(c)	A steam turbine operates under steady flow conditions, receiving steam from the boiler at the following state: Temperature=188°C, Enthalpy=2800 kJ/kg, velocity 70 m/s and elevation 4 m. The steam leaves the turbine at the following state: Pressure 20 kPa, Enthalpy 2000 kJ/kg, velocity 140 m/s, and elevation 1.5 m. Heat losses from the turbine to the surroundings are at the rate of 1600 kJ/hr. Calculate the power output of the turbine in kW if the rate of steam flow through the turbine is 7500 kg/hr.	**07**
Q.2	**(a)**	Explain the terms PMM – I and PMM – II.	**03**
	(b)	Compare steady flow processes with unsteady flow processes.	**04**
	(c)	Derive S.F.E.E. with usual notations and apply it to (1) Pump (2) Heat Exchanger	**07**
		OR	
	(c)	State Kelvin-Planck and Clausius statements of second law of thermodynamics and prove the equivalence of these two.	**07**
Q.3	**(a)**	What do you understand by the term “EXERGY” and “ANERGY”	**03**
	(b)	Explain the Third Law of Thermodynamics.	**04**
	(c)	Compare: Otto, Diesel and Dual cycles.	**07**
		OR	
Q.3	**(a)**	Define: Reversibility, Irreversibility, Availability.	**03**
	(b)	Explain with neat diagram: Heat pump and Refrigerator.	**04**
	(c)	A machine operation as a heat pump extracts heat from the surrounding atmosphere and draws 7.5 KW power from the electric motor. It supplies heat to a house at the rate of 2,00,000 kJ per hour for the heating of the room in winter season. Calculate the COP of heat pump. If the same machine is used to cool the house in the summer which require the heat rejection rate of 2,00,000 kJ per hour to the surrounding, then calculate the COP in this case. Also comment on the result.	**07**
Q.4	**(a)**	State the functions of the following components of vapour compression refrigeration system: (1) Condenser (2) Expansion Valve (3) Evaporator	**03**
	(b)	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.	**04**

	(c)	Determine the cycle efficiency of a Thermal power plant operating on an ideal Rankine cycle in which superheated steam expands in turbine from boiler pressure of 5MPa and temperature 500 ◦C to the condenser pressure of 10kPa.	**07**

OR

Q.4	**(a)**	What is bleeding? How does it affect the Rankine Cycle efficiency?	**03**
	(b)	Draw Otto cycle and derive its thermal efficiency equation.	**04**
	(c)	In an air standard diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression the temperature is 15 ^{0}C and the pressure is 0.1MPa. Heat is added until the temperature at the end of the constant pressure process is 1480 ^{0}C. Calculate: (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency	**07**
Q.5	**(a)**	Define: i) Enthalpy of formation, ii) Enthalpy of reaction, iii) Adiabatic flame temperature.	**03**
	(b)	State the principle of increase of entropy.	**04**
	(c)	Describe the experimental method to determine the calorific value of coal.	**07**

OR

Q.5	**(a)**	Calculate the availability and unavailability of a system that draws 15 MJ of heat from a heat source maintained at a temperature of 500K.The surrounding temperature is 290 K.	**03**
	(b)	Prove that $\Phi\delta Q/T <= 0$ with usual notations.	**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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