Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131905 Date:21-02-2022

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)**	Explain Guoy-Stodola theorem.	**03**
	(b)	Derive equation for filling of a tank.	**04**
	(c)	Prove that all reversible engines operating between operating between same temperatures limits have are equally efficient.	**07**
Q.2	**(a)**	Draw open cycle gas turbine diagram and represent simple Brayton cycle on T-s and p-V diagram.	**03**
	(b)	Distinguish between energy of non flow system and flow system.	**04**
	(c)	A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption.	**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)**	State zeroth law of thermodynamics with its applications.	**03**
	(b)	Compare Otto, Diesel and Dual cycle for same compression ratio and heat supplied. Also show comparison on p-v and T-s diagram.	**04**
	(c)	A heat engine receives heat at the rate of 1500 kJ/min and gives an output of 8.2 kW. Determine : (i) The thermal efficiency , (ii) The rate of heat rejection.	**07**
		OR	
Q.3	**(a)**	Define the following terms: (i) Available energy, (ii) Unavailable energy, (iii) Dead state	**03**
	(b)	What are the characteristics of entropy? Prove that entropy is a property of a system.	**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)**	Draw block diagram of Vapour Compression Refrigeration system. Write down all four processes only. Also show these processes on p-h diagram.	**03**
	(b)	State the types of irreversibility. What is their effect?	**04**
	(c)	Prove that violation of Kelvin-Plank statement leads to violation of Clausius statement.	**07**

OR

Q.4	**(a)**	Compare Brayton cycle and Rankine cycle.	**03**
	(b)	Show that the COP of a heat pump is greater than the COP of refrigerator by unity.	**04**
	(c)	Distinguish between energy of non flow system and flow system. Deduce the steady flow energy equation for a reciprocating compressor.	**07**
Q.5	**(a)**	Prove that entropy is the property of system.	**03**
	(b)	Write short note on thermodynamic equilibrium.	**04**
	(c)	Define following terms: state, path, process, isolated system, intensive property, quasi-static process, perfect gas.	**07**

OR

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)	Describe quasi-static process.	**04**
	(c)	Explain principle of increase of entropy. Apply it for the heat transfer through a finite temperature difference.	**07**

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