Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2020

Subject Code:3131905 Date:04/03/2021

Subject Name:Engineering Thermodynamics

Time:10:30 AM TO 12:30 PM Total Marks:56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Steam table is permitted**

			MARKS
Q.1	**(a)**	State, with justification, whether the following properties of a system are Intensive or Extensive. 1.Volume 2.Velocity 3.Temperature	**03**
	(b)	Define the term "Thermodynamic system". Discuss the type of thermodynamic system by giving suitable example of it.	**04**
	(c)	What do you mean by stoichiometric Air-fuel ratio? Find stochiometric amount of air (in kg) required to combust coal supplied to a boiler having following composition by mass; C=88%,H_2=5%,O_2=3%,N_2=1%,S=0.5%,Incombustible matter=2.5%	**07**
Q.2	**(a)**	Draw simple Vapor Compression Refrigeration (VCR) cycle on T-S and P-H plot and mention the various processes occurs.	**03**
	(b)	Why carnot cycle is not used as a standard of reference for steam power plant?	**04**
	(c)	In ideal Brayton cycle,air from the atmosphere at 1 atm and 27^{o}C is compressed to 6 atm and maximum cycle temperature is limited to 827^{o}C. If the heat supplied is 100 MW, find (1) the thermal efficiency of the cycle (2) work ratio (3) power output	**07**
Q.3	**(a)**	Discuss the Limitation of first law of thermodynamics.	**03**
	(b)	An engine manufacturer claims to have developed a heat engine with the following specifications • Power developed: 75 kW • Fuel burnt: 5 kJ/hr • Calorific value of fuel=75,000 kJ/kg • Heat source and heat sink temperature limits are 1000 K and 400 K respectively Is the claim of the manufacturer true or false? Give reasons of your answer.	**04**
	(c)	What do you mean Steady flow process? Write the Steady Flow Energy Equation (SFEE) for the open system and obtain the expression of; 1) Velocity of fluid at exit of "Nozzle" 2) Work done by the "Steam turbine"	**07**

Q.4	**(a)**	Explain Kelvin-planck statement of second law of thermodynamics	**03**
	(b)	A close system undergoes process from state 1 to 2, during which 100 kJ of heat is supplied to the system and 140 kJ of work is obtained. To restore the system to initial state 80 kJ of work need to be supplied to the system. What would be the magnitude and sign of heat transfer during the return path?	**04**
	(c)	Show that efficiency of a reversible heat engine operating between two constant temperatures is maximum.	**07**
Q.5	**(a)**	Define refrigerant for Vapor Compression Refrigeration (VCR) cycle and list desirable properties of good refrigerant	**03**
	(b)	For the same compression ratio and same amount of heat rejection, which cycle is most efficient: Otto, Diesel or Dual? Justify and explain your answer with P-V and T-S diagram	**04**
	(c)	Draw the layout and discuss the Regenerative Rankine cycle with a single direct contact feed water heater	**07**
Q.6	**(a)**	Define cut-off ratio. How cut-off ratio affect the efficiency of diesel cycle?	**03**
	(b)	Discuss any two factors which affecting the performance of Vapor Compression Refrigeration (VCR) cycle.	**04**
	(c)	A steam turbine working on a Rankine cycle is supplied with dry saturated steam at 25 bar and exhaust take place at 0.2 bar. For the steam flow rate 10 kg/s, Determine: 1. Quality of steam at the end of expansion in turbine 2.Power developed by turbine in kW 3. Pump work required in kW 4.Rankine efficiency	**07**
Q.7	**(a)**	What do understand from the term "Exergy"? Explain in brief.	**03**
	(b)	A block of 800 kg of steel at 1250 K is to be cooled to 500 K. If it is desired to use the steel as heat source of energy, calculate the available and unavailable energies. Take specific heat of steel as 0.5 kJ/kg K and ambient temperature 300 K.	**04**
	(c)	Justify the statement: "Entropy of an Isolated system either increase or remain constant during process between equilibrium states."	**07**
Q.8	**(a)**	State and explain third law of thermodynamics	**03**
	(b)	1 kg of ice at -5^{o}C is exposed to the atmosphere which is at 20^{o}C.The ice melts and comes into thermal equilibrium with the atmosphere. Determine the change in entropy of the Universe. Take C_p (solid ice)=2.1 kJ/kg K, C_p (liquid water)=4.187 kJ/kg K ,latent heat of water 335 kJ/kg	**04**
	(c)	Explain the availability of steady flow process.	**07**

****