Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2131905 Date: 11/06/2019

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. **Use of steam table is permitted. Take C_p=1.005 KJ/kg-k and C_v=0.718 KJ/kg-k for air and C_p=4.2 KJ/kg-k for water.**

			MARKS
Q.1	**(a)**	Define: intensive and extensive property.	**03**
	(b)	Explain: Process, path and thermodynamic cycle.	**04**
	(c)	A piston cylinder device contains 0.25 kg of air initially at 1.5 MPa and 300^{0}C. The air is first expanded isothermally to 500 KPa, then compressed polytropically with exponent of 1.2 to initial pressure and finally compressed at the constant pressure to the initial state. Find the work done for each process and net work done.	**07**
Q.2	**(a)**	State wheather following parameters are point function or path function: Enthalpy, entropy, exergy, work, heat transfer, volume, entropy generation.	**03**
	(b)	A turbine operates under steady flow conditions receiving the steam at 5 MPa, 400^{0}C and 80 m/s and rejects it at 300 KPa, 92 % dryness fraction and 40 m/s. The mass flow rate of steam is 30 kg/s. The heat loss is 25 KJ/kg. Find the power output of turbine and inlet area.	**04**
	(c)	The steam supply to an steady flow engine comprises two fluid streams which mix before entering the engine. One stream is supplied at the rate of 10 kg/min with an enthalpy of 4000 KJ/kg and at a velocity of 15 m/s. the other stream is supplied at 30 kg/min with an enthalpy of 3000 KJ/kg and velocity 50 m/s. At the exit from the engine fluid leaves in two streams: one of water at 22 kg/min with an enthalpy of 800 KJ/kg and the other of steam: the fluid velocity at the exit and heat transfer from the engine is negligible. The engine develops the power of 40 KW. Find the flow rate and enthalpy of exit steam.	**07**
		OR	
	(c)	A heat pump working on Carnot cycle takes in heat from a reservoir at 8 ^{0}C and delivers the heat to a reservoir at 50 ^{0}C. The heat pump is driven by reversible heat engine which takes in heat from 1000^{0}C reservoir and rejects the heat to 50 ^{0}C reservoir. The reversible heat engine also drives a machine that absorbs 25 KW. If the heat pump extracts 15 KW from the 8^{0}C reservoir, find (a) The rate of heat supply from the 1000 ^{0}C reservoir and (b) The rate of heat rejection to the 50^{0}c reservoir.	**07**
Q.3	**(a)**	Write the equation for entropy change of reversible and irreversible process and cycles with usual notations.	**03**
	(b)	Explain: Entropy principle.	**04**
	(c)	Derive the equation for maximum work obtainable from the two finite bodies at temperature at temperatures T_1 and T_2 with same constant heat capacity using entropy principle.	**07**

OR

Q.3	**(a)**	Explain in short: Exergy.	**03**
	(b)	Derive the exergy equation for a system undergoing a cycle working between the reservoirs of high temperature (T) and atmospheric temperature (T_0).	**04**
	(c)	Find the decrease in exegry when 50 kg of water at 80^0C mix with the 100 kg of water at 40^0C, the pressure is being taken as constant and surrounding temperature is 27^0C.	**07**
Q.4	**(a)**	Draw the T-s diagram of ideal Rankine vapour power cycle showing name of component for each process and write the energy equation for each component neglecting kinetic and potential energy.	**03**
	(b)	What are the methods to increase the efficiency of Rankine cycle and explain any one.	**04**
	(c)	In a Rankine power cycle Steam at 150 kg/h, 20 bar, 360^0 C is expanded in steam turbine to 0.08 bar. It then enters a condenser where it is condensed to saturated liquid water. Assuming turbine and pump each have 80% isentropic efficiency, find the network and cycle efficiency.	**07**

OR

Q.4	**(a)**	Give comparison between Otto, diesel and dual cycles on the basis of same compression ratio and heat rejection.	**03**
	(b)	Draw the brayton cycle diagram with ideal regeration, reheating and intercooling. Also draw the T-s diagram.	**04**
	(c)	An air standard diesel cycle has a compression ratio of 20. The state of air at the beginning of the compression is 95 KPa and 20 ^{0}C. If the maximum temperature in the cycle is not to exceed 2200 K, find the thermal efficiency and mean effective pressure.	**07**
Q.5	**(a)**	How are the maximum and minimum temperature in the rankine cycle are fixed?	**03**
	(b)	Explain the effect of compression ratio on the efficiency of Otto cycle.	**04**
	(c)	Air enters a compressor at 96 KPa and 17 ^{0}C with negligible velocity and exits at 1 MPa, 327 ^{0}C and 120 m/s. the compressor is cooled by ambient air at 17^0C at a rate of 1500 KJ/min. The power input to the compressor is 300 KW. Find the mass flow rate of air and rate of entropy generation.	**07**

OR

Q.5	**(a)**	Explain: Avogadro's law.	**03**
	(b)	Explain: Gibbs-Dalton's law.	**04**
	(c)	The exhaust gases from the turbine are used to heat the water in an adiabatic counterflow constant pressure heat exchanger. The gases are cooled from 260 to 120^0C while water enters at 50 ^{0}C. The flow rate for gas and water are 40 kg/min and 75 kg/min. The constant pressure specific heat for gas is 1.2 KJ/kg-k. Find the rate of exergy loss due to heat transfer. Take atmospheric temperature=27^0C	**07**

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