Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (New) EXAMINATION – WINTER 2019

Subject Code: 3131905 **Date: 30/11/2019**

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. **Usage of steam table is permitted.**

			Marks
Q.1	**(a)**	Explain the concept of quasi-static process.	**03**
	(b)	Write short note on thermodynamic equilibrium.	**04**
	(c)	State and prove Carnot's theorem.	**07**
Q.2	**(a)**	Explain zeroth law of thermodynamics.	**03**
	(b)	Write down Kelvin-Planck and Clausius statements of 2^{nd} Law of thermodynamics.	**04**
	(c)	In an air compressor air flows steadily at the rate of 0.5 kg/s through an air compressor. It enters the compressor at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg and leaves at 5 m/s with a pressure of 7 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 60 kJ/s. Calculate : (i) The power required to drive the compressor ; (ii) The inlet and output pipe cross-sectional areas.	**07**
		OR	
	(c)	Two Carnot engines work in series between the source and the sink temperatures of 550 K and 350 K. If both engines develop equal power, starting from basic principle determine the intermediate temperature.	**07**
Q.3	**(a)**	Prove that entropy is the property of system.	**03**
	(b)	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	**04**
	(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**
		OR	
Q.3	**(a)**	Define the following terms: (i) Available energy (ii) Unavailable energy (iii)Dead state	**03**
	(b)	State the types of irreversibility. What is their effect?	**04**

(c) A system at 500 K receives 7200 kJ/min from a source at 1000 K. The temperature of atmosphere is 300 K. Assuming that the temperatures of system and source remain constant during heat transfer find out : **07**

(i) The entropy produced during heat transfer ;

(ii) The decrease in available energy after heat transfer

Q.4 **(a)** Compare Carnot and Rankine cycle. **03**

(b) How actual vapour cycle differs from ideal vapour cycle? Explain in detail. **04**

(c) In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. **07**

OR

Q.4 **(a)** Explain the effect of sub-cooling of liquid on performance of Vapour Compression Refrigeration system. Also show the effect on *p-h* diagram. **03**

(b) Discuss with *T-s* diagram, the effect of superheat and condenser pressure variation on performance of Rankine cycle. **04**

(c) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar, find the following: **07**

(i) The air standard efficiency of the cycle.

(ii) The mean effective pressure for the cycle.

Q.5 **(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) 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 refrigerating system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 35°C and the lower temperature is – 15°C. The capacity is to be 12 tonnes. Neglect all losses. Determine: **07**

(i) Co-efficient of performance.

(ii) Heat rejected from the system per hour.

(iii)Power required

OR

Q.5 **(a)** Define the following terms related to combustion process: **03**

(i) HCV

(ii) LCV

(iii)Enthalpy of formation

(b) Derive an equation for air standard efficiency of Otto cycle. **04**

(c) Explain the minimum air requirement (Stoichiometric Air Requirement) for complete combustion of following fuel by mass and by volume: **07**

(i) Hydrogen

(ii) Methane

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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**

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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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Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III EXAMINATION – SUMMER 2020

Subject Code: 3131905 **Date:02/11/2020**

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 and refrigeration property table is permissible.**

			Marks
Q.1	**(a)**	State and define different thermodynamic systems	**03**
	(b)	Describe quasi-static process.	**04**
	(c)	A reversible heat engine operates between two reservoirs at temperature of 600ºC and 40ºC. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40ºC and -20ºC. The heat transfer to the heat engine is 2000 kJ and the net work output of combined engine refrigerator plant is 360 kJ. Evaluate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40ºC.	**07**
Q.2	**(a)**	State first law for a closed system undergoing (i) cycle and (ii) a change of state.	**03**
	(b)	Show that the COP of a heat pump is greater than the COP of refrigerator by unity.	**04**
	(c)	The mass rate of flow into a steam turbine is 1.5 kg/s, and the heat loss from the turbine is 8.5 kW. The following data are known for the steam entering and leaving the turbine. Determine power output from turbine.	**07**

	Inlet Conditions	Exit Conditions
Pressure	2.0 MPa	0.1 MPa
Temperature	350°C	
Quality		100%
Velocity	50 m/s	100 m/s
Elevation above reference plane	6 m	3 m
$g = 9.8066\ m/s^2$		

OR

	(c)	Nitrogen enters a diffuser at 100 kPa, 300 K, with a velocity of 250 m/s and the exit velocity is 25 m/s. If nitrogen can be considered as an ideal gas with C_p=1.042 kJ/kg K, Find the exit temperature of Diffuser.	**07**
Q.3	**(a)**	State and prove Clausius theorem.	**03**
	(b)	Suppose that 1 kg of saturated water vapor at 100ºC is condensed to a saturated liquid at 100ºC in a constant-pressure process by heat transfer to the surrounding air, which is at 25ºC. What is the net increase in entropy of the water plus surroundings?	**04**
	(c)	Explain principle of increase of entropy. Apply it for the heat transfer through a finite temperature difference.	**07**

OR

Q.3 **(a)** Define following terms (i) Availability (ii) Irreversibility and (iii) Dead state. **03**

(b) Explain Guoy-Stodola theorem. **04**

(c) 5 kg of air at 550 K and 4 bar is enclosed in a closed system.(i) Determine the availability of the system if the surrounding pressure and temperature are 1 bar and 290 K respectively. (ii) If the air is cooled at constant pressure to the atmospheric temperature, determine the availability and effectiveness. Assume specific heats remain constant during process. For air consider C_p= 1.005 kJ/kgK and C_v= 0.718 kJ/kgK. **07**

Q.4 **(a)** State the assumptions made for the analysis of air standard cycle **03**

(b) For the same compression ratio and heat rejection, which cycle is most efficient: Otto, Diesel or Dual? Explain with p-v and T-s diagram. **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**

OR

Q.4 **(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) Explain simple regenerative Rankine cycle. **04**

(c) An air standard Diesel cycle has a compression ratio of 20, with an inlet state of 95 kPa, 290 K, and a maximum cycle temperature of 1800 K. If air can be assumed to be an ideal gas with R= 0.287 kJ/kg.K and Cv= 0.717 kJ/kg.K, Determine net specific work output of the cycle. **07**

Q.5 **(a)** Draw open cycle gas turbine diagram and represent simple Brayton cycle on T-s and p-V diaram. **03**

(b) Explain Bomb calorimeter with neat sketch. **04**

(c) An ice-making machine operates on ideal vapour compression refrigeration cycle using refrigerant R-12. The refrigerant enters the compressor as dry saturated vapour at – 15°C and leaves the condenser as saturated liquid at 30°C. Water enters the machine at 15°C and leaves as ice at – 5°C. For an ice production rate of 2400 kg in a day, determine the power required to run the unit. Find also the C.O.P. of the machine. Use refrigerant table only to solve the problem. Take the latent heat of fusion for water as 335 kJ/kg. Assume Cp_{ice}=2.0935 kJ/kgK and Cp_{water}=4.187 kJ/kgK. **07**

OR

Q.5 **(a)** Draw the T-s and P-h diagram of VCR cycle when inlet to compressor is superheated vapour and condenser outlet is sub-cooled liquid. **03**

(b) Discuss factors affecting performance of VCR cycle. **04**

(c) Calculate the amount of theoretical air required for the combustion of 1 kg of acetylene (C_2H_2) to CO_2 and H_2O. **07**

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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 ΦδQ/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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Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (NEW) EXAMINATION – SUMMER 2022

Subject Code:3131905 Date:15-07-2022

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)**	Define: Intensive and Extensive properties with example.	**03**
	(b)	Explain: State, Process & Cycle in thermodynamics.	**04**
	(c)	Explain the thermodynamics system and its types with suitable examples.	**07**
Q.2	**(a)**	State the first law of thermodynamics and its applications.	**03**
	(b)	Derive the energy equation for turbine and pump with usual notations.	**04**
	(c)	Air enters an adiabatic nozzle steadily at 300 kPa, 200°C, and 30 m/s and leaves at 100 KPa and 180 m/s. The inlet area of the nozzle is 80 cm^2.Take enthalpy of air h=C_pT. Determine (*a*) the mass flow rate through the nozzle, (*b*) the exit temperature of the air, and (*c*) the exit area of the nozzle. Take C_p=1.005 KJ/kg-k, R=0.287 KJ/kg-k T=temperature. Neglect elevation change.	**07**
		OR	
	(c)	A piston–cylinder device, whose piston is resting on a set of stops, initially contains 4.5 kg of air at 180 KPa and 27°C. The mass of the piston is such that a pressure of 300 kPa is required to move it. Heat is now transferred to the air until its volume becomes 2.5 times. Determine the work done by the air and the total heat transferred to the air during this process. Also show the process on a P-v diagram	**07**
Q.3	**(a)**	State the two statement of second law of thermodynamics with sketch.	**03**
	(b)	A household refrigerator that has a power input of 500 W and a COP of 2.5 is to cool five large objects, 7.5 kg each, to 8°C. If the objects are initially at 30°C. Determine how long it will take for the refrigerator to cool them. The watermelons can be treated as water whose specific heat is 4.2 kJ/kg · °C	**04**
	(c)	Explain the following terms with schematic diagram & the equation of thermodynamic performance:, Heat engine, Heat pump, Refrigerator.	**07**
		OR	
Q.3	**(a)**	Explain the concept of entropy generation.	**03**
	(b)	An insulated piston–cylinder device contains 5 L of saturated liquid water at a constant pressure of 200 KPa. An electric resistance heater inside the cylinder is now turned on, and 3000 kJ of energy is transferred to the water. Determine the entropy change of the water during this process.	**04**
	(c)	Steam enters an adiabatic turbine at 9 MPa, 500°C,and 70 m/s and leaves at 50 kPa, 100°C, and 140 m/s. If the power output of the turbine is 7.5 MW, determine (*a*) the mass flow rate of the steam flowing through the turbine and (*b*) the isentropic efficiency of the turbine. Neglect elevation change.	**07**

Q.4	**(a)**	What do you mean by exergy of system.	**03**
	(b)	A heat engine receives heat from a source at 1500 K at a rate of 800 kJ/s, and it rejects the waste heat to a medium at 300 K. The measured power output of the heat engine is 450 kW, and the environment temperature is 27°C. Determine (*a*) the reversible power, (*b*) the rate of irreversibility and (*c*) the second-law efficiency of this heat engine.	**04**
	(c)	Steam expands in a turbine steadily at a rate of 10,000 kg/h, entering at 6 MPa and 550°C and leaving at 50 kPa as saturated vapor. Assuming the surroundings to be at 25°C, Determine (*a*) the power potential of the steam at the inlet conditions and (*b*) the power output of the turbine if there were no irreversibility's present.	**07**

OR

Q.4	**(a)**	Draw p-V and T-S diagrams of Otto, Diesel and Dual cycles.	**03**
	(b)	An ideal diesel engine has a compression ratio of 18 and uses air as the working fluid. The state of air at the beginning of the compression process is 80 kPa and 40°C. If the maximum temperature in the cycle is not to exceed 1850 K. Determine the thermal efficiency. Assume constant specific heats for air at room temperature for pressure and volume are 1.005 and 0.718 KJ/kg-k.	**04**
	(c)	A gas-turbine power plant operates on the simple Brayton cycle between the pressure limits of 100 and 1200 kPa. The working fluid is air, which enters the compressor at 30°C at a rate of 150 m^3/min and leaves the turbine at 400°C. Using constant specific heats for air and assuming a compressor isentropic efficiency of 82 percent and a turbine isentropic efficiency of 88 percent. Determine (*a*) the net power output, (*b*) the thermal efficiency. Take enthalpy of air $h=C_pT$, T=temperature.	**07**

Q.5	**(a)**	Draw the schematic and T-S diagram for ideal Rankine cycle.	**03**
	(b)	What are the different methods to increase the efficiency of Rankine cycle. Explain any one in detail.	**04**
	(c)	Explain the schematic and T-S diagrams for Brayton cycle with combined inter cooling, reheating and regeneration	**07**

OR

Q.5	**(a)**	Draw schematic and T-S diagram of simple VCR cycle.	**03**
	(b)	Explain the concept of combustion and stoichiometric ratio.	**04**
	(c)	Explain: Bomb calorimeter with neat sketch.	**07**

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