Seat No: _____________ Enrollment No: ___________________

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Winter 2019 - 20 Examination

Semester: 3 **Date: 25/11/2019**
Subject Code: 03109201 / 203109201 / 203113201 **Time: 2:00pm to 4:30pm**
Subject Name: Engineering Thermodynamics / Thermodynamics / Engineering Thermodynamics **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 **Objective Type Questions** - (Fill in the blanks, one-word answer, MCQ-not more than Five in case of MCQ) (All are compulsory) (Each of one mark) **(15)**

1. Zeroth law of thermodynamics forms the basis of _______ measurement
2. The value of dryness fraction for dry and saturated steam is_____________
3. The value of specific heat for water is _________ KJ/KgK
4. The portion of low-grade energy which can be converted into maximum useful work is known as ________________
5. According to entropy principle, entropy of the universe is always _____________
6. According to Clausius inequality, for irreversible cycle $\oint \frac{dQ}{T} < 0$. True or False
7. First law of thermodynamics refers to conservation of mass. True or False
8. for an ideal gas internal energy and enthalpy are functions of temperature only. True or False
9. Second law of thermodynamics gives the direction constraint to the any thermodynamic process. True or False
10. The triple point temperature of water is 1°C. True or False
11. A Heat Engine with 30% efficiency drives a refrigerator of COP 5. What would be the net heat input to the engine for each kw of heat removed in the refrigerator
(A) 66.6 KJ (B) 600 KJ (C) 667 KJ (D) 660 KJ

12. A system reaches to same final state by two different process (one reversible and other irreversible) from same initial point, then (Δs refers to system entropy change)
(A) $(\Delta S)_{irr} > (\Delta S)_{Rev}$ (B) $(\Delta S)_{irr} = (\Delta S)_{Rev}$
(C)$(\Delta S)_{irr} < (\Delta S)_{Rev}$ (D)$\Delta S)_{irr} = (\Delta S)_{Rev}$ only if fluid is ideal gas.

13. A Carnot heat engine has efficiency of 25% when reversed, then cop of corresponding Heat Pump will be
(A) 4 (B) 5 (C) 3 (D) 2.5

14. Heat Transfer takes place between two bodies, the governing law is
(A) Zeroth law (B) First law (c) Second law (d) Third law

15. A cyclic device rejects 100 KJ heat to a single reservoir, while absorbing 100 KJ work during a cycle. The device violates:
(A) 1^{st} law (B) 2^{nd} law (C) Both 1^{st} and 2^{nd} (D) Neither 1^{st} nor 2^{nd} law

Q.2 Answer the following questions. (Attempt any three) **(15)**

A) A mass of 1.5 kg of air is compressed in a quasi-static process from 0.1 MPa to 0.7 MPa for which P v = constant. The initial density of air is 1.16 kg/m^3. Find the work done by the piston to compress the air. Also represent the above process on PV diagram

B) A room for four persons, has two fans each fan consuming 0.18 kW power, and three 100 W lamps. Ventilation air at the rate of 80 kg/h enters with an enthalpy of 84 kJ/kg and leaves with an enthalpy of 59 kJ/kg. If each person puts out heat at the rate of 630 kJ/h determine the rate at which heat is to be removed by a room cooler, so that a steady state is maintained in the room.

C) Ten grammes of water at 20°C is converted into ice at –10°C at constant atmospheric pressure. Assuming the specific heat of liquid water to remain constant at 4.2 J/gK and that of ice to be half of this value, and taking the latent heat of fusion of ice at 0°C to be 335 J/g, calculate the total entropy change of the system. Also find the change in entropy of the Universe.

D) Define Irreversible process. What are the causes for process to be irreversible?

Q.3 A) Calculate the available energy of 40 kg of water at 75°C with respect to the surroundings at 5°C, the pressure of water being 1 atm. **(07)**

B) (i) Draw the phase equilibrium diagram for a pure substance on T-s plot with relevant constant property line and proper nomenclature of various region. **(08)**

(ii)A rigid vessel of volume 0.86 m^3 contains 1 kg of steam at a pressure of 2 bar. Evaluate the specific volume, temperature, dryness fraction, internal energy, enthalpy, and entropy of steam

OR

B) Prove that the Equivalence of Kelvin Planck and Clausius statements of second law. **(08)**

Q.4 A) Explain Rankine cycle with neat diagram. Also sketch the T-s diagram. **(07)**

OR

A) A household refrigerator is maintained at a temperature of 2°C. Every time the door is opened, warm material is placed inside, introducing an average of 420 kJ, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs. 2.50 per kWh. What is the monthly bill for this refrigerator? The atmosphere is at 30°C. **(07)**

B) In an ideal Brayton cycle, air from the atmosphere at 1atm, 300 K is compressed to 6 atm and maximum cycle temperature is limited to 1100 K by using a large air-fuel ratio. If the heat supply is 100 MW find, (a) the thermal efficiency of the cycle (b) Work ratio (c) power output. **(08)**