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Paper Id: 140314 **Roll No:** | | | | | | | | | | |

B TECH

(SEM-III) THEORY EXAMINATION 2018-19

THERMODYNAMICS

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x10 = 20

a. What do you mean by reversible process? What are the conditions which must be satisfied by the process during reversible process?
b. What do you mean by available energy?
c. What do you mean by Throttling process?
d. If temperature of a body is 40 °C then show its temperature in °F and °R
e. What do you mean by PMM-II?
f. Differentiate between two-stroke and four-stroke engine.
g. Define principle of entropy increase.
h. What are the limitations of first law of thermodynamics?
i. Differentiate between Heat pump and Refrigerator.
j. State Amagat's law in mixture of gases.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Determine the decrease in available energy when heat is transferred at finite temperature difference.

b. A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator, which operates, between reservoirs at temperature of 40°C and -20°C. The heat transfer to the heat engine is 2000 KJ and net work output of the combined engine refrigerator plant is 360 KJ. Evaluate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40°C.

c. The Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K. If both engines develop equal power, determine the intermediate temperature.

d. Define in pure substance by suitable phase change diagram the term (i) Triple Point (ii) Critical Point (iii) Saturation states (iv) Sub cooled state (v) Superheated vapour state.

e. 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 cm2. Determine (*a*) the mass flow rate through the nozzle, (*b*) the exit temperature of the air, and (*c*) the exit area of the nozzle.

SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10

(a) Show that heat is a path function, and not a property.

(b) A candle is burning in a well-insulated room. Taking the room (the air plus the candle) as the system, determine (a) if there is any heat transfer during this burning process and (b) if there is any change in the internal energy of the system.

(c) A 3.27 m^3 tank contains 100 kg of nitrogen at 175 K. Determine the pressure in the tank, using (*a*) the ideal-gas equation, (*b*) the van der Waals equation.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) Derive the steady flow energy equation for a single stream entering and a single stream leaving a control volume and prove that the enthalpy of a fluid before throttling is equal to that after throttling.

(b) A Carnot cycle operates between source and sink temperatures of 250°C and– 15°C. If the system receives 90 kJ from the source, find :(i) Efficiency of the system; (ii) The net work transfer; (iii) Heat rejected to sink.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) A system has a heat capacity at constant volume, $C_v = AT^2$
where $A = 0.042\ J/K^3$
The system is originally at 200 K, and thermal reservoir at 100 K is available. What is the maximum amount of work that can be recovered as the system is cooled down to the temperature of the reservoir?

(b) In a certain process, a vapour while condensing at 420^0C, transfers heat to water evaporating at 250^0C. The resulting steam is used in power cycle, which rejects heat at 35^0C. What is the fraction of the available energy in the heat transferred from the process vapour at 420^0C that is lost due to the irreversible heat transfer at 250^0C?

6. Attempt any *two* parts of the following: 5 x 2 = 10

(a) Prove that cycle efficiency of the Otto cycle depends only on the compression ratio.

(b) Why is Carnot cycle not practicable for a steam power plant?

(c) Show the reversible cycle of the simple steam power plant on p-v, T-s and h-s diagram and explain its working in brief.

7. Attempt any *one* parts of the following: 10 x 1 = 10

(a) Steam at 20 bar and 360^0C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. (a) Assuming ideal processes, find per Kg of steam, the net work and the cycle efficiency. (b) If the turbine and the pump have each 80 % efficiency, find the percentage reduction in the net work and cycle efficiency.

(b) An engine working on the Otto cycle is supplied with air at 0.1 MPa and 30^0C. The compression ratio is 8. Heat supplied is 2100 kJ. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and the mean effective pressure. Assume for air: $C_p = 1.005$ kJ/Kg-K, $C_v = 0.718$ kJ/Kg-K and $R = 0.287$ kJ/Kg-K.