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B. TECH.
(SEM-II) THEORY EXAMINATION 2018-19
THERMODYNAMICS AND HEAT ENGINES

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 x 10 = 20**

- a. Explain briefly the path function and point function?
- b. How is steady flow system characterized?
- c. Discuss the Claussius inequality?
- d. What is the difference between isentropic and adiabatic process?
- e. What do you mean by Dryness fraction of Steam?
- f. Define triple point?
- g. Why Economizers is used in Boilers?
- h. What is dryness fraction? How will you measure it?
- i. What do you understand by mechanical efficiency of an engine?
- j. What do you mean by Air Standard Efficiency?

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

- a. In an air standard Otto cycle engine, the temperature at the end of compression stroke is 650 K and the maximum cycle temperature is 2400 kJ/kg. If the engine delivers 700 kJ/kg of network, find the thermal efficiency and compression ratio of the engine?
- b. What do you mean by compound heat Engine? Where are they used?
- c. What are the advantages of high pressure boilers? Sketch and describe the working of locomotive boiler? Explain different types of safety valves used on boilers.
- d. Explain the Carnot heat engine cycle executed by a steady state flow?
- e. Derive an expression for Rankine cycle with the help of p-v. T-s and H-s diagram.

SECTION C**3. Attempt any one part of the following: 10 x 1 = 10**

- (a) Define internal energy. How is energy stored in molecules? A stationary mass of gas is compressed without friction from an initial state of 0.3 m³ and 0.105 MPa to a final state of 0.15 m³ and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 37.6 kJ of heat from the gas during the process. How much does the internal energy of the gas have?
- (b) Describe the application of first law of thermodynamics in heating and expansion of gas in non-flow processes.

4. **Attempt any *one* part of the following:** **10 x 1 = 10**
- Describe Kelvin-Planck statement of the second law of thermodynamics.
 - 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 reservoir at temperature of 40°C and -20°C . The heat transfer to the heat engine is 2000kJ and the net work out of the combined engine refrigerator plant is 360kJ .
 - Evaluate the heat transfer to the refrigerant and the net transfer to the reservoir at 40°C .
 - Reconsidering (i) given that efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values.
5. **Attempt any *one* part of the following:** **10 x 1 = 10**
- A vessel of volume 0.04m^3 contains a mixture of standard water and saturated steam at a temperature of 250°C . The mass of the liquid present is 9kg . Find the pressure, the mass, the specific volume, the enthalpy, the entropy, and the internal energy.
 - What is the critical state? Explain the term critical pressure, critical temperature and critical volume of water?
6. **Attempt any *one* part of the following:** **10 x 1 = 10**
- Explain : (i) Equivalent evaporation (ii) Boiler thermal efficiency (iii) Heat balance for a boiler with the help of equations.
 - 5 kg of water at 30°C is mixed with 1 kg of ice at 0°C . The process of mixing is adiabatic and the system is open to atmosphere. Make calculations for the temperature of mixture and the change of entropy? Take specific heat of water = 4.187 kJ/kg K and latent heat of ice = 335 kJ/kg .
7. **Attempt any *one* part of the following:** **10 x 1 = 10**
- Derive an expression for the air standard efficiency and mean effective pressure of a diesel cycle? State the assumptions made.
 - In Air Standard Diesel Cycle, the compression ratio is 16 , and at the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1 MPa . Heat is added until the temperature at the end of the constant pressure process is 1480°C . Calculate (i) the cut-off ratio, (ii) the heat supplied/kg of air, (iii) the cycle efficiency, and (iv) the mean effective pressure