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B. E. (Third Semester) Examination, April-May 2020

(New Scheme)

(Mech., Production & Automobile Branch)

ENGINEERING THERMODYNAMICS

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Part (a) of each questions is compulsory. Solve any* ***two*** *from (b), (c) and (d) of each question. Use of steam table and mollier chart is permitted. Assume data if required.*

Unit-I

1. (a) Define the coefficient of performance of a refrigerator. 2

(b) Establish the equivalence of the Kelvin-Planck and clausius statements. 7

(c) Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 421°C from a hot source, while engine B is its communication with a cold sink at a temperature of 4·4°C if the work output of engine A is twice to that of engine B.

Find :

(i) The intermediate temperature between A and B.

(ii) The efficiency of each engine.

(iii) The heat rejected to the cold sink. 7

(d) Explain the following :

(i) Entropy principle

(ii) Clausius inequality 7

Unit-II

2. (a) Define high grade energy and low grade energy with examples. 2

(b) Calculate the decrease in available energy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of the surrounding being 15°C. (C_p of water = 4·2 kJ/kg K) 7

(c) Derive first and second TDS equations with the help of Maxwell's equations. 7

(d) Explain the following :

(i) Second law efficiency

(ii) Joule-Kelvin effect 7

Unit-III

3. (a) State Amagat-Leduc law of partial volume. 2

(b) Explain Vander wall's equation and derive the expression for constant a and b in terms of critical properties. 7

(c) Derive virial equation of state in terms of compressibility factor. 7

(d) A mixture of 1 kg of oxygen and 2 kg of nitrogen

occupies 1.2 m^3 volume at temperature 300 K. Assuming perfect gas behaviour, determine the following parameters for the gas mixture :

(i) Specific volume

(ii) Pressure

(iii) Gas constant

(iv) Molecular mass 7

Unit-IV

4. (a) Define pure substance. 2

(b) Define the following :

(i) Wet steam

(ii) Dry and saturated steam

(iii) Superheated steam

(iv) Critical point

(v) Triple point

(vi) Dryness fraction

(vii) Subcooling 7

(c) A vessel of volume 0.04 m^3 contains a mixture of saturated steam at a temperature of 250°C. The

mass of liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. 7

(d) 3 kg of steam at 10 bar and 250°C undergoes a constant pressure process. The resulting steam is wet steam having dryness fraction 0.6.
Calculate :

(i) Work done

(ii) Change in enthalpy 7

Unit-V

5. (a) Define Boiler efficiency. 2

(b) Explain the construction and working of Babcock Wilcox boiler with the help of neat sketch. 7

(c) Explain the construction and working of Lamont boiler with the help of neat sketch. 7

(d) What is Boiler draught? Explain the classification of Boiler draught. 7