Code No: 5421AA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Semester Examinations, June/July - 2018
ADVANCED THERMODYNAMICS
(Thermal Engineering)

Time: 3hrs   Max.Marks:75

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each
question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

1.a) What do you mean by thermodynamic potential? List out various thermodynamic
potentials.   [5]

b) Explain briefly Amagat's law.   [5]

c) What do you understand by phase equilibrium?   [5]

d) Draw layout and p-h plot for simple vapour compression refrigeration cycle.   [5]

e) What are the advantages of direct energy conversion systems over conventional energy
conversion methods?   [5]

PART - B

5 × 10 Marks = 50

2.a) Derive an expression for availability in steady flow system.
b) Derive availability equation for non – flow process.   [5+5]

OR

3.a) Derive Maxwell Relations.
b) A water pump is used to raise water from a reservoir on ground to feed an overhead tank
of a multi storied building of 50 m height. First the water is also sent through a purifying
plant where in a pressure drop of 50 kPa occurs. Estimate the power input to the pump. If
the heat loss to the surrounding is 5% of the power input, and the water flow rate is 1000
liters per min. Given the water temperature rises by 1^0C while passing through the pump
and its Cp= 4.2 kJ/kg K, ρ = 1000 Kg /m^3.   [5+5]

4. 0.25 m^3 of gas under a pressure of 14 bar and temperature 60^0C is expanded to a pressure
of 3.5 bar along curve, the equation of which is $pv^{1.3}$ = C. If Cp and Cv are 2.18
and 1.55 respectively find
a) The heat added or rejected during the expansion and
b) Change in entropy.   [5+5]

OR

5.a) Prove that internal energy, enthalpy, Gibbs function and Helmholtz functions are
thermodynamic potentials.
b) A lump of steel of mass 10 kg is at a temperature of 200^0C. Estimate the maximum
possible work that can be obtained from it, when the ambient temperature is 27^0C,
Cp= 0.5 kJ/kg K.   [5+5]

6.a) Define chemical potential of a component in terms of U, H and G.

b) Gaseous butane at 25^0C is mixed with air at 400K and burned with 400% theoretical air. Determine the adiabatic flame temperature. [5+5]

OR

7. Calculate the maximum power developed and irreversibility of a chemical reaction process of fuel $C_8 H_{18}$ burnt with 200% theoretical air. The products of combustion leave at 1000 K and the ambient temperature is 288 K. [10]

8.a) Discuss the importance of Onsagar relations in evaluating the irreversibilities for coupled flows.

b) Explain the procedure for second law analysis of power cycle. Describe the second law analysis of Rankine power cycle. [5+5]

OR

9. Describe the working of combined cycle power generation with diagrams. [10]

10.a) What is thermionic emission effect? How space charge effect is minimized?

b) Derive the expression for power and efficiency for a thermionic generator. [5+5]

OR

11. Explain with a neat diagram the working principle of a Liquid metal Magneto hydro dynamic generator plant and its applications and advantages. [10]

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