

R17

Code No: 5421AA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, January - 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 is second law efficiency and its application in thermodynamics? [5]  
b) What is Joule's Thomson coefficient? Why is it zero for an ideal gas? [5]  
c) State the Gibbs phase rule. [5]  
d) Draw the p-v and T-s diagrams for refrigeration cycle. [5]  
e) How thermoelectric energy is generated? [5]

PART - B

5 × 10 Marks = 50

2. Air flows through an adiabatic compressor at 3 kg/s the inlet conditions are 2 bar and 310k and exit conditions are 20 bar and 560 k. compute the net rate of availability transfer and irreversibility. [10]

OR

- 3.a) Establish the inequality of Clausius.  
b) Two kg of air at 500 kPa, 80°C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of surroundings which is at 100 kPa, 5°C. For this process determine i) maximum work, ii) change in availability, iii) irreversibility. For air, take  $C_v = 0.718$  kJ/kg K,  $u = C_v \times T$  where  $C_v$  is constant, and  $pV = mRT$  where p is pressure in kPa, V is volume in  $m^3$ , m is mass in kg,  $R = 0.287$  kJ/kg K, and T is temperature in K. [5+5]

- 4.a) What is sensible heat? How is the sensible heat loss from a human body affected by the skin temperature, environment temperature, and air motion.  
b) Saturated air leaving the cooling section of an air conditioning system at 14°C at a rate of 50  $m^3$  /min is mixed adiabatically with the outside air at 32°C and 60 percent relative humidity, at a rate of 20  $m^3$  /min. assuming that the mixing processes occurs at a pressure of 1 atm, determine the specific humidity, the relative humidity, the dry bulb temperature, and the volume flow rate of the mixture. [5+5]

OR

- 5.a) For the atmospheric air at room temperature of 30°C and relative humidity of 60%. Determine partial pressure of air, humidity ratio, dew point temperature, density and enthalpy of air.  
b) Two streams of moist air, one having flow rate of 3 kg/s at 30°C and 30% relative humidity, other having flow rate of 2 kg/s at 35°C and 85% relative humidity get mixed adiabatically. Determine specific humidity and partial pressure of water vapour after mixing. Take  $C_p$ ; stream = 1.86 kJ/kg.K [5+5]

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- 6.a) Discuss about chemical potential and phase equilibrium. [5+5]  
b) Explain Heat of reaction and adiabatic flame temperature. [5+5]

OR

- 7.a) What are the higher and lower heating values of a fuel? How do they differ? How is the heating value of a fuel related to the enthalpy of combustion of that fuel? [5+5]  
b) Write short notes on chemical potential and phase equilibrium. [5+5]

- 8.a) What is a binary vapour cycle? What is its purpose?  
b) Consider a cogeneration plant for which the utilization factor is 1. Is the irreversibility associated with this cycle necessarily zero? Explain. [5+5]

OR

- 9.a) Using the formulation of irreversible thermodynamics, write the equations for two coupled transport processes.  
b) Describe Onsager's criterion on how to choose appropriate forces and fluxes. [5+5]

10. With a neat sketch explain the working of the magneto hydronic power generation. List out the limitations of using the equipment. [10]

OR

- 11.a) What is direct energy conversion system? Write its advantages, limitations and applications when compared with conventional energy system.  
b) Explain the working of a fuel cell and a photovoltaic cell. [5+5]

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