

Code No: C2102

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I - Semester Examinations, March 2011

ADVANCED THERMODYNAMICS

(THERMAL ENGINEERING)

Time: 3hours

Max. Marks: 60

Answer any five questions

All questions carry equal marks

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1. a) What are different laws of thermodynamics? Explain them along with the properties developed based on these laws.  
b) A rigid insulated tank is initially evacuated is connected through a valve to a supply line that carries steam at 1 MPa and 300<sup>0</sup>C. Now the valve is opened, and steam is allowed to flow slowly into the tank until the pressure reaches to 1 MPa, at which valve is closed. Determine final temperature of steam in tank. [12]
2. a) Explain the equation of state for real gases and suggest a suitable method for calculation of constants in the Vander Waal's equation. Describe briefly about generalized compressibility charts along with its importance.  
b) Determine the pressure of saturated steam at 40<sup>0</sup>C if at 35<sup>0</sup>C the pressure is 5.628 kPa, the enthalpy of vaporization is 2418.6kJ/kg and the specific volume is 25.22m<sup>3</sup>/kg. The enthalpy of vaporization is essentially constant over this temperature range. [12]
3. a) Explain the thermodynamics of cooling tower and how to evaluate the make up water requirement.  
b) 10 m<sup>3</sup>/min of dry air at 32<sup>0</sup>C fixed with a stream of hydrogen at 127<sup>0</sup>C to form a mixed stream at 47<sup>0</sup>C and 1 bar. The mixing occurs adiabatically and at steady state. Determine (i) The mass flow rates of the dry air and hydrogen, in kg/min, (ii) Mole fractions of the dry air and hydrogen in existing mixture. [12]
4. a) Determine the adiabatic flame temperature of the diesel fuel C<sub>12</sub> H<sub>26</sub> with 100% excess air and also with 100% theoretical air.  
b) Describe the Vant Hoff's equilibrium box and derive its equation. [12]
5. Calculate the maximum power developed and irreversibility of a chemical reaction process of fuel C<sub>8</sub> H<sub>18</sub> burnt with 200% theoretical air. The products of combustion leave at 1000 K and the ambient temperature is 288 K. [12]
6. a) Describe the working of combined cycle power generation with diagrams.  
b) Explain the procedure for second law analysis of power cycle. Describe the second law analysis of Rankine power cycle. [12]
7. a) Discuss the importance of Onsagar relations in evaluating the irreversibilities for coupled flows.  
b) What is fuel cell? Explain its working principle. [12]
8. Write short notes on any THREE
  - a. Photovoltaic cell
  - b. Vont Hoff's Equilibrium Equation
  - c. Claussius Clayperon Equation
  - d. Seebeck, Thompson and Peltier effects. [12]