Code No: 07A40802 **R07** **Set No. 2**

II B.Tech II Semester Examinations,December 2010
CHEMICAL ENGINEERING THERMODYNAMICS-I
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is sub cooled or compressed liquid?
   (b) State the law of corresponding states that can be deduced from the equation of state. [6+10]
2. (a) State relations between absolute, gauge, atmospheric and vacuum pressures.
   (b) Discuss in brief, how the pressure is measured?
   (c) What are usual units of expressing pressure? Show relations among them. [6+6+4]
3. The fundamental relation of a particular thermodynamic system is given by S=(KUVN)$^{1/3}$. Express the fundamental relation in the Euler form. [16]
4. Discuss the functioning of converging/diverging nozzle. Develop suitable equations. [16]
5. 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^{0}C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4^{0}C. If the work output of A is twice that of B, find
   (a) the intermediate temperature between A and B
   (b) the efficiency of each engine, and
   (c) the heat rejected to the cold sink. [16]
6. One mol of an ideal gas (γ =1.4) at 103 kPa and 306 K is compressed to a pressure 1.5 MPa. If the compression process can be approximated as P $\hat{\vartheta}^{1.3}$ = constant, determine the work done on the gas and the energy transferred as heat. [16]
7. A refrigeration plant produces 0.130 kg/s of the ice at -7^{0}C from water at 27^{0}C. If the power required to drive the plant is 30kW, determine the capacity of the ice plant in tones and the actual COP. C_p of ice is 2.1 kJ kg^{-1} K^{-1}. [16]
8. One gram mol of nitrogen behaving as an ideal gas undergoes an irreversible isothermal compression from 1 to 10 atm at 127^{0}C in a piston cylinder assembly. The heat removed from the gas as a result of compression process is absorbed by heat sink maintained at a temperature of 27^{0}C. The irreversible process is 83% efficient as compared to reversible process. Calculate Δ S of the gas, Δ S of the reservoir and Δ S_{total} . [16]

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Code No: 07A40802 **R07** **Set No. 4**

II B.Tech II Semester Examinations,December 2010
CHEMICAL ENGINEERING THERMODYNAMICS-I
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Prove any two Maxwell relations from first principle. [16]

2. (a) List few refrigerants.
   (b) Calculate the COP of a Carnot refrigerator and a Carnot heat pump, if both the devices are operating between the reservoirs at -11^{0}C and 41^{0}C. [6+10]

3. (a) Define gauge pressure and absolute pressure.
   (b) The pressure of a gas in a pipe line is measured with a mercury manometer having one limb open to the atmosphere. If the difference in the height of mercury in the two limbs is 562 mm, calculate the gas pressure. The barometer reads 761 mm Hg, the acceleration due to gravity is 9.79m/s^2, and the density of mercury is 13,640 kg/m^3. [6+10]

4. A fluid undergoes a reversible adiabatic compression from 0.5 MPa, 0.2m^3 to 0.05m^3 according to the law, $PV^{1.3}$=constant. Determine the change in enthalpy, internal energy and entropy during the process. [16]

5. (a) Define the following:
      i. Quasi-static processes,
      ii. Non-Quasistatic processes,
      iii. cyclical processes.
   (b) Distinguish between reversible and irreversible processes by giving suitable examples. [9+7]

6. Discuss the importance of throttling process. Mention a few applications of throttling process. [16]

7. It is desired to design a tank to store 10 k mol methane at 6.0 MPa and 300 K. Determine the size of the tank using the Red-lich-Kwong equation of state. The critical constants of methane are Pc = 4.60MPa and Tc = 190.6 K. [16]

8. A reversible engine operating between a reservoir at 600K and the ambient atmosphere at 300K drives a refrigerator operating between 240K and the ambient atmosphere. Determine the ratio of energy rejected by both the devices to the ambient atmosphere to the energy absorbed by the engine from the reservoir at 600K. [16]

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Code No: 07A40802 **R07** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
CHEMICAL ENGINEERING THERMODYNAMICS-I
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define fixed points and their importance.
   (b) Discuss open U-tube manometer indicating gauge pressure. [8+8]
2. Discuss the mathematical statement of second law of thermodynamics. What are its conclusions? [16]
3. (a) What is non ideal gas? How is it is different from ideal gas? Compare PV data for ideal and non ideal gas.
   (b) Define generalized compressibility factor Z. [10+6]
4. (a) Mention a few common refrigerants.
   (b) What are different methods for the liquefaction of gases? Discuss any one of them. [6+10]
5. (a) State the Clausius inequality.
   (b) Give two statements of second law of thermodynamics. Explain interms of expressions. [8+8]
6. (a) Discuss throttling process in brief.
   (b) Measurement of P and T does not give any information regarding the quality of wet steam. Specify, why? [8+8]
7. A fluid is confined in a cylinder by a spring loaded, frictionless piston, so that the pressure in the fluid is a linear function of the volume (p = a+b V). The internal energy of the fluid is given by the following equation,
   U = 34+3.15 pV,
   Where U is in kJ, p in kPa and V in cubic metre. If the fluid changes from an initial state of 170 kPa, $0.03m^3$ to a final state of 400 kPa, $0.06m^3$; with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. [16]
8. Discuss in brief generalized correlation of thermodynamic properties for gass. [16]

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Code No: 07A40802 **R07** **Set No. 3**

II B.Tech II Semester Examinations,December 2010
CHEMICAL ENGINEERING THERMODYNAMICS-I
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define the following:
   i. Phase rule,
   ii. Phase component,
   iii. Degree of freedom.
   (b) What is enthalpy? Is enthalpy a path function. [8+8]
2. (a) Differentiate between reversible and irreversible change.
   (b) State the Clausius statement of the second law of thermodynamics. [8+8]
3. A lump of 1000 kg steel at 1200 K is to be cooled to 400 K. If it is desired to use the steel as a source of energy, calculate the available energy and unavailable energy. The ambient temperature is 300 K and the specific heat capacity of steel is 0.5 kJ kg^{-1} K^{-1}. [16]
4. It is desired to design a tank to store 10 kmol methane at 6.0 MPa and 300 K. Determine the size of the tank using generalized compressibility chart. The critical constants of methane are Pc = 4.6 MPa and Tc = 190.6K. [16]
5. (a) Discuss Bourdon gauge for pressure measurement.
   (b) The pressure of a gas in a pipe line is measured with a mercury manometer having one limb open to the atmosphere. If the difference in the height of mercury in two limbs is 576 mm, calculate the gas pressure. The barometer reads 760 mm Hg, the acceleration due to gravity is 9.79 m/s^2, and the density of mercury is 13,640 kg/m^3. [6+10]
6. Discuss entropy from the microscopic view point. [16]
7. Saturated vapour steam at 100 kPa (t^{sat} = 99.63^{0}C) is compressed adiabatically to 300 kPa. If the compressor efficiency is 75 percent, what is the work required and what are the properties of the discharge stream? [16]
8. A water cooler supplies chilled water at 7^{0}C, when water is supplied to it at 27^{0}C at a rate of 0.7 litres/min., while the power consumed is 200 Watts. Compare the COP of this refrigeration plant with that of the ideal refrigeration cycle for a similar situation. [16]

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