Code No: RR210304 **Set No. 1**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS
(Common to Mechanical Engineering and Automobile Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define and explain the concept of Zeroth law of thermodynamics.
   (b) What are the different scales of temperature? Establish a mathematical relation between the Centigrade scale and the Fahrenheit scale. [6+10]

2. (a) In a vessel containing $0.002m^3$ of water kept initially at 20^0C is heated to its boiling point of 100^oC by a 0.5kw electric heater. Find the time required to achieve the desired object assuming that the system does not exchange heat with the surrounding.
   (b) A system receives 800kJ of heat 840kJ of work is transferred. Is it possible or not? Justify your answer. [10+6]

3. (a) State the corollaries of II law of thermodynamics.
   (b) A perfect gas(air) is cooled in a cylinder-piston arrangement reversibly at constant pressure from a temperature of 200^0C to 30^0C . Calculate the change of entropy per kg of air. [6+10]

4. (a) Using Maxwell's relations deduce the two Tds equations.
   (b) Derive the equation

$$\frac{(\partial V/\partial T)_s}{(\partial V/\partial T)_p} = \frac{1}{\gamma - 1}$$

[8+8]

5. Find the internal energy and enthalpy of unit mass of steam of a pressure of 7 bar
   (a) when its quality is 0.8,
   (b) when it is dry and saturated,
   (c) superheated, the degree of superheat being 65^0C. The specific heat of superheated steam at constant pressure is 2.1kJ/kg K. [16]

6. One kilogram of moist air initially at a total pressure of 1 atm has a dry bulb temperature of 20^0C and a relative humidity of 60% and is contained in a closed rigid vessel. Determine the amount of heat that must be transferred to the moist air in order to increase the dry bulb temperature to 40^0C. Calculate the final pressure and final relative humidity of the mixture. Suppose that heat is transferred to the system from a heat source that has a temperature of 100^0C. Determine the total entropy change associated with this process. [16]

7. An air standard duel cycle has a compression ratio of 16, and compression begins at 1 bar, 50^0C. The maximum pressure is 70 bar. The heat transferred to air at constant pressure is equal to that at constant volume. Estimate

   (a) The pressure and temperature at the cardinal points of the cycle.

   (b) The cycle efficiency and

   (c) The mean effective pressure of the cycle. Take $C_v = 0.718$KJ/KgK and $C_p =$ 1.005 KJ/KgK. [16]

8. In a vapour compression refrigerator, the working fluid is superheated at the end of compression and is under cooled in the condenser before throttling. Sketch a working cycle of a temperature entropy diagram and show how theoretical coefficient of performance may be calculated from this diagram. [16]

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Code No: RR210304 **Set No. 2**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS
(Common to Mechanical Engineering and Automobile Engineering)
Time: 3 hours **Max Marks: 80**
Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Define and explain zeroth law of thermodynamics.
   (b) Distinguish between adiabatic and isentropic process.
   (c) Identify the proper type of system in each case and explain the reason for your choice.
      i. Electric generator
      ii. Domestic tea kettle
      iii. Electric fan
      iv. A living human being. [4+4+8]

2. A cylinder contains $0.115m^3$ of gas at 1 bar and 90^0C. The gas is compressed to a volume $0.0288m^3$ and the final pressure being 5.67 bar. Calculate
   (a) Mass of the gas
   (b) The value of index of compression
   (c) Increase in internal energy and
   (d) Heat transfer during the process. [16]

3. (a) State and prove Clausius inequality.
   (b) Explain the increase in entropy principle.
   (c) A thermal energy source at 800 K loses 2000 kJ of heat to a sink at
      i. 500 K and
      ii. 750 K. Determine which heat transfer process is more irreversible.[6+4+6]

4. (a) Using Maxwell's relations deduce the two Tds equations.
   (b) Derive the equation

$$\frac{(\partial V/\partial T)_s}{(\partial V/\partial T)_p} = \frac{1}{\gamma - 1}$$

[8+8]

5. (a) Steam initially dry saturated, expands isetropically from a pressure of 16 bar to 0.16 bar. Find the index of isentropic expansion.
   (b) One kg of wet steam at 0.8, 0.1 MPa is contained in a cylinder piston assembly. Energy is added as heat at constant pressure till the temperature is raised to 400^0C. Determine final state of steam and the energy transferred using steam table. Plot the relevant Mollier diagram and obtain the same. [6+10]

6. (a) Methane at 150kPa, 20^0C enters an insulated mixing chamber at a rate of 1.0kg/s .It is mixed with air at 150kPa and 180^0 C in an air methane mass ratio of 15:1. The flow is steady and kinetic energy changes are negligible. Ambient pressure and temperature are 100kPa 15^0C. Determine:
   i. The temperature of the mixture leaving the chamber and
   ii. The irreversibility of the mixing per kg of methane.

   (b) How gravimetric analysis can be compared with volumetric analysis? [10+6]

7. (a) Explain with the help of suitable graphs the variation of the efficiency of the diesel cycle with compression ratio and cut-off ratio.

   (b) In an air standard diesel cycle, the compression ratio is 15.Compression begins at 0.1MPa, 40^0c. the heat added is 1.675 MJ/Kg. Find
   i. The maximum temperature of the cycle.
   ii. The work down per Kg of air.
   iii. The cycle efficiency.
   iv. The temperature at the end of the isentropic expansion.
   v. The cut-off ratio.
   vi. The mean effective pressure of the cycle. [6+10]

8. A steam power plant has the range of operation from 40 bar dry saturated to 0.05 bar. Determine
   (a) The cycle efficiency and
   (b) work ratio and specific fuel consumption for
   (c) car not cycle
   (d) Rankine cycle. [16]

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Code No: RR210304

Set No. 3

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Show that work is a path function and not a state function.
   (b) Justify the statement that work and heat are not properties. [8+8]

2. Air at 1.06 bar and 7^0C is heated at constant volume to a temperature of 847^0C. It is then expanded adiabatically until the pressure falls to 1.06bar, following which heat is rejected at constant pressure until the temperature is brought back to 7^0C. Show that the heat input is equal to work output of the cycle. [16]

3. (a) Draw neatly the sequences of operation of Carnot engine on p-v and T-s diagrams. Show that the entropy change during the cycle is zero
   (b) A Carnot engine operates between 1000K and 300K. the change in entropy of the source is 0.6 kJ/K. Find the heat added and the net work output.
   (c) CO2 gas is contained in 1.0 m3 tank initially at 1.2 bar and 300 K. The temperature is increased by 400K by
      i. stirring with a paddle wheel and
      ii. heat supply from a reservoir. Find the initial and final availabilities of the gas. Which method of heating is better from the thermodynamic point of view? [6+4+6]

4. (a) Using Maxwell's relations deduce the two Tds equations.
   (b) Derive the equation

$$\frac{(\partial V/\partial T)_s}{(\partial V/\partial T)_p} = \frac{1}{\gamma - 1}$$

[8+8]

5. (a) A vessel of volume of $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 250^0C. The mass of the liquid present is 9 kg. Find the pressure, the mass, the enthalpy, the entropy and the internal energy.
   (b) A vessel of $0.4m^3$ capacity contains 2 kg of wet steam at 6 bar pressure. Calculate
      i. the volume and mass of water, and
      ii. volume and mass of steam. [8+8]

6. Dry bulb and wet bulb temperature of moist air are found as 30^0C and 21^0C respectively. From the psychometric chart obtain:

(a) Relative humidity

(b) Humidity ratio

(c) Specific enthalpy

(d) Dew point temperature

(e) Specific volume of the mixture. [16]

7. (a) Explain Lenoir cycle with the help of P-V and T-S diagrams.

   (b) Derive an expression for its thermal efficiency. [8+8]

8. Explain clearly Rankine cycle and derive on expression for thermal efficiency of the cycle. [16]

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Code No: RR210304 **Set No. 4**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS
(Common to Mechanical Engineering and Automobile Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain with a neat sketch the working principle of a constant volume gas thermometer.
   (b) Explain the concept of temperature and equality of temperature. [8+8]

2. In a vessel 10 kg of oxygen is heated in a reversible, non flow, constant volume process so that the pressure of oxygen is increased two times that of the initial value. The initial temperature is 20^oC. Calculate
   (a) the final temperature,
   (b) the change in internal energy,
   (c) the change in enthalpy and
   (d) the heat transfer. Take R = 0.259 kj / kg K and C_v = 0.652 kj / kg K for oxygen. [16]

3. (a) What is absolute temperature scale? Develop this scale from Carnot theorem
   (b) A reversible engine during a cycle of operation interacts with three thermal reservoirs maintained at 200K,300K and 400K. It receives 5 MJ of heat from the reservoir at 400K and produces a net positive work of 840 kJ. Find the amount and direction of heat interaction with other reservoirs. [8+8]

4. (a) Deduce an expression for the non-flow availability for a system.
   (b) A 2-kg piece of iron is heated from room temperature of 25^oC to 400^oC by a heat source at 600^oC. What is the irreversibility in the process? Assume for iron C_p=0.450kJ/kgK. [6+10]

5. 1 kg of air at a pressure of 8 bar and a temperature of 100^0C undergoes a reversible polytropic process following $pv^{1.2}$ = constant. If the final pressure is 1.8 bar, determine
   (a) the final specific volume, temperature, and increase in entropy.
   (b) Repeat the problem if the process are to be irreversible and adiabatic between the states. Also with the results plot processes on p-v and T-s diagram. [16]

6. A rigid tank of volume $1.2m^3$ is divided into two equal parts by a partition. One compartment contains neon gas at 20^0C and 110kPa and other contains argon gas at 47^0C and 225kPa. Now partition is removed and the two gases are allowed to mix. If 10kJ of heat is lost to the surroundings at 20^0C during the mixing process, determine the final temperature and pressure of the mixture. [16]

7. (a) Derive an expression for thermal efficiency of Atkinson cycle.
   (b) Find the air standard efficiency of Atkinson cycle if the compression ratio is 5 and pressure at the end of heat reception is 2.5 times that at the beginning. Take adiabatic index as 1.41. [8+8]

8. A R-12 simple saturation cycle operates at temperature of 35^0C and -15^0C for the condenser and evaporator respectively. Determine the C.O.P. and power/ton of refrigeration of the system using
   (a) Refrigeration charts .
   (b) R-12 tables. Compare the result. [16]

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