Code No: R059210304 **Set No. 1**

II B.Tech I Semester Regular 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) Write the differences between system and control volume.
   (b) A gas undergoes a reversible non-flow process according to the relation P = (-3V+15)where V is the volume in m^3 and P is the pressure in bar. Determine the work done when the volume changes from 3 to 6 m^3. [6+10]

2. (a) Make an energy analysis of the steam turbine and rotary compressor.
   (b) The gas leaving the turbine jet engine flows steadily into the jet pipe with enthalpy 960 KJ/kg and velocity 250 m/s. The exit from the pipe is at enthalpy 860 KJ/kg, and exhaust is in line with intake. Neglecting heat loss from the system, determine the velocity of gas leaving the pipe. [8+8]

3. (a) State the Kelvin-Plank and Clausius statements of the second law of thermodynamics and establish equivalence between them.
   (b) Determine the power required to run a refrigerator that transfers 2000 KJ/min of heat from a cooled space at 0^0C to the surrounding atmosphere at 27^0C. The refrigerator operates on reversed Carnot cycle. [10+6]

4. (a) Describe the process of formation of steam and give its graphical representation
   (b) Steam enters an engine at a pressure 10 bar absolute and 250^0C. It is exhausted at 0.2 bar. The steam at exhaust is 0.9 dry. Find
      i. Drop in enthalpy
      ii. Change in enthalpy. [7+9]

5. (a) Deduce the equation PV^{γ}= constant for an adiabatic process.
   (b) The specific volume of 'H_2' at 90^0C is $0.9m^3$/kg.
      i. Diameter the pressure exerted by H_2 Using Vander wall?s equation
      ii. Compare the result obtained considering H_2 as ideal gas the values of Vander walls constant 'a' and 'b' are $25105N-m^4/(kg-mol)^2 and 0.0262m^3/kg-mol$. [7+9]

6. (a) Explain psychometric chart .
   (b) $100m^3$ of air per min at 40^0 DBT and 15% relative humidity is passed through adiabatic humidifier. The air is coming but at 25^0C DBT and 20^0C WBT Find
      i. Dew point temperature
      ii. Relative humidity
      iii. Water carried by the air per min [6+10]

7. (a) Discuss the use of air standard cycle analysis for the study of internal combustion engines.

   (b) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263m^3. The initial pressure is limited to 25 bar, find the following: (i) The air standard efficiency of the cycle. (ii) The mean effective pressure for the cycle. [6+10]

8. A refrigerator working on bell-Coleman cycle operates between pressure limits of 1.05 bar and 8.5bar. Air is drawn from the cold chamber at 10^0C, compressed and it is cooled to 30^0C. before entering the expansion cylinder. The expansion and compression follows the law $pv^{1.3}$=constant. Determine the theoretical C.O.P. of the system. [16]

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Code No: R059210304 **Set No. 2**

II B.Tech I Semester Regular 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 fluid contained in a horizontal cylinder fitted with a frictionless leak proof piston, is continuously agitated by means of a stirrer passing through the cylinder cover. The cylinder diameter is 0.4 m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485 m against the atmosphere. The net work done by the fluid during the process is 2 kJ. The speed of the electric motor driving the stirrer is 840 rpm. Determine torque in the shaft and power output of the motor. [16]

2. (a) State the zeroth law of thermodynamics. Explain how it forms the basis for temperature measurement?
   (b) A closed system undergoes a thermodynamic cycle consisting of four separate and distinct processes. The heat and work transferred in each process are as tabulated below.

Process	Heat Transfer in KJ/min	Work transfer in KJ/min
1-2	20,000	0
2-3	-10,000	30,000
3-4	0	20,000
4-1	15,000	-25,000

   Show that the data is consistent with the first law of thermodynamics. Also evaluate the net work output in KW and the change in internal energy. [6+10]

3. (a) State the limitations of first law of thermodynamics.
   (b) What is a thermal energy reservoir?
   (c) An engine operating on a Carnot cycle works with in temperature limits of 600 K and 300 K. If the engine receives 2000 KJ of heat, evaluate the work done and thermal efficiency of the engine. [6+2+8]

4. (a) Explain T-S diagram for a pure substance? [7M]
   (b) Steam at l0 bar and 300^0C passing through a convergent-divergent nozzle expands reversibly and adiabatic ally till the pressure falls to 2 bar. If the velocity of the steam entering into the nozzle is 50 m/sec. Determine the exit velocity of the steam. [9]

5. A certain quantity of air initially of air at a pressure of 7 bars and 250^0C has a volume of $0.03m^3$. It undergoes the following processes in the following sequence in a cycle.
   (a) Expands at constant pressure to $0.15m^3$

(b) Follows polytropic process with n = 1.3 and

(c) A constant temperature process (which completes the cycle.)

Evaluate the following.

(i) The heat received in the cycle

(ii) The heat rejected in the cycle

(iii) The e ciency of the cycle [16]

6. (a) A gas mixture consists of 0.4 Kg of carbon monoxide,1.1 kg of carbon dioxide and 1.5 Kg of nitrogen. Determine
   i. Mass fraction of each component
   ii. Mole fraction of each component
   iii. Average molar mass of the mixture and
   iv. Gas constant of the mixture.

   (b) Explain: partial molal properties [9+7]

7. (a) Discuss the use of air standard cycle analysis for the study of internal combustion engines.

   (b) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263m^3. The initial pressure is limited to 25 bar, find the following: (i) The air standard efficiency of the cycle. (ii) The mean effective pressure for the cycle. [6+10]

8. A dense air machine operates on reversed Brayton and is required for a capacity of 10TR. The cooler pressure id 4.2 bar and the refrigerator pressure id 1.4 bar. The air is cooled in the cooler at a temperature of 50^0C. and the temperature of air at inletr to compressor is -20^0C. Determine for the ideal cycle :

   (a) C.O.P

   (b) mass of air circulated per minute;

   (c) theoretical piston displacement of compressor;

   (d) theoretical piston displacement of expander; and

   (e) net power per tones of refrigerator.

   show the cycle. Show the cycle on and T-S planes. [16]

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Code No: R059210304 **Set No. 3**

II B.Tech I Semester Regular 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 gas expands according to the equation PV=100, where P is the pressure in KPa and V is the specific volume in m^3/kg. The initial pressure of the gas is 1000 KPa and the final pressure is 500 KPa. The gas is then heated at constant volume back to its original pressure of 1000 KPa. Determine the work of combined process. Also sketch the process on P-V coordinates. [16]

2. (a) State the zeroth law of thermodynamics. Explain how it forms the basis for temperature measurement?

   (b) A closed system undergoes a thermodynamic cycle consisting of four separate and distinct processes. The heat and work transferred in each process are as tabulated below.

Process	Heat Transfer in KJ/min	Work transfer in KJ/min
1-2	20,000	0
2-3	-10,000	30,000
3-4	0	20,000
4-1	15,000	-25,000

   Show that the data is consistent with the first law of thermodynamics. Also evaluate the net work output in KW and the change in internal energy. [6+10]

3. (a) State the limitations of first law of thermodynamics.

   (b) What is a thermal energy reservoir?

   (c) An engine operating on a Carnot cycle works with in temperature limits of 600 K and 300 K. If the engine receives 2000 KJ of heat, evaluate the work done and thermal efficiency of the engine. [6+2+8]

4. (a) Steam initially at a pressure of 10.5 bar 0.96 dry throttled to a pressure of 1 bar. Find the final condition of steam. Also calculate the change of entropy per kg of steam. Assume Cp for super heated steam = 2.1 KJ/kg. k [8]

   (b) Find the entropy of 1 kg of super heated steam at a pressure of 12 bar and a Temperature of 250^0C. Take specific of super heated steam as 2.1 kJ/ kg. k [8]

5. (a) Deduce the relation ship between absolute temperature and pressure in an polytropic process. [7M]

   (b) $0.3m^3$ of air at pressure 8 bars expands to $1.5m^3$. The final pressure is 1.3 bar. Assuming the expansion to be polytropic, calculate the heat supplied and change of internal energy. Take γ= 1.4 [9]

6. (a) $200m^3$ of air per minute at 15^0C DBT and 75%RH.If heated until its temperature is 25^0 C, find
   i. RH of heated air
   ii. WBT of heated air
   iii. Heat added to air per minute.
   (b) A vessel of 5 m^3 capacity contains two gases A and B in proportion of 40% and 60% respectively at 25^0C .If the value of R for the gases is 0.288 KJ/kg K and 0.295 KJ/KgK and if the total weight of the mixture is 2 kg, calculate
   i. Partial pressure
   ii. Total pressure
   iii. The mean value of the R for the mixture. [8+8]

7. (a) Compare Carnot, Sterling and Ericsson cycles operating between the same source and sink temperatures and with equal changes in specific volume.
   (b) An engine working on Otto cycle has the following conditions: pressure at the beginning of compression is 1 bar and pressure at the end of compressionis 12 bar. Calculate the compression ratio and air - standard efficiency of the engine. Assume $\gamma = 1.4$. [8+8]

8. The pressure limits of an air refrigeration system working on bell coleman cycle is 4.3 bar aznd 1 bar. The temperature of air entering in to the compressor and expander are -1^0C. and 27^0C. respectively. find
   (a) COP of the cycle if the compression and expansion are isentropic.
   (b) the ice making capacity in tones of ice for the air circulation through the system is 13 kg/min and water is supplied at $0^C$and ice formed at 0^0 and,
   (c) piston displacement per minute for the compression and expansion [16]

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Code No: R059210304 **Set No. 4**

II B.Tech I Semester Regular 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 fluid contained in a horizontal cylinder fitted with a frictionless leak proof piston, is continuously agitated by means of a stirrer passing through the cylinder cover. The cylinder diameter is 0.4 m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485 m against the atmosphere. The net work done by the fluid during the process is 2 kJ. The speed of the electric motor driving the stirrer is 840 rpm. Determine torque in the shaft and power output of the motor. [16]

2. (a) State the zeroth law of thermodynamics. Explain how it forms the basis for temperature measurement?
   (b) A closed system undergoes a thermodynamic cycle consisting of four separate and distinct processes. The heat and work transferred in each process are as tabulated below.

Process	Heat Transfer in KJ/min	Work transfer in KJ/min
1-2	20,000	0
2-3	-10,000	30,000
3-4	0	20,000
4-1	15,000	-25,000

   Show that the data is consistent with the first law of thermodynamics. Also evaluate the net work output in KW and the change in internal energy. [6+10]

3. (a) State the limitations of first law of thermodynamics.
   (b) What is a thermal energy reservoir?
   (c) An engine operating on a Carnot cycle works with in temperature limits of 600 K and 300 K. If the engine receives 2000 KJ of heat, evaluate the work done and thermal efficiency of the engine. [6+2+8]

4. (a) Explain the difference between internal energy and enthalpy of wet and dry steam
   - [7M]
   (b) 2 kg of steam initially at a pressure of 12 bar and a temperature of 250^0C expends polytropically to 1.2 bar. Find [9M]
      i. Final condition
      ii. Work done
      iii. Change in entropy ,assume the index of expansion as 1.25

5. (a) Explain

i. Throtl ling process

ii. Free expansion process.

(b) A steel flask of $0.04m^3$ capacity is to be used to store nitrogen at 120 bar, 20^0C. The flask is to be protected against excessive pressure by a fusible plug. Which will melt and allow the gas to escape if the temperature rises too high.

i. How many kg of nitrogen will the flask hold at the designed condition?

ii. At what temperature must the fusible plug melts in order to limit the pressure of a fill flask to a maximum of 150 bars. [6+10]

6. A tank of capacity $0.45m^3$ is insulated and is divided into two sections through a partition. One section initially contains H_2 at 3bar and 130^0c and has a volume of $0.3m^3$ and the other section initially holds N_2 at 6bar and 30^0c. The gases are then allowed to mix after removing the adiabatic partition. Determine

(a) The temperature of the equilibrium mixture

(b) The pressure of the mixture

(c) The change in entropy for each component and total value.
Assume $C_v(N_2) = 0.744kJ/kgk$ $C_v(H_2) = 10.352kJ/kgk$
$C_p(N_2) = 1.041kJ/kgk$ $C_p(H_2) = 14.476kJ/kgk$ [16]

7. (a) Explain graphically the variation of the efficiency of Diesel cycle with compression ratio and cut off ratio.

(b) A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. [8+8]

8. (a) Explain the four processes make up the simple ideal Rankine cycle. How do actual vapour cycles differ from the idealized ones?

(b) Why is an expansion valve preferred to expansion cylinder in vapour compression refrigeration cycle? [10+6]

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