**II B.Tech I Semester Regular Examinations, November 2007**
**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 the term property. State the differences between extensive, intensive and specific properties of a thermodynamic system. Give few example for each.
   (b) A mass of 2.5 kg of air is compressed in a quasi static process from 0.1 MPa to 0.7 MPa for which PV = constant. The initial specific volume is 0.80 $m^3$/kg. Find the work done by the piston to compress the air. [8+8]

2. A gas undergoes a thermodynamic cycle consisting of three processes beginning at an initial state where P1=1 bar, V1 = 1.5$m^3$ and U1 = 512 kJ. The processes are as follows:
   (a) Process 1-2: Compression with PV=constant to $P_2$ = 2 bar, $U_2$ = 690 KJ
   (b) Process 2-3: $W_{2-3}$ =0, $Q_{2-3}$=- 150 KJ, and
   (c) Process 3-1 : $W_{3-1}$ = 50 KJ.

   Neglecting KE and PE changes, determine the heat interaction $Q_{12}$ and $Q_{31}$. [16]

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 briefly the following process as applied to steam.
      i. Polytropic process
      ii. Isothermal process
   (b) In a contain amount of steam is produced at a pressure of 8 bar and dryness fraction 0.8 calculate
      i. External work done during evaporation
      ii. Internal latent heat of steam [6+10]

5. (a) Deduce the relation ship between absolute temperature and pressure in an polytropic process.
   (b) 0.3$m^3$ of air at pressure 8 bars expands to 1.5$m^3$ . The final pressure is 1.3 bar. Assuming the expansion to be polytropic, calculate the heat supplied and change of internal energy. Take $\gamma$= 1.4 [7+9]

6. (a) Define the following terms:
   i. Internal energy
   ii. Enthalpy

   (b) A gas mixture in an engine cylinder has $13\%CO_2, 12.5\%O_2\ and\ 74.\%N_2$ by volume. The mixture at $950^0$C expands reversibly, according to $PV^{1.2}$ =constant to 8 times its initial volume. Determine the work dome and heat transfer per unit mass of the mixture. The average $C_p$ values for $CO_2, O_2 and N_2$ are 1.235 KJ / KgK, 1.088 KJ /kgK and 1.172 kJ/kgK respectively. [6+10]

7. A closed cycle ideal gas turbine plant operates between temperature limits of 800C and 30C and produces a power of 100kW. The plant is designed such that there is no need for a refrigerator. A fuel of calorific value 45000kJ/kg is used. Calculate the mass flow rate of air through the plant and rate of fuel consumption. (Take $c_p$ = 1.0 kJ/kgK and$\gamma$ =1.4.). [16]

8. (a) Draw the line diagram of the Bell-Coleman refrigeration cycle. Explain with the help of a P-V diagram, different processses in the cycle.

   (b) Explain its advantages and disadvantages of Bell-Coleman cycle. [8+8]

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

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**Time: 3 hours** **Max Marks: 80**
**Answer any FIVE Questions**
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1. (a) Define the term property. State the differences between extensive, intensive and specific properties of a thermodynamic system. Give few example for each.
   (b) A mass of 2.5 kg of air is compressed in a quasi static process from 0.1 MPa to 0.7 MPa for which PV = constant. The initial specific volume is 0.80 $m^3/kg$. Find the work done by the piston to compress the air. [8+8]

2. A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is ?170 kJ. The system completes 100 cycles per minute. Complete the following table showing the method for each item, and complete the net rate of work output in KW. [16]

| Process | $\delta$Q(KJ/min) | $\delta$W(kf/min) | $\Delta$E(kj/min) |
|---|---|---|---|
| a-b | 0 | 2,170 | —– |
| b-c | 21,000 | 0 | —– |
| c-d | -2,100 | —– | -36,600 |
| d-a | —– | —– | —– |

3. (a) Name and define the property that remains constant during a reversible adiabatic process.
   (b) A reversible heat engine operates between reservoirs at 420 K and 280 K. If output from the engine is 2.5 KJ, determine the efficiency of the engine and its heat interactions with the heat reservoirs. Subsequently the engine is reversed and made to operate as heat pump between the same reservoirs. Make calculations for the coefficient of performance of the heat pump and the power input required when the heat transfer rate from the 280 K reservoir is 5 KW. [4+12]

4. (a) Explain with diagram the working procedure of combined separating and throttling calorimeter to obtain dryness fraction?
   (b) A $0.085m^3$ drum contains saturated water and water vapour at $334^0$C Find the mass of each if their volumes are equal. [7+9]

5. (a) Deduce the relationship between absolute temperature and absolute pressure in an adiabatic process.
   (b) 1.5 kg of air at pressure 6 bar occupies a volume of $0.2m^3$.If this air is expanded to a volume of $1.1m^3$. Find the work done and heat absorbed or rejected by the air for each of the following methods of trying one the process.

i. isothermally
ii. Adiabatic ally [7+9]

6. (a) Define
    i. Humidification
    ii. Dehumidification
    iii. sensible heating

   (b) Avessel of $6m^3$ capacity contains two gases ?A? and ?B? in proportion of 45% respectively at 300C.If the value of ?R? for the gases is 0.288 Kj /kg. k and 0.295 Kj /kg. K and if the total weight of the mixture is 2 kg, calculate
    i. Partial presser
    ii. The mean value of ?R? for the mixture. [6+10]

7. In a gas turbine plant working on Brayton cycle, the air at inlet is 27C,0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800C. The turbine and compressor efficiencies are each 80%. Find compressor work, turbine work, heat supplied, cycle efficiency and turbine exhaust temperature. Mass of air may be considered as 1 kg. Draw T-s diagram. [16]

8. In an ammonia vapour compression system, the pressure in the evaporator is 2 bar. Ammonia at exit is 0.85 dry and at entry its dryness fraction id 0.19. During comptression, the work done per kg of ammonia is 150kJ. Calculate the C.O.P and volume of vapour entering the compressor per minute, if the rate of ammonia circulation is 4.5kg/min. the latent heat and specific volume at 2 bar are 1325kJ/kg and $0.58m^3$/kg respectively. [16]

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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) List any five physical properties of matter which can be used for the measurement of temperature
   (b) State the concept of temperature and quality of temperature
   (c) In a general compression process, 2 kJ of mechanical work is supplied to 5 kg of working substance, and 800 J of heat is rejected to the cooling jacket. Calculate the change in specific internal energy. [5+5+6]

3. (a) Write Tds equations.
   (b) Calculate the entropy change of the universe as a result of the following processes:
      i. A copper block of 600 grams mass and with Cp of 150 J/kg-K at $100^0$C is placed in a lake at $8^0$C.
      ii. Two such blocks at 100 and $0^0$C are joined together. [4+12]

4. (a) Explain the following terms relating to steam formation
      i. Sensible heat of water
      ii. Latent heat of steam
   (b) Find the internal energy of 1 kg of steam at 20 bar when
      i. It is super heated, its temperature being $400^0$C
      ii. It is wet, its dryness being 0.9. Assume super heated steam to be have as a perfect gas from the commencement of superheating and thus obeys Charles low. Specific heat for steam = 2.3 k j /kg. k. [7+9]

5. (a) Derive an expression for heat transfer in a non-flow constant volume process.
   (b) A spherical shaped of 14 M diameter contain '$H_2$' at $33^0$C and 1.3 bar. Find the mass of '$H_2$' in the balloon using real gas equation. [7+9]

6. (a) Define the following terms:

i. Internal energy

ii. Enthalphy

(b) A gas mixture in an engine cylinder has $14\%CO_2, 13.5\%O_2 and 72.5\%N_2$ by volume. The mixture at $1050^0$C expands reversibly, according to $PV^{1.2}$ =constant to 7 times its initial volume. Determine the work dome and heat transfer per unit mass of the mixture. The average $C_p$ values for $CO_2, O_2 and N_2$ are 1.27 kj / kgK, 1.11 kj /kgK and 1.196 kJ/kgK respectively. [6+10]

7. (a) With the help of P-V diagram and T-s diagram explain Otto cycle clearly showing the pressure during which the heat is supplied and rejected.

   (b) The minimum pressure and temperature in a Otto cycle are 100 kPa and $27^oC$. The amount of heat added to the air per cycle is 1500 kJ/kg.

      i. Determine the pressure and temperatures at all points of air standard Otto cycle.

      ii. Calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8:1. [6+10]

8. (a) With the help of T-S and P-V diagrams explain simple Rankine cycle.

   (b) Define ton of refrigeration. Discuss the applicaitons of refrigeration. [10+6]

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Code No: R059210304

**Set No. 4**

**II B.Tech I Semester Regular Examinations, November 2007**

**THERMODYNAMICS**

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

**Answer any FIVE Questions**

**All Questions carry equal marks**

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1. (a) What is a thermodynamic system? What is the difference between a closed system and an open system? Give few examples for closed and open systems.

   (b) An engine cylinder has a piston of area 0.12 $m^2$ and contains gas at a pressure of 1.5 MPa. The gas expands according to a process which is represented by a straight line on a pressure-volume diagram. The final pressure is 0.15 MPa. Calculate the work done by the gas on the piston if the stroke is 0.30 m.[8+8]

2. (a) List any five physical properties of matter which can be used for the measurement of temperature

   (b) State the concept of temperature and quality of temperature

   (c) In a general compression process, 2 kJ of mechanical work is supplied to 5 kg of working substance, and 800 J of heat is rejected to the cooling jacket. Calculate the change in specific internal energy. [5+5+6]

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) Write short notes on the following

      i. Throttling calorimeter
      ii. combined separating and throttling calorimeter
      iii. Bucket calorimeter.

   (b) A rigid cylinder of volume $0.028m^3$ contains steam at 80 bar and $350^0$C.The cylinder is cooled until the pressure is 50 Bar ,calculate

      i. The state of steam after cooling
      ii. The amount of heat rejected by the steam. [8+8]

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

   (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 $\gamma$= 1.4 [7+9]

6. (a) The volumetric analysis of a dry flue gas in a boiler trail is given in percentage as $13\% CO_2, 1.5\% CO and 3.5\% O_2 and 82\% N_2$.Determine the percentage gravimetric analysis also find specific gas constant of the mixture.

   (b) The pressure and temperature air in a room are 1 bar and $28^0$C .If the relative humidity is found to be 30%. Find the partial pressure of the water vapour and dew point ,the specific volume of the each constituents and specific humidity, [8+8]

7. (a) What is a cycle? What is the difference between an ideal and actual cycle.

   (b) Derive an expression for efficiency of Brayton cycle in terms of pressure ratio. [8+8]

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 $10^0$C, compressed and it is cooled to $30^0$C. 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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