Code No: R21032 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, June - 2015
THERMODYNAMICS
(Com. to ME, AE, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Energy is a point function. Explain and prove. (8M)
   b) Write the differences between microscopic and macroscopic approach. (7M)

2. a) State the limitations of first law of thermodynamics. (5M)
   b) What is a thermal energy reservoir? (5M)
   c) Define PMMI and the relevance of it. (5M))

3. What is Carnot cycle? Explain with the help of suitable diagrams. Derive the expression for efficiency of Carnot cycle. 15 M

4. a) spherical shell of diameter 50 cm contains steam at a pressure of 40 bar and 0.85 dryness fraction. Calculate the mass of water and steam. (8M)
   b) Explain in detail the formation of steam with the help of T-H diagram indicating the salient points. (7M)

5. 0.2 m^3 of air at 3 bar and 120^0C is contained in a system. A reversible adiabatic expansion takes place till the pressure falls to 1.5 bar. The gas is then heated at constant pressure till enthalpy increases by 75 kJ. Calculate the work done and the index of expansion, if the above processes are replaced by a single reversible polytropic process giving the same work between the same initial and final states. 15 M

6. A mixture of ideal gases consists of 3 kg of Nitrogen and 5 kg of carbon dioxide at a pressure of 4 bar and temperature of 25^0 C .Find 15 M
   i) mole fraction of each constituent
   ii) equivalent molecular weight of the mixture
   iii) Equivalent gas constant of the mixture
   iv) Partial pressure and partial volumes v) volume and density of the mixture
   vi) C_p & C_v of the mixture

7. a) 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 compression is 12 bar. Calculate the compression ratio and air - standard efficiency of the engine. Assume $\gamma = 1.4$. (8M)
   b) Sketch the p-V and T-s diagrams of diesel cycle and derive its efficiency. (7M)

8. Derive the expression for COP of Bell Coleman cycle when the compression and expansion are isentropic. (15M)
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Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) Prove that heat and work are path functions. (8M)
   b) Define system and boundaries. Explain various types of system and boundary with examples. (7M)

2. a) State the first law of thermodynamics and prove that for non-flow process it leads to Q=W+ΔU. (8M)
   b) An engine operating on a Carnot cycle works with in temperature limits of600 K and 300 K. If the engine receives 2000 KJ of heat, evaluate the workdone and thermal efficiency of the engine. (7M)

3. a) Determine the power required to run a refrigerator that transfers 2000 KJ/minof heat from a cooled space at 0^0C to the surrounding atmosphere at 27^0C.The refrigerator operates on reversed Carnot cycle. (8M)
   b) Derive Clausius inequality and explain the significance. (7M)

4. a) Explain the following terms relating to steam formation: i. Sensible heat of water ii. Dryness fraction of steam iii. Enthalpy of wet steam iv. Superheated steam. (8M)
   b) Find the enthalpy and entropy of steam when the pressure is 2 M Pa and the specific volume is 0.09 m^3/kg. Use steam tables only. (7M)

5. a) Write down the Vander Waal's equation of state. How does it differ from the ideal gas equation of state? (8M)
   b) 1kg of CO^2 has a volume of $1m^3$at100^0C. Compute the pressure by (7M)
   i. Vander Waal's equation ii. Perfect gas equation.
   Take a = $362850Nm^4/(kg-mole)^2$; b = $0.0423m^3$/kg−mole;R = 8314J/kg mole-K

6. a) A vessel of $6m^3$ capacity contains two gases A and B in proportion of 45% respectively at 30^0C.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 (8M)
   i) Partial pressure ii) The mean value of R for the mixture.

   b) Write short notes on (7M)
   i) Mole fraction ii) Volumetric analysis iii) Dry bulb temperature
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7. a) Calculate the percentage loss in the ideal efficiency of a diesel engine with compression ratio 14 if the fuel cut off is delayed from 5% to 8% . (8M)

   b) Compare the Otto cycle and Diesel cycle for the same compression ratios and same heat inputs. (7M)

8. a) Explain the difference between the Bell Coleman and Joule cycle of refrigeration. (8M)

   b) An air refrigerating plant operates between 1.6 bar and 8 bar. The capacity of the plant is 5.5 ton. The temperature of the air entering the compressor and into an air engine is -4^0C and 29^0C respectively. The compression and expansion processes are polytropic with exponent n = 1.35. Determine the COP and the net power input for the plant. (7M)

Code No: R21032 **R10** SET - 3

II B. Tech I Semester Supplementary Examinations, June - 2015
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Time: 3 hours Max. Marks: 75

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1. a) Explain the terms state, path, process and cyclic process. (8M)
   b) Explain quasi-static process with examples. (7M)

2. a) Explain working of constant volume gas thermometer with a neat diagram. (8M)
   b) Derive steady flow energy equation. (7M)

3. a) State the Kelvin-Plank and Clausius statements of the second law of thermodynamics and establish equivalence between them. (8M)
   b) State and prove Carnot Principle or Carnot theorem. (7M)

4. a) Explain working of separating and throttling calorimeter. Which type of calorimeter is used when steam is too wet? (8M)
   b) What is the pure substance? Draw and explain P-T (pressure-temperature) diagram for a pure substance. (7M)

5. a) A mass of air is initially at 260^0C and 700 KPa and occupies 0.028m^3. The air is expanded at constant pressure to 0.084m^3.Apolytropic process with n = 1.5 is then carried out, followed by a constant temperature process, which completes a cycle. All the processes are reversible
   i. Sketch the cycle in the P-v &T-s planes ii. Find heat received & rejected in the cycle iii. Find efficiency (η) of the cycle. (8M)
   b) What is the difference between ideal gas and a perfect gas? What is equation of state? (7M)

6. a) State Dalton's law of partial pressures. (8M)
   b) Atmospheric air at 30^0C and a relative humidity of 65% is cooled at a constant pressure of 100 kN/m^2 to 20^0C. Calculate
   i. the final relative humidity and ii. the change in specific humidity. (7M)
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7. a) An engine equipped with a cylinder having a bore of 12 cm and a stroke of 40 cm operates on an Otto cycle. If the clearance volume is 1600 cm^3, compute the air standard efficiency. (8M)

   b) Derive the expression for efficiency of air standard Otto cycle. (7M)

8. A R-12 vapour compression refrigeration system is operating at a condenser pressure of 10 bar and an evaporator pressure of 2.2 bar. Its refrigeration capacity is 14 tonnes. The values of enthalpy at the inlet and outlet of the evaporator are 650 and 200 kJ/kg. The specific volume at inlet to the reciprocating compressor is 0.085 m^3/kg. The index of compression for the compressor is 1.15. Determine: (15 M)
   (a) the power input in kW required for the compressor and
   (b) the COP. Take 1 tone of refrigeration as equivalent to heat removal at the rate of 3.517 kW.

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1\. a) Discuss about concept of continuum (8M)

b) Explain causes for irreversibility in detail. (7M)

2\. a) A blower handles 1 kg/sec of air at 20^0C and consumes a power of 15 kW. The inlet and outlet velocities of air are 100 m/s and 150 m/s respectively. Find the exit air temperature, assuming adiabatic conditions. (8M)

b) Write a note on ideal gas temperature scale. (7M)

3\. a) Prove that " All reversible heat engines operating between the two given thermal reservoirs have same efficiency". (8M)

b) State and prove Clasius theorem. (7M)

4\. a) Explain working of throttling calorimeter with the help of diagram. (8M)

b) Derive Clasius Clapeyron equation and explain its significance. (7M)

5\. 1 kg of air at 1.2 bar pressure and 18^0C is compressed isentropically to 7 bars. Find the final temperature and the work done. If the air is cooled at the upper pressure to the original temperature of 18^0C ,what amount of heat is rejected and what further work of compression is done. 15 M

6\. A vessel of $2m^3$ capacity contains oxygen at 10 bar and 60^0C. The vessel is connected to another vessel of$4m^3$ capacity containing carbon monoxide at 1.5 bar and 25^0C. A connecting valve is opened and the gases mix adiabatically calculate i) The final pressure and temperature of the mixture b) Change of entropy of the oxygen. 15 M
Take for oxygen C_v = 21.07kJ/Mol-K
For carbon monoxide C_v = 20.86kJ/Mol-K

7\. a) Explain graphically the variation of the efficiency of Diesel cycle with compression ratio and cut off ratio. (8M)

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. (7M)

8\. a) Explain the important components of a simple vapour compression refrigeration system. Also discuss the functions of each component. (8M)

b) An air refrigerating plant operates between 1.6 bar and 8 bar. The capacity of the plant is 5.5 ton. The temperature of the air entering the compressor and into an air engine is -4^0C and 29^0C respectively. The compression and expansion processes are polytropic with exponent n = 1.35. Determine the COP and the net power input for the plant. (7)
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