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

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

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Free expansion has zero work transfer explain.
   b) Prove that heat and work are path functions. (7M+8M)

2. a) State the conditions for a process to be reversible
   b) A mass of gas is compressed in a quasi-static process from 75 kPa, 0.1 m^3 to 0.45 MPa, 0.03m^3. Assuming that the pressure and volume are related by $pv^n = c$, find net work done by gas system. (7M+8M)

3. a) Explain 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 of600 K and 300 K. If the engine receives 2000 KJ of heat, evaluate the work done and thermal efficiency of the engine. (4M+4M+7M)

4. a) Derive Clausius – Clapeyron equation.
   b) A 3 MPa steam received from a boiler is charged to a throttling calorimeter where its pressure and temperature are found to be 1 bar and 146^{0}C, respectively. Determine the quality of the boiler steam. (7M+8M)

5. a) Define Joule – Thompson coefficient and derive it.
   b) Explain significance of Joule – Thompson coefficient with the help of a p-T graph. (8M+7M)

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:
   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. (15M)

7. a) Draw p-v and T-s plots of Otto cycle and explain various processes constituting the cycle.
   b) Derive the expressions for efficiency and mean effective pressure of Otto cycle. (8M+7M)

8. Explain ideal vapour compression refrigeration cycle with neat sketches of lay out, T-s and p-h diagrams and derive the expression for COP. (15M)
~~~~~~~~~~~~~~~~~~~~~~~~~~

Code No: R21032 **R10** SET - 2

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

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Explain the terms state, path, process and cyclic process.
   b) Discuss the macroscopic and microscopic point of view of thermodynamics. (8M+7M)

2. One kg of air at 27^0C is heated reversibly at constant pressure until the volume is doubled and then heated reversibly at constant volume until the pressure is doubled. For a total path find work, heat transfer and change in entropy. (15M)

3. a) Write the differences between refrigerator and heat pump? Describe the COP for both of them?
   b) The capacity of refrigerator is 280 tons. Determine the quantity of ice produced at 0^0C within 24 hours when water is supplied at a temperature of 20^0C. (8M+7M)

4. a) Explain with the help of a neat sketch separating and throttling calorimeter. How dryness fraction is measured using it?
   b) A steam vessel contains steam at 10.5 bar and dryness fraction 0.8.Determine the
   i) Specific volume ii) Specific enthalpy
   iii) Specific internal energy iv) Specific entropy of steam using steam tables. (7M+8M)

5. An ideal gas cycle of three processes uses Argon (Mol. wt. 40) as a working substance. Process 1-2 is a reversible adiabatic expansion from 0.015 m^3, 650 kPa, 270^oC to 0.066 m^3. Process 2-3 is a reversible isothermal process. Process 3-1 is a constant pressure process in which heat transfer is zero. Sketch the cycle in the p-v and T-s planes, and find: (15M)
   a) the work transfer in process 1-2,
   b) the work transfer in process 2-3, and
   c) the net work of the cycle. Take $\gamma = 1.67$.

6. a) Write short notes on:
   i) Mole fraction ii) Volumetric analysis iii) Dry bulb temperature
   b) An air water vapour mixture has a relative humidity of 60 % at l atmosphere and 30^0C. Determine per $100m^3$ of the mixture
   i) Mass of water vapour ii) Mass of dry air (9M+6M)

7. a) Draw p-v and T-s plots of Diesel cycle and explain various processes constituting the cycle.
   b) Derive the expressions for efficiency and mean effective pressure of Diesel cycle. (8M+7M)

8. Explain actual vapour compression refrigeration cycle with neat sketches of lay out, T-s and p-h diagrams and derive the expression for COP. (15M)
~~~~~~~~~~~~~~~~~~~~~~~~~~~~

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

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

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~~~~

1. a) What is meant by quasi static process and explain any practical example of such process.
   b) A system with initial internal energy of 300KJ is receiving heat of 280KJ at constant volume process and rejects heat of 260KJ at constant pressure when 60KJ of work is done on the system. The system is brought to its original state by an adiabatic process. Calculate the adiabatic work and value of internal energy at salient points. (8M+7M)

2. a) Explain "internal energy", 'heat and work".
   b) To a closed system 100 KJ of work is supplied. If the initial volume is 0.5 m^3 and pressure of a system changes as P = (8 - 4V), where P is in bar and V is in m^3, determine the final volume and pressure of the system. (7M+8M)

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. (7M+8M)

4. a) Explain pressure-temperature diagram for a pure substance?
   b) A vessel contains one kg of steam which contains 1/3 liquid and 2/3 vapour by volume The temperature of the steam is 151.86^0C. Find the quality, specific volume and specific enthalpy of the mixture. (7M+8M)

5. a) Write down the van der Waals equation of state. How does it differ from the ideal gas equation of state?
   b) A gas occupies 0.034 m3 at 600 kPa and 85^oC. It is expanded in the non-flow process according to the law $pv^{1.2} = c$ to a pressure of 60 kPa after which it is heated at constant pressure back to its original temperature. Sketch the process on the p-v and T-s diagrams, and calculate for the whole process the work done, the heat transferred. Take C_p = 1.047 and C_v = 0.775 kJ/kgK for the gas. (7M+8M)

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 value is opened and the gases mix adiabatically calculate a) The final pressure and temperature of the mixture b) Change of entropy of the oxygen.
   Take for oxygen C_v = 21.07 kJ/Mol-K For carbon monoxide C_v = 20.86 kJ/Mol-K. (15M)

7. a) Draw p-v and T-s plots of Dual combustion cycle and explain various processes constituting the cycle.
   b) Derive the expressions for efficiency and mean effective pressure of Dual combustion cycle. (8M+7M)

8. Explain Bell-Coleman cycle with neat sketches of lay out and T-s diagrams and derive the expression for COP. (15M)
~~~~~~~~~~~~~~~~~~~~~~~~~~~

Code No: R21032 **R10** SET - 4

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

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~~~

1. a) What is thermodynamic system? Explain different types of system.
   b) A gas undergoes two processes that are in series. The first process is an expansion that is carried out according to the law PV = constant and the second process is a Constant pressure process that returns the gas to the initial volume of the first process. The start of the first process is at 400 KPa and 0.025 m^3 with the expansion to 200 KPa. Sketch the process on a P-V diagram, and determine the work of the combined process. (5M+10M)

2. a) State the first law of thermodynamics and prove that for non-flow process it leads to $Q=W+\Delta U$.
   b) Define PMMI and the relevance of it. (8M+7M)

3. a) Prove that Kelvin-Planck statement and Clausius statement of Second law of thermodynamics are equivalent.
   b) Two reversible heat engines A and B are arranged in series with A rejecting heat directly to B through an intermediate reservoir. Engine A receives 200 kJ of heat from a reservoir at 421^0C, and engine B is in thermal communication with a sink at 4.4^0C. If the work output of A is twice that of B find: i) the intermediate temperature between A and B,ii) the efficiency of each engine and iii) the heat rejected to the cold sink. (7M+8M)

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. (8M+7M)

5. Two kg mole of Carbon di oxide at a pressure of 1.8 bar, 80^0C is mixed in a thermally insulated vessel with 3 kg-mole of Nitrogen is at equilibrium, Determine the final temperature and pressure and the change in entropy of the mixture. (15M)

6. A psychrometer gives the following readings of an air stream : (15M)
   Dry bulb Temperature=30^0C
   Wet bulb Temperature=20^0C Determine
   i) dew point temperature ii) relative humidity iii) specific humidity
   iv) degree of saturation v) vapour density vi) enthalpy of air stream per kg of dry air
   Barometer reading = 740 mm of Hg.

7. a) Draw p-v and T-s plots of Ericcson cycle and explain various processes constituting the cycle.
   b) Derive the expressions for efficiency of Ericcson cycle.
   (8M+7M)

8. a) Derive the expression for COP of Bell Coleman cycle when the compression and expansion are isentropic
   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 polytrophic with exponent n= 1.35. Determine the COP and the net power input for the plant. (8M+7M)
~~~~~~~~~~~~~~~~~~~~~~~~~~