Uka Tarsadia University (Diwaliba Polytechnic)
Diploma in Mechanical Engineering
Assignment (Thermodynamics – 020040303)

Unit-1 Basic concepts of thermodynamics

1. Explain different types of pressure and show relationship between gauge pressure, absolute pressure and atmospheric pressure.
2. Write the SI unit of heat and work.
3. Define power and give its unit
4. Draw figure showing relationship between gauge pressure, absolute pressure and atmospheric pressure.
5. Write down thermometric property of thermocouple and Mercury In glass thermometer?
6. Name the instrument used for measuring atmospheric pressure
7. State the SI unit of heat and work.
8. Write the example of following:
   1.Open system 2.Close system 3.Isolated system
9. Give thermometric property of thermocouple and Mercury In glass thermometer?
10. Define power and give its unit
11. Give reference points taken to construct Celsius scale?
12. Explain closed, open and isolated systems with neat sketches.
13. Explain zeroth law of thermodynamics and its significance.
14. Explain construction and working of Mercury In glass thermometer.
15. One system expands at constant pressure of 9 bar from initial volume of $1m^3$ to final volume of $3.5\ m^3$. Calculate work during this process.
16. Describe closed, open and isolated systems with appropriate sketches.
17. Describe zeroth law of thermodynamics in detail.
18. Explain mechanical, chemical and thermal equilibrium
19. Pressure at point A measured by U-tube manometer is +1.5 bar. Pressure measured by barometer at point A is 0.99 bar. Find the absolute pressure at point A.
20. State and explain zeroth law of thermodynamics in detail.
21. Write note on thermodynamic system.
22. Explain thermodynamic equilibrium along with examples.
23. Vacuum pressure at point A measured by U-tube manometer is 2 bar. Pressure measured by barometer at point A is 0.99 bar. Find the absolute pressure at point A.
24. Explain thermodynamic system, boundary and surroundings with examples.
25. With neat diagram, explain thermodynamic system, boundary and surroundings
26. Convert following into different temperature scales:
    a. 15^oC
    b. 0 K
    c. 98.6^oF
    d. 5^oR
27. Convert following into different temperature scales:
    e. 15^oC
    f. 0 K
    g. 98.6^oF
    h. 5^oR
28. Write a note on Mercury In glass thermometer.

29. Describe closed, open and isolated systems with appropriate sketches.
30. Pressure at point A measured by U-tube manometer is +1.5 bar. Pressure measured by barometer at point A is 0.99 bar. Find the absolute pressure at point A.

Unit-2 First law of thermodynamics

1. Calculate work done by piston on gas if volume of gas changes from $5m^3$ to $2m^3$ at constant pressure of 1 bar.
2. Write the law of conservation of energy. What is perpetual motion machine of first kind (PMM-1)?
3. What is enthalpy? Give its equation.
4. Calculate work done by piston on gas if volume of gas changes from $4m^3$ to $2m^3$ at constant pressure of 0.5 bar.
5. State two assumptions of Joules experiment.
6. Write down the mathematical formula for work of gas following PV = C
7. Define enthalpy. Give its equation.
8. Write down mathematical conclusion of joules experiment.
9. What is "control volume"? Draw control volume for nozzle & pipe.
10. Define control volume. Draw control volume for diffuser & pipe.
11. Give formula for displacement work. Name energies in transit
12. First law of thermodynamics is used to relate which two energies?
13. Calculate work done by piston on gas if volume of gas changes from $7m^3$ to $2m^3$ at constant pressure of 2 bar.
14. Write down formula for displacement work. Name energies in transit.
15. What is "control volume"? Draw control volume for nozzle & pipe.
14. Name different types of energies in detail.
15. Write a note on Joules experiment with neat diagram.
16. State first law of thermodynamics. Give the relation between work and heat for closed and open system.
17. Derive Steady Flow Energy Equation and apply it to turbines.
18. Explain energy and state its types.
19. State and explain limitations of first law of thermodynamics.
20. 1.5 kg of liquid having a constant specific heat Cp= 2.5 kJ/kg K is stirred in a well-insulated chamber causing a temperature rise of 250C. Find change in internal energy work done for the process.
21. Define Energy and give details of different energies.
22. Write down the statement of first law of thermodynamics and its limitations.
23. State and explain Joules experiment with neat sketch.
24. A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.1 MPa, temperature 188°C, enthalpy 2785kJ/kg, velocity 32.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?
25. Derive the equation of work for $pv^n=C$ process.
26. Write Steady Flow Energy Equation and apply it to nozzle.
27. Briefly describe Joules experiment.

28. 2.5 kg of liquid having a constant specific heat Cp= 2.5 kJ/kg K is stirred in a well-insulated chamber causing a temperature rise of 255°C. Find change in internal energy work done for the process.
29. Give the statement of first law of thermodynamics. Describe the relation between work and heat for closed and open system.
30. Derive Steady Flow Energy Equation and apply it to compressor.
31. Describe Joules experimental setup and explain in detail.
32. A blower handles 1 kg/s of air at 20°C 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. Take Cp ofair is 1.005 kJ/Kg-K.

Unit-3 Ideal gases and Thermodynamic processes

1. Write characteristics equation of gas and unit of each element of this equation.
2. Write equation of work done for constant temperature process & show meaning of each element of this equation in short.
3. Write equation of work done for isentropic process & show meaning of each element of this equation in short.
4. Draw following process on P-V and T-S diagram.
   Constant volume process (isochoric process)
   Constant pressure process (Isobaric process)
   Constant temperature process (Isothermal process)
   Constant entropy process (Isentropic process).
5. Explain Boyle's law and Charles's law .
6. Explain Gay Lussac Law and Avogadro's law.
7. Write characteristics gas equation and each term.
8. Write the S.I unit of characteristics gas constant and universal gas constant.
9. If a gas has temperature, pressure and volume are 300° C, 10 bar and 14.5 m^3 respectively. Find its characteristics gas constant if its mass is 30 kg.
10. Derive characteristic gas equation for ideal gas. PV=mRT
11. For constant pressure process prove that $W = m R (T_2-T_1)$.
12. Prove that $C_p - C_v = R$.
13. A gas is enclosed in a closed vessel of volume 0.4 m^3 has absolute pressure 3 bar & temperature 40°C. If it is compressed up to 7 bar & its C_v=0.72 kJ/kg k and R=0.29 kJ/kg k, then find its mass & change in internal energy.
14. 1 kg of air is at pressure 15 bar and temperature 980 °C. If a constant temperature it is expanded up to pressure 2.5 bar then find (a) final volume (b) final temperature (c) work done.
15. Air of volume 0.1 m^3 and pressure 1.5 bar is expanded up to volume 0.5m^3 isothermally. Find its final volume and heat transfer during the process.
16. Air of volume 0.3 m^3 and pressure 2 bar is expanded up to volume 0.7m^3 isothermally. Find its final volume and heat transfer during the process.
17. 0.5 kg air is compressed from 1 bar pressure and 20° C. temperature to 6 bar pressure by constant temperature process. Take R= 0.287 kJ/kg k. Find work done.

Unit-4 Second law of thermodynamics

1. Write Kelvin-Planck statement and Clausius statement for 2nd law of thermodynamics.
2. Draw the schematic diagram of steam power plant.
3. Explain Heat reservoir.
4. Draw the symbolic representation of refrigeration system.
5. What is Perpetual Motion machine of second kind ? Is it possible?
6. Define irreversibilities and write any five effects, which make the process irreversible one.
7. Define internal, external and total reversible processes.
8. Define reversible cycle and write names of three reversible cycles.
9. Differentiate between refrigerator and heat pump.
10. Explain Thermodynamics Temperature Scale.
11. One heat engine receives 2000 kJ heat & rejects 1000 kJ heat. Find its thermal efficiency
12. List different types of irreversibilities & explain any one of them.
13. Explain irreversible process with different example.
14. Draw the equivalence between Kelvin-plank and Clausius statements with neat sketch.
15. Prove that entropy is a point function/ property of state.
16. One heat engine receives 6000 kJ/hr energy from source of 327^0C & rejects 3000 kJ/hr to into sink of 25^0 during its cycle working. Find its thermal efficiency. Show this cycle of this engine is reversible or irreversible.
17. Write a short note on Carnot cycle.
18. A heat pump utilized to keep warm a room, takes 65 kJ heat from outside atmosphere and rejects 40 kJ heat into room. Find its COP and work required.

Unit-5 Thermodynamic cycles

1. Define following terms (a) process (b)Cycle
2. Write application and limitation of Carnot cycle.
3. Write two application of Carnot cycle.
4. Write application of Otto cycle.
5. Show classification of thermodynamic cycle.
6. Write limitations of air standard cycle.
7. Differentiate cycle and process.
8. Draw Carnot cycles on P-V diagrams and explain various processes in them.
9. Draw Otto Cycle on P-V and T-S diagrams and explain various processes in them.
10. Draw Dual cycle on P-V and T-S diagrams and explain various processes in them.
11. Draw Brayton Cycle on T-S diagrams and explain various processes in them.
12. State assumptions made in air standard thermodynamic cycle.
13. Show that the efficiency of Otto cycle depends only on the compression ratio.
14. Show that efficiency of Carnot cycle is independent of working substance.
15. Explain application and limitation of Brayton cycle.
16. Differentiate between Otto cycle and Diesel cycle.
17. Derive the equation of air standard efficiency for Otto cycle.
18. Describe the Dual cycle ,Otto cycle and Diesel cycle and represent them on P-V&T-S diagrams.

19. For a engine working on Otto cycle, pressure at the starting of compression process is 2 bar and at the end of compression process is 14 bar. If Υ =1.4 Find value of compression ratio and thermal efficiency. Take R = 287 kJ/kg K.
20. A heat engine works between temperature of 1000 K and 300 K. Find minimum heat rejection rate for unit network output.
21. A Carnot cycle operates between source and sink temperatures of 500^{o} C and -40^{0} C. If the system receives 200 kJ from the source , find : (a) Efficiency of the system, (b) The net work transfer, and (c) Heat rejected to sink.
22. In a engine working on ideal Otto cycle the temperature at the beginning and at the end of compression is 50^{0} C and 400^{0} C . Calculate the air standard effiency and compression ratio.
23. One heat engine works between temperature of 150^{0}C&700^{0}C.Find its maximum possible thermal efficiency.
24. Find maximum possible thermal efficiency if one heat engine works between temperature of 350^{0}C&900^{0}C.

Unit-6 Refrigeration cycles

1. State the names of refrigeration cycle.
2. Define coefficient of performance.
3. Define one tone of refrigeration.
4. Define relative COP.
5. Write the unit of refrigeration and Write the equation of COP of refrigeration system
6. Draw P-V and T-S diagram of Reversed Carnot cycle.
7. Draw the neat sketch of Bell Coleman Refrigerator with all nomenclature.
8. Prove1TR = 3.5 Kw
9. Find the C.O.P of a refrigeration system if work input is 80kJ/kg and refrigeration
10. A machine working on Carnot refrigeration cycle operates between320K and 270K Determine the COP when it is operated as refrigerator machine.
11. Explain Bell Coleman cycle with schematic diagram.
12. Describe the reversed Carnot cycle and represent it on P-V &T-S diagrams.
13. Describe the Carnot cycle and represent it on P-V&T-S diagrams.
14. Explain the method of improvement of COP in reversed Carnot cycle..
15. What is refrigeration? What is refrigerating effect? What is one tone of refrigeration?
16. Write the name of various process of Reversed Carnot Cycle and explain it in brief.
17. Describe the Reversed Brayton cycle and represent it on P-V&T-S diagrams.
18. Write the name of various process of Reversed Brayton Cycle and explain it in brief.
19. Write the application and limitations of Reversed Carnot cycle.
20. Write the advantage and disadvantage of Reversed Brayton cycle.
21. With a schematic diagram and T-S diagram, explain ideal vapour compression cycle.
22. What is refrigeration? How it is produced? What are the main components of vapour compression system? Mention their functions.
23. A Carnot refrigerator has working temperature of -30^{0} C and 35^{0} C. The actual COP is 0.75 of the maximum. Calculate the power consumption and heat rejected to the surroundings per ton of refrigeration.
24. Explain the Bell Coleman Refrigerator with neat sketch.
25. Write the equation of COP for Reversed Carnot cycle and Reversed brayton cycle with P-V diagram.

26. A Refrigeration workingsystem on a Reversed Carnot cycle. It absorb heat 1278 KJ/min at -5.55^{0}C.If ambient temperature is 30^{o}C so find (1) Work Done (2) COP.
27. A Carnot refrigerator has working temperature of -23^0 C and 40^0 C. The actual COP is 0.83 of the maximum. Calculate the power consumption and heat rejected to the surroundings per ton of refrigeration.