Subject Name: Thermodynamics

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Year and Sem, Department:II/I ,ME

Unit-I: (Introduction to Thermodynamics)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- Thermodynamics: It is the branch of science which deals with the study of heat work and properties of the system.
- System: It is defined as a quantity of matter or region in a space upon which attention is focused is called system.
- Surrounding: everything external to the system is known as surrounding.
- Boundary: the layer which separates the system from its surrounding is known as boundary.
- Universe: system and surrounding together known as universe.
- Open system: it is the system in which both energy and mass transfer takes place across the system boundary.
- Closed system: In this type of system there is no mass transfer but energy can transfer across the system boundary.
- Isolated system: it is the system in which there is no mass and energy transfer across the system boundary.
- Zeroth law of thermodynamics: If two systems are in thermal equilibrium with the third system separately then the two systems are also in thermal equilibrium with each other.

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. What do you understand by macroscopic and microscopic viewpoints? Explain. (March 2016)
2. What is constant volume gas thermometer? Why is it preferred to a constant pressure gas thermometer?(March 2016)
3. Differentiate reversible and irreversible processes.(March 2016).
4. What is open system.Give an example.(march 2017)
5. What is path function.(March2017)
6. What is the principle of thermometry.(December 2016)
7. Explain irreversibility.(December 2016)
8. What is positive and negative work interactions.(May 2018)
9. Define enthalpy.(may 2018)
10. What is quasistatic process.(May 2018)

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. A mass of 8 kg gas is expands in a flexible container so that the p-v relationship is in the form of pv1.2=const. the initial pressure is 1000 kPa and the initial volume is 1 m3. The final pressure is 5 kPa. If the specific internal energy of the gas is decreases by 40 kJ/kg, find the heat transfer in magnitude and direction.(march 2016)
2. A cylinder, Acyl = 7.012 cm2 has two pistons mounted, the upper one, mp1 = 100 kg, initially resting on the stops. The lower piston has 2 kg water below it, with a spring in vacuum connecting the two pistons. The spring force fore is zero when the lower piston stands at the bottom, and when the lower piston hits the stops the volume is 0.3 m3. The water, initially at 50 kPa, V = 0.00206 m3, is then heated to saturated vapor. i) Find the initial temperature and the pressure that will lift the upper piston. ii) Find the final T, P, v and work done by the water.(march 2016)
3. Explain the working of constant volume gas thermometer.(march 2017)

4. Explain about quasistatic process.(March 2017)
5. Prove that internal energy is a property of the system.(March 2017).
6. What is meant by thermodynamic equilibrium? Explain with the help of examples.(December 2016).
7. What is positive and negative work interactions.(May 2018).
8. Show that heat is a path function and not a property. (June2019)
9. A piston-cylinder device operates 1 kg of fluid at 20 atm. Pressure. The initial volume is 0.04 m3. The fluid is allowed to expand reversibly following a process pV1.4 = constant so that the volume becomes double. The fluid is then cooled at a constant pressure until the piston comes back to the original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle.(june 2019).
10. A reciprocating air compressor takes in 2 m3/min at 0.11 MPa, 200C which is delivers at 1.5 MPa, 111 0C to an aftercooler where the air is cooled at constant pressure to 25 0C. The power absorbed by the compressor is 4.15 kW. Determine the heat transfer in compressor and the cooler.(December 2017)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. If the value of $n = 0$ in the equation $pv^n = C$, then the process is called **constant pressure process.**
2. In the first law of thermodynamics the total energy of the system remains **constant.**
3. series of operations, which takes place in a certain order and restore the initial conditions at the end, is known as **Thermodynamic cycle.**
4. An isothermal process is governed by **Boyle's law**
5. The value of 1 mm of Hg is equal to **133.3 N/m^2.**
6. Work done in a constant volume process is **zero.**
7. Heat transfer is **path** function.
8. The process in which no heat transfer takes place through boundaries is called as **adiabatic process.**
9. The thermodynamic work done by the system on the surrounding is considered as **positive.**
10. Isentropic means **entropy** is constant.

Unit-II: (First and second law of thermodynamics)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- Thermodynamic property: There are certain characteristics of the system to which some physically meaningful numbers can be assigned is called property.
- Intensive property: It is the property which is independent upon mass or extent or size of the system.
- Extensive property: It is the property which depends on mass or size or extent of the system is called extensive property.
- Isothermal process: Temperature is constant in the process.
- Isobaric process: Pressure is constant in the process.
- Isochoric Process: Volume is constant in the process.
- Isentropic process: Entropy is constant in the process.
- Isenthalpic process: Enthalpy is constant in the process.
- Adiabatic process: No heat transfer in the process.
- Thermodynamic is the study of 3 E'S , energy, Equilibrium, entropy.
- Energy can be in two forms; Energy in transit and Energy in storage.
- PMM1: There can be no machine which would continuously supply mechanical work without some other form of energy disappearing simultaneously.

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. State and discuss the 'Clausis' theorem.(March 2016)
2. Differentiate reversible and irreversible processes. Entropy remains constant in a reversible adiabatic process. Justify. (March 2016)
3. What is PMM of second kind.(march 2017)
4. Write two statements of second law of thermodynamics.(March 2017).
5. State and prove the 'Clausis' theorem. (December 2017)

6. What is PMM 1? Why it is impossible? (December 2017)
7. A heat pump takes up heat from cold outdoors and transfers it to warmer indoor space. Is this a violation of second law of thermodynamics? Explain.(December 2018)
8. What are the limitations of first law of thermodynamics.
9. Define COP of refrigerator.
10. Define COP of heat pump.

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Give the differential form of S.F.E.E. Under what condition the S.F.E.E. does reduces to Euler's equation. (March 2016).
2. Prove that the COP of the reversible refrigerator operating between two given temperatures is the maximum. (March 2016).
3. Prove that equivalence of kelvin plank and clausius statements. .(March 2017).
4. Derive clausius inequality. .(March 2017).
5. What is meant by thermodynamic equilibrium? Explain with the help of examples.(December 2016)
6. What is meant by SFEE and derive it and reduce it for the turbine. .(December 2016
7. Discuss the significance of Third law of thermodynamics. .(December 2016)
8. Explain the concept of irreversibility and its significance. .(December 2016)
9. In a steam power plant 1 MW is added at 7000C in the boiler , 0.58 MW is taken at out at 400C in the condenser, and the pump work is 0.02 MW. Find the plant thermal efficiency. Assuming the same pump work and heat transfer to the boiler is given, how much turbine power could be produced if the plant were running in a Carnot cycle? (December 2017)
10. Differences in surface water and deep-water temperature can be utilized for power generation. It is proposed to construct a cyclic heat engine that will operate near Hawaii, where the ocean temperature is 200C near the surface and 50C at some depth. What is the possible thermal efficiency of such a heat engine? (December 2017)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. There is a loss of heat in an irreversible process :**True**
2. An adiabatic process is one in which **no heat enters or leaves the gas.**

3. The processes occuring in open system which permit the transfer of mass to and from the system, are known as **flow processes**
4. The entropy **increases** in an irreversible cyclic process.
5. There is no change in internal energy in an isothermal process.**True.**
6. The absolute zero temperature is taken as **-273°C**
7. The sum of internal energy (U) and the product of pressure and volume ($p.v$) is known as **Enthalpy**
8. Second law of thermodynamics implies that cycle efficiency of thermodynamic process must be **less than unity**
9. Ratio of specific heat capacity at constant pressure to specific heat capacity at constant volume is always **Greater than Unity**
10. For any irreversible process, net entropy change is **always positive**

Unit-III: (Pure Substance and Ideal gas laws))

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- Pure substance: a pure substance is a substance of constant chemical composition throughout its mass.
- Triple point: It is point on a PV diagram where all the three phase solid, liquid, and gas exist in equilibrium.
- Dryness fraction: It indicates mass fraction of vapour in a liquid vapour mixture.
- Sensible heat : The amount of heat required to raise the temperature of water from its 0 degree calcium to saturation temperature is known as sensible heat of liquid.
- Latent heat : Amount of heat required to evaporate the 1 kg of saturated liquid to 1 kg of dry steam at constant pressure is known as LATENT HEAT.
- Amount of super heat: The amount of heat required to raise the temperature of steam from its saturation temperature to any desired temperature is known as degree or amount of super heat.
- Saturation temperature: It is the temperature at the liquid starts boiling.
- Super heated temperature: It is the temperature of the steam above the saturation temperature is called super heated temperature.

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Draw P-V diagram for water and a pure substance other than water. Also draw P-T diagram of water.(March 2016)
2. Define ideal gas. And show that for ideal gas internal energy depends only on its temperature. .(March 2016)
3. What is dryness fraction.(March 2017)
4. What do you mean by throttling.(March2017)
5. Explain the non flow process. (December 2016)
6. Write the Clausius Clapeyron equation and its significance.(December 2016)
7. What do you understand by triple point? (May 2018)
8. Define an ideal gas. What is universal gas constant?(May 2018)
9. What is the difference between critical point and triple point?(June2019)
10. Is it true that water boils at higher temperatures at higher pressures? Explain.

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. What do you understand by triple point? Give the pressure and Temperature of water at its triple point.(December 2016)
2. Water at 400C is continuously sprayed into a pipeline carrying 5 tonnes of steam at 5 bar, 3000C per hour. At a section downstream where the pressure is 3 bar, the quality is to be 95%. Find the rate of water spray in kg/hr.(December 2016).
3. What is critical state? Explain the terms critical pressure, critical volume and critical temperature of water?(may 2018)
4. A steam pressure of holding capacity 4 m3 contains a mixture of saturated water and saturated steam at 2500C.
5. The mass of the liquid present is 1 ton. Determine (i) Quality; (ii) Specific Volume; (iii) Specific Enthalpy; (iv) Specific Entropy and (v) Specific Internal Energy of steam.(May 2018)
6. Write short notes on “Mollier diagram”. Why do isobars on the Mollier diagram diverge from one another? (May 2018)

7. A pressure cooker holding 2 kg of steam at 5 bar and 90% dry is being cooled slowly. What quantity of heat has to be extracted so as to reduce the steam quality down to 60%? Also calculate the pressure and temperature of the steam that remains in the pressure cooker after the heat rejection.(May 2018)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. The amount of heat required to raise the temperature of the unit mass of gas through one degree at constant volume, is called **specific heat at constant volume.**
2. When the gas is heated at constant volume, the heat supplied increases the internal energy of the gas.**True.**
3. Workdone in a free expansion process is **Zero.**
4. According to Gay-Lussac law for a perfect gas, p/T = constant, if v is kept constant.**True**
5. The value of specific heat at constant pressure (c_p) is **more** that of at constant volume (c_v).
6. C_p-C_v=**R**
7. The value of gas constant (R) in S. I. units is **287 J/kgK**
8. According to Avogadro's law, the density of any two gases is **directly proportional** to their molecular masses, if the gases are at the same temperature and pressure.
9. The specific heat of water is **4.187 KJ/Kg**
10. The universal gas constant of a gas is the product of molecular mass of the gas and the gas constant.**True**

Unit-IV: (mixtures amd psychometry)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- Vader Waals Equation of State :on account for the volume that a real gas molecule takes up, the van der Waals equation replaces V in the ideal gas law with , where Vm is the molar volume of the gas and b is the volume that is occupied by one mole of the molecules.

- In chemistry, the mole fraction or molar fraction (xi) is defined as the amount of a constituent (expressed in moles), ni divided by the total amount of all constituents in a mixture.
- Dalton's law of partial pressures: states that the total pressure of a mixture of gases is equal to the sum of the partial pressures of the component gases.
- Psychrometrics, psychrometry, and hygrometry are names for the field of engineering concerned with the physical and thermodynamic properties of gas-vapor mixtures.
- Dry bulb Temperature: The dry-bulb temperature (DBT) is the temperature of air measured by a thermometer freely exposed to the air, but shielded from radiation and moisture.
- The wet-bulb temperature (WBT) is the temperature read by a thermometer covered in water-soaked cloth (wet-bulb thermometer) over which air is passed.
- The dew point is the temperature to which air must be cooled to become saturated with water vapor. When further cooled, the airborne water vapor will condense to form liquid water (dew).
- Humidity is the concentration of water vapour present in air.

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Draw psychrometric chart and show psychrometric processes in the chart. (March 2016)
2. What is the difference in wet bulb temperature, dew point temperature, and thermodynamic wet bulb temperature?(March 2016)
3. Define wet bulb temperature and dry bulb temperature.(March 2017)
4. What is meant by molecular internal energy? (December 2016)
5. Write the Carrier’s equation and its significance.(December 2016)
6. What is Specific humidity and relative humidity? (May 2018)
7. Explain Mole fraction, Volume fraction(May 2018)
8. Draw psychrometric chart and show psychrometric processes in the chart. (December 2017

9. State Gibb's theorem and write expressions of average specific internal energy, average)specific enthalpy and average specific heats of the mixtures. (December 2017)
10. Distinguish between wet bulb temperature and thermodynamic wet bulb temperature.(December 2018)

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Explain the method of evaluation of internal energy pf gaseous mixture.(March 2017)
2. Write about Vander Waals equation for real gases.(December 2016)
3. Explain the steps involved in the construction of Psychrometric chart at 2 bar pressure and also explain the process of adiabatic saturation.(December 20116)
4. What are the Daltons Law of partial pressures? How it is different from Avagadro's law?(December 2016)
5. What is an adiabatic saturation? When does the wet bulb temperature equal the saturation temperature?(December 2016)
6. Explain the following: i) Heating and dehumidification ii) Cooling and dehumidification.(May 2018)
7. Discuss why does the enthalpy of air-vapour mixture remains constant during an adiabatic saturation process.(June 2019)
8. Explain Daltons law of partial pressures.(June 2019)
9. State Avagadro's Hypothesis.(December 2018)
10. Discuss about sensible heating, cooling and dehumidification processes.(December 2018)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. The pressure exerted by an ideal gas is **two-third**of the kinetic energy of all the molecules contained in a unit volume of gas. two-third.
2. The kinetic energy of molecules of a gas becomes zero at absolute **zero** temperature.
3. Stirling and Ericsson cycles are **reversible cycles.**

4. The amount of heat transferred to convert unit mass of solid to vapour or vice versa is called as **latent heat of sublimation.**
5. In free expansion of gas, the work transfer is **zero.**
6. When humidity ratio of air **decreased**_ air is said to be dehumidified.
7. In adiabatic evaporative cooling, heat transfer between chamber and surroundings is **Zero.**
8. Expression for general gas equation **is PV=mRT**
9. According to Daltons law the total pressure of the mixture of the gas is equal **to sum of partial pressures of all.**
10. Temperature of the gas is produced due to **kinetic energy of the molecukles.**

Unit-V: (Power cycles)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

- An Otto cycle is an idealized thermodynamic cycle that describes the functioning of a typical spark ignition piston engine. It is the thermodynamic cycle most commonly found in automobile engines.
- The Diesel cycle is a combustion process of a reciprocating internal combustion engine. In it, fuel is ignited by heat generated during the compression of air in the combustion chamber, into which fuel is then injected.
- The dual combustion cycle (also known as the mixed cycle, Trinkler cycle, Seiliger cycle or Sabathe cycle) is a thermal cycle that is a combination of the Otto cycle and the Diesel cycle, first introduced by Russian-German engineer Gustav Trinkler, who never claimed to have developed the cycle though.

- The Stirling cycle is a thermodynamic cycle that describes the general class of Stirling devices. This includes the original Stirling engine that was invented, developed and patented in 1816 by Robert Stirling with help from his brother, an engineer.
- The Atkinson-cycle engine is a type of internal combustion engine invented by James Atkinson in 1882. The Atkinson cycle is designed to provide efficiency at the expense of power density.
- The Brayton cycle is a thermodynamic cycle named after George Brayton that describes the workings of a constant-pressure heat engine.
- The Rankine cycle is a model used to predict the performance of steam turbine systems. It was also used to study the performance of reciprocating steam engines. The Rankine cycle is an idealized thermodynamic cycle of a heat engine that converts heat into mechanical work while undergoing phase change.

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Draw P-V, T-S diagrams of Sterling cycle, and explain. (March 2016)
2. Compare efficiencies of Otto and dual cycle. (March 2106)
3. Draw lay out of bell colleman cycle.(March 2017)
4. Draw pv and TS diagram for Atkinson cycle(March 2017)
5. Draw p-v and T-s diagrams of Lenoir cycle. (December 2016)
6. Draw the Bell Coleman cycle in operation.(December 2016)
7. What is a ton of refrigeration? (May 2018)
8. What is an air standard cycle? Why are such cycles conceived?(May 2018)
9. Draw the P-V diagram of Lenoir cycle. (June 2019)
10. Draw the P-V and T-S plots of Otto cycle. (June 2019)

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Explain the diesel cycle with the help of PV and TS diagram.(marvh 2017)
2. Explain the working of Bell colleman cycle(March 2017)
3. Write about Dual combustion cycles and the significance of the same.(December 2016)
4. How is a reversed Carnot cycle used for refrigeration? Explain the processes.(December 2016)
5. Derive an expression for thermal efficiency of Otto cycle.(May 2018)

6. Explain the working of Bell- Coleman cycle. (May 2018)
7. Explain the working of Atkinson Cycle.(May 2018)
8. With a neat sketch explain the working of simple vapour compressing refrigeration cycle and derive the expression for COP.(December 2018)
9. Define mean effective pressure and thermal efficiency of an air standard cycle.(December 2018)
10. Draw the variation of thermal efficiency against compression ratio of an Otto-cycle.(December 2018)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. A cycle consisting of one constant pressure, one constant volume and two isentropic processes is known as **Diesel cycle.**
2. The efficiency of Diesel cycle approaches to Otto cycle efficiency when **cut-off is zero**
3. The efficiency of Stirling cycle is **equal** Carnot cycle.
4. The efficiency of Diesel cycle increases with **decrease in cut-off**
5. When cut-off ratio is **zero** the efficiency of Diesel cycle approaches to Otto cycle efficiency.
6. Internal combustion engine is the example of **non-cyclic engines.**
7. The cycle which consists of two reversible isotherms and two reversible isochores is called as **stirling** cycle.
8. Two reversible isothermal processes and two reversible isobaric processes are carried out in **Ericsson cycle.**
9. The purpose of study of air standard cycle is **to simplify the analysis of internal combustion engine.**
10. How is the heat added in the Otto cycle? **reversibly at constant volume**