GUJARAT TECHNOLOGICAL UNIVERSITY

DI -3 SEMESTER – OLD PAPER – S23 TO S25 – QUESTION BANK(English)

Subject Name & Code:

Engineering Thermodynamics- 4321902

Unit I: Basic Concepts of Thermodynamics

Repeated Questions:

1. **Classify thermodynamic system.**
   - **Appeared in:** SUM23 (Q1b, 04 marks), WIN23 (Q1a, 03 marks), WIN24 (Q1c-OR, 07 marks), SUM24 (Q1b, 04 marks)
2. **Explain Zeroth law of thermodynamics and state its application.**
   - **Appeared in:** WIN23 (Q1b, 04 marks), WIN22 (Q1b, 04 marks), SUM24 (Q1a-i, 03 marks)
3. **Classify system boundaries and give examples.**
   - **Appeared in:** WIN23 (Q1c, 07 marks), SUM24 (Q1b, 04 marks), WIN24 (Q1c, 07 marks)
4. **Define: a) Open system b) Close system c) Isolated system and give one example of each.**
   - **Appeared in:** WIN23 (Q1a, 03 marks)
5. **Differentiate between Point and Path function.**
   - **Appeared in:** WIN23 (Q1c-OR, 07 marks), WIN22 (Q1c-OR, 07 marks)
6. **Differentiate between Intensive and Extensive Property.**
   - **Appeared in:** WIN23 (Q1c-OR, 07 marks), SUM24 (Q1c, 07 marks)
7. **Differentiate between Heat and work.**
   - **Appeared in:** WIN23 (Q1c-OR, 07 marks), WIN22 (Q1c-OR, 07 marks)
8. **Define: 1) Enthalpy 2) Flow work 3) Pressure.**
   - **Appeared in:** WIN22 (Q1a, 03 marks), SUM23 (Q1a, 03 marks)
9. **Define: Steady Flow, Flow Work, Flow Process.**
   - **Appeared in:** WIN23 (Q2a-OR, 03 marks), SUM23 (Q1-6, 07 marks)
10. **Define: 1) Entropy 2) Enthalpy 3) Temperature.**
    - **Appeared in:** SUM23 (Q1a, 03 marks)
11. **Define: a)Perfect Gas b)Quasi Perfect Gas c)Real Gas.**
    - **Appeared in:** WIN23 (Q4a-OR, 03 marks)
12. **Define: 1) control volume 2) Flow work 3) Flow process.**
    - **Appeared in:** SUM23 (Q1-6, 07 marks)
13. **Define (1) Fixed Boundary (2) Movable Boundary (3) Real Boundary (4) Imaginary Boundary.**
    - **Appeared in:** SUM25 (Q1c-OR, 07 marks)
14. **Classify thermodynamic property and explain Extensive Property and Intensive Property.**
    - **Appeared in:** SUM25 (Q1a, 03 marks)
15. **Classify energy and explain both internal energy briefly.**
    - **Appeared in:** SUM25 (Q1b, 04 marks)
16. **Explain shaft work and flow work with proper sketch and example.**
    - **Appeared in:** SUM25 (Q1c, 07 marks)
17. **Explain Conventional Sign of work, heat and internal energy during exchange of it with boundary.**

- **Appeared in:** SUM25 (Q2a, 03 marks)

Other Important Questions:

18. **Do as directed: i. Concept of temperature and thermal equilibrium is deals with…. (a) Zeroth law, (b) First law, (c) Second law, (d) Third law ii. A system which consists of single phase is called homogeneous system. (True/False) iii. System in which only energy can cross its boundary is known as open System. (True/False)**
    - **Appeared in:** SUM24 (Q1a, 03 marks)
19. **Identify intensive & extensive properties from given list: Density, enthalpy, surface Area, thermal Capacity, thermal conductivity, internal energy, Pressure.**
    - **Appeared in:** SUM24 (Q1c, 07 marks)
20. **A system contains with the enthalpy of 240 KJ, internal Energy of 90000 J and volume of 0.5 m3, Find the pressure in bar.**
    - **Appeared in:** SUM24 (Q1c-OR, 07 marks)
21. **Draw the boundaries of the following system & State types of system and boundary involve in it. 1. System of water-steam contained in a boiler. 2. System of gas entrapped in a closed piston cylinder assembly.**
    - **Appeared in:** WIN22 (Q1c, 07 marks)
22. **Explain all thermodynamic equilibrium.**
    - **Appeared in:** SUM23 (Q1-5, 09 marks)

Unit II: Ideal Gases and Thermodynamic Processes

Repeated Questions:

1. **Prove that Cp – Cv = R.**
   - **Appeared in:** WIN23 (Q4b, 04 marks), SUM23 (Q4a-OR, 03 marks), SUM24 (Q4c, 07 marks), SUM25 (Q5b-OR, 04 marks)
2. **Write and explain Charles's law for gas. / Explain Charles law and Gay Lussac's law for ideal gas.**
   - **Appeared in:** WIN23 (Q4a, 03 marks), SUM23 (Q4b-OR, 04 marks)
3. **State Boyle's law and Charle's law.**
   - **Appeared in:** WIN24 (Q4a, 03 marks), SUM25 (Q4c, 07 marks)
4. **Derive characteristic gas equation PV = mRT.**
   - **Appeared in:** SUM23 (Q4b, 04 marks), SUM24 (Q4c-OR, 07 marks), WIN24 (Q4b, 04 marks)
5. **Differentiate between process and cycle.**
   - **Appeared in:** WIN23 (Q3a, 03 marks), SUM24 (Q4b-OR, 04 marks), WIN24 (Q4a-OR, 03 marks), SUM25 (Q4b, 04 marks)
6. **Illustrate/Draw the following processes on P-V & T-S Diagram: a) Isothermal b) Isobaric c) Adiabatic/Isentropic d) Polytropic.**
   - **Appeared in:** WIN23 (Q4b-OR, 04 marks), SUM24 (Q4a-OR, 03 marks), WIN24 (Q3c-OR, 07 marks), SUM25 (Q4a-OR, 03 marks)
7. **What is a polytropic process? Plot different polytropic processes on a P-V diagram.**
   - **Appeared in:** SUM23 (Q4a, 03 marks)
8. **Define: 1) Isothermal Process 2) Isobaric process 3) Adiabatic process.**
   - **Appeared in:** WIN22 (Q4a-OR, 03 marks)
9. **Define: 1. Ideal gas 2. Specific heat 3. Throttling process.**
   - **Appeared in:** WIN22 (Q4a, 03 marks)
10. **Explain specific heat at constant volume and specific heat at constant pressure.**
    - **Appeared in:** WIN22 (Q4b-OR, 04 marks), SUM25 (Q3c, 07 marks)
11. **Derive expression for work done during isentropic process.**
    - **Appeared in:** WIN24 (Q4b-OR, 04 marks)
12. **Derive equation of work done in polytropic process.**
    - **Appeared in:** WIN24 (Q5b, 04 marks)
13. **Explain constant volume process with P-V and T-S diagram and also derive formula for work, heat and internal energy.**
    - **Appeared in:** SUM25 (Q3c-OR, 07 marks)

Other Important Questions (Numericals & Theory):

14. **4 kg of air at atmospheric pressure of 3 bar absolute and temperature of 45°C is expanded at constant pressure till its volume becomes four times of initial volume. Find: a) change in internal energy b) change in enthalpy c) Final volume d) work done.**
    - **Appeared in:** WIN23 (Q4c, 07 marks)
15. **0.6 liter gas is at 1 bar absolute pressure and temperature of 40°C. It is compressed polytropically up to 0.2 liter. If compression process index is 1.3 then find work done and heat transfer during this process. Take cv=0.713 KJ/Kg and R=0.287 KJ/Kg.**
    - **Appeared in:** WIN23 (Q4c-OR, 07 marks)
16. **Air at volume 0.1 m3 and pressure 1.5 bar is expanded to volume 0.5 m3 isothermally. Find final pressure of air and work done during this process.**
    - **Appeared in:** SUM23 (Q4c, 07 marks)
17. **One incompressible tire has volume of 0.4 m3. Initial pressure and temperature of air is 4 bar ab and 300 K respectively. If pressure is raised up to 7 bar, find final temperature of air. Also find mass of enclosed air. Take R = 0.287 Kj/kgk.**
    - **Appeared in:** SUM23 (Q4c-OR, 07 marks)
18. **If a gas have temperature, pressure and volume as 300°C, 10 bar and 14.3 m3**

respectively. Find its characteristic gas constant R, if mass of gas is 20 Kg.
- **Appeared in:** SUM24 (Q3c, 07 marks)

19. **An ideal gas temperature 30ºC, pressure 0.25 MPa and volume 0.15 m3. If the gas is compressed to 1 MPa and 0.04 m3, find out the temperature of gas.**
    - **Appeared in:** SUM24 (Q3c-OR, 07 marks)
20. **A gas is enclosed in a closed vessel of volume 0.4 m³ has absolute pressure 3 bar & temperature 40º C. If it is heated to get pressure 6 bar. If Cv = 0.72 KJ/ kgK & R= 0.29 kJ/kgK, Then find its mass & change in internal energy.**
    - **Appeared in:** WIN24 (Q3c, 07 marks)
21. **0.5 Kg air is compressed from 1 bar absolute pressure and 15 °C temperature to 6 bar absolute pressure by isothermally process. Draw P-V and T-S diagram for isothermal process. Find out 1) work done 2) heat transfer. Take R = 0.287 KJ/Kg K.**
    - **Appeared in:** WIN22 (Q4c, 07 marks)
22. **6 Kg of air is heated at constant pressure from temperature 30 ºC to 525 ºC. if its Cp = 0.987 KJ/Kg.K and Cv = 0.73 KJ/Kg.K. Draw P-V and T-S diagram for constant pressure process. Find. 1) Characteristic gas constant (R) 2) Ratio of specific heats (γ) 3) Change in internal energy (ΔU) 4) Work done (W) 5) Heat transfer (Q).**
    - **Appeared in:** WIN22 (Q4c-OR, 07 marks)
23. **If an ideal gas temperature is 300 and pressure 2.0 bar and volume 0.15 m3. If this gas is compressed to 8.5 bar and volume rise to 0.08 m3 than what is final temperature of gas.**
    - **Appeared in:** SUM25 (Q4a, 03 marks)
24. **2 Kg gas enclosed in a closed vessel is heated from 2 bar to 5 bar. The initial temperature of gas is . Find out (1) Final temperature (2) change in internal energy. Take Cv = 0.72 Kj/Kg K.**
    - **Appeared in:** SUM25 (Q4c-OR, 07 marks)
25. **Give difference between Reversible and Irreversible Process.**
    - **Appeared in:** SUM24 (Q4b, 04 marks)
26. **Match the following: 1 Gay Lussac law - C The absolute pressure is directly proportional to its absolute temperature. 2 Charl's law - B The volume is directly proportional to its absolute temperature. 3 Boyl's law - A The volume is inversely proportional to its absolute pressure.**
    - **Appeared in:** SUM24 (Q4a, 03 marks)
27. **Match the following: 1 Isothermal Process - C Constant temperature 2 Isochoric Process - A Constant volume 3 Isentropic process - B Constant entropy.**
    - **Appeared in:** SUM24 (Q4a-OR, 03 marks)

Unit III: First Law of Thermodynamics

Repeated Questions:

1. **State and prove that internal energy is a property / point function.**
    - **Appeared in:** WIN23 (Q2b, 04 marks), SUM23 (Q1-7, 08 marks), WIN24 (Q2a, 03 marks), SUM24 (Q2b-OR, 04 marks), WIN22 (Q2a, 03 marks)
2. **State the first law of thermodynamics for a system (non-flow process) / cyclic process.**
    - **Appeared in:** WIN23 (Q2a, 03 marks), WIN24 (Q2a-OR, 03 marks), WIN22 (Q2a, 03 marks)
3. **Explain Joule's experiment with a neat sketch.**
    - **Appeared in:** WIN23 (Q2b-OR, 04 marks), SUM23 (Q2b, 04 marks), WIN24 (Q2b-OR, 04 marks), WIN22 (Q2b, 04 marks), SUM25 (Q2a-OR, 03 marks)
4. **List the assumptions for and apply the Steady Flow Energy Equation (SFEE) to a Nozzle.**
    - **Appeared in:** WIN23 (Q2c, 07 marks), SUM24 (Q2c, 07 marks), WIN24 (Q2c, 07 marks), SUM25 (Q2b-OR, 04 marks)
5. **Apply the Steady Flow Energy Equation (SFEE) to a Boiler.**
    - **Appeared in:** WIN23 (Q2c, 07 marks), WIN24 (Q2c, 07 marks)
6. **What is a Perpetual Motion Machine of the First Kind (PPM-1)?**
    - **Appeared in:** WIN23 (Q2a, 03 marks)
7. **Define: Steady Flow, Flow Work, Flow Process.**
    - **Appeared in:** WIN23 (Q2a-OR, 03 marks)
8. **State the conditions for a steady flow process.**
    - **Appeared in:** SUM23 (Q2a, 03 marks), WIN22 (Q2a-OR, 03 marks)
9. **Apply the Steady Flow Energy Equation (SFEE) to a Turbine.**
    - **Appeared in:** SUM23 (Q2-4, 07 marks), WIN24 (Q2c, 07 marks)
10. **Apply the Steady Flow Energy Equation (SFEE) to a Heat Exchanger.**
    - **Appeared in:** SUM23 (Q2-4, 07 marks)
11. **Prove "Internal Energy is a property".**
    - **Appeared in:** SUM24 (Q2b-OR, 04 marks)

Other Important Questions (Numericals & Theory):

12. **In a gas turbine unit, the gas flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of the gases at inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocities of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate (i) The rate at which heat is rejected to**

the turbine, and (ii) The area of the inlet pipe given that the specific volume of gases at the inlet is 0.45 m³/kg.

- **Appeared in:** WIN23 (Q2c-OR, 07 marks)

13. **In a gas turbine system, air enters with a velocity of 200 m/s & enthalpy of 6699 kJ/kg with a steady mass flow rate of 4.5 kg/sec. Air exits from the system at a velocity of 150 m/s & enthalpy of 5460 kJ/kg. If 50.4 kJ/kg heat is wasted into the surroundings, find the power developed by the gas turbine.**
    - **Appeared in:** SUM23 (Q1-8, 08 marks), WIN24 (Q2c-OR, 07 marks), WIN22 (Q2c, 07 marks)
14. **A heat engine receives heat at the rate of 1500 kJ/min and gives an output of 8.2 kW. Determine: (i) The thermal efficiency, (ii) The rate of heat rejection.**
    - **Appeared in:** SUM24 (Q2c-OR, 07 marks)
15. **A system receives 180 kJ heat energy at constant volume then rejects 200 kJ heat at constant pressure and 40 kJ work is done on the system during constant pressure. Then the system returns to its original state by an adiabatic process. Calculate the adiabatic work. If the initial internal energy is 235 kJ then calculate the internal energy at each point (U2 and U3).**
    - **Appeared in:** SUM25 (Q2c, 07 marks)
16. **Fluid enters a nozzle with a velocity of 50 m/s and enthalpy of 3000 kJ/kg and exits with an enthalpy of 2700 kJ/kg. Neglect the heat loss and find the exit velocity of the fluid. (Use SFEE for Nozzle).**
    - **Appeared in:** SUM25 (Q2b-OR, 04 marks)
17. **In a gas turbine, air enters with a velocity of 220 m/s and enthalpy of 5678 kJ/kg with a steady mass flow rate of 3.6 Kg/s. Gas exits from the system at 170 m/s and enthalpy of 4560 kJ/kg. If 54 kJ/kg heat is wasted into the surroundings, find the power developed by the gas turbine.**
    - **Appeared in:** SUM25 (Q2c-OR, 07 marks)
18. **10 kg of air enters into a nozzle with negligible velocity. Its pressure reduces from 392.4 KPa to 196.4 KPa during the flow from the nozzle and the temperature reduces from 950 ºC to 760 ºC during the flow. Apply SFEE to the Nozzle. Find the velocity of air at the exit. Take $\gamma = 1.4$, Cp = 1.005 KJ/Kg, Cv = 0.72 KJ/Kg, and R = 0.287 KJ/Kg.K.**
    - **Appeared in:** WIN22 (Q2c-OR, 07 marks)
19. **State the general energy equation.**
    - **Appeared in:** SUM25 (Q2b, 04 marks)
20. **Define steady and unsteady process with an example.**
    - **Appeared in:** WIN24 (Q2a-OR, 03 marks)

Unit IV: Second Law of Thermodynamics

Repeated Questions:

1. **State and explain the Kelvin-Planck statement of the second law.**
    - **Appeared in:** WIN23 (Q3b, 04 marks), SUM24 (Q3b, 04 marks), WIN24 (Q3b, 04 marks), SUM25 (Q3b-OR, 04 marks), WIN22 (Q3b, 04 marks)
2. **State the Clausius statement of the second law.**
    - **Appeared in:** SUM25 (Q3b-OR, 04 marks), WIN22 (Q3b, 04 marks)
3. **Define and explain the concept of a Heat Engine, Refrigerator, and Heat Pump.**
    - **Appeared in:** SUM24 (Q3a-OR, 03 marks), WIN24 (Q3b-OR, 04 marks), WIN22 (Q3a-OR, 03 marks)
4. **Define the Coefficient of Performance (COP) of a heat pump and a refrigerator.**
    - **Appeared in:** SUM25 (Q3a-OR, 03 marks)
5. **Prove that (COP)_{HP} = 1 + (COP)_{Ref}**
    - **Appeared in:** WIN23 (Q3c, 07 marks)
6. **State the limitations of the first law of thermodynamics.**
    - **Appeared in:** SUM24 (Q3a, 03 marks), WIN24 (Q2b, 04 marks), WIN22 (Q3a, 03 marks)
7. **Define Entropy and explain its importance in thermodynamics.**
    - **Appeared in:** SUM24 (Q3b-OR, 04 marks), WIN24 (Q3a, 03 marks), WIN22 (Q3b-OR, 04 marks)
8. **With the help of Kelvin-Planck's statement, explain the concept of PMM-2.**
    - **Appeared in:** WIN23 (Q3b, 04 marks)
9. **Differentiate between a heat pump and a refrigerator with a sketch and COP equation.**
    - **Appeared in:** WIN23 (Q3b-OR, 04 marks)
10. **What is irreversibility? Explain mechanical irreversibility.**
    - **Appeared in:** SUM23 (Q3b-OR, 04 marks)

Other Important Questions (Numericals & Theory):

11. **An inventor claims that his engine takes 130 KJ at a temperature of 270K and rejects 35 KJ at a temperature of 220K and delivers 22 kwh of work. Is his engine theoretically possible?**
    - **Appeared in:** WIN23 (Q3c-OR, 07 marks)
12. **A heat engine receives 500 KJ/cycle of heat from a source. If the COP of a refrigerator working between the same source and sink is 0.4, then find out 1) heat rejected by the heat engine 2) Thermal efficiency of the heat engine.**

- **Appeared in:** SUM23 (Q3c, 07 marks)

13. **Compare the aims of a heat engine and a refrigerator with a sketch.**
    - **Appeared in:** SUM23 (Q3c-OR, 07 marks)
14. **A Heat Engine takes 10000 KJ/hr of heat energy from a source at a temperature of 327°C and rejects 5000 KJ/hr of heat into a sink at 27°C. Draw a block diagram of the heat engine clearly. Find out its thermal efficiency and decide whether this heat engine is reversible or irreversible.**
    - **Appeared in:** WIN22 (Q3c, 07 marks)
15. **A Heat Engine receives heat energy of 1500 KJ/min and develops a power of 7 KW. Draw a block diagram of the heat engine clearly. Find out the thermal efficiency and heat rejection rate.**
    - **Appeared in:** WIN22 (Q3c-OR, 07 marks)
16. **State the application of the second law of thermodynamics.**
    - **Appeared in:** SUM25 (Q3b, 04 marks)
17. **Explain heat reservoir, heat source, and heat sink.**
    - **Appeared in:** SUM25 (Q3a, 03 marks), WIN24 (Q3b-OR, 04 marks)
18. **Write both statements of the second law of thermodynamics.**
    - **Appeared in:** WIN24 (Q3a-OR, 03 marks)
19. **Write the limitations of the Carnot cycle.**
    - **Appeared in:** SUM23 (Q3a-OR, 03 marks)
20. **Write different statements for the Third law of thermodynamics.**
    - **Appeared in:** SUM23 (Q2-5, 03 marks)

Unit V: Thermodynamic Cycles

Repeated Questions:

1. **Draw P-V and T-S diagrams for the Otto cycle and write its efficiency equation.**
   - **Appeared in:** WIN23 (Q5b-OR, 04 marks), WIN24 (Q4c-OR, 07 marks), SUM25 (Q5a-OR, 03 marks)
2. **Draw P-V and T-S diagrams for the Diesel cycle and write its efficiency equation.**
   - **Appeared in:** WIN23 (Q5b-OR, 04 marks), WIN24 (Q5b, 04 marks), SUM25 (Q5a, 03 marks), WIN24 (Q4c-OR, 07 marks)
3. **Explain the Carnot cycle with the help of P-V and T-S diagrams.**
   - **Appeared in:** SUM23 (Q5b, 04 marks), WIN22 (Q5b, 04 marks)
4. **Write the limitations of the Air Standard Cycle.**
   - **Appeared in:** WIN23 (Q5a, 03 marks), SUM23 (Q5a, 03 marks)
5. **Classify thermodynamic cycles.**
   - **Appeared in:** WIN23 (Q5a-OR, 03 marks), SUM24 (Q5a, 03 marks), WIN24 (Q5a, 03 marks)
6. **State the general assumptions for deriving the air standard efficiency.**
   - **Appeared in:** SUM25 (Q5b, 04 marks)
7. **Explain the Brayton cycle with the help of P-V and T-S diagrams.**
   - **Appeared in:** WIN24 (Q5c, 07 marks), WIN22 (Q5b-OR, 04 marks)
8. **State the limitations of the Brayton cycle.**
   - **Appeared in:** SUM25 (Q5b-OR, 04 marks)
9. **State the Carnot theorem and its corollaries.**
   - **Appeared in:** WIN23 (Q5b, 04 marks)
10. **Differentiate between power-producing and power-absorbing cycles.**
    - **Appeared in:** WIN23 (Q5a-OR, 03 marks)

Other Important Questions (Numericals & Theory):

11. **A hot air engine works on the Brayton cycle with a pressure ratio of 3. If the temperature before adiabatic compression and expansion are 298 K and 923 K, determine: a) heat supplied b) heat rejected c) work done per kg of air d) thermal efficiency. Take cp=1.0 kj/kgk and cv=0.715 kj/kgk.**
    - **Appeared in:** WIN23 (Q5c, 07 marks)
12. **One of the engine manufacturer companies claims that his engine works between the highest temperature of 2400°C and the lowest temperature of 400°C. If it produces 2.5 kW power during one hour from 0.2 kg/hr of fuel and the fuel has a calorific value of 45000 kj/kg, is the claim possible or not?**
    - **Appeared in:** WIN23 (Q5c-OR, 07 marks)
13. **For an engine working on the Otto cycle, the pressure at the beginning of compression is 1 bar and at the end of compression is 12 bar. If $\gamma = 1.4$, find the compression ratio and thermal efficiency.**
    - **Appeared in:** SUM23 (Q5c, 07 marks), WIN22 (Q5c, 07 marks)
14. **In an engine working on the Diesel cycle, the compression ratio is 15 and the fuel is cut off at 5% of the stroke length. Find the air standard efficiency. Take γ=1.4.**
    - **Appeared in:** SUM24 (Q5c-OR, 07 marks), WIN24 (Q5c-OR, 07 marks), WIN22 (Q5c-OR, 07 marks)
15. **In a constant volume Otto cycle, the pressure at the end of compression is 15 times that at the start. The temperature of air at the beginning of compression is 38°C and the maximum temperature attained in the cycle is 1950°C. Determine (i) compression ratio, (ii) thermal efficiency. Take γ=1.4.**
    - **Appeared in:** SUM24 (Q5c, 07 marks)
16. **One air standard Otto cycle has a compression ratio of 7.5. The pressure and temperature at the start of compression are 1 bar and 27°C respectively. If the maximum temperature of the cycle is 1200°C, find the work done, heat supplied, and**

thermal efficiency. Take γ = 1.4, Cv = 0.714 kJ/kgK.
    - **Appeared in:** WIN24 (Q4c, 07 marks)
17. **In an Otto cycle engine, the clearance volume is 30% of the swept volume. Find the air standard efficiency.**
    - **Appeared in:** SUM25 (Q5c, 07 marks)
18. **In a diesel engine, the compression ratio is 16. The pressure and temperature at the beginning of the compression stroke are 1 bar and 20°C respectively, and the maximum temperature of the cycle is 1430°C. Find the thermal efficiency of the cycle.**
    - **Appeared in:** SUM25 (Q5c-OR, 07 marks)
19. **Derive an equation for the thermal efficiency of the Carnot cycle.**
    - **Appeared in:** SUM24 (Q5a-OR, 03 marks)
20. **Draw P-V and T-S diagrams for the Dual cycle and write the formula of thermal efficiency for it.**
    - **Appeared in:** WIN24 (Q4c-OR, 07 marks)

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