ARYA GROUP OF COLLEGES

Guess Paper 2025-2026 (III Sem.)

3ME4-05 Engineering Thermodynamics

(BRANCH: Mechanical Engineering)

Unit 1

Short Answers

Q1. Recall and articulate the definitions of the terms System, Surroundings, and Boundary in the context of thermodynamics.

Q2. State the definitions of Isothermal Process and Adiabatic Process within the context of thermodynamics.

Q3. What is meant by closed system? Give an example.

Q4. Define open system. Give an example.

Q5. Distinguish between open and closed system.

Q6. Define isolated system.

Q7. Define specific heat capacity at constant pressure.

Q8. Define specific heat capacity at constant volume.

Q9. What is meant by thermodynamic property?

Q10. Define intensive and extensive properties.

Q11. When a system is said to be in" Thermodynamic equilibrium?

Q12. What is quasi - static process?

Q13. Define internal Energy.

Q14. Define the terms equilibrium, path and process.

Q15. What is polytropic process? Under what condition it approaches isobaric, isothermal, and isochoric?

Q16. Define enthalpy and show that the enthalpy is only function of temperature for perfect gas.

Descriptive Answers

Q1. What is Zeroth law and first law of thermodynamics.

Q2. State corollaries first law of thermodynamics.

Q3. What is meant by "Perpetual motion of machine of First Kind"?

Q4. What is mean by control volume and control surface?

Q5. Prove that for an isolated system, there is no change in internal energy.

Q6. What is meant by reversible and irreversible process?

Q7. Prove that the difference in specific heat capacities equal to Cp - Cv = R.

Q8. What is the work transfer in free expansion process? And why?

Q9. Write the steady flow energy equation for

a. Pump

b. Heat exchanger
c. Nozzle
d. Turbine

Q10. Write note on temperature scale.

Q11. What is the difference between Macroscopic & Microscopic View of study?

Q12. A system undergoes a process 1-2 in which it absorbs 200kJ energy as heat while does 100kJ of work. Then it follows the path 2-3 in which it rejects 50 kJ energy as heat, when 80 kJ work is done on it. If it is required to restore the system to state 1 through an adiabatic path, calculate the work and heat interactions along the adiabatic. Also calculate the net- work and heat rejections.

Q13. A 0.5 m^3 vessel is fitted with air at atmospheric pressure. The air is churned by a paddle wheel attached to a shaft 0.1 m in dia. Rotating at a speed of 1800 rpm. A force of 5N acts on the rim of the shaft what would be the pressure in the vessel after 10 second of operation?

Q14. Apply first law to the following process of a closed system using ideal gas as the working substance

i) Constant Volume
ii) Constant Pressure
iii) Constant Temperature
iv) Reversible Adiabatic

Q15. Five kilogram of air initially at 25oC and atmospheric pressure (101.325kpa) is heated in a rigid container by adding 10KJ of heat. Calculate the change in internal energy of the system and the final temperature attained.

Q16. Explain the following

i) Property and types of properties
ii) Thermodynamic equilibrium

Q17. Mass of gas is compressed in a quasi-static process from 80 kPa, 0.1 m3 to 0.4 MPa, 0.03 m3. Assuming that the pressure and volume are related by pvn = constant, find the work done by the gas system.

Q18. Derive the steady flow energy for the following devices

i) Pump
ii) Heat Exchanger
iii) Nozzle
iv) Turbine

Unit 2

Short Answers

Q1. Define the term COP?

Q2. State Carnot's Theorem.

Q3. State the Kelvin –Planck statement of second law of Thermodynamics.

Q4. State the Clausius statement of second law of Thermodynamics

Q5. What are the assumptions of carnot theorem?
Q6. What is PMM2 and why is it impossible?
Q7. What is different between heat pump and refrigeration?
Q8. What is meant by heat engine?
Q9. Define the term source, sink and heat reservoir.
Q10. Define the term absolute entropy?

Descriptive Answers

Q1. What is meant by principle of increase of entropy?
Q2. Define change of entropy? How is entropy compared with heat transfer and absolute temperature?
Q3. Why the performance of refrigerator and heat pump are given in terms of C.O.P and not in terms of efficiency?
Q4. What is meant by principle of increase of entropy?
Q5. What do you mean by "clausius inequality"?
Q6. What is the essence of the second law of thermodynamics?
Q7. During a process a system receives 30 KJ of heat from a reservoir and does 60 KJ of work. Is it possible to reach initial state by an adiabatic process? Prove it by first law of thermodynamics
Q8. A carnot cycle operates between source and sink temperatures of 250 °C and -15°C. If the system receives 90KJ from the source, Find,
   a. Efficiency of the system.
   b. The net work transfer.
   c. Heat rejected to sink.
Q9. Discuss Temperature-Entropy diagram.
Q10. Discuss Available energy and availability function.
Q11. Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator? If this system is used as a heat pump, how many MJ of heat would be available for heating for each MJ of heat input to the engine?
Q12. Which is the more effective way to increase the efficiency of a Carnot engine: to increase T1, keeping T2 constant; or to decrease T2, keeping T1 constant.

Unit 3

Short Answers

Q1. What is wet and dry steam?

Q2. State phase rule of pure substances.
Q3. Define pure substance?

Q4. Define latent heat of ice?
Q5. What is saturation temperature and saturation pressure?
Q6. Define latent heat of vaporizations.
Q7. Define the terms 'Boiling point 'and 'Melting point'
Q8. What is meant by super-heated steam? And indicate its use.
Q9. Define the sensible heat of water.
Q10. Define the term super heat enthalpy.
Q11. State Charle's law.
Q12. Distinguish between ideal and real gas.
Q13. What is difference between universal and characteristic gas constant?

Descriptive Answers

Q1. Define dryness fraction and What is quality of steam and wetness fraction?
Q2. Explain the term: Degree of super heat, Degree of sub cooling.
Q3. Define triple point and critical point for pure substance.
Q4. Write the formula for calculating entropy change from saturated water to super heated steam conditions.
Q5. derive the relation for the entropy change of an ideal gas in terms of T-P, T-V, P-V.
Q6. What is meant by steam power cycles?
Q7. Define the term Efficiency ratio.
Q8. What is meant by isentropic efficiency?
Q9. Is ice water a pure substance? Why?
Q10. Differentiate between saturated liquid and compressed liquid.
Q11. Define Joule – Thomson Co-efficient.
Q14. State Dalton's law of partial pressure.
Q15. Determine the specific liquid enthalpy, specific enthalpy of evaporation and specific enthalpy of dry saturated steam at 0.5 MN/m2.
Q16. Determine the saturation temperature, specific liquid enthalpy, specific enthalpy of evaporation and specific enthalpy of dry saturated steam at a pressure of 2.04 MN/m2.
Q17. Determine the specific enthalpy of steam at a pressure of 2.5 MN/m2 and with a temperature of 320°C.
Q18. A vessel with a volume of 0.1m^3 contains an ideal gas at 100°C, 600kpa. It expands isentropically to a final pressure of 150kpa. Evaluate the work done. Assume Cv = 0.7202Kj/kgK and Cp = 1.0044 Kj/kgK.
Q19. Two Vessels A and B both containing nitrogen, are connected by a valve which is opened to allow the contents to mix and achieve an equilibrium temperature of 27 0C. Before mixing the following information is known about the gases in two vessels.

Vessel A	Vessel B
P=1.5MPa	P=0.6MPa
T=50 0C	T=20 0C
Contents=0.5kg mol	Contents=2.5 kg

Calculate the final equilibrium pressure, and the amount of heat transferred to the surrounding. If the vessel had been perfectly insulated, calculate the final temperature and pressure which would have been reached.

Q20. A Fluid at 200kpa and 300°C has a volume of $0.8m^3$. in a frictionless process at constant volume and pressure changes to 100kpa. Find the final temperature and heat transferred.

(i) If the fluid is air

(ii) If the fluid is steam.

Q21. What do you understand by the degree of superheat and degree of sub cooling? Explain with the help of figure.

Q22. Explain the following

i. Compressibility factor

ii. Reduced properties

iii. Dalton's law of partial pressure

Q23. Steam 0.95 dry at a pressure of 0.7 MN/m2 is supplied to a heater through a pipe of 25 mm internal diameter; the velocity in the pipe is 12 m/s. Water enters the heater at 19°C, the steam is blow into it and the mixture of water and condensate leaves the heater at 90°C. Calculate

a. The mass of steam entering the heater in kg/h
b. The mass of water entering the heater in kg/h

Unit 4

Short Answers

Q1. Define thermodynamic variables.
Q2. What are independent and dependent variable.
Q3. Write Maxwell's equations.
Q4. What is equation of state?
Q5. Define the compression ratio.
Q6. What is an air-standard cycle?
Q7. State the four processes of the Otto cycle.
Q8. State the four processes of the Diesel cycle.
Q9. Sketch an air-standard Otto cycle on P –V and T– S diagrams.
Q10. Sketch an air-standard Diesel cycle on P –V and T – S diagrams.
Q11. How does the Diesel cycle differ from the Otto cycle?
Q12. Define the cut-off ratio for an air-standard Diesel cycle.
Q13. Derive an expression for the efficiency of an air-standard Otto cycle in terms of its compression ratio.
Q14. Derive an expression for the efficiency of an air-standard Diesel cycle.For the same compression ratio and heat rejection, explain with the help of P–V and T–s diagrams why the efficiency of Otto cycle is greater than that of Diesel cycle.
Q15. For the same maximum pressure and temperature of the cycle and the same heat rejection, which cycle is more efficient: Otto or Diesel? Explain with the help of P–v and T–s diagrams.

Descriptive Answers

Q1. Derive Maxwell relations equations.
Q2. Define Joule – Thomson Co-efficient.
Q3. Define Co – efficiency of volume expansion and isothermal compressibility.
Q4. What is compressibility factor?
Q5. Derive the Clausius- Clapreyon equation & what is significance of Clausius Clapeyron Equation?
Q6. Write down the two Tds Equations.
Q7. State Helmholtz function.
Q8. State Gibbs function.
Q9. Identify the application of clausius chaperon equation.
Q10. State Otto Cycle.
Q11. Discuss Diesel Cycle.
Q12. Discuss Dual Cycle.
Q13. Discuss Brayton cycle.
Q14. Discuss Ericsson cycle.
Q15. An engine equipped with a cylinder having a bore of 15 cm and a stroke of 45 cm operates on an Otto cycle. If the clearance volume is 2000 cm3, compute the air standard efficiency.
Q16. For an engine operating on air standard Otto cycle, the clearance volume is 10% of the swept volume. If the specific heat ratio of air is 1.4, compute the air standard cycle efficiency.
Q17. An engine working on the Otto cycle has an air standard cycle efficiency of 56% and rejects 544 kJ/kg of heat. The pressure and temperature of air at the beginning of compression are 0.1 MPa, and 30 °C respectively. Compute the compression ratio of the engine, the work done per kg of air, the pressure and temperature at the end of compression, and the maximum pressure in the cycle.
Q18. Under what condition we will get (η)diesel>(η)duel>(η)otto

Unit 5

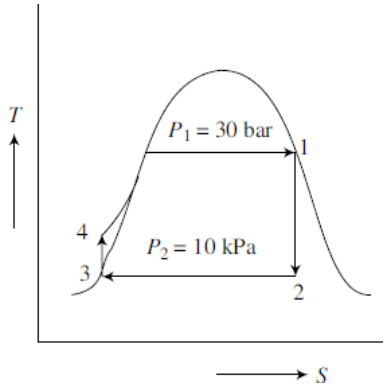
Short answers

Q1. Define regeneration process.
Q2. What are the basic components of steam power plant?
Q3. What do you understand by steam rate and heat rate?
Q4. Define regeneration process.
Q5. Define Internal Efficiency?
Q6. Define Boiler Efficiency
Q7. As pressure of steam is increased, why reheating is necessary?
Q8. What do you understand by the mean temperature of heat addition?
Q9. What do you understand by steam rate and heat rate?
Q10. What are the four basic components of a steam power plant?
Q11. What is metallurgical limit?

Descriptive answers

Q1. What is cogeneration? Explain the working principle of cogeneration plant.

Q2. A steam power plant is designed to operate on Rankine cycle. Steam enters the turbine as saturated vapour at 30 bar and leaves as saturated liquid in the condenser at 10 kPa. The mass flow rate of steam is 1 kg/s. Determine the net power output of the cycle and the thermal efficiency of the Rankine cycle



Q3. Why is a Carnot cycle not practicable for a steam power plant?

Q4. What are the four basic components of a steam power plant working on Rankine cycle? Show by a block diagram.

Q5. Draw the nature of P–V and T–S plots of a Rankine cycle (with saturated steam at turbine inlet).

Q6. A steam power plant operates on the rankine cycle with superheated steam entering the turbine at 4Mpa and 300oC. The steam is condensed in the condenser at 20 kpa. Determine the thermal efficiency of the cycle assuming ideal conditions.

Q7. How are maximum temperature and maximum pressure in Rankine cycle fixed?

Q8. Explain the characteristics of an ideal working fluid in vapour cycles

Q9. A steam power station uses the following cycle:
Steam at boiler outlet- 150bar, 550oC
Reheat at 40 bar to 550oC
Condenser at 0.1bar
Using mollier chart and ideal process, find the (a) quality at turbine exhaust (b) cycle efficiency and (c) steam rate