



ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU -27

B.Sc. (PHYSICS)– IV SEMESTER

SEMESTER EXAMINATION: APRIL 2023

(Examination conducted in May 2023)

PH 422 – THERMAL PHYSICS AND ELECTRONICS

(For current batch students only)

Time: 2 Hours

Max Marks: 60

This paper contains 2 printed pages and 3 parts

PART-A

Answer any 4 of the following. Each question carries 8 marks.

4X8 = 32

1. On the basis of kinetic theory of gases derive an expression for the pressure of an ideal gas.
2. What is an adiabatic process? For an adiabatic process prove that $PV^\gamma = \text{constant}$.
3. a) Define Helmholtz function.
b) Derive the first two Maxwell's thermodynamic relations from thermodynamic potentials. [2+6]
4. a) What is meant by biasing of a transistor?
b) With a neat circuit diagram explain voltage divider bias and mention its advantages. [2+6]
5. a) Explain the construction and working of a n-channel FET.
b) What are the differences between BJT and UJT. [6+2]
6. a) Explain the concept of virtual ground.
b) Describe the working of an inverting amplifier and find an expression for the voltage gain. [2+6]

PART-B

Answer any 4 of the following. Each question carries 5 marks.

4X5 = 20

7. For oxygen at 0°C , calculate mean free path and collision frequency. The number of molecules per $\text{m}^3 = 3 \times 10^{25}$, diameter of oxygen molecule = $3.6 \times 10^{-10}\text{m}$. Molecular mass of oxygen is 32. Given, $R = 8.31 \text{ J/mol/K}$.
8. Calculate the change of entropy when 0.05 kg of water at 0°C is converted into steam at 100°C . The specific heat capacity of water is 4200 J/kg/K . Latent heat of vaporization = $2.27 \times 10^6 \text{ J/kg}$.

9. A Carnot engine whose sink is at 8°C has an efficiency of 60%. It is desired to increase the efficiency to 80%. By how many degrees should the temperature of the source be changed?
10. A half wave rectifier is employed to supply a dc voltage of 50V. If the resistance of the diode is $25\ \Omega$ and the load resistance is $1\ \text{k}\Omega$, what should be the ac voltage (rms) at the secondary of the transformer.
11. The frequency of a Colpitt's oscillator is 18 MHz. Find the value of the inductor to be used if $C_1 = 100\ \text{pF}$ and $C_2 = 10\ \text{pF}$. Also calculate the voltage feedback fraction.
12. The data sheet for a FET indicates that $I_D = 10\ \text{mA}$, $I_{DSS} = 20\ \text{mA}$. Determine the value of V_{GS} (off) when (i) $V_G = -1\text{V}$ and (ii) $V_G = -1.5\ \text{V}$.

PART-C

13) Answer any 4 of the following.

4X2 = 8

- a) The coefficient of viscosity of a gas at constant temperature is the same at all pressures. Explain.
- b) Why does Joule-Thomson expansion produce heating above inversion temperature and cooling below.
- c) Food gets cooked quicker in pressure cooker. Give reason.
- d) In a transistor, though emitter and collector are made of the same type of material, they cannot be interchanged. Give reason.
- e) Why does a CE amplifier cause phase reversal?
- f) If the two input voltages of an OP-AMP are kept at the same value, can you expect the output to be zero? Explain