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DCPH401

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IV Semester B.Sc. Degree Examination, September - 2023

PHYSICS

Thermal Physics and Electronics

Paper : PHY, DSCT 4

(NEP Scheme Freshers 2021-22 and Onwards)



Time : 2½ Hours

Maximum Marks : 60

Instructions to Candidates:

1. Answer the number of questions as cited in each part.
2. Non - programmable scientific calculators are allowed.

PART - A

Answer any **Four** questions. Each question carries **Two** marks.

(4×2=8)

1. State and explain the first law of thermodynamics.
2. Mention the two types of heat engines.
3. Mention the number of degrees of freedom of a
 - i. monatomic molecule and
 - ii. diatomic molecule.
4. Distinguish between knee voltage and breakdown voltage in the Zener diode.
5. Why is common emitter amplifier widely preferred over the other two?
6. Write the circuit symbol of
 - i. OR gate and
 - ii. AND gate.

PART - B

Answer any **Four** questions. Each question carries **Five** marks.

(4×5=20)

7. A certain quantity of air at 27°C and one atmospheric pressure is suddenly compressed to half its volume. Find the new pressure and temperature. (Given γ for air = 1.4).

[P.T.O.]



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8. A Carnot's engine has an efficiency of 40% when the temperature of the sink is 27°C. What must be the change in temperature of the source so as to make the efficiency 50%?
9. The mean kinetic energy of hydrogen gas at 273K is 5.62×10^{-21} J and the molar gas constant is $8.31 \text{ JK}^{-1} \text{ mol}^{-1}$. Calculate the Avogadro number.
10. The intrinsic carrier density of Ge at 27°C is $2.4 \times 10^{19} \text{ m}^{-3}$. Calculate its intrinsic resistivity if the electron and the hole mobilities are respectively $0.38 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$ and $0.18 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$.
11. In a phase shift oscillator, resistors each of $20 \text{ k}\Omega$ and capacitors each of 12 pF are used. Calculate the angular frequency and hence frequency of oscillation.
12. Three voltages 0.6V, -1.4 V and 0.3 V are applied to the input resistors each of $40 \text{ k}\Omega$ in a summing amplifier. If the feedback resistor is $200 \text{ k}\Omega$, find the output voltage.

PART - C

Answer any **Four** questions. Each question carries **Eight** marks.

(4×8=32)

13. a. What are intensive and extensive variables of a thermodynamic system?
b. Arrive at the expressions for work done by a gas in an
 - i. isothermal expansion and
 - ii. adiabatic expansion.

(2+6)
 14. Obtain Maxwell's thermodynamic relations from thermodynamic potentials.

(8)
 15. Derive Planck's radiation formula.

(8)
 16. a. Explain with relevant diagrams, the forward biased characteristics of a p-n junction.
b. Define α and β of a transistor. Arrive at the relation between them.

(4+4)
 17. With necessary circuit diagrams, derive the expressions for the voltage gain of an ideal Op-Amp as
 - i. an inverting amplifier and
 - ii. a non - inverting amplifier.

(8)
 18. a. State de Morgan's theorems.
b. Realise AND, OR and NOT gates using NAND gate.

(2+6)
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