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Sixth Semester B.Sc. Degree Examination, September/October 2021

(CBCS Scheme)

Physics

Paper VIII — ELECTRONICS, MAGNETIC MATERIALS, DIELECTRICS AND QUANTUM MECHANICS – II

Time : 3 Hours] *[Max. Marks : 70*

*Instructions to Candidates : Answer **FIVE** questions from each Part.*

PART – A

Answer any **FIVE** of the following. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) Define differential gain and common mode gain. **(4)**

   (b) Obtain an expression for voltage gain of an inverting amplifier with a neat circuit diagram. Also draw the input and output waveforms. **(4)**

2. Explain with a circuit diagram the operation of a first order high pass filter using an op-amp and hence derive an expression for the magnitude of voltage gain. **(8)**

3. (a) State De-Morgan's theorems. **(2)**

   (b) What is XOR gate? Write the symbol and truth table for XOR gate. Draw the circuit diagram using basic gates. **(6)**

4. Derive an expression for paramagnetic susceptibility and hence Curie's law. **(8)**

5. Define Lorentz field. Obtain an expression for the internal field of a dielectric. **(8)**

6. (a) What is a wave function? Give its physical significance. **(3)**

   (b) Write the conditions to be satisfied by the wave function. **(5)**

7. Obtain an expression for the time independent Schrodinger's equation for a particle in one dimension. Extend it to three dimensions. **(8)**

8. Solve Schrodinger's wave equation for a particle in one dimensional box of infinite height and obtain energy Eigen values. **(8)**

PART – B

Solve any **FIVE** of the following problems. Each problem carries **4** marks : **(5 × 4 = 20)**

9. Estimate the values of 'R' and 'C' for an output frequency of 1 kHz in an RC phase shift oscillator.

10. An amplifier has a band width of 200 kHz and voltage gain of 80. Calculate the new band width and voltage gain if 5% negative feedback is introduced.

11. Calculate the magnetization and magnetic flux density of a paramagnetic material having magnetic field strength 10^4 Am^{-1} and magnetic susceptibility 3.7×10^{-3}.

12. The dielectric constant of He gas at NTP is 1.0000684. Calculate electronic polarisability of He atoms if the gas contains 2.7×10^{25} atoms per m^3, and also calculate the radius of He atom.

13. A solid dielectric material has polarisability 7×10^{-40} Fm^2. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material having 3×10^{28} atoms/m^3.

14. Calculate the first and second excited state energy of a proton inside the nucleus of size 2×10^{-14} m. Given : Mass of the proton $= 1.6 \times 10^{-27}$ kg.

15. A moving electron is confined in one dimensional potential box of width 0.1 nm. Calculate the first two energy eigen values.

16. The period of harmonic oscillator in its ground state is 1.2×10^{-14} sec. Calculate the zero point energy in eV and also the spacing between the energy levels.

PART – C

Answer any **FIVE** of the following. Each question carries **2** marks : **(5 × 2 = 10)**

17. (a) Can an op-amp be used as a buffer multiplier? Explain.

(b) Can NOR gate be used as NOT gate? Explain.

(c) NAND and NOR gates are called universal gates. Justify.

(d) Transformer cores are made of soft iron but not steel. Justify.

(e) Can all dielectrics produce electronic polarization? Explain.

(f) Is zero point energy of a harmonic oscillator zero? Explain.

(g) Can one Eigen value have many Eigen functions? Explain.

(h) The minimum value of principal quantum number for a particle in one dimensional box is one but not zero. Justify.
