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VI Semester B.Sc. Degree Examination, September - 2021

PHYSICS

Electronics, Magnetic Materials, Dielectrics and Quantum Mechanics - II

(CBCS Scheme Freshers+Repeaters 2018-19 and Onwards)

Paper : VIII

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

1. Answer any **FIVE** questions from each part.
2. Use of non - programmable scientific calculator is allowed.

PART - A

Answer any **FIVE** questions. Each question carries **8** marks. **(5×8=40)**

1. a. Write any three characteristics of an ideal Op-Amp.

b. Derive an expression for output voltage of a differential amplifier using an Op-Amp. **(3+5)**

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2. a. What is Barkhausen criterion for sustained oscillations?

b. Explain the working of Phase - Shift oscillator with a neat circuit diagram. Write expression for it's frequency of oscillation. **(2+6)**

3. a. Write the symbol and truth table of NAND gate.

b. What is half adder? Draw the logic diagram of half adder and write it's truth table. **(2+6)**

4. Derive an expression for paramagnetic susceptibility on the basis of Quantum Theory. **(8)**

5. a. Explain the Weiss domain theory of Ferromagnetism.

b. What is hysteresis? Define retentivity and coercivity. **(5+3)**

6. a. Write any three comparisons between ionic polarisation and orientational polarisation.

b. Derive Clausius - Mossotti equation for a 3 - dimensional cubic lattice. **(3+5)**

7. a. Write the expressions for momentum and energy operators.

b. Set up the time independent one dimensional Schrodinger wave equation. **(2+6)**

8. Set up Schrodinger wave equation for a one dimensional linear harmonic oscillator and derive the expressions for Eigen values and represent them graphically. **(8)**

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PART - B

Answer any **FIVE** problems. Each question carries **4** Marks. **(5×4=20)**

9. In an Op-Amp, $R_i = 1k\Omega$, $R_f = 1M\Omega$ and input voltage is 2 mV. Calculate voltage gain and output voltage in case of (a) inverting and (b) non - inverting amplifier.
10. For a low pass filter, Calculate R_f so that the gain is 100 for the allowed frequency. Also find the value of R to get cut - off frequency of 2 kHz. Given C = 0.02 μF, $R_i = 1k\Omega$.
11. Convert the decimal 64.2 to octal and then to binary.
12. A paramagnetic material has magnetic field intensity of $10^4 Am^{-1}$. If the susceptibility of the material at room temperature is 3.7×10^{-3}, calculate the magnetisation and flux density of the material.
13. If a sample of sulphur contains 3.76×10^{28} atoms per m^3, find the electronic polarizability of sulphur. Given, dielectric constant of sulphur = 3.5 and $\varepsilon_0 = 8.85\times10^{-12} Fm^{-1}$.
14. Determine the normalization constant of the wave function $\psi = A\sin x$
15. Find the momentum and energy of an electron in its ground state and first excited state when it is confined to a one dimensional box of side 2 nm. Given h = 6.625×10^{-34}Js.
16. Calculate the probability of finding a particle in one dimensional box of length L between 0.3L and 0.5L.

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PART - C

Answer any **FIVE** questions. Each question carries **2** marks. **(5×2=10)**

17. a. Why is it desirable to have a high CMRR in an operational amplifier?
    b. Is the Boolean identify AC+ABC=AC true? Justify.
    c. Does the susceptibility of a paramagnetic material depend on temperature? Explain.
    d. Why is soft iron preferred over steel for fabrication of transformer core?
    e. Can all crystals exhibit piezoelectric effect? Explain.
    f. Does a free particle have quantised energy states? Explain.
    g. Is $\psi = ax^2$ an acceptable wave function? Explain.
    h. What is the probability of finding the particle at any state at x = 0 and x = L in an one dimensional box of infinite height.