Bajaj College of Science, Wardha

Practice Sheet During Lockdown

B.Sc- Sem VI

Subject: PHYSICS

Unit:1. Quantum Mechanics II

1. Obtain the expression for normalized wave function and energy Eigen values for a particle in one dimensional box. (7)
2. Obtain the expression for normalized wave function and energy Eigen values for a particle in three dimensional box. (7)
3. State and prove the Ehrenfest Theorem. (7)
4. Define operator. Obtain operator for momentum, K.E, Total Energy. (5)
5. Define expectation value. State expectation value for position, momentum, energy. (5)
6. Derive the expression for Schrodinger's time dependant wave equation. (5)
7. Derive the expression for Schrodinger's time independant wave equation. (5)
8. Define (i) Well behaved function (ii) Normalised wave function. (4)
9. Show that the function f(x)=sinax is an Eigen function of operator $\frac{d^2}{dx^2}$. What is Eigen value of operator? (2)
10. Find the Eigen value of operator $\frac{d^2}{dx^2}$ for wave function $\psi = Acosx$. (2)
11. Find the ground state energy and momentum for an electron confined to a one dimensional box of length 1 A. (4)
12. Calculate the energy difference between the ground state and the first excited state for an electron in a box of length 1A. (4)
13. Find the ground state energy for a ball of mass 10 gm moving in one dimensional box of length 10 cm. (4)
14. State the physical significance of wave function ψ. (2)

Unit:2. Nuclear Physics.

1. Define radioactivity. State the law of radioactive decay. Show that the number of nuclei in radioactive sample decreases exponentially with the time. Draw the graph for radioactive decay. (7)
2. Discuss the Gamow's theory of alpha decay. (7)

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3. Discuss the Pauli's neutrino hypothesis. Explain the neutrino theory of Beta decay. (7)
4. Derive the expression for average life of radioactive nuclei. Give the relation between half-life and average life. (5)
5. Define half-life. Obtain expression for Half-life. (5)
6. Discuss a method for determination of range of α-particles. (5)
7. Explain, experimental determination of energy of α-particles. (5)
8. Explain, experimental determination of energy of β-particles. Discuss the β-decay energy spectrum. (5)
9. What is α-decay, β-decay, r-decay. Give example. (5)
10. Give properties of α, β, r- particles. (2)
11. β-decay and their types. Examples. (5)
12. Calculate the B.E per nucleon for α-particles. Given: m_H = 1.007825 amu, m_N= 1.008665 amu, m_α =4.00260 amu , 1 amu = 931.5 MeV. (4)
13. Find the Q value . ${}^{238}_{94}Pu \rightarrow {}^{234}_{92}U + {}^{4}_{2}He$ Atomic masses of Pu, U , He are 238.04955 amu, 234.04095 amu, and 4.002603 amu, 1 amu = 931 Mev. (4)
14. Half-life of Radium is 1600 years. Find the period after which 1 gm of Radium decays to remain up to 0.25 gm. (2)
15. Half-life of Co^{58} is 72 days. Calculate its average life . Hence find decay constant. (4)
16. Find the energy equivalent of β^- particle in MeV. (2)
17. Find the energy equivalent of 1 gm substance in MeV. (2)

Unit:3. Physics of Solid State.

1. Derive an expression for thermal conductivity and show that it depends on density of free electrons. (7)
2. Derive an expression for electrical conductivity. (5)
3. State and prove the Wiedmann Franz law. (5)
4. What is Hall effect ? Describe an experiment to determine the Hall coefficient. (5)
5. Derive an expression for Hall voltage and Hall coefficient. (7)

Show that Fermi energy at absolute temperature is .$E_{F0} = \left(\frac{3n}{8\prod}\right)^{\frac{2}{3}} \frac{h^2}{2m}$. (5)

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6. Distinguish between conductor, insulator and semiconductor on the basis of the band theory of solids. (5)
7. For sodium there are 2.5* 10^{28} free electrons per cubic meter. Calculate the Fermi energy. (4)
8. A rectangular metal slab of thickness 2mm carries current 100 mA in direction parallel to its length. A uniform magnetic field of flux density 0.5 Wb/m^2 applied to the slab perpendicular to its length produces Hall voltage of 8 mv. Calculate the Hall coefficient and charge carrier density. (4)
9. Find the Fermi temperature for a metal having Fermi energy 2.39 * 10^{-19} J. Boltzmann constant = 1.38 * 10^{-23} J/K (2)
10. The resistivity of a rectangular bar of p-type silicon is 2*10^5 ohm.cm. The Hall coefficient for the bar is 1.5 *10^2 m^3 /C. Find the mobility of charge carriers.(2)
11. Explain the Kronig Penny model. (5)

Unit:4. Op-Amp & Oscillators.

1. What is an oscillator? Explain the Hartley oscillator. (7)
2. Explain the Colpitt's oscillator. (7)
3. What is a multistage amplifier? Derive the equation for overall gain of a multistage amplifier. (5)
4. Explain the concept of negative feedback. State its advantages. (5)
5. Discuss the working of difference amplifier. (7)
6. Explain the block diagram of Op-Amp. (5)
7. Explain the working of Op-Amp as i) inverting amplifier, ii) non-inverting amplifier, iii) adder iv) substractor [any one] (5)
8. Characteristics of ideal Op-Amp (2)
9. Parameters of Op-amp [any three] (5)
10. Derive the expression for gain of amplifier with feedback. State and explain the Barkhausen's criteria for oscillations. (5)
11. Calculate the gain with feedback for an amplifier with negative feedback if β=0.04 and gain without feedback is 1000. (2)
12. An Op-Amp is used in inverting mode. If the closed loop gain is -50, input resistance is 20 KΩ, find the resistance in feedback circuit. (2)
13. An OP-Amp has slew rate of 0.5 volt/μ sec and peak value of voltage equal to 10 v. Calculate the minimum operating frequency. (2)

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14. Three amplifier stages of individual gain 2, 5, 34 are cascaded. Calculate the output if a signal of 25 mv is given at the input. (2)
15. In a Hartley oscillator the inductances are L_1= 50 μH, L_2= 2mH and mutual inductance M= 30 μH and capacitance c= 20 pF. Calculate resonant Frequency. (4)
16. For Colpitt's oscillator, c_1 = 0.005 μF, c_2= 0.05 μF, L= 10 μH. Find the resonant frequency. (4)

Unit:5.Digital Electronics.

1. Rules of binary addition and binary substraction. (2)
2. Discuss the 1's complement and 2's complement method for substraction with suitable example. (7)
3. What is XOR gate ? Give its symbol and truth table. (5)
4. State and prove the De Morgan's theorem. Draw logic circuit. (5)
5. Explain the half adder with truth table. (5)
6. Explain the half Substractor with truth table. (5)
7. Explain the full adder with truth table. (5)
8. Explain the full substractor with truth table. (5)
9. Draw logic diagram for Y= A+(B.C) with truth table. (4)
10. Prove (A.B.C) + (A.$\bar{B}$.C) + (A.B.$\bar{C}$) = A(B+C) (4)
11. Convert binary number to decimal a) 11001.0010 b) 11110. 110 (2)
12. Convert decimal to binary a) 52.25 b) 24.75 (2)

Unit:6.Communication and Fiber Optics.

1. What is an optical fiber? Explain the step index optical fiber and graded index optical fiber. (7)
2. Explain the propagation of light along optical fiber. (5)
3. Show that numerical aperture of an optical fiber is given by N.A = $\sqrt{n_f^2 - n_c^2}$ where n_f and n_c are R.I of core and cladding respectively. (5)
4. Explain total internal reflection. (2)
5. Merits and Demerits of frequency modulation. (5)
6. Define modulation. Explain the need for modulation. (2)

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7. Calculate the fractional difference between the R.I of core and cladding, numerical aperture, acceptance angle and critical angle of an optical fiber having core R.I n_1 = 1,50 and cladding R.I n_2 = 1.45. (4)
8. Calculate the maximum acceptance angle and critical angle of the optical fiber having core R.I = 1.50 and cladding R.I = 1.48. (2)
9. Define frequency modulation. Obtain an expression for frequency modulated carrier with sinusoidal modulation. (5)
10. What is amplitude modulation? Obtain an expression for A.M modulated wave with sinusoidal modulation. (5)
11. A50 KW carrier is to be modulated to a level of i) 80% and ii) 10% . What is total side band power in each case? (2)

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