Total Number of Questions : 24

Time : 2.00 Hours

Max. Marks : 100

1. What are the differences between photodiode and p-n junction solar cell ? (3 Marks)

2. Define acceptance angle and numerical aperture of an optical fibre. (3 Marks)

3. State D'Alembert's principle. (3 Marks)

4. Define gyromagnetic ratio. State the relation connecting $\vec{\mu}_s$ and $\vec{s}$ of an electron. (3 Marks)

5. Discuss the entropy of mixing and Gibb's Paradox of an ideal gas. (3 Marks)

6. Discuss magnetic behaviour of an ideal fermi gas and Pauli's paramagnetism to obtain net magnetic moment acquired by the gas. (4 Marks)

7. Describe the principle of Laser. Explain how population inversion is achieved in laser. (4 Marks)

8. Explain the difference between type I and type II superconductor using Meissner effect. (4 Marks)

9. Determine the interplanar spacing between the two parallel planes with Miller indices (h, k, l) in a cubic crystal of side 'a'. (4 Marks)

10. Explain the functions of the ALE and $IO/\overline{M}$ signals of the 8085 microprocessor. (4 Marks)

11. Design and explain sample-and-hold circuit using op-amp. Give its applications. (4 Marks)

12. The motion of a particle of mass 'm' in one dimension is described by the Hamiltonian $H = \dfrac{p^2}{2m} + \dfrac{1}{2}m\omega^2 x^2 + \lambda x$. What is the difference between the quantised energies of the first two levels ? (4 Marks)

13. A particle in the infinite square well potential $V(x) = \begin{cases} 0, & 0 < x < a \\ \infty, & \text{otherwise} \end{cases}$ is prepared in a state

    with the wave function $\psi(x) = \begin{cases} A \sin^3\left(\dfrac{\pi x}{a}\right), & 0 < x < a \\ 0, & \text{otherwise} \end{cases}$. Find the expectation value of the

    energy of the particle. (4 Marks)

14. Let (p, q) be canonical variables. Check whether the following transformations are canonical

    a) (Q, P) = (q tan p, log (sin p))   b) $(Q, P) = \left(\dfrac{1}{p}, q\, p^2\right)$. (4 Marks)

15. Find the values of a and b for which the force $\vec{F} = (axy + z^3)\hat{i} + x^2\hat{j} + bxz^2\hat{k}$ is conservative. (4 Marks)

16. If Fourier transform of f(x) is F(S), prove that Fourier transform of f(x) cos ax is

    $\dfrac{1}{2}\left[f(s-a) + f(s+a)\right]$. (5 Marks)

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17. Briefly explain semi-emperical mass formula. (5 Marks)

18. According to the shell model, what spins and parities should be expected for the ground state of following nuclei $^7Li_3$, $^{16}O_8$, $^{39}K_{19}$? (5 Marks)

19. Give the circuit of differential amplifier with one op-amp and derive the formula for its voltage gain. (5 Marks)

20. Explain the principle of Mossbauer spectroscopy based on recoilness emission and absorption. (5 Marks)

21. Explain different data transfer schemes of Intel 8085 microprocessor. (5 Marks)

22. State Cauchy integral theorem. Find the integral of $\int_C \dfrac{3z^2 + 7z + 1}{z + 1} dz$ where C is circle; $|z| = \dfrac{1}{2}$. (5 Marks)

23. Find the value of $\int_0^1 x[J_1(x)]^2 dx$ where $J_1(x)$ is Bessel's function. (5 Marks)

24. The polynomial $f(x) = 1 + 5x + 3x^2$ is written as a linear combination of Legendre polynomials $\left\{ P_0(x) = 1, P_1(x) = x, P_2(x) = \dfrac{1}{2}(3x^2 - 1) \right\}$ as $\sum_n C_n P_n(x)$. Find the value of C_0. (5 Marks)

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