

Paper II – Physics

36. The Fourier transform of a Gaussian function is:
- A. Gaussian
 - B. Lorentzian
 - C. Sinc
 - D. Delta
37. The Lagrangian of a free particle of mass m moving in 1D is:
- A. Mv
 - B. mv^2
 - C. $\frac{1}{2}mv^2$
 - D. $-\frac{1}{2}mv^2$
38. In electromagnetic waves in vacuum, the ratio E/B is:
- A. 0
 - B. $1/c$
 - C. c
 - D. c^2
39. What is the value of anode current of SCR comprising two-transistor analogy with the gate current of 40 mA if the gain of PNP and NPN transistors are 0.3 and 0.4 respectively?
- A. 253 mA
 - B. 113 mA
 - C. 73.33 mA
 - D. 53.33 mA
40. An ideal op-amp has:
- A. Zero input impedance
 - B. Infinite gain
 - C. Infinite output impedance
 - D. Finite gain
41. The electromagnetic field tensor $F_{\mu\nu}$ is:
- A. Symmetric
 - B. Antisymmetric
 - C. Diagonal
 - D. Zero
42. The fission chain reaction will be critical if multiplication factor (K) is:
- A. $K = 1$
 - B. $K > 1$
 - C. $K < 1$
 - D. $K > 2$
43. Band gap is zero in:
- A. Metals
 - B. Insulators
 - C. Semiconductors
 - D. Dielectrics
44. Calculate the interatomic distance for given Bragg's angle $= 30^\circ$, and for a plane (1, 1, 1) the wavelength of x-ray incident is $1.75 \text{ \AA}$.
- A. $3.31 \text{ \AA}$
 - B. $3.33 \text{ \AA}$
 - C. $3.031 \text{ \AA}$
 - D. $4.51 \text{ \AA}$
45. The expectation value of position for a normalized wave function is:
- A. x
 - B. $\int \psi(x) dx$
 - C. $\int |\psi(x)|^2 dx$
 - D. $\int x |\psi(x)|^2 dx$

46. Calculate the hall voltage when the magnetic field is 8 A/m, current is 4 A, width is 5 m and the concentration of carrier is 10^{20} .
- 4.125 V
 - 0.3125 V
 - 4.2 V
 - 0.4 V
47. The Poisson bracket $\{x, p\} =$
- 1
 - 0
 - $\hbar$
 - 1
48. In a waveguide, TE₁₀ is:
- Cutoff mode
 - Dominant mode
 - Forbidden
 - Evanescent
49. Binding energy per nucleon peaks at:
- Helium
 - Uranium
 - Iron
 - Lithium
50. The Poynting vector represents:
- Charge current
 - Magnetic field
 - Electric potential
 - Energy flux
51. An ion C is four times heavier than an ion D. The ratio of the thermal de-Broglie wavelength of ion D to that of ion C is:
- 1 : $\sqrt{4}$
 - 1 : $\sqrt{2}$
 - $\sqrt{2} : 1$
 - 2 : 1
52. The Coriolis force in a rotating frame act:
- Along radius
 - Along gravity
 - Perpendicular to velocity and rotation axis
 - Opposite to motion
53. The Laplace transform of te^{-2t} is:
- $\frac{1}{(s+2)^2}$
 - $\frac{1}{s^2+4}$
 - $\frac{1}{(s+2)^2}$
 - $\frac{1}{(s-2)^2}$
54. For a harmonic oscillator, energy levels are:
- Continuous
 - Degenerate
 - Equally spaced
 - Random
55. In an NPN transistor in active mode:
- Collector-emitter junction is forward biased
 - Base-emitter junction is forward biased
 - Both junctions reverse biased
 - Both junctions forward biased

56. Green's function solves:
- Algebraic equations
 - Boundary conditions only
 - Inhomogeneous equations
 - Eigenvalue problems only
57. Liénard–Wiechert potentials describe:
- Stationary charges
 - Fields due to moving charges
 - Magnetic monopoles
 - Time-independent fields
58. Fermi energy refers to:
- Highest filled state at $T=0$
 - Ground state energy
 - Ionization energy
 - Lattice energy
59. The density of a quantum system with two microstates is given by $\begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix}$. Choose the correct option.
- $\langle \sigma_z \rangle = -\frac{1}{3}, \langle \sigma_x \rangle = \frac{2}{3}$
 - $\langle \sigma_z \rangle = \frac{1}{3}, \langle \sigma_x \rangle = \frac{2}{3}$
 - $\langle \sigma_z \rangle = -\frac{1}{3}, \langle \sigma_x \rangle = -\frac{2}{3}$
 - $\langle \sigma_z \rangle = \frac{1}{3}, \langle \sigma_x \rangle = -\frac{2}{3}$
60. The Legendre polynomial $P_2(x)$ is:
- $(1 - x^2)^2$
 - $x^2 - 1$
 - $x(1-x)$
 - $\frac{1}{2}(3x^2 - 1)$
61. A conducting spherical shell with charge Q has electric field inside equal to:
- 0
 - $\frac{Q}{4\pi\epsilon_0 r^2}$
 - Q
 - ∞
62. Dirac equation is for:
- Bosons
 - Photons
 - Relativistic spin- $\frac{1}{2}$ particles
 - Molecules
63. The spin quantum number for Ω hyperon is:
- $\frac{1}{2}$
 - 1
 - $\frac{3}{2}$
 - 3
64. The delta function satisfies:
- $\delta(x)=1$
 - $\delta(x)=0$
 - $\int \delta(x)dx=0$
 - $\int_{-\infty}^{\infty} f(x)\delta(x-a)dx = f(a)$
65. Bessel functions arise in:
- Spherical coordinates
 - Cylindrical coordinates
 - Cartesian coordinates
 - Polar coordinates

66. In quantum tunneling, the particle can:
- Cross classically forbidden region
 - Vanish
 - Have infinite energy
 - Reflect completely
67. If S be an mechanical system with Lagrangian $L(p,q,t)$ and generalised coordinates $q = (q_1, q_2, \dots, q_n)$, Then the Lagrange equations of motion for S :
- constitute a set of n first order ODE
 - can be transformed to the Hamiltonian from using Legendre transform
 - are equivalent a set of n first order ODE when expressed in terms of Hamiltonian functions
 - is a set of 2^{nd} second order ODE
68. The commutator $[x,p]$ equals:
- 0
 - $\hbar$
 - $-i\hbar$
 - $i\hbar$
69. The Hamiltonian is conserved if it:
- Has no explicit time dependence
 - Depends on coordinates only
 - Is zero
 - Is quadratic
70. If the perturbation $H' = ax$, where a is a constant, is added to an infinite square well potential
- $$V(x) = \begin{cases} 0 & \text{for } 0 \leq x \leq \pi \\ \infty & \text{otherwise} \end{cases}$$
- The correction to the ground state energy to first order in a is:
- $a\pi$
 - $\frac{a\pi}{2}$
 - $\frac{2}{a\pi}$
 - $\frac{4}{a\pi\sqrt{2}}$

