Q. 1 Which of the following is false?

(a) A symmetric matrix is one for which the transpose of the matrix is the same as the original matrix.

(b)Diagonal elements of an antisymmetric matrix are all zeros.

(c) An anti symmetric matrix is one for which the transpose of the matrix is the negative of the original matrix.

(d) The inverse of a matrix and inverse of its transpose are the same.

Q. 2 The laplace transform of the function $t^n, \; n = 1,2,\ldots$ is

(a) $\frac{n!}{s^{n+1}}$

(b) $\frac{n!}{s^n}$

(c) $\frac{n!}{s^{n-1}}$

(d) $\frac{n}{s^{n+1}}$

Q. 3 Which of the following is true?

(a) Two non zero vectors are orthogonal if and only if their inner product is non zero.

(b)The vector addition may or may not be commutative.

(c)The dot product of two vectors will be zero only if both vectors are zero.

(d)Dot product of vectors is commutative.

Q. 4 The number of different combinations of *n* different things, *k* at a time, without repetitions, is

(a) $\frac{n!}{k!(n-k)!}$

(b) $\frac{n!}{k!(n+k)!}$

(c) $\frac{n!}{(n-k)!}$

(d) $\frac{n!k!}{(n+k)!}$

Q. 5 The binomial and Poisson distributions give approximately the same results, when

(a) p and q are equal and n is small
(b) When p is small and n is large
(c) When p is small and n is small
(d) When p and q are equal

Q. 6 For a normal random variable X

(a) about $\frac{2}{3}$ of its values will lie between μ-σ and μ+σ

(b) about half of its values will lie between μ-σ and μ+σ

(c)about 90% of its values will lie between μ-σ and μ+σ

(d) about 95% of its values will lie between μ-σ and μ+σ

Q. 7 A function *f(x,y)* is harmonic if

(a) $\frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} = 0$

(b) $\frac{\partial f}{\partial x} - \frac{\partial f}{\partial y} = 0$

(c) $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} = 0$

(d) $\frac{\partial^2 f}{\partial x^2} - \frac{\partial^2 f}{\partial y^2} = 0$

Q. 8 If *G* is a group of even order, then

(a) $a^2 = e$ for all $a \in G$

(b) $a^2 = e$ for at least one $a \in G$

(c) $a^2 = a$ for all $a \in G$

(d) none of above

Q. 9 The set $G = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$ *such that* $a, b \in R$ under matrix multiplication, forms

(a) abelion group

(b) non – abelion group

(c) cyclic group

(d) none of above

Q. 10 A three dimensional length element $dl = dx\,i + dy\,j + dz\,k$ in cartesian

coordinates $[x, y, z[$ may be expressed in spherical polar coordinates $[r, \square, \square[$ as

(a) $dl = dr\, e_r \square d\, \square e_{\square} \square d\, \square e_{\square}$

(b) $dl = dr\, e_r \square rd\, \square e_{\square} \square rd\, \square e_{\square}$

(c) $dl = dr\, e_r \square rd\, \square e_{\square} \square r \sin \square d' \square e_{\square}$

(d) $dl = dr\, e_r \square d\, \square e_{\square} \square r \sin \square d\, \square e_{\square}$

Q. 11 In photoelectric effect, the classical theory of light cannot explain the

(a) spontaneity of photoelectric emission

(b) the stopping potential being independent of light intensity

(c) The photoelectric current being proportional to light intensity

(d) both (a) and (b)

Q. 12 The wave particle duality is evident in

(a) the photograph effect

(b) the Maxwell's equations

(c) the faraday effect

(d) the compton effect

Q. 13 Which of the following is true?

(a) Newton's second law can be obtained from Schrodinger's equation.

(b) Schrodinger's equation can be obtained from Newton's second law.

(c) both (a) and (b) are correct.

(d) none of above.

Q. 14 For a bounded particle, which of the following is true?

(a) the energy is a continuous function of frequency.

(b) the rest mass energy is zero.

(c) the energy states are discrete.

(d) the uncertainty principle is not valid.

Q. 15 Applications of barrier penetration by microscopic particle include

(a) emission of α particles in the decay of radioactive nuclei

(b) the periodic inversion of ammonia molecule

(d) Barrier penetration of electrons in the tunnel diode

(d) all of above

Q. 16 For purely orbital angular momentum, the Lande' g factor is

(a) 2

(b) 1

(c) 0

(d) 3/2

Q. 17 If an observable has no explicit time dependence and it commutes with the Hamiltonian, then it is a quantum mechanical

(a) dynamical variable

(b) constant of the stagnation

(c) universal constant

(d) constant of the motion.

Q. 18 At what speed (m/s) must a 10.0 mg object be moving to have a de Broglie wavelength of 3.3×10^{-41} m?

(a) 4.1

(b) 1.9×10^{-11}

(c) 2.0×10^{12}

(d) 3.3×10^{-42}

Q. 19 An electron cannot have the quantum numbers n, l, m_l as

(a) 6, 1, 0

(b) 3, 2, 3

(c) 3, 2, -2

(d) 1, 0, 0

Q. 20 The Klein Gordon equation is given as

(a) $\square^2 \square - \frac{1}{c^2} \frac{\partial^2 \square}{\partial t^2} - \square^2 \square = 1$

(b) $\square^2 \square - \frac{1}{c^2} \frac{\partial^2 \square}{\partial t^2} - \square^2 \square = 0$

(c) $\nabla^2\psi - \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} - \psi^2\psi = 1$

(d) $\nabla^2\psi - \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} - \psi^2\psi = 0$

Q. 21 Which of the following is wrong?

(a) The quantum no. m_l determines the space orientation of orbital angular momentum vector

(b) Total energy of the atom does not depend on m_l.

(c) Eigenfunctions are degenerate w.r.t. m_l.

(d) The z component of angular momentum is $L_z = m_l\ m_l \cdot 1$

Q. 22 In their experiment in 1922, Stern and Gerlach measured

(a) magnetic diople moment for silver atom

(b) electric dipole moment for silver atom

(c) the hyperfine splitting of silver atom

(d) fobidden energy gap in silver atom

Q. 23 For an atom placed in external magnetic field, the most dominant interaction is

(a) Hartee interaction

(b) Coulombic interation

(c) spin-orbit interation

(d) Zeeman splitting

Q. 24 The coherence length for sodium light of wavelength 589 nm is 0.02945 m. The coherence time approximately would be

(a) 20 s

(b) 20 ms

(c) 0.1 ps

(d) 0.1 ns

Q. 25 If the external magnetic field is stronger than the internal magnetric field in an atom , the interation produced is called

(a) Stark effect

(a) Frank-condon effect

(c) Residual coulomb interaction

(d) Paschen-Bach interaction

Q. 26 The pure rotational spectrum falls in

(a) Visible region

(b) Extreme IR or microwave region

(c) radio frequence region

(d) UV region

Q. 27 In the Raman effect

(a) The scattered frequency is same as the incident frequency

(b) Incident frequency is not related to the characteristic frequency of the scattering molecule

(c) During scattering process the molecule does not change the energy state

(d) allowed rotational transitions are $\Delta r = \pm 3$

Q. 28 The rate of stimulated emission is much more dominant than spontaneous emission if

(a) $h\nu \gg kT$

(b) $h\nu \ll kT$

(c) $h\nu \approx kT$

(d) $T \to 0\text{K}$

Q. 29 Phonons are the quanta of

(a) acoustic radiation

(b) matter radiation

(c) Cavity radation

(d) none of above

Q. 30 The principle series of hydrogen atom is observed during the transition of electron from

(a) s to p state

(b) p to s state

(c) d to p state

(d) p to d state

Q. 31 In an extrinsic semiconductor, the

conduction process becomes intrinsic, when

(a) Temperature is low

(b) Temperature is high

(c) $T \to 0K$

(d) The conduction process never becomes intrinsic.

Q. 32 Voltage variable capacitances (VVCs) or Varactors are

(a) Reverse biased diodes

(b)forward biased diodes

(c)Piezoelectric crystals

(d)vacuum triodes

Q. 33 In a transistor amplifier, the d.c load line locates

(a) values for collector current i_C and collector-emitter voltage V_{CE} for series circuit comprised of transistor and load R_L, at constant V_{CC}

(b)values for emitter current i_E and emitter-base voltage V_{BE} for series circuit comprised of transistor and load R_L, at constant V_{CC}

(c)values for base current i_B and emitter-base voltage V_{BE} for series circuit comprised of transistor and load R_L, at constant V_{CE}

(d)values for base current i_B and collector current i_C for series circuit compreised of transistor and load R_L, at constant V_{CE}

Q. 34 An FET (Field Effect Transistor) differs from BJT (Bipolar Junction Transistor) primarily because of

(a) its very low input resistance in comparison to BJT

(b) its low gain in comparison to BJT

(c) its very high input resistance in comparison to BJT

(d) none of above

Q. 35 The amplifier band width is defined as difference between two frequencies at which the power is

(a) ¼ of midfrequency power

(b) 33% of midfrequency power

(c) half of midfrequency power

(d) 67% of midfrequency power

Q. 36 The BarkHausen criterion for an amplifier to behave as an oscillator is

(a) $|A\beta| = 1$

(b) $|A\beta| < 1$

(c) Phase shift around the loop must be $n = 1/2$

(d) both (a) and (c)

Q. 37 Which of the following is a true cell?

(a) photoemissive cell

(b) photoconductive cell

(c) photovoltaic cell

(d) both (b) and (c)

Q. 38 For getting an output from XNOR gate, both inputs must be

(a) high

(b) low

(c) at the same logic level

(d) at the opposite logic level

Q. 39 Only one IC is active at a time to avoid a bus conflict caused by two ICs writing different data to the same bus, is ensured by

(a) control bus

(b) control instructions

(c) address decoder

(d) CPU

Q. 40 The register in the 8085A that is used to keep track of the memory address of the next op-code to be run in the program is the

(a) stack pointer

(b) program counter

(c) instruction pointer

(d) accumulator

Q. 41 A monoclinic crystal is represented by

(a) $a \neq b \neq c$, $\square \neq \square \neq \square \neq 90^o$

(b) $a = b \neq c$, $\square = \square = 90^o$, $\square \neq 90^o$

(c) $a = b = c$, $\square = \square = \square = 90^o$

(d) $a \neq b = c$, $\square = \square = \square = 90^o$

Q. 42 In a cubic crystal, the planes (001) and (010) are

(a) parallel to each other

(b) perpendicular to each other

(c) at 45^o to each other

(d) none of above

Q. 43 The molar specific heat of a metal has contribution due to

(a) lattice vibration

(b) free electrons

(c) lattice vibration and free electrons both

(d) none of above

Q. 44 A crytal shows piezoelectricity only if

(a) it possesses a center of inversion symmetry

(b) it does not possess a center of inversion symmetry

(c) it possesses a diad rotational symmetry axis

(d) it does not possess a diad rotational symmetry axis

Q. 45 The Lorentz-Drude theory considers free electrons in a metal to be moving in a

(a) constant potential

(b) variable but non-periodic potential

(c) variable and periodic potential

(d) any of above potential

Q. 46 The domain theory of ferromagnetism was proposed by

(a) Curie

(b) Ronald

(c) Debye

(d) Weiss

Q. 47 The drawback of free electron theory was that

(a) it could not explain positive Hall coefficient for some metals

(b) predicted high value of specific heat for metals

(c) could not explain non-spherical Fermi surface

(d) all of above

Q. 48 The width of the super conducting energy gap

(a) increases with increase of temperature

(b) decreases with increase of temperature

(c) may increase or decrease with increase of temperature

(d) does not change with temperature

Q. 49 In Type I superconductors, the transition from superconducting to normal state by application of magnetic field is

(a) sharp

(b) not sharp

(c) may or may not be sharp

(d) the transition does not take place by the application of magnetic field

Q. 50 The quasicrystals are characterized to be

(a) hard and brittle, having high electrical, thermal resistivity and low surface energy

(b) hard and brittle, having low electrical, thermal resistivity and low surface energy

(c) soft, having high electrical, thermal resistivity and high surface energy

(d) soft, having low electrical, thermal resistivity and high surface energy

Q. 51 The crystal lattice of diamond is

(a) bcc with basis at 000 and $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ positions

(b) bcc with basis at 000 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$ positions

(c) fcc with basis at 000 and $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ positions

(d) fcc with basis at 000 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$ positions

Q. 52 The isotope $^{14}_{6}C$ has a half life of 5,730 years. Starting with a sample of 1,000 C-14 nuclei, the number of nuclei that will still be undecayed in 25,000 years is

(a) 58

(b) 49

(c) 86

(d) 124

Q. 53 Which of following is the correct daughter nucleus associated with beta decay of $^{184}_{72}Hf$?

(a) $^{183}_{72}Hf$

(b) $^{183}_{73}Ta$

(c) $^{184}_{73}Ta$

(d) none of above

Q. 54 In the nuclear interaction, between two protons, the mediating paricle is

(a) a photon

(b) a neutral pion

(c) W^+ boson

(d) W^- boson

Q. 55 What conservation law is violated by the decay

$\square^0 \square \square^{\square} \square e^- \square \square_{\square}$

(a) electric charge

(b) baryon number

(c) energy

(d) electron lepton number

Q. 56 The standard model of particle physics is based on gauge group

(a) $SU\square 3\square \times SU\square 2\square \times U\square 1\square$

(b) $SU\square 3\square \times SU\square 2\square$

(c) $SU\square 5\square$

(d) $SU\square 2\square \times U\square 1\square$

Q. 57 The quark content of which of the following particles is incorrect?

(a) $p- uud$

(b) $n-udd$

(c) $\square^{\square} - u\bar{d}$

(d) $K^{\square} - \bar{u}s$

Q. 58 According to the shell model of nuclear structure

(a) Each nucleon exists in quantized energy states

(b) There are fewer collisions between the nucleons

(c) none of (a) and (b) is true

(d) both (a) and (b) are true

Q. 59 According to Gellmass and Nishijima scheme

(a) $\frac{Q}{e} = \frac{B \square S}{2} \square I_3$

(b) $\frac{Q}{e} = B \square S \square \frac{I_3}{2}$

(c) $\frac{Q}{e} = \frac{B \square S \square I_3}{2}$

(d) $\frac{Q}{e} = B \square S \square I_3$

Q. 60 According to CPT theorem, the CP violation implies

(a) T violation

(b) T conservation

(c) parity violation

(d) parity conservation

Q. 61 Two nuclei have their mass numbers in the ratio 1:3. The ratio of their nuclear densities would be

(a) 1:3

(b) 3:1

(c) 1:1

(d) either of (a) and (b)

Q. 62 Used fuel rods from a nuclear reactor contain about

(a) 96% usable uranium and plutonium

(b) 33% usable uranium and plutonium

(c) 4% usable uranium and plutonium

(d) 0% usable uranium and plutonium

Q. 63 Constraints that can be expressed as equations of coordinates and time, i.e., by an expression of the form $f(r_1, r_2, r_3, \ldots, t) = 0$, are said to be

(a) holonomic

(b) non holonomic

(c) scleronomous

(d) non scleronomous

Q. 64 Scleronomous constraints have:

(a) explicit time dependence

(b) no explicit time dependence

(c) no time dependence at all

(d) may or may not have a time dependence

Q. 65 Hamilton's principle is an example of a

(a) consevation law

(b) continuity equation

(c) variational principle

(d) both (b) and (c)

Q. 66 If the Lagrangian is cyclic in q_j then,

(a) p_j is not conserved

(b) p_j is not conserved

(c) q_j appears in the Lagrangian

(d) the Lagrangian is circular

Q. 67 Canonical transformations can often be conveniently found or verified by using

(a) rotational matrix

(b) generating function

(c) degeneration function

(d) separation tensor

Q. 68 The expression for the conserved angular momentum in a central force problem is,

(a) $L = m r^2 \dot{\square}$

(b) $L = \frac{m}{r^2 \dot{\square}}$

(c) $L = mr \dot{\square}$

(d) $L = 2 m r^2 \dot{\square}$

Q. 69 The Poisson Bracket of two functions of F and G of the coordinates and canonical momenta q and p is defined to be

(a) $[F, g]_{\bar{q}, \bar{p}} = \sum \left[\frac{\partial F}{\partial q_k} \frac{\partial G}{\partial p_k} - \frac{\partial F}{\partial p_k} \frac{\partial G}{\partial q_k} \right]$

(b) $[F, g]_{\bar{q}, \bar{p}} = \sum \left[\frac{\partial F}{\partial q_k} \frac{\partial G}{\partial p_k} \square \frac{\partial F}{\partial p_k} \frac{\partial G}{\partial q_k} \right]$

(c) $[F, g]_{\bar{q}, \bar{p}} = \sum \left[\frac{\partial F}{\partial q_k} \frac{\partial G}{\partial p_k} - \frac{\partial F}{\partial p_k} \frac{\partial G}{\partial q_k} \right]^2$

(d) $[F, g]_{\bar{q}, \bar{p}} = \sum \left[\frac{\partial F}{\partial q_k} \frac{\partial G}{\partial p_k} \square \frac{\partial F}{\partial p_k} \frac{\partial G}{\partial q_k} \right]^2$

Q. 70 Which of the following is efficient in frequency range of (3 – 300) Ghz?

(a) Transmission line

(b) Wave guides

(c) Both (a) and (b)

(d) none of these

Q. 71 For lossless waveguides $\square_c$ and $\square$ are

(a) $\infty, 0$

(b) $0, \infty$

(c) $0, 0$

(d) ∞, ∞

Q. 72 Which vector is needed to determine the power flow in wave guides

(a) Poynting vector

(b) Power vector

(c) Phase vector

(c) S – vector

Q. 73 Which of the following Maxwell's equation expresses Ampere's law

(a) $\nabla . E = \frac{\rho}{\varepsilon_0}$

(b) $\nabla . B = 0$

(c) $\nabla \times E = \frac{-\partial B}{\partial t}$

(d) $\nabla \times B = \frac{J}{\varepsilon_0 c^2} \frac{1}{c^2} \frac{\partial E}{\partial t}$

Q. 74 Maxwell's equation $\oint B . ds = 0$ implies that

(a) Total Magnetic flux crossing any closed surface is zero.

(b) Magnetic flux lines occur in closed loops.

(c) There are no magnetic monopoles.

(d) All of above.

Q. 75 For a sinusoidally varying input voltage of frequency ω, the ratio of conduction current density to displacement current density is proportional to

(a) $\frac{\sigma}{\omega \varepsilon}$

(b) $\frac{\omega \varepsilon}{\sigma}$

(c) $\frac{\sigma}{\omega \varepsilon}$

(d) $\sqrt{\omega \varepsilon}$

Q. 76 Magnetostriction is a property by which a ferromagnetic substance, when placed in magnetic field shows

(a) an increase in length in the direction of magnetic field

(b) an increase in length in the direction opposite to the magnetic field

(c) increase in temperature

(d) decresase in temperature

Q. 77 On a conductor of non uniform curvature, the charge

(a) has the greatest concentration on the parts of least curvature.

(b) has the greatest concentration on the parts of greatest curvature.

(c) is distributed uniformly on the whole surface

(d) is distributed uniformly over its volume.

Q. 78 Which of the follwing statements regarding fields E_1 and E_2 is correct?

$E_1 = x \hat{i} - y \hat{j}$ and $E_2 = x y^2 \hat{i} - y^3 \hat{j}$

(a) Both E_1 and E_2 can represent electrostatic field.

(b) Neither E_1 nor E_2 can represent electrostatic field.

(c) Only E_1 can represent electrostatic field.

(d) Only E_2 can represent electrostatic field.

Q. 79 Joule-Thomson cooling efffect is

(a) Independent of temperature.

(b) temperature dependent

(c) dependent on the moleculer weight of the gas

(d) dependent on the total mass of the gas

Q. 80 The mean square displacement of a particle undergoing Brownian motion at a temperature T is proportinal to

(a) $\frac{1}{T}$

(b) $\frac{1}{\sqrt{T}}$

(c) $\sqrt{T}$

(d) T

Q. 81 For a diatomic – gas having 3 tanslational and 2 rotational degrees of freedom, the energy is given by

(a) $\frac{5}{2} kT$

(b) $5kT$

(c) $\frac{3}{2}kT$

(d) $3kT$

Q. 82 The processes that take place in a Carnot cycle are 1. Adiabatic expansion 2. Adiabatic compression 3. Isothermal expansion 4. isothermal compression. The correct sequence of these processes in the carnot cycle is

(a) 1, 3, 4, 2

(b) 3, 1, 2, 4

(c) 3, 1, 4, 2

(d) 1, 3, 2, 4

Q. 83 The Gibbs function for a system is given as $G = H – TS$, where H is enthalpy. T is temperatute and S is the entropy of the system. In the case of a reversible, isothermal, isobaric process

(a) G = constant

(b) $G > 0$ and changes with T

(c) $G < 0$ and changes with S

(d) G changes with both T and S

Q. 84 If the maximum wavelength λ_m is $4753\ \mathring{A}$, then the temperature of the surface of the photosphere of the sun will be

(a) 6200 K

(b) 6800 C

(c) 68000 K

(d) 68000 C

Q. 85 The Bose – Einstein statistics describe

(a) all integer spin particles

(b) all half – integer spin particles

(c) both interger and half – integer spin particles

(d) only photons

Q. 86 The Fermi – Dirac distribution function is given as

(a) $f(E) = \frac{1}{e^{(E-E_F)/kT} - 1}$

(b) $f(E) = \frac{1}{Ae^{E_F/kT} - 1}$

(c) $f(E) = \frac{1}{e^{(E-E_F)/kT} - 1}$

(d) $f(E) = \frac{1}{Ae^{E_F/kT} - 1}$

Q. 87 The diffusion coefficient in solid state diffusion process

(a) increases linearly with temperature

(b) increases exponentially with temperature

(c) does not depend on temperature

(d) decreases exponentially with temperature

Q. 88 If n is an exact number and $Q = x^n$, then uncertainty in Q is given as

(a) $\frac{\Delta Q}{|Q|} = \frac{\Delta x}{|x|}$

(b) $\frac{\Delta Q}{|Q|} = |n| \frac{\Delta x}{|x|}$

(c) $\frac{\Delta Q}{|Q|} = \frac{|\Delta x|^n}{|x|}$

(d) $\frac{\Delta Q}{|Q|} = \frac{\Delta x}{n|x|}$

Q. 89 A box car integrator improves the signal/noise ratio by

(a) gating the detection

(b) averaging over multiple pulses

(c) both (a) and (b)

(d) none of above

Q. 90 According to the method of least squares, the best fitting curve has the property that

(a) $\sum_{i=1}^{n} [y_i - f(x_i)]^2 = a\ minimum$

(b) $\sum_{i=1}^{n} [y_i - f(x_i)] = a\ minimum$

(c) $\sum_{i=1}^{n} [y_i - f(x_i)]^{1/2} = a\ minimum$

(d) $\sum_{i=1}^{n} [y_i - f(x_i)]^{3/2} = a\ minimum$

where, y is dependent and x is independent variable, while $f(x)$ describes the fitting curve.