ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ ਜਲੰਧਰ

PUNJAB TECHNICAL UNIVERSITY JALANDHAR

Max. Marks: 90 **Time: 90 Mins.**

Entrance Test for Enrollment in Ph.D. Programme

Important Instructions

- ***Fill all the information in various columns, in capital letters, with blue/black ball point pen.***
- ***Use of calculators is not allowed.***
- ***All questions are compulsory. No negative marking for wrong answers.***
- ***Each question has only one right answer.***
- ***Questions attempted with two or more options/answers will not be evaluated.***

Stream *(Engg./Arch./Pharm./Mgmt./App.Sci./Life Sci.)* **APPLIED SCIENCES**

Discipline / Branch **PHYSICS**

Name .....

Father's Name .....

Roll No. ..... Date: **19-11-2011**

Signature of Candidate .....

Signature of Invigilator .....

Q. 1 A graph in which the square root of the frequency of an X-ray is plotted as a function of atomic number is called a

(a) Moseley Plot

(b) Bragg's plot

(c) Ulrey's curves

(d) Compton plot

Q. 2 A π-meson can be represented by a wavefunction which has the space transformation properties under inversion and rotation same as that of a

(a) pseudo-scalar

(b) scalar

(c) vector

(d) axial vector

Q. 3 For any system of N freely moving particles each with mass 'm_0' and kinetic energy 'K', such as the molecules of a gas in a box, the total rest mass is given by

(a) $M_0 = \sum_{i=1}^{N} (m_0)_i$

(b) $M_0 = \sum_{i=1}^{N} [(m_0)_i + K_i]$

(c) $M_0 = \sum_{i=1}^{N} [(m_0)_i + \frac{K_i}{c^2}]$

(d) $M_0 = \sum_{i=1}^{N} (m_0)_i c^2$

Q. 4 The zero-point energy of a harmonic oscillator is

(a) $\frac{1}{2}\hbar\omega$ and corresponds to n=1

(b) $\frac{1}{2}\hbar\omega$ and corresponds to n=0

(c) $\hbar\omega$ and corresponds to n=1

(d) $h\nu$ and corresponds to n=0

Q. 5 What is the chemical name for quartz ?

(a) SiO_2

(b) SiO_3

(c) SiO

(d) SiO_4

Q. 6 How many α and β particles are emitted in the radioactive chain starting with $_{94}Pu^{242}$ and ending with $_{82}Pb^{206}$?

(a) (9,12)

(b) (9,6)

(c) (3,9)

(d) (6,9)

Q. 7 If u(x) = A exp(−αx) is an eigen-function of the operator $\hat{C} = \frac{d^2}{dx^2} + \frac{2}{x}\frac{d}{dx} + \frac{2b}{x}$, the corresponding eigen-value is

(a) b

(b) b^2

(c) $1/b$

(d) $2b$

Q. 8 In how many number of ways the two indistinguishable particles obeying Bose Einstein statistics can be distributed in 5 states ?

(a) 25

(b) 10

(c) 20

(d) 15

Q. 9 Which one of the following statements is NOT correct ?

(a) Hall coefficients for semiconductors are large

(b) Hall angle is positive for positive carriers

(c) Hall angle is negative for electrons

(d) Hall effect can not be used to study metals

Q. 10 The smallest energy that a photon can have and still produce a pair in the field of a free electron is

(a) 0.51 MeV
(b) 1.02 MeV
(c) 2.04 MeV
(d) 4.08 MeV

Q. 11 In electrodynamics, the charge density of a point charge is a

(a) Dirac function
(b) Dirac delta function
(c) Schrodinger wave
(d) discrete function

Q. 12 The inner product of two functions *f(x) and g(x)* is defined as

(a) $< f \mid g >= \int_a^b f(x) g^*(x) dx$

(b) $< f \mid g >= \int_0^b f^*(x) g(x) dx$

(c) $< f \mid g >= \int_a^b f^*(x) g(x) dx$

(d) $< f \mid g >= \int_0^b f(x) g(x) dx$

Q. 13 Maxwell's curl equation for static magnetic field is

(a) $\nabla . \vec{B} = 0$

(b) $\nabla \times \vec{B} = 0$

(c) $\nabla . \vec{B} = \mu_o$

(d) $\nabla \times \vec{B} = \mu_o \vec{J}$

Q. 14 The poynting vector is associated with

(a) flux in magnetic field

(b) power flow in electrostatic field

(c) current in electrostatic field

(d) charge in the electrostatic field

Q. 15 Which of the following antennas is best guided by a waveguide ?

(a) Bi-conical

(b) Horn

(c) Helical

(d) Discone

Q. 16 What is the frequency range of microwaves ?

(a) 1 GHz – 30 GHz

(b) 30 GHz – 300 GHz

(c) 3 MHz – 300 MHz

(d) 30 KHz – 300 KHz

Q. 17 Probability density function of thermal noise follows

(a) Binomial distribution
(b) Gaussian distribution
(c) Poisson distribution
(d) Negative Binomial distribution

Q. 18 The amount of information in a continuous signal is

(a) zero
(b) 2- bits
(c) 4- bits
(d) Infinity

Q. 19 Which of the following diodes will produce the highest pulsed power output ?

(a) Schottky Barrier Diode
(b) Gun diode
(c) IMPATT diode
(d) Varactor diode

Q. 20 A ruby MASER is preferred to the ammonia MASER for microwave applications because

(a) it has greater wavelength

(b) it has low noise

(c) it does not require cooling

(d) it possesses better frequency stability

Q. 21 Synchronous satellites orbit the earth once in

(a) 1 hour

(b) 1.5 hours

(c) 24 hours

(d) 365 days

Q. 22 Another name for horizontal retrace in TV receiver is

(a) fly back

(b) burst

(c) damper

(d) ringing

Q. 23 Number of known neutrino species are

(a) 1

(b) 2

(c) 3

(d) 4

Q. 24 Photomultipliers are based on the principle of

(a) pyro-electric effect

(b) photo voltaic effect

(c) photo conduction

(d) secondary emission

Q. 25 A triple frequency of six-phase half wave rectifier for 220V, 60 Hz will be

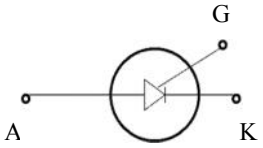
(a) 2160 Hz

(b) 720 Hz

(c) 360 Hz

(d) 60 Hz

Q. 26 The figure shown represents



(a) silicon controlled rectifier

(b) field effect transistor

(c) photo-emissive diode

(d) tunnel diode

Q. 27 If *a, b & c* are constants, which of the following is a linear inequality ?

(a) $ax + bcy$

(b) $ax^2 + cy^2 = 121$

(c) $abx + a^2y \geq 15$

(d) $ax + xy \geq 20$

Q. 28 If $c > 0$ and $f(x) = e^x - cx$ for all real numbers x, then the minimum value of f is

(a) $f(c)$

(b) $f(e^c)$

(c) $f(1/c)$

(d) $f(\log a)$

Q. 29 Evaluate $\sum_{n=1}^{\infty} \frac{n}{n+1}$

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

(b) log 2

(c) 1

(d) $+\infty$

Q. 30 The function $f(z) = \frac{1}{(1-z)^2} + \sin(\frac{1}{1-z})$

at $z = 1$ has

(a) no singularity

(b) a pole of order 1

(c) a pole of order 2

(d) an essential singularity

Q. 31 A Group G in which $(ab)^2 = a^2b^2$ for all a, b in G is necessarily

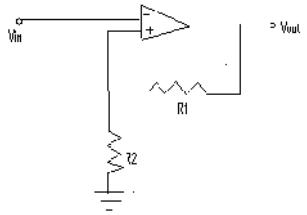
(a) finite

(b) cyclic

(c) of order 2

(d) abelian

Q. 32 The circuit shown in figure is that of



(a) a non-inverting amplifier

(b) an inverting amplifier

(c) an oscillator

(d) a Schmitt trigger

Q. 33 which of the following statements is **wrong** ?

(a) Radio waves travel at the speed of light

(b) Radio waves can be reflected and refracted

(c) Radio waves always take the shortest path between two points

(d) Radio waves can not propagate through vacuum

Q. 34 FM broadcast is done using

(a) short waves

(b) microwaves

(c) medium waves

(d) VHF & UHF waves

Q. 35 Ionosphere roughly extends from

(a) 50 Km to 110 Km

(b) 50 Km to several earth radii

(c) earth's surface to 110 Km

(d) 50 Km to 220 Km

Q. 36 Bolometers are used for the measurement of

(a) optical inputs

(b) thermal radiation

(c) electrical signals

(d) potential difference

Q.37 In a VTVM the alternating voltage measurement corresponds to

(a) saw tooth wave inputs
(b) square wave inputs
(c) sine wave inputs
(d) triangular wave inputs

Q. 38 Which of the following is the unit of magnetic flux density ?

(a) Tesla

(b) Lumens

(c) Daraf

(d) Weber

Q. 39 Constantan contains

(a) Copper & Nickel

(b) Copper & Tungsten

(c) Tungsten & Silver

(d) Silver and Tin

Q. 40 Piezoelectric materials serve as a source of

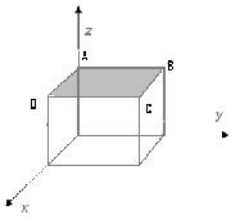
(a) microwaves

(b) ultrasonic waves

(c) musical waves

(d) resonant waves

Q. 41 Miller indices of face ABCD are



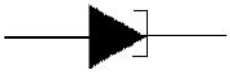
(a) (1 0 0)

(b) (1 1 1)

(c) (0 0 1)

(d) (0 0 0)

Q. 42 The figure shown below represents a



(a) Tunnel diode

(b) PNP transistor

(c) Photosensitive diode

(d) Photo-emissive diode

Q. 43 Solar cell is an example of

(a) Photo voltaic cell

(b) photo conductive cell

(c) photo emissive cell

(d) photo radiation cell

Q. 44 Nernst heat theorem is commonly known as

(a) Third law of thermodynamics

(b) Second law of thermodynamics

(c) Zeroeth law of thermodynamics

(d) First law of thermodynamics

Q. 45 The equation $\frac{d\rho}{dt} = \frac{\partial \rho}{\partial t} + [\rho, H] = 0$ embodies

(a) Liouville's theorem,

(b) Equation of continuity

(c) Virial theorem

(d) Poisson equation

Q. 46 How many quarks are contained in a neutron ?

(a) 3
(b) 2
(c) 1
(d) 0

Q. 47 The Boolean function for AND gate is

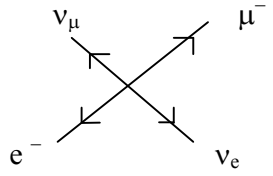
(a) $A + B = Y$

(b) $A - B = Y$

(c) $A \,.\, B = Y$

(d) $A + \overline{A} = Y$

Q. 48 The Feynman diagram shown below represents the process



(a) muon decay

(b) inverse muon decay

(c) electron scattering

(d) neutrino scattering

Q. 49 The particle 'τ' is a

(a) meson
(b) lepton
(c) baryon
(d) hadron

Q. 50 barn is a unit of

(a) length

(b) volume

(c) cross-section

(d) magnetic moment

Q. 51 Mass of W-boson is approximately

(a) 91 GeV

(b) 81 GeV

(c) 45 GeV

(d) 1 GeV

Q. 52 The integral $\int_0^1 (\log_e \frac{1}{y})^{n-1} dy$ represents a

(a) β - function
(b) Γ - function
(c) error function
(d) exponential function

Q. 53 The argument of the quotient of two complex numbers is equal to the

(a) quotient of their arguments

(b) difference of their arguments

(c) sum of their arguments

(d) product of their arguments

Q. 54 Isospin shift operator I^+ is defined as

(a) $I^+ = \sqrt{I(I+1) - I_3(I_3+1)}$

(b) $I^+ = \sqrt{I(I-1) + I_3(I_3-1)}$

(c) $I^+ = \sqrt{I(I+1) + I_3(I_3-1)}$

(d) $I^+ = \sqrt{I(I-1) + I_3(I_3-1)}$

Q. 55 The differential equation known as Legendre's equation can be expressed as

(a) $\frac{d}{dx}\{(1-x^2)\frac{dy}{dx}\} + n(n+1)y = 0$

(b) $\frac{d}{dx}\{(1-x^2)\frac{dy}{dx}\} = 0$

(c) $\frac{d}{dx}\{(1+x^2)\frac{dy}{dx}\} + n(n+1)y = 0$

(d) $\frac{d}{dy}\{(1-x^2)\frac{dy}{dx}\} + n(n+1)y = 0$

Q. 56 The function $(1+x)^n$ is a

(a) hypergeometric function

(b) power series

(c) binomial function

(d) polynomial

Q. 57 Path followed by a particle in sliding from one point to another in the absence of friction in the shortest time is

(a) paraboloid

(b) ellipsoid

(c) cycloid

(d) linear

Q. 58 A particle describes a circular orbit under the influence of an attractive central force towards a point on the circle. The force varies as

(a) inverse fifth power of the distance

(b) inverse second power of the distance

(c) square of the distance

(d) inversely proportional to the distance

Q. 59 Which of the following is not a Kepler's law of planetary motion ?

(a) All planets move in elliptical orbits having the sun as one focus

(b) The areas swept out by the radius vector of planet relative to the sun in equal times are equal

(c) The square of the period of revolution of any planet about the sun is proportional to the cube of semi-major axis

(d) The force on the planet varies inversely as its distance from the sun.

Q. 60 Which of the following statements is **wrong** ?

(a) The Poisson bracket does not obey commutative law

(b) The Poisson bracket obeys the distributive law

(c) The Poisson bracket remains invariant under canonical transformations

(d) The Lagrange bracket does not remain invariant under canonical transformations

Q. 61 The resultant of two infinitesimal rotations about the same point is the

(a) product of these rotations

(b) vector sum of these rotations

(c) sum of these rotations

(d) difference

Q. 62 A rocket of proper length moves directly away from earth. A light pulse sent from the earth is reflected from the mirrors at the rear of the rocket. If the first reflected pulse is received 100 seconds after emission, what is the distance of the rocket ?

(a) 1.5×10^{10} m

(b) 3×10^{10} m

(c) 3×10^{8} m

(d) 1.5×10^{8}m

Q. 63 The main advantage of using a crystal oscillator is

(a) constant frequency of oscillation

(b) suitability for low voltages

(c) high output voltage

(d) high efficiency

Q. 64 How many flip-flop circuits are needed to divide by 16 ?

(a) 2

(b) 4

(c) 8

(d) 16

Q. 65 With a JK Master-Slave flip-flop, the master is clocked when the clock is

(a) low

(b) high

(c) constant

(d) any time

Q. 66 If P_c is the power of the un-modulated signal and m is the modulation index, then the power of the modulated signal is given by

(a) mP_c

(b) $m^2 P_c$

(c) $m^2 \frac{P_c}{2}$

(d) $m^2 \frac{P_c}{2} + P_c$

Q. 67 Which of the following is NOT a trans-uranium element ?

(a) Neptunium

(b) Amaricium

(c) Berkelium

(d) Thallium

Q. 68 The expression $\frac{g_i}{n_i} + \delta = e^{\alpha + E_i / kT}$ represents Maxwell Boltzmann distribution when

(a) $\delta = 0$

(b) $\delta = -1$

(c) $\delta = +1$

(d) $\delta = n_i / g_i$

Q. 69 As compared to a CB amplifier, a CE amplifier has

(a) lower current amplification

(b) higher current amplification

(c) lower input resistance

(d) higher input resistance

Q. 70 A projectile is shot along the earth's surface. The Coriolis force tends to deflect the particle

(a) to the right of its direction in Northern hemisphere

(b) to the left of its direction in Northern hemisphere

(c) to the right of its direction in Southern hemisphere

(d) does not affect its normal trajectory.

Q. 71 The ratio of specific heats C_p and C_v for a photon gas is

(a) 1.33

(b) 1.5

(c) 1

(d) ∞

Q. 72 The number of normal modes of vibration in a solid is fixed by the number of lattice sites. Quantum mechanically these modes give rise to quanta called

(a) photons

(b) phonons

(c) gluons

(d) leptons

Q. 73 Strong interactions between quarks are mediated by the exchange of gluons. How many species of gluons are there ?

(a) 27

(b) 9

(c) 8

(d) 61

Q. 74 LEDs normally work on a voltage of

(a) 1-2 V

(b) 10-20 V

(c) 50-60 V

(d) 100-250 V

Q. 75 Which of the following materials finds application in light emitting diodes ?

(a) Silicon

(b) Phosphorus

(c) Sulphur

(d) Gallium Phosphide

Q. 76 In Superhetrodyne receiver, the frequency of local oscillator is

(a) equal to that of incoming signal
(b) higher than the incoming signal
(c) slightly less than incoming signal
(d) half of the incoming signal

Q. 77 The electric filed on an equipotential surface is

(a) zero
(b) infinity
(c) perpendicular to surface
(d) parallel to the surface

Q. 78 The velocity at which the mass of a particle becomes double its rest mass is

(a) $\frac{\sqrt{3}}{2}c$

(b) $\sqrt{\frac{3}{2}}c$

(c) $\frac{\sqrt{3}}{4}c$

(d) 0.99c

Q. 79 In '*n*' repeated trials, the probability that A_1 occurs k_1 times, A_2 occurs k_2 times…….. is equal to $\frac{n!}{k_1!k_2!.....k_s!}p_1^{k_1}p_2^{k_2}.....p_s^{k_s}$ where $k_1+k_2+.....+k_s=n$. These numbers form the distribution called

(a) Binomial distribution
(b) Poisson distribution
(c) multinomial distribution
(d) Normal distribution

Q. 80 Who discovered Photoelectric effect ?

(a) Edison

(b) Thomson

(c) Hertz

(d) Faraday

Q. 81 In special theory of relativity, particles which could travel at velocity greater than the velocity of light were postulated. These are known by which name ?

(a) Rishons

(b) Techyons

(c) bosons

(d) rotons

Q. 82 The diameter of an atom is

(a) 10^{-6} m

(b) 10^{-10} m

(c) 10^{-15} m

(d) 10^{-18} m

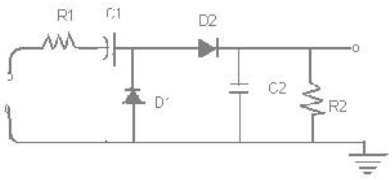
Q. 83 Which of the following is an acceptor impurity element ?

(a) Arsenic
(b) Gallium
(c) Phosphorus
(d) Antimony

Q. 84 Hall effect can be used to measure the

(a) magnetic field intensity
(b) average number of holes
(c) carrier concentration
(d) electrostatic field intensity

Q. 85 The circuit shown in figure is of



(a) Bridge rectifier
(b) Low frequency rectifier
(c) Half-wave voltage doubler
(d) Full-wave voltage doubler

Q. 86 In satellite communication, what type of modulation is used ?

(a) AM
(b) PAM

(c) PCM

(d) FM

Q. 87 In hydrogen atom the separation between $S_{1/2}$ and $P_{1/2}$ levels due to spin-orbit interaction is called;

(a) Anomalous shift

(b) Lamb Shift

(c) Bohr Magneton

(d) Zeeman Shift

Q. 88 What is the process of internal conversion of x-rays into photo-electrons called ?

(a) Photoelectric effect
(b) Auger effect
(c) Thomson effect
(d) Rayleigh scattering

Q. 89 Which of the following possesses the property of dichroism ?

(a) Tourmaline crystal
(b) Calcite crystal
(c) Wallaston prsm
(d) Rochon Prism

Q. 90 100 molecules of a gas are enclosed in a cubical volume divided into two equal halves. What is the ratio of time spent by the system in the most probable macrostate (50, 50) and the macrostate (45, 55) ?

(a) 1.5
(b) 1.64
(c) 1.11
(d) 1.00