



## Hemchandracharya North Gujarat University PHD Exam

Exam Name : HNGU\_PHD\_Physics\_02.02.2024\_03.00 PM TO 05:00 PM

Exam Date : 2024-02-02

Exam Time : 03:00:00 PM To 05:00:00 PM

Total Marks : 100

**Note : The correct answer is indicated by the green color. સાચો જવાબ લીલા રંગ દ્વારા સૂચવવામાં આવે છે.**

Question List:

Section: Section-A

- Which sentence is grammatically correct? [ 1 Mark ]
  - **She doesn't like coffee.**
  - She were doesn't likes coffee.
  - They doesn't like coffee.
  - I doesn't like coffee.
- Choose the synonym for "Ubiquitous." [ 1 Mark ]
  - Scarce
  - Abundant
  - Rare
  - **Widespread**
- Identify the correctly spelled word. [ 1 Mark ]
  - Accesible
  - **Accessible**
  - Accessible
  - Accessibel
- What is the plural form of "Crisis"? [ 1 Mark ]
  - Criseses
  - Crisis
  - **Crises**
  - Crisisies
- Which sentence is punctuated correctly? [ 1 Mark ]
  - The cat meowed, loudly.
  - The cat, meowed loudly.
  - **The cat meowed loudly.**
  - The, cat meowed loudly.
- If all cats are mammals and Fluffy is a cat, what can be concluded? [ 1 Mark ]
  - Fluffy is not a mammal.

- **Fluffy is a mammal.**
  - Fluffy is a bird.
  - Mammals are not cats.
  
- **What comes next in the sequence: 2, 5, 10, 17, ...? [ 1 Mark ]**
  - **26**
  - 260
  - 39
  - 340
  
- **If today is Monday, what day will it be 10 days from now? [ 1 Mark ]**
  - Tuesday
  - Sunday
  - **Wednesday**
  - Friday
  
- **Which word does not belong to the group? [ 1 Mark ]**
  - Banana
  - **Potato**
  - Apple
  - Grapes
  
- **What programming language is often used for systems programming and is known for its efficiency and low-level control? [ 1 Mark ]**
  - Java
  - Python
  - **C**
  - JavaScript
  
- **What does CPU stand for? [ 1 Mark ]**
  - **Central Processing Unit**
  - Central Printed Unit
  - Computer Processing Unit
  - Central Peripheral Unit
  
- **Which file format is commonly used for compressed archives? [ 1 Mark ]**
  - PDF
  - JPEG
  - **ZIP**
  - DOCX
  
- **What is the function of RAM in a computer? [ 1 Mark ]**
  - Long-term storage
  - **Short-term memory**
  - Processing data
  - Input and output
  
- **Which of the following is an example of a web browser? [ 1 Mark ]**
  - Microsoft Word
  - Excel
  - **Google Chrome**
  - Photoshop
  
- **What does the acronym HTML stand for? [ 1 Mark ]**
  - Hyperlink Text Markup Language
  - Hypertext Transfer Protocol
  - High-Level Text Management Language
  - **Hypertext Markup Language**
  
- **What is the main principle of the Solid State Reaction method? [ 1 Mark ]**

- Liquid-phase synthesis
  - Gas-phase synthesis
  - **Solid-phase synthesis**
  - Electrochemical synthesis
- **What is the disadvantage of the Solid State Reaction method? [ 1 Mark ]**
    - High energy consumption
    - **Limited control over stoichiometry**
    - Fast reaction kinetics
    - Low temperature requirements
- **Microwave synthesis is based on the absorption of electromagnetic waves primarily by: [ 1 Mark ]**
    - **Conduction electrons**
    - Convection currents
    - Radio waves
    - Magnetic fields
- **In the preparation of YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> superconductor through Microwave Synthesis, which elements are involved? [ 1 Mark ]**
    - Yttrium, Barium, Oxygen
    - Yttrium, Boron, Copper
    - **Yttrium, Barium, Copper**
    - Yttrium, Beryllium, Carbon
- **What is the principle behind the Sol-gel method? [ 1 Mark ]**
    - Gas-solid reaction
    - Liquid- Liquid reaction
    - **Solid-liquid reaction**
    - Liquid-gas reaction
- **The synthesis of Lithium Niobate (LiNbO<sub>3</sub>) using the Sol-gel method involves which type of material? [ 1 Mark ]**
    - **Metal oxides**
    - Organic polymers
    - Ceramic nanoparticles
    - Metallic alloys
- **Pulsed Laser Deposition (PLD) is a technique used for: [ 1 Mark ]**
    - Vacuum evaporation
    - Sputtering
    - Spin coating
    - **Laser-assisted film growth**
- **.Which method is NOT a thin film synthesis technique? [ 1 Mark ]**
    - Zone Melting
    - Vacuum Evaporation
    - Sputtering
    - **Co-precipitation**
- **What is the Czochralski method primarily used for? [ 1 Mark ]**
    - Thin film growth
    - **Crystal growth**
    - Zone melting
    - Co-precipitation
- **Which method involves the growth of crystals from a molten flux? [ 1 Mark ]**
    - Czochralski Method
    - Bridgman Method
    - Stockbarger Method
    - **Verneuil Method**

- **What is the fundamental principle of X-ray diffraction? [ 1 Mark ]**
  - Interference of light waves
  - **Interference of X-rays**
  - Absorption of X-rays
  - Reflection of light
  
- **What is used as a crystal's "fingerprint" in X-ray diffraction? [ 1 Mark ]**
  - Crystal color
  - **Powder pattern**
  - Crystal size
  - Crystal weight
  
- **Scanning Electron Microscopy (SEM) is primarily used for: [ 1 Mark ]**
  - **Imaging surfaces**
  - Imaging internal structures
  - Measuring resistance
  - Analyzing crystal structures
  
- **Which microscopy technique provides information about topography and profilometry? [ 1 Mark ]**
  - Transmission Electron Microscopy (TEM)
  - Scanning Tunneling Microscopy (STM)
  - Scanning Electron Microscopy (SEM)
  - **Atomic Force Microscopy (AFM)**
  
- **What is the Van der Pauw method used for in resistivity measurements? [ 1 Mark ]**
  - **Measurement of arbitrary shape samples**
  - Measurement of thin films
  - Measurement of crystal sizes
  - Measurement of surface area
  
- **In the four-point probe method, what does the correction factor account for? [ 1 Mark ]**
  - Sample temperature
  - **Probe spacing**
  - Carrier injection
  - Surface preparation
  
- **What is Ferro-electricity related to in dielectric materials? [ 1 Mark ]**
  - Magnetic properties
  - **Electric polarization**
  - Thermal conductivity
  - Mechanical strength
  
- **What is a characteristic of the Cole-Cole plot in dielectric behavior analysis? [ 1 Mark ]**
  - Crystal size distribution
  - **Frequency dependence**
  - Magnetic susceptibility
  - Temperature variation
  
- **What does Beer-Lambert's law describe in UV-Vis spectroscopy? [ 1 Mark ]**
  - **Light absorption by materials**
  - Heat generation in materials
  - Electrical conductivity of materials
  - Magnetic susceptibility of materials
  
- **Which type of electrons contributes to charge transfer absorption in UV-Vis spectroscopy? [ 1 Mark ]**
  - $\pi$  electrons
  - $\sigma$  electrons
  - **$\eta$  electrons**
  - Free electrons

- **What does FT-IR stand for? [ 1 Mark ]**
  - Fast Transmission Infrared
  - **Fourier Transform Infrared**
  - Frequency-Tunable Infrared
  - Field Termination Infrared
  
- **In FT-IR spectroscopy, what is analyzed using the Fourier Transform technique? [ 1 Mark ]**
  - Mass spectrum
  - **Absorption spectrum**
  - Refraction spectrum
  - Emission spectrum
  
- **What is the basic principle of a Vibrating Sample Magnetometer (VSM)? [ 1 Mark ]**
  - **Measurement of magnetic susceptibility**
  - Measurement of thermal conductivity
  - Measurement of electrical resistivity
  - Measurement of mass spectrum
  
- **Which type of magnetometer is based on the Superconducting Quantum Interference Device (SQUID)? [ 1 Mark ]**
  - Vibrating Sample Magnetometer (VSM)
  - **SQUID Magnetometer**
  - FT-IR Magnetometer
  - Electron Spin Resonance Magnetometer
  
- **What does Thermogravimetry measure? [ 1 Mark ]**
  - **Mass changes with temperature**
  - Electrical resistivity with temperature
  - Magnetic susceptibility with temperature
  - Absorption spectrum with temperature
  
- **What is Differential Scanning Calorimetry primarily used for? [ 1 Mark ]**
  - Measuring mass changes
  - **Measuring heat changes**
  - Measuring magnetic susceptibility
  - Measuring electrical conductivity
  
- **Which detector type is commonly used in X-ray diffraction? [ 1 Mark ]**
  - Gas-filled detector
  - Scintillation detector
  - **Semiconductor detector**
  - Photoelectric detector
  
- **In X-ray fluorescence methods, what does XFS stand for? [ 1 Mark ]**
  - **X-ray Fluorescence Spectrometry**
  - X-ray Fluorescence Synthesis
  - X-ray Flux Spectrometer
  - X-ray Flux Synthesis
  
- **What is the principle of mass spectrometry? [ 1 Mark ]**
  - Measurement of mass changes with temperature
  - Measurement of magnetic susceptibility
  - **Measurement of mass spectrum**
  - Measurement of electrical resistivity
  
- **In mass spectrometry, what does the Mass Spectrum represent? [ 1 Mark ]**
  - Absorption spectrum
  - Mass changes with time
  - Mass changes with temperature

- **Ion abundance at different mass-to-charge ratios**
- What is the primary purpose of correlating IR spectra with molecular structure? [ 1 Mark ]
  - Determining crystal structure
  - Identifying elements in a sample
  - Measuring mass spectrum
  - **Identifying functional groups in molecules**
- What is the typical range of infrared radiation used in IR spectroscopy? [ 1 Mark ]
  - Ultraviolet
  - Visible
  - **Infrared**
  - X-ray
- What does a neutron diffractometer primarily measure? [ 1 Mark ]
  - Mass spectrum
  - X-ray spectrum
  - Zman spectrum
  - **Diffraction pattern of neutrons**
- Which element is commonly used in  $^{57}\text{Fe}$  Mossbauer spectroscopy? [ 1 Mark ]
  - **Iron (Fe)**
  - Nickel (Ni)
  - Cobalt (Co)
  - Copper (Cu)
- In X-ray technique, what is the purpose of using a collimator? [ 1 Mark ]
  - To generate X-rays
  - **To focus X-rays on the detector**
  - To absorb X-rays
  - To measure -Beta ray intensity

## Section: Section-B

- What computational technique is commonly used for the root of functions? [ 1 Mark ]
  - **Bisection method**
  - Interpolation
  - Extrapolation
  - Simpson's rule
- What does Noether's theorem relate to in classical mechanics? [ 1 Mark ]
  - Poisson brackets
  - Stability analysis
  - **Symmetry and invariance**
  - Hamilton-Jacobi theory
- Which of the following is related to the Lorentz invariance of Maxwell's equations? [ 1 Mark ]
  - Dispersion relations in plasma
  - **Radiation from moving charges**
  - Retarded potentials
  - Maxwell's boundary conditions
- What is the purpose of the WKB approximation in quantum mechanics? [ 1 Mark ]
  - Describing fine structure
  - **Tunneling through a barrier**
  - Spin-orbit coupling
  - Relativistic quantum mechanics
- Which model is used to describe Bose-Einstein condensation? [ 1 Mark ]

- **Ising model**
  - Fermi-Dirac model
  - Blackbody radiation model
  - Diamagnetic model
- **What is the primary function of impedance matching in electronic circuits? [ 1 Mark ]**
  - Amplification
  - Filtering
  - Noise reduction
  - **Maximizing power transfer**
- **What is described by the Frank-Condon principle? [ 1 Mark ]**
  - Electron spin resonance
  - Rotational transitions
  - **Vibrational transitions**
  - Hyperfine structure
- **What property of solids is related to the concept of Bravais lattices? [ 1 Mark ]**
  - Elastic properties
  - Bonding
  - Lattice specific heat
  - **Reciprocal lattice**
- **What is the evidence of shell structure in nuclei? [ 1 Mark ]**
  - Binding energy
  - **Spin and parity**
  - Fission and fusion
  - Alpha decay
- **Which method is used for the solution of first-order differential equations? [ 1 Mark ]**
  - Finite difference method
  - Integration by trapezoid rule
  - **Runge-Kutta method**
  - Interpolation
- **What does stability analysis in dynamical systems involve? [ 1 Mark ]**
  - Conservation laws
  - Perturbation theory
  - **Study of equilibrium points**
  - Poisson brackets
- **What does the term "retarded potentials" refer to in electromagnetic theory? [ 1 Mark ]**
  - **Delayed reactions of charges**
  - Maxwell's equations in free space
  - Dispersion relations in plasma
  - Lorentz invariance
- **What is the primary focus of the Born approximation in quantum mechanics? [ 1 Mark ]**
  - Spin-orbit coupling
  - **Phase shifts in scattering**
  - WKB approximation
  - Fine structure
- **What phenomenon is associated with the diffusion equation? [ 1 Mark ]**
  - Bose-Einstein condensation
  - **Random walk**
  - Brownian motion
  - First-order phase transitions
- **What is the main purpose of Fourier transforms in experimental methods? [ 1 Mark ]**

- Linear and nonlinear curve fitting
  - Filtering and noise reduction
  - Modulation techniques
  - **Signal analysis in frequency domain**
- **What does Zeeman effect describe in atomic physics? [ 1 Mark ]**
    - Electron spin resonance
    - **Splitting of spectral lines in a magnetic field**
    - Rotational transitions
    - Vibrational spectra
- **What property of materials is described by the Drude model? [ 1 Mark ]**
    - Superconductivity
    - Elastic properties
    - **Electrical and thermal conductivity**
    - Hall effect
- **What is the primary focus of the liquid drop model in nuclear physics? [ 1 Mark ]**
    - Shell structure
    - Alpha decay
    - **Binding energy**
    - Fission and fusion
- **What technique involves estimating the value of a function outside the range of known values? [ 1 Mark ]**
    - Interpolation
    - **Extrapolation**
    - Integration by trapezoid rule
    - Runge-Kutta method
- **What is the role of canonical transformations in classical mechanics? [ 1 Mark ]**
    - Poisson brackets
    - Stability analysis
    - Conservation laws
    - **Changing the form of Hamilton's equations**
- **What is the primary focus of dispersion relations in plasma? [ 1 Mark ]**
    - Radiation from moving charges
    - Lorentz invariance
    - **Electron motion in electromagnetic fields**
    - Reflection and refraction in dielectrics
- **What does the Dirac equation describe in relativistic quantum mechanics? [ 1 Mark ]**
    - Fine structure
    - WKB approximation
    - Spin-orbit coupling
    - **Motion in a central potential**
- **What is the primary purpose of a diode in an electronic circuit? [ 1 Mark ]**
    - Voltage amplification
    - Current regulation
    - Signal modulation
    - **Rectification**
- **What does the dot product of two perpendicular vectors represent geometrically? [ 1 Mark ]**
    - Magnitude of one vector
    - Angle between the vectors
    - Scalar projection of one vector onto the other
    - **Area of the parallelogram formed by the vectors**



- Which vector operation is involved in finding the area of a parallelogram formed by two vectors? [ 1 Mark ]
  - **Cross product**
  - Dot product
  - Scalar multiplication
  - Vector addition
- What is the determinant of an identity matrix? [ 1 Mark ]
  - 0
  - **1**
  - -1
  - Undefined
- According to Newton's laws of motion, what is the relationship between an object's mass (m), acceleration (A), and the force applied (F)? [ 1 Mark ]
  - **F=ma**
  - C=F/m
  - m=F/a
  - F=C/m
- In the context of special relativity, what does the Lorentz transformation describe? [ 1 Mark ]
  - **Transformation of velocities**
  - Transformation of energy
  - Transformation of forces
  - Transformation of mass
- What is the term for a type of motion where a system repeats its motion over regular intervals, such as a swinging pendulum? [ 1 Mark ]
  - Chaotic motion
  - **Periodic motion**
  - Random motion
  - Oscillatory motion
- What does the Hamiltonian represent in Hamiltonian mechanics? [ 1 Mark ]
  - **Total energy of the system**
  - Kinetic energy of the system
  - Potential energy of the system
  - Angular momentum of the system
- What does Gauss's law for electrostatics state? [ 1 Mark ]
  - Magnetic field lines start and end at magnetic poles.
  - **The total electric flux through a closed surface is proportional to the charge enclosed.**
  - Electric potential is constant in a conductor.
  - The force between two charges is inversely proportional to the square of the distance between them.
- Which law describes the magnetic field produced by a current-carrying wire? [ 1 Mark ]
  - Faraday's law
  - **Biot-Savart law**
  - Ampere's law
  - Ohm's law
- What is the basis for the concept of electromagnetic induction? [ 1 Mark ]
  - Motion of charged particles
  - **Change in magnetic field**
  - Electric potential difference
  - Ampere's theorem
- According to Fresnel's law, what happens when light passes from one medium to another? [ 1 Mark ]

- It changes color.
  - **It reflects and refracts.**
  - It slows down.
  - It becomes polarized.
- **In the context of electromagnetism, what is polarization? [ 1 Mark ]**
    - A charged particle in an electric field
    - Alignment of electric and magnetic fields
    - The separation of charges in a dielectric
    - **Orientation of electric field vectors in a transverse wave**
- **What does the term "dielectric" refer to in electromagnetic theory? [ 1 Mark ]**
    - A strong magnetic material
    - A material that conducts electricity
    - A material with magnetic properties
    - **An insulating material with no net charge**
- **What is a common phenomenon associated with tunneling through a barrier in quantum mechanics? [ 1 Mark ]**
    - Acceleration of particles
    - Reflection of particles
    - **Violation of classical barriers**
    - Suppression of wave-particle duality
- **What does time-independent perturbation theory in quantum mechanics aim to solve? [ 1 Mark ]**
    - Evolution of wave functions with time
    - Variations in particle mass
    - **Corrections to energy levels caused by external influences**
    - Interactions between identical particles
- **In precision and accuracy, what does the term "least squares fitting" refer to? [ 1 Mark ]**
    - **Minimizing the sum of the squared differences between observed and calculated values**
    - Selecting the smallest measurement unit
    - Maximizing the accuracy of measurements
    - Eliminating errors in experimental data
- **In quantum mechanics, what does Fermi's golden rule describe? [ 1 Mark ]**
    - **Probability of a transition between energy levels**
    - Time-independent perturbation effects
    - Spin quantization of particles
    - Eigenvalues of a wave function
- **What law does Planck's distribution law describe in blackbody radiation? [ 1 Mark ]**
    - Zeroth law of thermodynamics
    - First law of thermodynamics
    - **Second law of thermodynamics**
    - Third law of thermodynamics
- **What type of particles follow Bose-Einstein statistics? [ 1 Mark ]**
    - Fermions
    - **Bosons**
    - Quarks
    - Leptons
- **What is the primary function of a diode in an electronic circuit? [ 1 Mark ]**
    - Voltage amplification
    - Current regulation
    - Signal modulation
    - **Rectification**

- **In a semiconductor junction diode, what happens when it is forward-biased? [ 1 Mark ]**
  - High resistance
  - **Low resistance**
  - No current flow
  - Current flow only in reverse direction
  
- **What is the purpose of a transistor in electronic circuits? [ 1 Mark ]**
  - To store charge
  - **To amplify or switch electronic signals**
  - To generate electromagnetic waves
  - To control mechanical motion
  
- **What is a common application of opto-electronic devices such as LEDs (Light Emitting Diodes)? [ 1 Mark ]**
  - Voltage regulation
  - Signal modulation
  - **Light emission**
  - Current amplification
  
- **What is the role of operational amplifiers (op-amps) in electronic circuits? [ 1 Mark ]**
  - Voltage regulation
  - Current amplification
  - Signal modulation
  - **Amplification and signal processing**
  
- **Which type of device is commonly used for analog-to-digital conversion in electronic systems? [ 1 Mark ]**
  - Operational amplifier
  - Transistor
  - Digital-to-analog converter
  - **Analog-to-digital converter**
  
- **What is the primary function of a field-effect transistor (FET)? [ 1 Mark ]**
  - Voltage regulation
  - Current amplification
  - Signal modulation
  - **Switching electronic signals**
  
- **What is the primary advantage of using hetero-junction devices in semiconductor technology? [ 1 Mark ]**
  - Lower manufacturing cost
  - **Higher efficiency and performance**
  - Greater mechanical strength
  - Enhanced thermal conductivity.