VINAYAKA MISSION'S RESEARCH FOUNDATION, SALEM

(Deemed to be University under section 3 of the UGC Act 1956)

Ph.D Entrance Test – November – 2025

Faculty of Arts & Sciences / Physics

Instructions / Note:

1. Answer all the questions. Each question carries one mark.
2. No negative marks for wrong answers.
3. Read each question carefully and answer in the OMR sheet provided for each question with only blue/ black pen to fill the circles in the OMR Sheet.
4. Question number 1 - 35 questions belong to Research Methodology component and Question number 36-70 questions belong to the subject at PG level
5. Return the question paper along with the OMR sheet.

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36. A tensor is _____
    A. Scalar quantity
    B. A geometric object that generalizes scalars, vectors, and matrices
    C. A type of vector only
    D. A complex function

37. Which of the following is a special function commonly used in mathematical physics?
    A. Exponential function only
    B. Bessel functions
    C. Linear functions only
    D. Constant functions

38. Fourier series is used to _____
    A. Represent periodic functions as a sum of sines and cosines
    B. Solve differential equations only
    C. Perform matrix operations
    D. Calculate tensor components

39. Fourier transform converts a function from _____
    A. Time domain to frequency domain
    B. Vector to scalar
    C. Real to imaginary numbers
    D. Scalar to matrix

40. The Lagrangian of a system is defined as _____
    A. Kinetic energy minus potential energy
    B. Potential energy minus kinetic energy
    C. Total energy of the system
    D. The Hamiltonian function

41. Hamiltonian formulation of mechanics is based on _____
    A. Lagrangian only
    B. Generalized coordinates and momenta
    C. Newton's laws only
    D. Vector calculus only

42. Canonical transformations are _____
    A. Transformations that preserve the form of Hamilton's equations
    B. Arbitrary coordinate changes
    C. Only time-dependent transformations
    D. Transformations changing the energy of the system

43. Poisson brackets are used to _____
    A. Calculate numerical integrals
    B. Describe the time evolution of dynamical variables in Hamiltonian mechanics
    C. Define potential energy
    D. Solve quantum mechanical equations

44. The hydrogen atom problem is solved using the Schrödinger equation in _____
    A. Cartesian coordinates
    B. Spherical coordinates
    C. Polar coordinates only
    D. Cylindrical coordinates

45. Angular momentum in quantum mechanics is characterized by _____
    A. Continuous values only
    B. Quantized values and operators that do not commute
    C. Classical vectors only
    D. Fixed magnitude for all particles

46. Spin is _____
    A. A classical rotation of particles
    B. An intrinsic quantum property of particles without classical analog
    C. Always zero for electrons
    D. Not related to magnetic moments

47. Pauli matrices are used to represent _____
    A. Orbital angular momentum
    B. Spin operators for spin-1/2 particles
    C. Position operators
    D. Energy eigenvalues

48. Maxwell's equations describe _____
    A. The motion of planets
    B. The behavior of electric and magnetic fields and their interactions
    C. Quantum states of particles
    D. Thermodynamic processes

49. Which of the following is NOT one of Maxwell's equations?
    A. Gauss's law for electricity
    B. Gauss's law for magnetism
    C. Newton's second law
    D. Faraday's law of induction

50. Electromagnetic waves in free space travel at a speed of _____
    A. The speed of sound
    B. The speed of light
    C. Zero
    D. Variable depending on the medium

51. In a dielectric medium, electromagnetic waves _____
    A. Travel faster than in vacuum
    B. Are absorbed completely
    C. Travel slower than in vacuum and may be attenuated
    D. Are unaffected by the medium

52. Relativistic electrodynamics incorporates _____
    A. Classical mechanics only
    B. Effects of special relativity on electric and magnetic fields
    C. Thermodynamics
    D. Quantum mechanics exclusively

53. The microcanonical ensemble describes _____
    A. Systems with fixed energy, volume, and number of particles
    B. Systems in thermal equilibrium with a heat bath
    C. Systems with varying particle number
    D. Non-equilibrium systems

54. The canonical ensemble is characterized by _____
    A. Fixed energy
    B. Fixed temperature, volume, and number of particles
    C. Variable particle number
    D. No energy exchange

55. Bose–Einstein statistics describe _____
    A. Particles that obey Pauli exclusion principle
    B. Particles that can occupy the same quantum state (bosons)
    C. Classical particles only
    D. Fermions with half-integer spin

56. A phase transition is _____
    A. A gradual change in temperature
    B. A transformation between different states of matter with abrupt changes in properties
    C. Continuous increase in pressure only
    D. A chemical reaction

57. Magnetism in solids arises mainly due to _____
    A. Atomic nuclei only
    B. Electron spin and orbital motion
    C. Phonons
    D. Crystal lattice vibrations

58. Superconductivity is defined as _____
    A. Zero electrical resistance and expulsion of magnetic fields below a critical temperature
    B. High electrical resistance
    C. Magnetism at room temperature
    D. Thermal expansion

59. Nanomaterials are characterized by _____
    A. Bulk properties only
    B. Unique properties due to their nanoscale size and high surface area
    C. Only magnetic properties
    D. No practical applications

60. X-ray diffraction patterns are explained by _____
    A. Newton's laws
    B. Bragg's law
    C. Ohm's law
    D. Maxwell's equations

61. The liquid drop model of the nucleus treats the nucleus as _____
    A. A collection of independent particles
    B. A charged liquid drop with collective properties
    C. A rigid solid
    D. A gas of free particles

62. The shell model of the nucleus explains _____
    A. Collective vibrations of the nucleus
    B. Magic numbers and nuclear energy levels based on nucleons in shells
    C. Nuclear reactions only
    D. Radioactive decay rates

63. Alpha decay involves the emission of _____
    A. An electron
    B. A helium nucleus (2 protons and 2 neutrons)
    C. A neutrino
    D. A photon

64. Beta decay changes _____
    A. The number of protons only
    B. A neutron into a proton or vice versa inside the nucleus
    C. The nucleus into an alpha particle
    D. The atomic mass only

65. Particle accelerators are used to _____
    A. Slow down particles
    B. Accelerate particles to high speeds for collision experiments
    C. Measure atomic mass
    D. Detect gravitational waves

66. A diode primarily allows current to flow _____
    A. In both directions equally
    B. In one direction only
    C. Only when voltage is zero
    D. Without any resistance

67. A transistor can be used as _____
    A. A resistor only
    B. An amplifier and a switch
    C. A capacitor
    D. A diode replacement only

68. An operational amplifier (op-amp) is primarily used for _____
    A. Performing mathematical operations like amplification, addition, and integration
    B. Power supply
    C. Digital logic
    D. Data storage

69. Logic gates perform _____
    A. Analog signal processing
    B. Digital Boolean operations like AND, OR, NOT
    C. Voltage regulation
    D. Frequency modulation

70. Microprocessors are _____
    A. Complete computers on a single chip including memory and I/O devices
    B. Central processing units used to process instructions
    C. Only memory devices
    D. Devices for analog signal processing