Detailed Syllabus for the post of LECTURER IN PHYSICS (Kerala General Education (DIET)) - Direct Recruitment, LECTURER IN PHYSICS (BY-TRANSFER) (Kerala General Education (DIET)) - By Transfer Recruitment and LECTURER IN PHYSICS (Kerala General Education (DIET)) - Direct Recruitment SR for : SC/ST

(Cat.Nos: 388/2022, 389/2022, 396/2022)

PART I - General Subject (50 Marks)

Module 1 : Community Engagement – Resources & Practices

Total: 10 Marks

Unit 1: Community Resources

Resources that enhance or facilitate the lives of people in a community - examples of community resources are factories, educational institutions, cinema halls, libraries, religious places, hospitals, community centers, parks, etc - make use of these resources in education as it develops a sense of value and belonging among students.

Unit 2: Community Engagement

Community Engagement in Education - and symbiotic relationship that exists between communities and Education Institutions - sustainable networks, partnerships, communication media, and activities - Linking formal learning and the local community

Unit 3: Forms of community engagement

Community-student engagement -Researching with the community, sharing knowledge with the community, Designing new curriculum and courses, Involving local practitioners as trainers, Social Innovation by students and the like

Unit 4: Practices for Community engagement

Engagement practices and activities - formal or informal - include building relationships through collaboration initiatives, community campaigns, Community Survey, Community services, Excursions, cooperatives, small businesses, consultation meetings &

conferences, sports events, cultural events, community development and community research projects.

Unit 5: Rural Community Development

Social, economic, political and cultural framework of the rural society - Rural Resilience - Rural Institutions Close to Community, Participatory Learning - Approaches and Methods, Community Project Proposals and Project Management, Community living camps, Engagement with - School, Street Committee, Health Centre, Panchayat, SHGs - Programmes

Module II : Syllabus for General Subject - ICT in Education

Total: 10 Marks

Unit 1: Potentials of ICT in Education

ICT as a means to connect with the world – Pedagogy and ICT – Potentials and Advantages of Approaches to ICT

Unit 2: ICT integration in Curriculum transaction

Computer based Curricular planning- ICT Based Model of Curriculum Transaction - Considerations for integrating ICT – Innovations in Curriculum Transaction

Unit 3: ICT and Internet Resources for Teaching and Learning

Resources – Access and Creation, resource mobilization – Web-based learning, Social Networking –Virtual learning Environment - Designing e-initiatives

Unit 4: ICT in Classrooms

Creating Personal learning environments - ICT integrated Inclusive education - Assistive and Adaptive technologies

Unit 5: ICT for Assessment and Evaluation

Purposes and Techniques of Evaluation, Scope of ICT for evaluation- Innovative Practices in Assessment & Evaluation

Module 3 : PERSPECTIVES OF EDUCATION (10 Marks)

PHILOSOPHICAL PSYCHOLOGICAL AND SOCIOLOGICAL PERSPECTIVES OF EDUCATION

Philosophical perspectives of Education

Role of education in philosophizing the issues of life –Metaphysics, Epistemology, Logic, Phenomenology, Aesthetics and Axiology. Critical appraisal of schools of philosophy in the context of Twenty First Century – aims, content, methods and ongoing changes.

Focus of education in the 21st century. Building perspectives on educational philosophies, Modern schools of Philosophy-Empiricism, Positivism, Relativism.- Post -structuralist views and eclectic views. Comparative study of philosophies and educational contributions of Indian and western thinkers

Psychological perspectives of education

Learning and development- Learner Characteristics and Learning styles with special reference to pre- primary, primary, secondary, higher secondary and adult learners Learning in twenty first century classrooms., Characteristics And types, Development – language development, emotional, moral, motor and identity development. Cognitive Functions- Thinking, Reasoning, Problem Solving and Meta-cognition, Personality- types characteristics and development

Intelligence-different types~ Multiple, Cultural, social and emotional, impact on learners. Mental Health-, Factors affecting Mental Health (parents, family environment, society, school practices) - Strategies for enhancing Mental health

Sociological perspectives of education

Education for social security, wellness and progress, sustenance and transformation in society. Determinants of social change in the context of globalization.-Constraints on social change in India with respect to caste, ethnicity, class, language, religion, gender, regionalism, political interest

Education and Secularism - Role of teacher in inculcating democracy and international values.- Pluralism – Role of education in creating unity in diversity- Nationalism and education.-Role of Education in addressing cultural lag, privatization, globalization and partnership in social progress – Current trends in social development and transformation of values in society.

Module 4 : Teaching aptitude (10 Marks)

Teaching aptitude.

1. Teaching -characteristics, levels, phases and maxims
2. teaching methods, techniques and strategies
3. modern trends in professional development and ethics
4. technology integration in education
5. Research, evaluation and innovations in classroom teaching, -

Module 5 : Research Aptitude (10 Marks)

- Research Meaning, Characteristics and Types
- Steps to Research
- Methods of Research
- Aims of Educational Research
- Research Ethics
- Research paper, Article, Workshop, Seminar, Conference and Symposium
- Thesis writings – its characteristics and Format

PART II

Module I

CLASSICAL MECHANICS **(6 marks)**

Lagrangian and Hamiltonian Formulation : Preliminary ideas about Constraints and Generalized coordinates, D'Alemberts principle and Lagrange's equation, Simple applications of Lagrangian formulation, Hamilton's Principle, Conservation theorems and symmetries.

Hamiltonian Formulations: Legendre Transformation and Hamilton's equations, Cyclic co-ordinates and conservation theorems, Principle of least action, Canonical transformations and examples, Infinitesimal canonical transformations.

Kinematics of Rigid Bodies : Independent co-ordinates, orthogonal transformation, Transformation matrix, Euler angles, Euler theorem, Infinitesimal rotation, Rate of change of a vector, Centrifugal and Coriolis forces, Inertia tensor, Euler's equation of motion, Torque-free motion of a rigid body.

Small Oscillations : Formulation of the problem, Eigenvalue equation, Eigenvectors and Eigenvalues, Orthogonality, Principal axis transformation, Frequencies of free vibrations, Normal coordinates, Free vibrations of a linear triatomic molecule, Forced vibration and Dissipative forces.

Module II

ELECTRODYNAMICS AND PLASMA PHYSICS (6 marks)

Electrostatics, Magnetostatics and Time varying fields: Coulomb's law, Gauss's law, Laplace and Poisson equations, Solutions, Boundary value problems, Green's identities and Green's function, uniqueness theorem, Method of images with simple examples, Multipole expansion, Ponderable media, Dielectrics. Biot-Savart law, Ampere's law, Boundary value problems, Ampere's theorem, Multipoles, Electromagnetic induction, Maxwell's equations.

Plane electromagnetic waves : Plane waves in nonconducting medium, Polarization, Reflection and Refraction, Dispersion in dielectrics, conductors and plasma, Superposition of waves.

Relativistic electrodynamics: Special theory of relativity, Lorentz transformations, Addition of velocities, 4-vectors, Covariance of electrodynamics, Transformations of electromagnetic fields.

Plasma Physics : Plasma -Definition, concepts of plasma parameter, Debye shielding, Motion of charged particles in an electromagnetic field -Uniform electric and magnetic fields, Distribution function.

Module III

ELECTRONICS (6 Marks)

Transistor Amplifiers BJT: Biasing and ac models, Voltage amplifiers, Power amplifiers, Emitter follower FET: h-parameters, FET small signal model, Biasing FET, Analysis of common source and common drain amplifiers at low and high frequencies, FET ,MOSFET

Circuit symbol and equations, small signal model, CMOS and Digital MOSFET gates.

Microwave and Photonic Devices: Tunnel diode, Transferred electron devices. Photo-detectors, Photoconductor and photodiode, p-n junction solar cells - short circuit current.

Operational Amplifier: Dual input differential amplifier DC and AC analysis , Op-Amp block diagram representation, analysis of a typical Op-Amp equivalent circuit, ideal Op-Amp characteristics, equivalent circuit, open loop configurations.

Module IV

QUANTUM MECHANICS (7 marks)

Origin, Hilbert Space; Dimension and Basis of a Vector Space; Square-Integrable Functions; Wave Functions; Dirac's Bra and Ket notation; Schwarz Inequality. Operators- Adjoint of an Operator; Hermitian Operators; Unitary Operators; Commutator Algebra; Commutator of Operators and Uncertainty Relation.

Functions of Operators; Eigenvalues and Eigenvectors of an Operator. Representation in Discrete Bases- Matrix Representation of Bras, Kets and Operators; Change of Bases and Unitary Transformations; Matrix Representation of the Eigenvalue Problem. Representation in Continuous Bases- Position and Momentum Representations and relation between them.

Postulates of Quantum Mechanics and Exactly Solvable Problems in one Dimension. The State of a System; Probability Density; The Superposition Principle, Observables and Operators.

The Hydrogen Atom; Effect of Magnetic Fields on Central Potentials. Space-time symmetries- Space translation and conservation of linear momentum; Time translation and conservation of energy; Space rotation and conservation of angular momentum; Space inversion and time reversal. Identical particles; Pauli exclusion principle; Bosons and Fermions; Spin wave functions for two electrons.

Module V

MATHEMATICAL PHYSICS (6 Marks)

Functions of Complex Variables : Introduction, Analyticity, Cauchy-Reimann conditions, Cauchy's integral theorem and integral formula, Laurent expansion, Singularities, Calculus of residues and applications .

Group Theory : Groups, Multiplication Table, Conjugate elements and classes, Subgroups, Direct product groups, Isomorphism and homomorphism, Permutation groups, Distinct groups of given order, Exercises.

Group Representation Theory : Unitary representations, Schur's lemmas, orthogonality theorem and interpretations, Character of a representation, Character Tables and examples, Irreducible representations of Abelian and non-Abelian groups, Connection with quantum numbers, Symmetry group of the Schrodinger equation, Symmetry and degeneracy, Basis functions of irreducible representations, Qualitative ideas of Lie groups.

Calculus of Variations : One dependent and one independent variable, Applications of the Euler equation, Generalization to several independent variables, Several dependent and independent variables, Lagrange Multipliers, Variation subject to constraints, Rayleigh-Ritz variational technique.

Module VI

NUCLEAR AND PARTICLE PHYSICS (7 marks)

Nuclear Forces: Properties of the nucleus, size, binding energy, angular momentum , The deuteron and two-nucleon scattering experimental data, Simple theory of the deuteron structure, Low energy n-p scattering, characteristics of nuclear forces, Spin dependence, Tensor force, Scattering cross sections, Partial waves, Phase shift, Singlet and triplet potentials, Effective range theory, p-p scattering

Nuclear Decay: Basics of alpha decay and theory of alpha emission, Beta decay, Energetics of beta decay, Fermi theory of beta decay, Comparative half-life, Allowed and forbidden transitions, Selection rules, Parity violation in beta decay. Neutrino. Energetics of Gamma Decay, Multipole moments, Decay rate

Nuclear Models, Fission and Fusion: Shell model potential, Spin-orbit potential, Magnetic dipole moments, Electric quadruple moments, Valence Nucleons, Collective structure, Nuclear vibrations, Nuclear rotations, Liquid drop Model, Semiempirical Mass formula, Energetics of Fission process, Controlled Fission reactions. Fusion process, Characteristics of fusion, solar fusion, Controlled fusion reactors.

Conservation of energy and masses, Electric charges, Conservation of angular momentum, Baryon and lepton numbers, Conservation of strangeness, Conservation of isospin and its components, Conservation of parity, Charge conjugation, CP violation, time reversal and CPT theorem

Module VII

SOLID STATE PHYSICS (6 Marks)

Crystal Structure, binding and nanostructures: Symmetry elements of a crystal, Types of space lattices, Miller indices, Diamond structure, NaCl structure, BCC, FCC, HCP structures with examples, Description of X-Ray diffraction using reciprocal lattice, Brillouin zones, Van der Waals interaction, Cohesive energy of inert gas crystals, Madelung interaction, Cohesive energy of ionic crystals, Covalent bonding, Metallic bonding, Hydrogen-bonded crystals.

Nanomaterials: Definition, Synthesis and properties of nanostructured materials

Lattice Vibrations: Vibrations of monatomic and diatomic lattices, Quantization of lattice vibrations, Inelastic scattering of neutrons, Einstein and Debye models of specific heat, Thermal conductivity

Piezoelectricity, Applications of Piezoelectric Crystals ; Diamagnetism and Paramagnetism: Langevin's diamagnetism equation, Quantum theory of diamagnetism of mononuclear systems, Quantum theory of paramagnetism, Hund's rule, Paramagnetic susceptibility of conduction electrons.

Module VIII

SPECTROSCOPY (6 Marks)

Microwave Spectroscopy : Introduction, The Spectrum of a non rigid rotator, Example of HF, Spectrum of a symmetric top molecule, Examples, Instrumentation for Microwave Spectroscopy-Information derived from rotational spectra.
Infrared Spectroscopy : Vibrational energy of an anharmonic oscillator – diatomic molecule (Morse Curve), IR spectra - Spectral Transitions and Selection Rules.

Raman Spectroscopy : Introduction, Rotational Raman Spectrum of diatomic and poly atomic molecules- linear and Symmetric top molecules, Vibrational Raman Spectrum of a Symmetric top molecule, Combined use of Raman and Infrared Spectroscopy in structure determination, Non linear Raman effects, Hyper Raman Effect, Stimulated Raman effect and inverse Raman effect.

Spin Resonance Spectroscopy : Interaction between nuclear spin and magnetic field, Level population, Larmour Precession, Resonance condition, Bloch equations, Relaxation times, Spin-Spin and spin-lattice relaxation, The Chemical shift, Instrumentation for NMR spectroscopy, CWNMR and FTNMR, Imaging, Electron Spin Spectroscopy of the unpaired electron, Total Hamiltonian, Mossbauer Spectroscopy : Resonance Fluorescence of gamma - rays, Recoilless emission of gamma rays and Mossbauer Effect.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.

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