

**FURTHER DETAILS REGARDING MAIN TOPICS OF
PROGRAMME NO. 01B/2015 (Item No. 3)**

LECTURER IN PHYSICS

(NCA Notification)

COLLEGIATE EDUCATION

(CATEGORY NO. 107/2013)

Module I: Mathematical Methods of Physics

Curvilinear coordinates, circular cylindrical and spherical polar coordinates

Vector algebra and Vector calculus,

Matrices – Cayley Hamilton Theorem, Eigen values and Eigen vectors.

Special Functions (Gamma, Beta, Hermite, Bessel, Laguerre, Legendre)

Complex Analysis – Analytic function, Taylor and Laurent expansions, poles, residue and evaluation of integrals.

Fourier Series, Fourier and Laplace transforms.

Tensors, Introductory group theory, representation of groups. Irreducible representation SU (2), SU(3).

Module II: Classical Mechanics

Newtons laws, Lagrangian and Hamiltonian formalism. Canonical Transformation and Poisson Bracket

Hamilton Jacobi Theory

Rigid body Dynamics -

Small oscillations

Special theory of relativity

Non linear Dynamics – logistic map – bifurcation – attractors – fractal, fractal dimension.

Module III: Quantum Mechanics

Wave particle duality, Fundamental postulates of Q.M., Schrodinger picture & Heisenberg picture

Eigen value problem (particle in a box, harmonic oscillator). Tunneling through a barrier. Heisenberg uncertainty principle. Algebra of linear vector space, Dirac notation, Angular Momentum algebra (spin, addition of angular momentum).

Time independent perturbation theory and applications :

Variational method.

Time dependent perturbation theory and Fermi Golden Rule.

Elementary theory of Scattering phase shifts, partial waves, Born approximation.

Relativistic Quantum Mechanics : Klein Gordon – Dirac equations.

Module IV: A) Electro Dynamics & Statistical Physics

Review of Electrostatics and Magnetostatics

(Gauss's law, Biot Savart Law, Amperes theorem)

Maxwell's equation in free space and linear isotropic media – boundary conditions on the fields at interfaces. Scalar and vector potentials.

(Retarded potential Lienard Wiehert potential, field of a moving point charge)

Electromagnetic waves in free space. Dielectrics and conductors. Reflection, refraction, polarisation
Transmission lines and Wave guides.

Statistical Physics

B) Laws of thermodynamics. Thermodynamic potentials

Phase space, micro and macrostates, Micro canonical, canonical and grand canonical ensembles and partition functions. Classical and quantum statistics, Ideal Bose and Fermi gases.

First and second order phase transitions. Diamagnetism, paramagnetism and ferromagnetism.

Module V: Spectroscopy and Condensed Matter Physics

A) Spectroscopy

Introduction to Atomic Spectroscopy :- LS coupling, - J J coupling, - Zeeman effect, - Stark effect, Lande - g factor

Electronic, rotational, vibrational and Raman Spectra of diatomic molecules, selection rules.

Spin Resonance Spectroscopy : NMR, ESR, Mossbauer Spectroscopy.

Laser : Spontaneous and stimulated emission, Einstein coefficients. Optical pumping, population inversions, rate equation. Modes of resonators and coherence length.

B) Condensed Matter Physics

Bravais lattice, Reciprocal lattice. Diffraction and the structure factor. Brillouin zone.

Vibrations of crystals with monoatomic and diatomic basis – Phonon heat capacity – Density of states in one and three dimensions – Einstein and Debye models

Free electron theory and electronic specific heat.

Hall Effect

Super conductivity Type I and Type II superconductors.

Josephson functions, BCS theory

Module VI: Nuclear and Particle Physics & Electronics

A) Nuclear Properties : size shape and charge distribution, spin and parity – Binding energy, semi empirical mass formula, liquid drop model, Nature of nuclear force. Elementary ideas of alpha, beta and gamma decay and their selection rules. Fission and fusion. Nuclear reactions. Reaction cross-section, Q value.

Elementary particles and their Quantum numbers.

Quark Model

A) Electronics :

Semi conductor devices (diodes, transistors, FET) Amplifiers, Oscillators.

Opto electronic devices (solar cells, photo detection, LED), Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators) A/D and D/A converters.

Module VII: Recent Developments in Physics

Nanotechnology

Properties of metal, semi conductor, rare gas and molecular nanoclusters – superconducting fullerene – quantum confined materials – quantum wells, wires, dots and rings – meta materials – graphene

Non Linear Dynamics

Soliton – Effect of nonlinearity and dispersion.

Non Conventional Energy Resources

Wind Energy, Solar Energy, Tidal energy, Bio.

Evolution of Universe

Big Bang Theory : Spontaneous symmetry breaking, Higgs Boson.

Basis of Quantum Computing

Module VIII Research Methodology/Teaching Aptitude

I. TEACHING APTITUDE

- Teaching: Nature, objectives, characteristics and basic requirements;
- Learner's characteristics;
- Factors affecting teaching;
- Methods of teaching;
- Teaching aids;
- Evaluation systems.

II. RESEARCH APTITUDE

- Research: Meaning, Characteristics and types;
- Steps of research;
- Methods of research;
- Research Ethics;
- Paper, article, workshop, seminar, conference and symposium;
- Thesis writing: its characteristics and format.

Module IX(a) Salient Features of Indian Constitution

Salient features of the Constitution - Preamble- Its significance and its place in the interpretation of the Constitution.

Fundamental Rights - Directive Principles of State Policy - Relation between Fundamental Rights and Directive Principles - Fundamental Duties.

Executive - Legislature - Judiciary - Both at Union and State Level. - Other Constitutional Authorities.

Centre-State Relations - Legislative - Administrative and Financial.

Services under the Union and the States.

Emergency Provisions.

Amendment Provisions of the Constitution.

Module IX (b) Social Welfare Legislations and Programmes

Social Service Legislations like Right to Information Act, Prevention of atrocities against Women & Children, Food Security Act, Environmental Acts etc. and Social Welfare Programmes like Employment Guarantee Programme, Organ and Blood Donation etc.

Module X (a) Renaissance in Kerala

TOWARDS A NEW SOCIETY

Introduction to English education - various missionary organisations and their functioning- founding of educational institutions, factories, printing press etc.

EFFORTS TO REFORM THE SOCIETY

(A) Socio-Religious reform Movements

SNDP Yogam, Nair Service Society, Yogakshema Sabha, Sadhu Jana Paripalana Sangham, Vaala Samudaya Parishkarani Sabha, Samathwa Samajam, Islam Dharma Paripalana Sangham, Prathyaksha Raksha Daiva Sabha, Sahodara Prasthanam etc.

(B) Struggles and Social Revolts

Upper cloth revolts. Channar agitation, Vaikom Sathyagraha, Guruvayoor Sathyagraha, Paliyam Sathyagraha. Kuttamkulam Sathyagraha, Temple Entry Proclamation, Temple Entry Act .Malyalee Memorial, Ezhava Memorial etc.

Malabar riots, Civil Disobedience Movement, Abstention movement etc.

ROLE OF PRESS IN RENAISSANCE

Malayalee, Swadeshabhimani, Vivekodayam, Mithavadi, Swaraj, Malayala Manorama, Bhashaposhini, Mathnubhoomi, Kerala Kaumudi, Samadarsi, Kesari, AI-Ameen, Prabhatham, Yukthivadi, etc

AWAKENING THROUGH LITERATURE

Novel, Drama, Poetry, *Purogamana Sahithya Prasthanam*, *Nataka Prashtanam*, Library movement etc

WOMEN AND SOCIAL CHANGE

Parvathi Nenmenimangalam, Arya Pallam, A V Kuttimalu Amma, Lalitha Prabhu. Akkamma Cherian, Anna Chandi, Lalithambika Antharjanam and others

LEADERS OF RENAISSANCE

Thycaud Ayya Vaikundar, Sree Narayana Guru, Ayyan Kali. Chattampi Swamikal, Brahmananda Sivayogi, Vagbhadananda, Poikayil Yohannan (Kumara Guru) Dr Palpu, Palakkunnath Abraham Malpan, Mampuram Thangal, Sahodaran Ayyappan, Pandit K P Karuppan, Pampadi John Joseph, Mannathu Padmanabhan, V T Bhattathirippad, Vakkom Abdul Khadar Maulavi, Makthi Thangal, Blessed Elias Kuriakose Chaavra, Barrister G P Pillai, TK Madhavan, Moorkoth Kumaran, C. Krishnan, K P Kesava Menon, Dr. Ayyathan Gopalan, C V Kunjuraman, Kuroor Neelakantan Namboothiripad, Velukkutty Arayan, K P Vellon, P K Chathan Master, K Kelappan, P. Krishna Pillai, A K Gopalan, T R Krishnaswami Iyer, C Kesavan. Swami Ananda Theerthan, M C Joseph, Kuttippuzha Krishnapillai and others

LITERARY FIGURES

Kodungallur Kunhikkuttan Thampuran, KeralaVarma Valiyakoyi Thampuran, Kandathil Varghese Mappila. Kumaran Asan, Vallathol Narayana Menon, Ulloor S Parameswara Iyer, G Sankara Kurup, Changampuzha Krishna Pillai, Chandu Menon, Vaikom Muhammad Basheer. Kesav Dev, Thakazhi Sivasankara Pillai, Ponkunnam Varky, S K Pottakkad and others

Module X (b) General Knowledge and Current Affairs

General Knowledge and Current Affairs

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.