



excel beyond expectancy

CARE Academy

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PG TRB - Physics Syllabus

Unit I MATHEMATICAL PHYSICS

Dimensional analysis:

Differential equation (ordinary and partial) – order of equation – Expressions for gradient, divergence, curl and Laplacian – vector algebra and vector calculus – Gauss divergence theorem – Green's theorem – Stokes' theorem. Matrix: Cayley – Hamilton theorem, inverse of matrix – Eigen values and Eigen vectors. Polynomials: Hermite, Bessel and Legendre Functions. Special function: Beta and Gamma functions. Probability: Elementary probability theory – Random variables – Binomial – Poisson and Normal distribution. Complex variables: Analytic functions – Singular points – Cauchy's integral theorem and formula -Taylor's and Laurent's expansions, poles, Calculus of residues and evaluation of integrals. Integral transforms: Fourier series and Fourier transform and their properties.

Unit II CLASSICAL MECHANICS

Mechanics of particles and systems of particles:

Constraints and Generalized coordinates, Law of conservation of Energy, Linear and Angular momentum, Conservative and Non-Conservative systems, Degrees of freedom, Holonomic – Nonholonomic – Scleronomic systems. Lagrangian Formalism: Lagrange equations of motion – D'Alembert's principle – Applications (Simple pendulum, Atwood's machine, Harmonic Oscillator, Electrical circuit). Hamiltonian Formalism: Hamilton's equation of motion – Cyclic co-ordinates – Hamilton's equation from variational principle, Principle of least action, Canonical transformation, Liouville's theorem. Rigid body Dynamics: Euler's angles – Moment of inertia tensor, Euler's equation of motion – Symmetrical top, Special theory of Relativity: Inertial and Non- inertial frames, Lorentz transformation, Lorentz inverse transformation, Length contraction, Time dilation, Mass invariance, Einstein's mass-energy relation.

Unit III ELECTROMAGNETIC THEORY

Electrostatics:

Coulomb's law – Gauss's law and its application. Laplace and Poisson's equations. Magnetostatics: Biot Savart's law – Ampere's law – Magnetic scalar and vector potentials – magnetic susceptibility – Equation of continuity – Displacement current – Maxwell's equations (free space and linear isotropic media) – Electromagnetic waves – Poynting's theorem – Dielectrics: Retarded potentials – Polarization – Radiation from a linear antenna – Transmission lines and Wave guides.

Unit IV QUANTUM MECHANICS

Failures of Classical mechanics – Black body radiation – Wave and particle duality – Postulates of Quantum mechanics – Wave function and properties – Expectation values – Heisenberg's uncertainty principle – Schrodinger equations (time – dependent and time- independent). Eigen value problems: Particle in a box (1D and 3D), Particle in a finite potential well & barrier, Tunnelling, Harmonic oscillator. Operators: Ladder operators, Angular momentum operator, Hydrogen atom, spin – Stern Gerlach experiment. Approximation methods: Variational principle, Time independent (1st and 2nd order) degenerate and non-degenerate perturbation theory – Time-Dependent perturbation theory – Fermi's golden rule, Identical particles. Relativistic Quantum Mechanism: Pauli's spin Matrices, Dirac and Klein Gordon equation. Commutators. Scattering theory: Scattering cross-section, Scattering by a central potential, Partial wave analysis, Breit-Wigner formula.

Unit V D. AND STATISTICAL MECHANICS

Laws of d. and their consequences – thermodynamic system (closed and open) – thermodynamic processes (isothermal, adiabatic, isochoric, isobaric, isotropic) – cyclic process – thermodynamic potentials (U, S, G, H) – relation between them. Specific heat – equation of state – intensive and extensive variables – The P-V

diagram – Carnot cycle and its efficiency – Entropy – reversible and irreversible – T-S diagram – Equipartition theorem. Phase space – micro and macrostates – Liouville's theorem – ensembles – partition function – classical (MB distribution) – Maxwell's distribution of velocities – Kinetic Theory of gases – Pressure exerted by gas – Mean free path – Mean – RMS and most probable speed – and quantum (BE & FD distribution) statistics – applications to black body radiation – Bose Einstein condensation.

Unit VI ATOMIC PHYSICS AND SPECTROSCOPY

Quantum states of an electron in an atom – Hydrogen atom spectrum – Electron spin – Spin orbit coupling – Fine structure – Relativistic correction – Spectroscopic terms and selection rules – Hyperfine structure – Exchange symmetry of wave functions – Pauli's exclusion principle – Hund's rule – Periodic table – Alkali type spectra – LS and JJ Coupling – Zeeman, Paschen – Back and Stark effects. Principles of ESR, NMR, Chemical shift – Frank Condon principle – Born Oppenheimer approximation – Electronic, rotational and vibrational spectra of diatomic molecules, Selection rules.

Unit VII SOLID STATE PHYSICS

Crystal Physics:

Lattice, Crystal structures – Bravais lattices – Miller indices – Reciprocal lattices – Lattice Dynamics: Monoatomic, diatomic lattices – Theories of specific heat – Einstein's and Debye's model for lattice specific heat. Classical free electron theory: Drude model – Thermal conductivity – Wiedemann Franz law. Energy bands in solids: Energy bands in metals, insulators and semiconductors, E-k diagram – Density of states – Brillouin zones – Wave equation of electron in a Periodic potential. Semiconductor Physics: Types of semiconductors – Mobility – Carrier concentration of charge carriers – Bloch's theorem – Kronig – Penney model. Dielectrics: Polarization Mechanism – Clausius – Mossotti Equation – Piezo, Pyro and Ferroelectricity. Magnetism: Dia, Para, Ferro, Anti-Ferro and Ferri magnetism. Superconductivity: Meissner effect – Type I and Type II superconductivity – BCS theory – Josephson effect.

Unit VIII NUCLEAR AND PARTICLE PHYSICS

Nuclear properties (size, shape, charge distribution, spin and parity) – Binding energy, Nuclear force – Liquid drop model – semi – empirical mass formula, Shell model and Collective model – Deuteron, Ground state of deuteron – excited state of deuteron – Meson theory of nuclear force – Yukawa potentials – Elementary ideas of alpha, beta and gamma decays – Radioactive decay – Fission, Fusion – Chain reaction – Nuclear reactor. Elementary particles: Classification of elementary particles, Fundamental interactions (EM, Strong, Weak, Gravitational) and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.) – Gell-Mann- Nishijima formula. Elementary particles – Classifications – Quark model, Baryons and Mesons, Parity non-conservation in weak interaction.

Unit IX ELECTRONICS Semiconducting devices:

Diodes – Junction diode – Rectification – Zener diode – Light Emitting Diode. Junction Transistors: common base, common emitter and common collector configurations – Static characteristics – Transistors as amplifier and oscillators – FET, JFET, MOSFET. IC: Fabrication technology, Monolithic IC Processing. 555 Timer, Phase shift, Wien bridge oscillators. Operational Amplifier (IC 741): Op-Amp characteristics, Inverting and Non-inverting Amplifiers, Adder, Subtractor, Differentiator and Integrator. Digital techniques and applications: Flip Flops, Registers – Counters. Digital integrated circuits: Logic gates, NAND and NOR – Universal building blocks – Half and Full adder. Communication Electronics: Modulation and Demodulation (AM, FM, Phase), Transmitter and Receiver, Satellite and Fiber optic communication.

Unit X EXPERIMENTAL PHYSICS

Units and dimension of physical quantities – significant figures. Data interpretation and analysis, precision and accuracy, error analysis, propagation of errors, Least square fitting. Measurement of fundamental constants – e , h , c – Detection of X-rays, gamma rays, Charged particles, neutrons. Ionization chamber – proportional counter – Measurement of e/m ratio – Measurement of Hall voltage, mobility and charge carrier concentration – measurement of resistance and capacitance in series and parallel.

Unit I Perspectives of Education

Pre-primary Education – Universalisation of Elementary Education (UEE) – Primary Education – Equalization of Education opportunities – Secondary and Higher Education – SSA, RMSA, Samagra Shiksha, RUSA – Uniform Pattern of Education – RTE Act, 2009 – Formal, Non-formal and In-formal – Enrolment, Stagnation, Dropouts - Functional Literacy Programme – Open Schooling – Delinking degrees from employment — Brain drain Vocationalisation of Education – Skill Development.

Education of the Socially Disadvantaged Groups: Tribal, Scheduled and Marginalized groups – Special and Diverse needs of learners – Inclusive education – Universal Design of Learning - Barriers in Education – Challenges in affordability and accessibility of Education – Commissions and Committees in Education (Pre-Independence, Post-Independence) - Constitutional Provisions - Socialism, Secularism, Democracy, Sovereign and Egalitarian State - Central and State Government Policies related to Education.

Unit II Philosophical and Sociological Foundations of Education

Philosophical bases of Education – Metaphysics, Ontology, Epistemology, Axiology – Schools of thought: Idealism, Naturalism, Realism, Pragmatism – Propounding Indian Philosophers (Gandhiji, Tagore, Vivekananda, J.Krishnamurti, Aurobindo) and Western Philosophers (Plato, Russell, Pestalozzi, Rousseau, Froebel, Montessori, Dewey) in Education – Innovations emerged from experiments in education.

Sociological bases of Education – Socialization, Social Stratification, Mobility, Social Justice & Social Change – Sociologists (Auguste Comte, Max Weber, Marx, Durkheim, Spencer, Paulo Freire) – Education for International and National understanding – Peace, Value and Environmental Education – Liberalization, Privatization and Globalization in Education - UN-Sustainable Development Goals (SDGs) – Physical and Health Education – Gender perspectives in Education.

Unit III History and Culture of Tamil Nadu

Historical development, Role of Social and Political movements in Education – Initiatives for development: Establishment of State Universities and Educational Infrastructure – Developmental aspects: Professional Education (Medical, Engineering, Law, Teaching, Physical and Sports), Liberal Arts, Social Sciences and Humanities — Tamil Literature, Tradition & Culture: Art & Architecture – Historical sites – Ethnic groups of Tamil Nadu – Freedom fighters & Women leaders of social transformation of Tamil Nadu.

Unit IV Childhood & Adolescence

Psychology of Childhood & Adolescence – Stages of development (Early & Later childhood & Adolescence) – Adolescent characteristics - Dimensions of development (Cognitive, Physical, Psycho-Social, Emotional, Language, Moral) – Theories: Piaget, Bruner, Erik Erickson, Daniel Goleman, Kohlberg) – Developmental tasks and mental abilities – Individual differences – Understanding Learners (Slow and Late-bloomers, Children with Special Needs (CWSN) – Programmes for Diverse learners (Differentiated, Mediated, Remedial & Enrichment)

Unit V Learning and Teaching

Learner, Learning Process and Learning characteristics – Factors contributing to learning: Biological, Psychological, Socio-economic & Cultural - Memory, Remembering and Forgetting – Learning Curve – Paradigms: Behaviourism, Cognitivism, Constructivism, Humanism, Connectivism - Theories of Learning: Trial & Error (Thorndike), Classical Conditioning (Pavlov), Operant Conditioning (Skinner), Insight (Wolfgang Kohler), Gestalt theory – Transfer of learning. Significance of Language in understanding curriculum and subjects – Psycholinguistic - Types of Learning – Micro-Teaching: Skills & Components – Lesson Planning – Learning Styles: Visual, Auditory, Kinesthetic and Reading - Teaching styles: Autocratic and Permissive – Teaching approaches: Teacher and Student centered, Hybrid approaches – Outcome Based Education – Methods of Teaching (Inductive, Deductive, Analytic, Heuristic, Project) – Models of Teaching: Concept Attainment, Advanced-Organizers, Inquiry-Training) – Teacher Attributes – Teacher autonomy and accountability.

Unit VI Intelligence & Personality

Psychological attributes: Cognitive abilities, Attention, Interest, Motivation, Aptitude & Attitude, Value systems, Maslow's hierarchical theory of Human Needs – Achievement Motivation - Intelligence Basics & Theories (Single, Two-factor, Triarchic, Group-Factor, Multi-Factor, Guilford's Structure of Intellect, Gardner's Multiple Intelligence and Emotional Intelligence) – Creativity and Intelligence – IQ & EQ – Assessment of Intelligence – Understanding Learning difficulties and Learning disabilities (Dyslexia, Dyscalculia, Dysgraphia, Dyspraxia)

Personality – Trait theories: Allport, R.B.Cattell, Eysenck, Type: Hippocrates, Krestchmer, Sheldon, Carl Jung, Spranger – Assessment of Personality – Mental Health & Mental Hygiene : Conflict & Frustration, Unrest – Adjustment: Defense mechanisms – Guidance and Counselling .

Unit VII Educational Evaluation

Test, Measurement, Assessment & Evaluation – Principles of Evaluation - Characteristics of Test: Objectivity, Reliability, and Validity – Types: Formative, Summative, Norm and Criterion Referenced Test —

Scholastic & Non- Scholastic - Achievement Test – Diagnostic and Prognostic Tests – Continuous and Comprehensive Evaluation - Standardization of an achievement test - Table of weightages, Blue Print, Preparation of Question Paper, Scoring key, Item analysis (Index of Difficulty & Discrimination), Reliability – Tools for assessment: Observation, Interview, Portfolio, Rubrics, Peer-Reviews, Check-lists, Rating Scales.

Unit VIII Management & Administration

Principles of Management – Structure of Educational management (Central, State & Local levels) – Personnel, Material and Financial management: Functions (POSDCORB) - SWOC Analyses in Educational Administration – Total Quality Management (TQM) – Assessment and Accreditation of Educational Institutions – Leadership theories and styles – Role of Administrators, School Heads, Teachers and Stakeholders in Planning and Administration.

Unit IX Curriculum Design and Development

Principles of Curriculum, Curriculum patterns (Teacher, Learner, Problem, Subject, Activity/ Experience, Broad-field) – Types (Core, Competency-Based, Null, Hidden, Rhetoric) – Approaches to Curriculum Organisation (Topical, Spiral, Logical, Psychological, Unitary & Integrated) – Curriculum Development process - Models of Curriculum (Ralph Tyler, Wheeler, Hilda Taba, Stufflebeam) – Curriculum Evaluation.

Unit X Instructional and Educational Technology

Bloom's and Revised Taxonomy of Educational Objectives - Levels of Teaching (Memory, Understanding & Reflective) – Instructional designing – Programmed learning (Principles, Types: Linear, Branched) – Systems approach – ADDIE Model - Cybernetics – TPACK - FOSS- OER – MOOCs - Learning Management Systems (LMS) - Smart Classroom, Blended Learning, Flipped Learning – Augmented Reality - Virtual Modes (O-labs, Classrooms, Library) – Virtual Reality – AI in Education.

PG TRB General Knowledge Syllabus

Unit I History of India

Indus Valley Civilisation – Vedic Period- Buddhism and Jainism- Mauryan Empire-Guptas; Delhi Sultanate-Age of Vijayanagaram-Mughals and Marathas; Arrival of Europeans- Early uprising against British rule-English Education and Its impact- Westernisation and Modernisation-Birth of Indian National Congress– Freedom Struggle.

Unit II History of Tamil Nadu

Archaeological discoveries - Sangam literature; Pallavas – Imperial Cholas and Later Pandyas- Nayaks-their contribution to art and Architecture; Palayakar revolt against British Rule-Role of Tamil Nadu in freedom struggle-Justice Party-Self-Respect Movement- Dravidian Movement.

Unit III Indian Polity

Preamble to the Constitution - Fundamental Rights, Directive Principles of State Policy-Centre-State Relations–Judiciary in India-Empowerment of Women– Rights of Transgender.

Unit IV Geography

Salient features of Physical geography of India; Distribution of key natural resources; Geographical phenomena such as earthquakes, tsunami, cyclones.

Unit V General Science

Scientific knowledge and scientific temper-Main concepts of life science; evolution, nutrition, health and hygiene, human diseases; Environment and Ecology.

Unit VI Current Affairs and Sports

Recent achievements in national and international sports-contributions of eminent authors.

Unit VII Indian Economy

Planning, Mobilisation of resources, growth, development and employment; Major crops-cropping patterns in various parts of the country; e-technology in the aid of farmers.

Unit VIII Science and Technology Unit VIII Science and Technology

Latest inventions in science and technology. Indigenisation of technology and developing new technology; achievements of Indians in science and technology; application of Science and Technology in the area of IT, Space, Computers and Robotics..

Unit IX Aptitude and Mental Ability

Simplification- Percentage – Highest Common Factor (HCF)- Lowest Common Multiple (LCM)- Ratio and Proportion- Simple Interest- Compound Interest—Area-Volume- Time and Work.

Unit X Abbreviations

Commonly used acronyms and abbreviations of national and international organisations and institutes, as well as major government schemes.