Syllabus for written examination to be held for recruitment to the post of Post Graduate Teachers under Science & Commerce Stream, pursuant to Advt. No. 06 of 2017/18.

1. **Part- A (Compulsory)** following syllabus/ standard are adopted.

	Subject	Syllabus to be followed
i).	General English	: Higher secondary (+2) level.
ii).	Gen. Knowledge	: Enclosed below
iii).	Pedagogy	: General Pedagogy of Graduation Standard
iv).	Computer Aptitude	: Diploma standard

2. For **Part- B (Concerned Subjects)** the P.G. syllabus covering Paper-I & II are adopted for the following subjects are enclosed below

i) Physics
ii) Chemistry
iii) Zoology
iv) Botany
v) Mathematics
vi) Odia
vii) English
viii) Commerce

General Knowledge

The paper in General Knowledge will include knowledge of current events and matters as of everyday observation and experience in the scientific aspects of life as may be expected of an educated person. The paper will also include questions on History of India and Geography of such standard which the candidates should be able to answer without special study. Total 10 marks.

PAPER-I

Unit-I - **Algae** - General characteristics, Organization of thallus, Cell Structure, Reproduction, Alternation of generation, Economic importance; Structure, Reproduction and life cycle of *chlamydomonas* and Spirogyra.

Cyanobacteria – General characteristics, Cell structure, Heterocysts, Reproduction and Economic importance.

Fungi - General characteristics, organization of thallus, Reproduction, Alternation of generations, Economic importance; Structure, Reproduction and life cycle of Yeast, *Mucor* and *Rhizopus*.

Lichens – Thallus structure and Reproduction of Lichen.

Plant Diseases – Late blight of potato, Smut and rust of wheat, Citrus Canker, Mosaic Disease of tobacco.

Unit-II - **Bryophytes** - General characteristics, Alternation of generation, Economic significance;
Structure & Reproduction of *Riccia, Anthoceros* and *Sphagnum*.

Pteridophytes - General characteristics, Alternation of generation, Stelar structure, Heterospory and seed habit; General Morphology, Anatomy and Reproduction of *Psilotum, Sellaginella* and *Marsilea*.

Gymnosperms - General characteristics, Resemblances with and differences between Pteridophytes and Angiosperms; General Morphology, Anatomy and Reproduction of *Cycas*.

Unit-III - **Morphology of Angiosperms** - Root, Stem and their modifications; Leaves and their types, Venation and modifications; Phyllotaxy; Inflorescence; Structure of flower, Floral diagram and Floral Formula; Important features of the families; Cruciferae, Fabaceae, Malvaceae and Poaceae.

Unit-IV - **Anatomy** - Anatomy of typical dicot stems, root and leaf; Secondary growth and anomalous secondary growth of stems.

Embryology of Angiosperms- Microsporangium, Male gametophyte, Megasporangium, Female gametophyte, Pollination, Fertilization, Sexual incompatibility, Endosperm, Embryo, Seed development, Structure and types of seeds, Seed dispersal, Seed dormancy and germination.

Unit-V - **Ecology** - Ecological factors; Ecological adaptations - Hydrophytes, Xerophytes, Mesophytes; Plant succession; Bio-geochemical cycles, Ecosystem and their components, Major ecosystems, Environmental pollution- air, soil and water pollution and their control measures.

SYLLABUS FOR BOTANY.

PAPER-II

Unit-I-

Viruses- General characteristics, size and shape, structure, viral multiplication.

Bacteriophages- Types, Multiplication, Lytic cycle, Lysogeny.

Archaea – General features, cell structure and types.

Eubacteria - Morphology, Internal structure, Transformation, Conjugation, Transduction.

Unit- II - **Cell Biology** - Cell structure, Cell wall, Cell membrane, Plastids, Mitochondria, Golgi bodies, Glyoxisomes, Perosisomes, Ribosomes, Nucleus and Nucleolus; Structure of Chromosomes; Cell cycle – Mitosis and Meisosi.

Unit - III - **Genetics** - Mendel's laws of Inheritance, Interaction of genes; Linkage, Recombination and Gene mapping; Extra-Nuclear inheritance; Mutation-Types and induction, DNA damage and repair; Types of polyploidy, Role of mutation and polyploidy in crop improvement.

Unit - IV - **Molecular Biology** - DNA is the genetic material, Structure and Replication of DNA, DNA polymerase; Structure and types of RNA; RNA polymerase and transcription, RNA processing; Translation; Regulation of gene action in prokaryotes with reference to lac-operon.

Plant Biotechnology- General idea about plant tissue culture, sterilization techniques, clonal propagation, somaclonal variation; Protoplast isolation and somatic hybridization.

Transgenic plants- *Agrobacterium*-mediated gene transfer, Direct gene transfer, Insect (Bt.) and herbicide(glyphosate) resistant transgenic plants.

Unit - V - **Plant Physiology** – Water relations of plant cells, absorption of water, ascent of sap, transpiration, mineral nutrition; Phloem transport.

Plant Biochemistry – enzymes; Photosynthesis and photorespiration, respiration, nitrogen metabolism.

Plant growth regulators – (auxins, gibberellin, cytokinin, abscisic acid, ethylene), Photoperiodism and venalization.

(5)

56.
37

Chemistry

PAPER-I

SECTION-A : PHYSICAL CHEMISTRY

Unit-I:

Classical thermodynamics

Brief resume of concepts of law of thermodynamics – free energy, chemical potential and entropies – Partial molar properties – partial molar free energy – partial molar volume and partial molar heat content and their significances – concept of fugacity and determination of fugacity – activity – activity coefficient – Third law of thermodynamics, excess functions for non ideal solutions

8

6

P T O

Non-equilibrium thermodynamics

Thermodynamic criteria - Entropy production and entropy balance equations - chemical equations and chemical affinity- generalized fluxes and forces - phenomenological equations - Onsager's reciprocity relations.

Statistical thermodynamics

Enscmble-phase space - Quantum statistics - partition functions - Statistical thermodynamics - Einstein and Debye specific heat equations.

Unit-II:

Chemical dynamics

Empirical rate laws - Theories of reaction rates - Determination of reaction mechanism - Reaction in solutions - catalysed reaction kinetics - Techniques for fast reactions viz. flow method, relaxation method, flash photolysis, NMR method.

Electrochemistry

Electrochemistry of solutions - Debye - Huckel - Onsager treatment and its extension, Ion association - Thermodynamics of electrified interfaces - Lipmann equation - Butler Volumer equation - theory of double layer at interfaces and semiconductor - corrosion and prevention methods.

Unit-III:

Surface chemistry

Adsorption - Surface tension, Capillary action - pressure difference across curved surface isotherm - BET equation - surface films on liquids.

Micelles : Surface active agents and their classifications - Structure of micelles - CMC - Thermodynamics of micellizations - Solubilization -micro emulsion - reverse micelle.

Polymers : Definition, type of polymers - kinetie of polymerization - mechanism of polymerization - Molecular mass and its determination (Osmometry, Viscometry, diffusion and light scattering methods).

Solid state chemistry : Structural classification of solids of binary and ternary compounds - defects in solids - Electrical properties : Metals, insulator, semiconductor, super conductors - band theory of solids.

Phase equilibria : Thermodynamic derivation of phase rule - Three component systems and their application.

ntum Mechanics

ostulates – Particle in box, rigid rotator – harmonic oscillator – variation principles, first order perturbation principle – angular momentum.

Molecular orbital theory

Huckel theor of conjugated systems – Free valence index, bond order and charge density calculations – application to ethylene – butadiene – cyclopropylene radical, cyclobutadiene

Electronic structure of atoms

Electronic configuration, L-S coupling – term separation of energies of p^n and d^n configurations – spin orbit coupling – Zeeman splitting.

SECTION – B : INORGANIC CHEMISTRY

Unit-I

Periodic properties and chemical bonding

Chemical periodicity, VSEPR theory for different types of molecules, Walsh diagram (tri- and penta – atomic molecules), $d\pi$-$p\pi$ bond, bent rule and energetic of hybridization some simple reactions of covalently bonded molecules.

Acid-base concept and Non-aqueous solvents

Hard-soft acid base concept – acid base strength – theoretical basis of hardness and softness. Non aqueous solvents: types and characteristics – reactions in non-aqueous solvents.

Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operations – definitions of group, subgroup, cosets relation between orders of a finite group and its subgroup – Conjugacy relation and classes. Point symmetry group – Stoneflies symbols – representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} groups) – Character of a representation – The great Orthogonality theorem (without proof) and its importance – Character tables and their use.

Chemistry of transition and inner transition elements:

General characteristics of 1st row transition elements and inner transition elements with special reference to electronic structure, ionic radii, oxidation states, complex formation, magnetic behaviour and spectral properties.

Coordination compounds and Metal - Ligand Bonding

Nomenclature and isomerism of coordination compounds - valence bond theory and its limitations - Crystal field theory and its applications to octahedral, tetrahedral and square planer complexes - Limitations of crystal field theory - Molecular orbital theory: sigma bonding and energy level diagram in octahedral, tetrahedral and square planar complexes: bonding and energy level diagram in octahedral complexes.

Electronic spectra of transition metal complexes

Types of electronic transitions, selection rule - Spectrochemical, series - Spectroscopic ground states, correlation - Orgel and Tanabe-Sugano diagrams for transition metals complexes (d^1 to d^9 states), calculations of Dq, B and b parameters - charge transfer spectra.

Unit-III

Metal - Ligand Equilibria in Solution

Stepwise and overall formation constants and their interrelation, factors affecting the stability of metal complexes - chelate effect and its thermodynamic origin - determination of binary formation constants by pH-metry and spectrophotometry, Job's method of continuous variation.

Reaction mechanism of transition metal complexes

Energy profile of a reaction - Thermodynamic and kinetic stability of metal complexes - Kinetic application of valence bond and crystal field theories.

Substitution reactions of octahedral complexes: acid hydrolysis - base hydrolysis: conjugate base mechanism and the direct/indirect evidences - Substitution reactions in square planar complexes: the trans effect and its application to synthesis of complexes - theories of trans effect - mechanism and factors affecting the substitution reactions.

Redox reactions: Outersphere reactions, Marcus theory for outerasphere reaction - inner sphere reactions.

Nuclear chemistry

Radioactive disintegrations, radio isotopes and their applications, nuclear reactions, fission and fusion, radio analytical techniques and activation analysis.

ntum Mechanics

ostulates – Particle in box, rigid rotator – harmonic oscillator – variation principles, first order perturbation principle – angular momentum.

Molecular orbital theory

Huckel theor of conjugated systems – Free valence index, bond order and charge density calculations – application to ethylene – butadiene – cyclopropylene radical, cyclobutadiene

Electronic structure of atoms

Electronic configuration, L-S coupling – term separation of energies of p^n and d^n configurations – spin orbit coupling – Zeeman splitting.

SECTION – B : INORGANIC CHEMISTRY

Unit-I

Periodic properties and chemical bonding

Chemical periodicity, VSEPR theory for different types of molecules, Walsh diagram (tri- and penta – atomic molecules), $d\pi$-$p\pi$ bond, bent rule and energetic of hybridization some simple reactions of covalently bonded molecules.

Acid-base concept and Non-aqueous solvents

Hard-soft acid base concept – acid base strength – theoretical basis of hardness and softness. Non aqueous solvents: types and characteristics – reactions in non-aqueous solvents.

Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operations – definitions of group, subgroup, cosets relation between orders of a finite group and its subgroup – Conjugacy relation and classes. Point symmetry group – Stoneflies symbols – representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} groups) – Character of a representation – The great Orthogonality theorem (without proof) and its importance – Character tables and their use.

Unit-II

Chemistry of transition and inner transition elements:

General characteristics of 1st row transition elements and inner transition elements with special reference to electronic structure, ionic radii, oxidation states, complex formation, magnetic behaviour and spectral properties.

Coordination compounds and Metal – Ligand Bonding

Nomenclature and isomerism of coordination compounds – valence bond theory and its limitations – Crystal field theory and its applications to octahedral, tetrahedral and square planer complexes – Limitations of crystal field theory – Molecular orbital theory: sigma bonding and energy level diagram in octahedral, tetrahedral and square planar complexes: bonding and energy level diagram in octahedral complexes.

Electronic spectra of transition metal complexes

Types of electronic transitions, selection rule – Spectrochemical, series – Spectroscopic ground states, correlation – Orgel and Tanabe-Sugano diagrams for transition metals complexes (d^1 to d^9 states), calculations of Dq, B and b parameters – charge transfer spectra.

Unit-III

Metal – Ligand Equilibria in Solution

Stepwise and overall formation constants and their interrelation, factors affecting the stability of metal complexes – chelate effect and its thermodynamic origin – determination of binary formation constants by pH-metry and spectrophotometry, Job's method of continuous variation.

Reaction mechanism of transition metal complexes

Energy profile of a reaction – Thermodynamic and kinetic stability of metal complexes – Kinetic application of valence bond and crystal field theories.

Substitution reactions of octahedral complexes: acid hydrolysis – base hydrolysis: conjugate base mechanism and the direct/indirect evidences – Substitution reactions in square planar complexes: the trans effect and its application to synthesis of complexes – theories of trans effect – mechanism and factors affecting the substitution reactions.

Redox reactions: Outersphere reactions, Marcus theory for outerasphere reaction – inner sphere reactions.

Nuclear chemistry

Radioactive disintegrations, radio isotopes and their applications, nuclear reactions, fission and fusion, radio analytical techniques and activation analysis.

SECTION-A : ORGANIC CHEMISTRY

Unit-I

Stereochemistry, structure and reactivity

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiopicand diasterotopic atoms, groups and faces, sterospecific and steroselective synthesis - Asymmetric synthesis - Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

PTO

Aliphatic nucleophilic substitution

The S_N2, S_N1, mixed S_N1 and S_N2 and S_ET mechanisms. The neighbouring group mechanism, neighbouring group participation by p and s bonds, anchimeric assistance Classical and non-classical carbocations, phenonium ions, norbormyl system, common carbocations rearrangements – Application of NMR spectroscopy in the detection of carbocations.

The SN1 mechanism.

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aliphatic electrophilic substitution

Bimolecular mechanisms – S_E2 and S_{Ei}. The S_E1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving ground and the solvent polarity on the reactivity.

Unit-II

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams, the ortho/para ratio, ipso attach, orientation in other ring systems – Quantitative treatment of reactivity in substrates and electrophiles – Diazonium coupling – Vilsmeir reaction, Gattermann – Koch reaction.

Aromatic Nucleophilic Sustitution

The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nuleophile. The von Richter, Sommelet – Hauser, and Smiles rearrangements.

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance – Reactivity for aliphatic and aromatic sustrates at a bridgehead. Reactivity in the attacking radicals – The effect of solvents on ractivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Addition to Carbon – Carbon Multiple Bonds

Mechanism and stereochemical aspects of addition reactions involving electrophies, nucleophiles and free radicals, regio – and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring – Hydrogenation of double andtriple bonds, hydrogenation of aromatic rings. Hydroboration – Michael reaction – Sharpless asymmetric epoxidation.

Addition to Carbon – Hetero Multiple Bonds.

Mechanism of metal Hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents,organozinc and organolithium reagents tocarbonyl and unsaturated carbonyl compounds. Witting reaction – Mechanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Elimination Reactions

The E_2, E_1 and E_1CB mechanisms and their spectrum –Orientation of the double bond Reactivity – effect of substrate structures, attacking base, the leaving and the medium. Mechanism and orientation in pyrolytic elimination.

Unit-III

Pericyclic Reactions

Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3- butadiene, 1,3,5 – hexatriene and allyl system. Classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motions – antrafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and chelotropic reactions.

Sigmatropic rearrangements – suprafacial and antrafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3,3 – and 5,5 – Sigmatropic rearrangements, Claisen, Cope and aza- Cope rearrangements. Fluxional tautomerism. Ene reaction.

Photochemical Reactions

Interaction of electromagnetic radiation with matter, type of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Photochemistry of Alkenes : Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1.5- dienes.

Photochemistry of Carbonyl Compounds : Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β,γ-unsaturated and α,β- unsaturated compounds, cyclohexadienones.

Photochemistry of Aromatic Compounds : Isomerisations, additions, substitutions.

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog.

Unit-IV

Disconnection approach

An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversion, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction and amine synthesis.

Protecting groups : Principle of protection of alcohol, amine, carbonyl and carboxyl groups.

One group C-C disconnections

Alcohols and carbonyl compounds, regioselectivity, Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

Two group C-C disconnection

Diels – Alder reaction, 1.3 – difunctionalised compounds, α, β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Micheal addition and Robinson annelation.

Ring synthesis: Saturated heterocycles, synthesis of 3-, 4-, 5- and 6- membered rings, aromatic heterocycles in organic synthesis.

SECTION-B: ANALYTICAL CHEMISTRY

Unit-I

Introduction to analytical chemistry and data processing

Role of analytical chemistry, classification of analytical methods, types of instrumental analysis – Errors of analysis, classification, source and minimization of errors, absolute and relative errors, accuracy and precision, significant figures, mean value and deviation, average and standard deviation, median value, range, confidence intervals. Sampling in analysis. Definition, theory of sampling, technique of sampling, statistical criteria of good sampling, stratified sampling, transmission and storage of samples.

Environmental samples and their analyses

Aquatic pollution: Inorganic, organic, pesticides, agricultural, industrial etc.-Water qualify parameters: dissolved oxygen, biochemical oxygen demand, solids, metals, content of chlorides, fluoride, sulfate, phosphate, nitrate.

Analytical methods for measuring BOD, DO, COD, fluoride, nitrate (As, Cd, Cr, Hg, Pb, Se etc.)

Unit-II

Ultraviolet and Visible Spectroscopy

Various electronic transitions, Beer-Lambert's Law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compoiunds, dienes, conjugated polyenes. Fieser – Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds.

Infrared Spectroscopy

Principles – Vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, aryl aminers. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes), esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds. H-bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

Nuclear Magnetic Resonance Spectroscopy

Principles, chemical shift, spin-spin interaction, shielding mechanism, chemical shift values and correlation for protons bonded to carbon (Aliphatic, olefinic, enols, carboxylic acids, amines, amides & mercapto) chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry, hindred rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra nuclear magnetic double resonance, chemical shift reagents, solvent effects.

Mass Spectrometry

Principles, Ion production – EI, CI, FD and FAB – factors affecting fragmentation, ion analysis and abundance – Mass spectral fragmentation of organic compounds, common functional groups – Molecular ion peak – Metastable peak, Mc Lafferty rearrangement. Nitrogen rule – High resolution mass spectrometry – Examples of mass spectral fragmentation of simple organic compounds with respect to their structure determination.

Problems relating to elucidation of structure of simple organic molecules using UV-VIS, IR, NMR and Mass spectral data.

Unit-III

Solvent Extraction and ion exchange

Solvent Extraction: Principles, classification of extraction, mechanism of extraction, extraction equilibria, techniques of extraction, applications in analytical chemistry.

Ion exchange: Type of ion exchange resins, synthesis and characteristics of ion exchange resins, action of ion exchange resins, ion exchange equilibria, technique of ion exchange, application of ion exchange in analytical chemistry.

Chromatographic methods

Basic principles and applications of chromatographic techniques (Paper, TLC, Ion Exchange, HPLC, GLC).

Spectroscopic methods

Atomic adsorption spectroscopy : Principles and application of AAS in chemical analysis.

Flame photometric methods : Principles - Interference in flame photometry - Application in quantitative analysis.

Nephelometric method: Principle and applications in analysis.

X-ray diffraction method : Wiese indices, Miller indices, Laue method, Bragg's law and applications in determination of crystal structure.

Unit-IV

Electron spin resonance

Principles zero filed splitting and Kramer's degeneracy, factors affecting the g value, hyperfine splitting and applications to sample radicals.

Thermal analytical methods

Thermogravimetric analysis (TGA) - Derivative Thermogravimetric analysis (DTG) - Applications of theromogravimetry.

Differential Thermal Analysis (DTA) - Applications of differential thermal analysis in simultaneous TG-DTA curves.

Thermogravimetric titration: Principle and applications.

Electroanalytical methods

Classification of electro analytical methods - Principles and applications of voltammetry, cyclic voltammetry, anodic stripping voltammetry, Polarography, amperometry, coulometry, conductometry and ion selective electrodes.

Commerce

PAPER-I

Unit I : Business Environment

Meaning and Elements of Business Environment; Economic Environment; Economic Planning; Competition Policy; Consumer Protection; Environment Protection; Liberalization, Privatization and Globalization; Industrial Policy; Industrial Growth.

Unit II : Financial Accounting

Accounting and Financial Accounting; Generally Accepted Accounting Principles (GAAP); Accounting Standards; Accounting Equation and Financial Transactions; Books of Accounts; Bank Reconciliation Statement (BRS); Trial Balance & Errors; Financial Statements and their Analysis (Income Statement, Balance Sheet and Cash Flow Statement); Annual Financial Reports of a Company; Consignment and Joint Venture.

Unit III : Cost and Management Accounting

Cost Accounting and Management Accounting; Cost Classification, Analysis and Control; Statement of Costs; Methods of Costing (Job and Process Costing); Marginal Costing, Break-even Analysis and C-V-P Analysis; Activity Based Costing; Budgetary Control System and Variance Analysis; Responsibility Accounting and Segment Performance Analysis; Human Resources Accounting.

Unit IV : Business Studies

Forms of Business; Channels of Distribution; Business Risks and Insurance; Commercial Banks; Principles of Management, Scientific Management & Management Functions; Recruitment & Selection; Training & Development; Marketing Mix; Financial Planning; Fixed & Working Capital.

SYLLABUS FOR COMMERCE

PAPER II

Unit I : Business Statistics

Data Sources & Tabulation and Analysis; Sampling, Need, Errors & Methods of Sampling; Analysis & Interpretation of Data; Measures of Central Tendency; Measures of Dispersion; Correlation & Regression; Hypothesis Testing; T-Test, F-Test, Z-Test & Chi-Square Test.

Unit II : Business Mathematics

Stock & Shares; Profit & Loss; Invoicing & Discounting of Bills of Exchange; Logarithms; Annuities & Interest Rates; Simple & Compound Interest; Set Theory and Functions; Matrices & Determinants; Differentiation & Integration; Permutation and Combination.

Unit III : Business Management & Entrepreneurship

Planning – Objective, Strategies, Planning Process, Decision Making; Organizing; Organizational Structure; Formal & Informal Organizations; Staffing; Motivation; Leadership; Communication; Controlling.

Types of Entrepreneurs; Ownership Structure; Selection of an Appropriate Form of Ownership Structure; Factors affecting Entrepreneurial Growth; Institutional Support to Entrepreneur; Developing Entrepreneurial Competencies; Entrepreneurship Development Programmes; Venture Capital;

Unit IV : Business Regulatory Framework & Financial Services

Indian Contract Act, 1872; Sales of Goods Act, 1930; Special Contract Act – Indemnity & Guarantee, Bailment & Pledge, Contract of Agency; Partnership Act, 1932.

Importance of Banking in Business; Reserve Bank of India; NABARD & Rural Banking; E-banking; Development Banking; Financial System in India; Nature & Scope of Financial Services; Merchant Banking; Leasing & Hire Purchase; Credit Rating; Credit & Debit Cards.

English

PAPER-I

The candidate shall answer questions from each Unit which are compulsory.

Unit-1 There shall be one question with a suitable alternative relating to major developments in English literature from Renaissance to the Age of Moderns from the following topics.

i) Elizabethan and Jacobean Drama
ii) Metaphysical Poetry
iii) Restoration Drama
iv) Augustan Satire
v) Rise of the Novel in the Eighteenth Century
vi) Romantic Poetry
vii) Victorian Crisis and Compromise
viii) Early and Later Victorian Novels
ix) The Modernist Movement
x) Modern Poetry
xi) Modern Drama
xii) Stream-of-Consciousness Novels

Unit - 2 The candidate shall answer **four** short-answer-type questions out of six relating to forms of literature.

i) Lyric
ii) Ballad
iii) Ode
iv) Sonnet
v) Epic
vi) Elegy,
vii) Verse libre
viii) Tragedy
ix) Comedy
x) Romantic Comedy
xi) Revenge Tragedy
xii) Comedy of Humours
xiii) Comedy of Manners
xiv) Heroic Tragedy
xv) Thesis Play/Play of Ideas
xvi) Poetic Drama
xvii) Theatre of the Absurd
xviii) Epic Theatre
xix) Theatre of Cruelty
xx) Expressionist Drama

xxi) Picaresque Novel
xxii) Epistolary Novel
xxiii) Gothic Novel
xxiv) Historical Novel
xxv) Science Fiction
xxvi) Detective Fiction
xxvii) Autobiographical Novel
xxviii) Essay
xxix) Short Story
xxx) Travelogue

Unit -3 The candidate shall answer **two** questions out of four relating to literary theory from the following topics.

i) Plato : Theory of Mimesis
ii) Aristotle : Definition of Tragedy
iii) Coleridge : Theory of Imagination
iv) Wordsworth : Theory of Poetry
v) Matthew Arnold : Touchstone Theory
vi) T.S. Eliot : Theory of Impersonality
vii) New Criticism
viii) Structuralism
ix) Deconstruction
x) Marxian Approaches to Literature
xi) New Historicism
xii) Feminism
xiii) Psycho-analytical Approaches to Literature
xiv) Post-Modernism
xv) Post-Colonialism

Unit-4 The candidate shall attempt **four** short-answer-type questions out of six relating to the following basic concepts.

i) Allegory
ii) Anagnorisis
iii) Aporia
iv) Catharsis
v) Conceit
vi) Comic Relief
vii) Expressionism
viii) Epiphany
ix) Fancy
x) Hubris
xi) Imagery
xii) Irony
xiii) Metaphor
xiv) Myth
xv) Naturalism
xvi) Negative Capability
xvii) Objective Correlative
xviii) Peripeteia
xix) Paradox
xx) Pun

xxi)	Personification	
xxii)	Pathetic Fallacy	
xxiii)	Poetic Justice	
xxiv)	Realism	
xxv)	Symbol	
xxvi)	Surrealism	
xxvii)	Three Dramatic Unities	

Unit - 5 The candidate shall attempt an appreciation of a poem commenting on aspects of its form content and style.

SYLLABUS

English

PAPER-II

The candidate shall answer questions from each Unit which are compulsory.

Unit- 1 The candidate shall write an essay on a subject of general interest in not less than 1200 words choosing one out of five topics.

Unit- 2 The candidate shall attempt a précis in 200-210 words of a given passage of about 600 words.

Unit- 3 The candidate shall answer five questions relating to a comprehension passage. The answer to each question should not exceed 30 words.

Unit- 4 The candidate shall be required to write a report on a given topic in not more than 300 words.

Unit- 5 The candidate shall be required to prepare a brochure/pamphlet on a given theme.

Unit- 6 The candidate shall answer objective type questions each carrying 1 mark relating to grammar in context. The following items are to be covered.

i) Tense and Aspects
ii) Prepositions
iii) Modals
iv) Phrasal Verbs
v) Linking Devices
vi) Direct and Indirect Speech
vii) Concord
viii) Conditional Sentences
ix) Correlatives
x) Complement and Adjuncts

PAPER - I

UNIT - I ALGEBRA AND NUMBER THEORY

Group Theory : Groups, Subgroups, Normal Subgroups and Quotient Groups, Homomorphisms and applications, Permutation groups, Conjugacy and Class equation, Simple group, Sylow Theorms.

Ring Theory : Rings, Special Classes of rings, Homomorphisms, Ideals and Quotient rings, Maximal and Prime ideals, Polynomial rings, Principal Ideal Domain, Unique Factorization Domain.

Field : Field of Quotients of an Integral Domain, Polynomials over the rational field, Algebraic Extension of Fields: Irreducible polynomials and Eisenstein: Criterion, roots of Polynomial, Splitting field and its degree of extension, Multiple roots, Ruler and Compass Constructions, Symmetric function of roots, Solution of Cubic and Biquadratic Equations.

Number Theory : Integers, g.c.d., Fundamental Theorem of Arithmetic, Euclidean Alogorithm, Arithmetical functions (Euler-function, Mobius function-), Dirichlet multiplication, Linear Congruences, Euler-Fermat Theorem, Linear Diophantine Equations, Fermat's Theorem, Fermat Little Theorem, Polynomial Congruence, Lagrange's Theorem, Chinese Remainder Theorem, Wilson's Theorem and Applications.

UNIT -II ANALYSIS -I

Basic Topology : Finite, Countable and Uncountable sets, Metric Spaces, Topological Spaces, Basis, Closed sets, Open Sets, Limit Points, Properties of Connected Spaces and Compact Spaces, Heine Boril Theorem.

Sequence and Series : Convergent Sequences, Subsequences, Convergence of Monotone Sequences, Couchy Sequences, Upper and Lower limits of Sequences, Bolzano Weirstrass Theorem, Series of non-negative terms, Convergence tests, Power Series, Couchy Convergence Criterion, Absolute Convergence, Alternating Series.

Continuity and Differentiability : Properties of Continuous Function, Continuity and Compactness, Continuity and Connectedness, Discontinuity, Monotonic functions, Mean Value Theorem, Taylor Series.

Function of Several Variables : Continuity Differentiability, Extreme Values, Maxima and Minima, Line Integral, Surface Integral, Volume Integral, Applications of Green's Theorem, Stokes Theorem and Gauss Theorem.

UNIT - III COMPLEX ANALYSIS

Analytical Functions : Continuity, Differentiability, Couchy-Reimenn Equations, Analytic Functions, Harmonic Functions.

Bilinear Transformation : Elementary Transformations, Bilinear Transformation, Mapping by Elementary Functions.

Complex Integration : Couch's Theorem, Couchy's Integral Formula, Maximum Modulus Theorem, Liouville's Theorem, Morera's Theorem, Related Problems.

Singularities and Calculus of residues : Series Expansion, Taylor's Series, Laurent's Series, Zeros of Analytic Function, Singularities, Residues, Councy's Residue Theorem, Evaluation of Definite Integrals.

UNIT - IV OPERATIONS RESEARCH

Linear Programming : Simpler Method, Computational Procedure, Use of Artificial Variables.

Duality in Linear Programming : General Primal-dual pair, Duality Theorems, Complementary Slackness Theorem, Duality and Simplex Method, Dual Simplex Method.

Games and Strategies : Two-person-Zero Sum Games, Minimax-Maximin Principle, Games with Saddle Points, Mixed Strategies, Graphical Solutions, Dominance Property, Arithmetic Method of nxn Games, General Solution of nxn rectangular Games.

Transportation and Assignment : General Transportation Problem, Finding Initial Basic Feasible Solution, Test of Optionality, Transportation Algorithm, Transhipment Problems.

Mathematical Formulation of Assignment Problem, Method of Solution of Assignment Problem, Travelling Salesman Problem.

UNIT - V NUMERICAL ANALYSIS

Root Finding for Non-Linear Equations :Newton's Method, Secant Method, One-point Iteration Method, Multiple Roots, Newton Methods of Non-Linear Systems.

Interpolation Theory : Finite Differences, Newton's Forward and Backward differences, Newton's Divided differences, Lagrange's Interpolation, Errors in data and Forward differences, Hermite Interpolation, Piece-wise linear Interpolation.

Numerical Integration : Newton-cote integration formula, trapezoidal rule, Simpsons' rule, Gaussian quadrature, Asymptotic error formulas and their applications.

Numerical Methods for Ordinary Different Equations : Euler's Method, Multistep Methods, Midpoint Method, Trapezoidal Method, Single Step Method and Runge-Kutta Method.

PAPER-II

87

UNIT-I ANALYSIS

Riemann stieltjes integral Existence of the integral, Properties of the integral, Fundamental theorem of calculus, change of variables in on integral, Differentiation of integral.

Sequence and series of functions

Uniform convergence of sequence of functions, Cauchy criterion for uniform convergence, weierstrass test for uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, construction of continuous function on the real line which is nowhere differentiable.

Measure Theory Lebesgue outer measure , Properties of outer measure, Measurable sets, Cantor set, Borel set, and sets, Non measurable sets, Measurable functions, Properties of measurable functions.

Lebesgue integration and l^p spaces comparison of Lebesgue and Riemann integral, Lebesgue integral of bounded measurable functions over sets of finite measure, Bounded convergence theorem, Lebesgue integral for nonnegative measurable function. Fatou's Lemma, Monotone convergence theorem, l^p spaces, essential supremum of a function, Minkowski and Holder inequalities, Absolute summable and summable series in a normal linear space completeness in l^p.

UNIT-II FUNCTIONAL ANALYSIS

Normed Linear space Linear spaces, Subspaes, Quotient spaces, properties of norm, Riesz Lemma, Continuity of linear maps, Bounded linear operations, Equivalent norms, Hahn Banach theorem and its consequences.

Banach spaces Uniform boundedness principle, closed graph theorem and its consequences, open mapping theorem and its consequences.

Spaces of Bounded linear functional Duals and transposes, Duals of l^p, $L^p[a,b]$, C[a,b], Weak convergence, weak* convergence, Reflexivity.

Hilbert space Inner product spaces, Orthonormal sets, Gram Schmidt Orthonormalisation, Bessel's Inequality, Riesz. Fischer theorem, Projection theorem, Riesz representation theorem.

UNIT-III LINEAR ALGEBRA

Vectorspace, Subspace, Linear Dependence , Independence, Dimension and Basis , Linear Transformation, Range and Kernel, Rank and Nullity, Inverse of Linear Transformation, Linear Map associated with matrix.

Elementary Row Operations, Rank and Nullity of Matrix, Inverse of a Matr4ix, Determinants and product of Determinats, Eigen values, Eigen vectors, Characteristic roots.

Canonical forms, Tringular form, Nilpotent Transformations, Similarity of Matrices, Quadratic form.

Traces and Transpose, Hermitian, Unitary and Normal Transformation.

UNIT- IV DISCRETE MATHEMATICS-

Logic- Fundamentals of logic, Normal forms, Logical Inferences, Methods of proof, Mathematical Induction, Rules of Inferences for quantified propositions.

Lattice and Boolean Algebra - Binary relations, Equivalence relations, prset, Lattice, Hasse Diagram, Algebraic properties of Lattice, Paths and closures, Directed graphs and adjacency matrix, Boolean Algebra, Boolean functions, Minimization of Boolean functions.

Recurrence relation -

Generating functions of sequences, Calculating co-efficients of generating functions, Recurrence relation, solving recurrence relations by substitution and generating functions. Solution by the method of characteristic roots.

Graph Theory -

Trees and their properties, spanning trees, Binary trees, Euler's formula, Euler's circuits, Hamiltanian Graphs

UNIT - V DIFFERENTIAL EQUATIONS

Linear Differential Equations with constant coefficients and variable coefficients, system of Linear Differential Equations. Laplace Transformation : Linearity of the Laplace transformation Laplace transforms of derivatives and integrals, shifting theorems. Differentiation and integration of transforms. Convolution theorem Solution of integral equations and systems of differential equations using Laplace Transformation.

Series Solution of differential equations: Power series method, Bessel, Legendre and Hypergeometirc equations. Bessel, Legendre functions and their properties . Stürm-Liouville problem, Orthogonality of eigen functions. Orthogonality of Bessel fuctions and Legendre polynomials.

Partial Differential Equations of the 1st order. Lagrange's solution some special types of equations, their solution, Charpit's general method of solution. Partial Differential Equations of second and Higher orders. Classification of linear partial differential equations of second order. Homogeneous and non-homogeneous equations with constant colfffficients, Monge's method.

Fourier Series and Fourier Transform, Convergence of Fourier series, Application of Fourier series and Fourier Transforms to Boundary value problems. Solution of Laplace equation, wave equation and heat conduction equations.

SYLLABUS

Odia

PAPER-I

ଓଡିଆ ଭାଷାର ଇତିହାସ

ଓ

ଓଡିଆ ସାହିତ୍ୟର ଇତିହାସ

ୟୁନିଟ – I : ଓଡିଆ ଭାଷାର ଉତ୍ପତ୍ତି ଓ କ୍ରମ ବିକାଶ (ଆଦିକାଳରୁ ଷୋଡଶ ଶତାବ୍ଦୀ ପର୍ଯ୍ୟନ୍ତ) ।

ୟୁନିଟ – II : ଓଡିଆ ଭାଷା ସହିତ ସଂସ୍କୃତ, ପାଲି ଓ ପ୍ରାକୃତ ଭାଷାର ସଂପର୍କ ।

ୟୁନିଟ – III : ଓଡିଆ ଶବ୍ଦ ଭଣ୍ଡାର (ତତ୍ସମ, ତଦ୍ଭବ, ଦେଶଜ ଓ ବୈଦେଶିକ) ।

ୟୁନିଟ – IV : ଓଡିଆ ଭାଷା ଉପରେ ବୈଦେଶିକ ପ୍ରଭାବ ।

ୟୁନିଟ – V : ଓଡିଆ ସାହିତ୍ୟର ଇତିହାସ (ଆଦି ପର୍ଯ୍ୟାୟ) ।

[ବୌଦ୍ଧଗାନ ଓ ଦୋହା, ପ୍ରାଚୀନ ଓଡିଆ ଗଦ୍ୟ ସାହିତ୍ୟ, ପ୍ରାଚୀନ ଓଡିଆ କବିତାର ସ୍ୱରୂପ]

ୟୁନିଟ –VI : ଓଡିଆ ସାହିତ୍ୟର ଇତିହାସ (ମଧ୍ୟ ପର୍ଯ୍ୟାୟ) ।

[ଓଡିଆ ପୁରାଣ ଓ ସନ୍ଥ ସାହିତ୍ୟ, ପ୍ରାକ୍ ରୀତି କାବ୍ୟଧାରା]

ୟୁନିଟ –VII : ଓଡିଆ ସାହିତ୍ୟର ଇତିହାସ (ଉତ୍ତର ମଧ୍ୟ ପର୍ଯ୍ୟାୟ) ।

[ଓଡିଆ ରୀତି ସାହିତ୍ୟ, ଓଡିଆ ପଦାବଳୀ ସାହିତ୍ୟ]

ୟୁନିଟ –VIII : ଓଡିଆ ସାହିତ୍ୟର ଇତିହାସ (ଆଧୁନିକ ପର୍ଯ୍ୟାୟ) ।

[ଓଡିଆ ସାହିତ୍ୟରେ ନବ ଜାଗରଣ, ପତ୍ର-ପତ୍ରିକା, ପ୍ରବଂଧ, ଗଳ୍ପ, ଉପନ୍ୟାସ, କବିତା ଓ ନାଟକର କ୍ରମ ବିକାଶ]

SYLLABUS

Cdc

PAPER-II

ଓଡିଆ ସାହିତ୍ୟର ବିଶେଷ ଅନୁଶୀଳନ

ୟୁନିଟ – I : ସାରଳା ଦାସ, ବଳରାମ ଦାସ, ଜଗନ୍ନାଥ ଦାସ, ଅଚ୍ୟୁତାନନ୍ଦ ଦାସ ।

ୟୁନିଟ – II : ବତ୍ସା ଦାସ, ନାରାୟଣାନନ୍ଦ ଅବଧୂତ ସ୍ୱାମୀ, ମାର୍କଣ୍ଡ ଦାସ, ଦେବଦୁର୍ଲ୍ଲଭ ଦାସ ।

ୟୁନିଟ – III : ଦୀନ କୃଷ୍ଣ ଦାସ, ଉପେନ୍ଦ୍ର ଭଞ୍ଜ, ଅଭିମନ୍ୟୁ ସାମନ୍ତସିଂହାର, ବଳଦେବ ରଥ ।

ୟୁନିଟ – IV : ବ୍ରଜନାଥ ବଦଜେନା, ଗୋପାଳ କୃଷ୍ଣ, ବନମାଳୀ, ଭୀମ ଭୋଇ ।

ୟୁନିଟ – V : ଫକୀର ମୋହନ, ରାଧାନାଥ ରାୟ, ମଧୁସୂଦନ ରାଓ, ରାମଶଙ୍କର ରାୟ ।

ୟୁନିଟ –VI : ଗଙ୍ଗାଧର ମେହେର, ବିଶ୍ୱନାଥ କର, ନନ୍ଦକିଶୋର ବଲ୍, ନୀଳକଣ୍ଠ ଦାସ ।

ୟୁନିଟ–VII: କାଳନ୍ଦୀ ଚରଣ ପାଣିଗ୍ରାହୀ, କାଳୀଚରଣ ପଟ୍ଟନାୟକ, ସଚ୍ଚି ରାଉତରାୟ, ଗୋଦାବରୀଶ ମହାପାତ୍ର ।

ୟୁନିଟ –VIII : ଗୋପୀନାଥ ମହାନ୍ତି, ସୁରେନ୍ଦ୍ର ମହାନ୍ତି, ବିନୋଦ ଚନ୍ଦ୍ର ନାୟକ, ଗୁରୁପ୍ରସାଦ ମହାନ୍ତି ।

SYLLABUS

Physics

PAPER- I

Unit-I : Mathematical Physics

1. Complex variable :
   Cauchy's theorem, Cauchy's integral formula, classification of singularitie branch point and branch cut, Residue theorem, evaluation of integral usin residue theorem.

2. Special functions :
   Basic properties and solutions (series expansion, recurrence and orthogonalit relations) of Bessel, Legendre, Laguerre functions, Solution of inhomogeneou partial differential equation by method of Green's function.

3. Group theory :
   Definitions, isomorphism and homomorphism, point group, group representation, reducible and irreducible representation, Lie group and Lie algebra with SU(2) and 0(3).

4. Tensors:
   Cartesian tensors, covariant, contravariant and mixed tensor, tensor algebra, properties of symmetric and anti symmetric tensor. Levi Civita and metric tensor.

Unit-II: Classical Mechanics

1. Hamilton's principle:
   Hamilton's principle, Lagrange's equation from Hamilton's principle,Solution of Lagrange equation of motion for Simple harmonic oscillator, Hamilton' equations of motion, canonical equations from variational principle, principle of least action
2. Canonical transformation:
   Generating function and Legendre transformation, Integral invariant of Poincare, Lagrange and Poisson's brackets, infinitesimal canonical transformation, conservation theorems in Poisson bracket formalism, Jacobi Identity.
3. Rigid body:
   Independent coordinates, orthogonal transformation and rotations (finite and infinitesimal), Euler's angles, Euler's theorem on the motion of rigid body, Inertia Tensor and principal axis transformation, angular momentum and kinetic energy of rotation in terms of Euler's angles. Euler's equation of motion, torque free motion of rigid body,heavy symmetrical top with one point fixed. , motion in a non inertial frame of reference, Coriolis force
4. Small oscillation:
   Theory of small oscillation, Normal modes and normal frequencies, application to tri atomic molecules.
5. Hamilton-Jacobi theory:
   Hamilton-Jacobi equation for Hamilton's principal function, Harmonic oscillator problem, Hamilton's Characteristic function, Action angle variable and its application to Kepler's problem.

Unit-III: Classical Electrodynamics

1. Electrostatics and Magnetostatics:
   Scalar and vector potential, Gauge transformation, multiple expansion of (i) scalar potential and electrostatic energy due to static charge distribution, (ii) vector potential due to stationary current distribution, Electrostatic and magnetostatic energy, Poynting 's theorem, Maxwell's stress tensor,
2. Relativistic electrodynamics:
   Equation of motion in an electromagnetic field, electromagnetic field tensor, covariance of Maxwell's equation, Maxwell's equations as equations of motion, Lorentz transformation laws for electromagnetic field, and the fields due to point charge in uniform motion, Field invariants , covariance of Lorentz force equation of motion, and equation of motion of a charged particle in an electromagnetic field, Energy momentum tensor and conservation laws for electromagnetic field, Relativistic Lagrangian and Hamiltonian of a charged particle in an electromagnetic field.
3. Dispersion:
   The oscillator model and dispersion in dielectric and conductors, anomalous dispersion and resonant absorption, Krammer- Kroning dispersion relation.

4. Radiation, scattering and Diffraction:
Field due to localized oscillating source, electric dipole,magnetic diapole, electric quadrupole field radiation, centre-fed linear antenna with sinusoidal current,scattering by a small dielectric sphere in long wave length limit, Raleigh scattering,

5. Radiation from moving Charge:
Lienard Wiechert potential, Field due to a charge moving with velocity, field due to accelerated charge, radiation at low velocities, total power radiated by the accelerated charge, Larmor 's formula and its relativistic generalization, angular distribution of radiation from an accelerated charge, Thomson scattering.

Unit-IV: Quantum Mechanics-I

1. Wave packet:
Gaussian wave packet, spreading of wave packet, coordinate and momentum representation, **x** and **p** in these representation, Dirac delta function,
2. Operator method in Quantum Mechanics:
Formulation of Quantum Mechanics in vector space language, uncertainty product of two arbitrary operators, one dimensional harmonic oscillator by operator method.
Matrix representation of operators, Schrodinger, Heisenberg and interaction pictures. Dirac bracket notation,
3. Three dimensional potential well, Fermi energy, Radial solution of Hydrogen atom and its total wave function .
4. Symmetry , invariance principle and conservation Laws:
Space translational invariance , time translational invariance and rotational invariance and conservation laws.
5. Angular momentum:
Angular momentum algebra, addition of two angular momenta j_1=1/2, j_2=1/2. Clebsch-Gordon Coefficients, examples, matrix representation of j_1=1/2 and j_2=1. Spin angular momentum, Pauli spin matrices and their properties, eigen value and eigen function,
6. Approximation methods:
Time independent perturbation theory, First and second order correction to energy and eigen functions, Degenerate perturbation theory, application to one electron system, relativistic mass correction, Spin-Orbit coupling, Zeeman effect, linear Stark effect. Fine structure of spectral line of H-like atom

Unit-V: Statistical Mechanics

1. Objectives of Classical Statistical Mechanics:
Microstates, macro states, phase space, Liouville's theorem, concept of ensembles, Ergodic hypothesis, postulates of equal a priory probability, Boltzmann's postulates of entropy, micro canonical ensemble, entropy of ideal gas, Gibb's paradox, Sakur-Tetrode equation,
2. Canonical ensemble:
Expression for entropy, canonical partition function, Helmholtz free energy, energy fluctuation,

3. Grand canonical ensemble:
   Grand canonical partition function, chemical potential, density fluc chemical potential of an ideal gas,
4. Quantum Statistical Mechanics:
   Density matrices for micro canonical, canonical and grand canoni ensembles, B-E and F-D distribution. Equation of states for B-E system, Bos condensations, Planck's law of black body radiation, equation of state for idea Fermi gas at low density-high temperature and at high density-lov temperature, theory of white dwarf star, relation between chemical potentia and Fermi energy,

5. Phase Transition:
   First and second order phase transition in matter, Landau theory of phase transition and its application to ferromagnetism.

SYLLABUS

Physics

PAPER-II

Unit-I :Quantum Mechanics-II

1. WKB Approximation:
   Connection formulae, Bohr quantization rule, barrier penetration and α-decay,
2. Variational method:
   He atom as an example, First order perturbation, exchange degeneracy.
3. Time dependant perturbation theory:
   Interaction picture, Transition probability, constant and harmonic perturbation, Fermi Golden Rule, electric dipole radiation, selection rule, Spontaneous emission, Einstein's A and B coefficients, Principle of Laser
4. Scattering theory:
   Laboratory and center of mass system, differential and total scattering cross section, scattering amplitude, scattering by spherically symmetric potential, Partial wave analysis and phase shift, scattering by rigid sphere and square well, Coulomb scattering, Formal theory of scattering, Green's function in scattering theory, Born approximation,
5. Symmetry and Conservation laws:
   space and time translational invariance, rotational invariance of the dynamical systems, Discrete symmetries- space reflection, charge conjugation and time reversal symmetries..
6. Identical Particles:
   Symmetric and anti-symmetric wave functions, Slater determinant, symmetric and anti-symmetric wave functions of two identical spin ½ particles.

Unit-II: Relativistic Quantum Mechanics and Field theory

1. Klein-Gordon Equation:
   Klein-Gordon equation and its drawback, need for a relativistic equation.
2. Dirac Equation:
   Dirac equation, properties of Dirac γ-matrices,Non-relativistic reduction o
   Dirac equation,magnetic moment of electron, Spin-Orbit coupling, Covarianc
   of Dirac equation and bilinear covarints.

3. Solution of Dirac Equation:
Free particle solution of Dirac equation and its physical interpretation, projection operator for spin and energy,Zitterbewegung, Hole theory.
4. Symmetry in Dirac equation:
Charge conjugation, space reflection, time reversal symmetries of Dirac equation, Continous systems and fields, transition from discrete to continous systems, Lagrange and Hamiltonian formulation, Noether's theorem.
5. Quantization of Free field:
Second quantization, covariant quantization of electromagnetic field, quantization of neutral scalar field and Dirac field.

Unit-III : Electronics

1. Amplifiers:
Frequency response of linear amplifier, amplifier pass band, R-C, L-C and transformer coupled amplifier, feed back amplifier, book-strapping the FET, stability, noise
2. Operational amplifier: differential and integral amplifier,input and out put impendance, summing integrating and differentiating amplifier, comparators
3. Oscillators:
Feedback criteria for oscillation, phase shift, Wien bridge, crystal controlled and Klystron oscillators, multi vibrators- astable, monostale and bistable
4. Digital Circuits:
Logic fundamentals, Boolean theorem, Logic gates-RTL,DTL,TTL, RS flip-flop, JK flip-flops
5. Boolean algebra, De Morgan theorem, AND,NAND,NOT,NOR gates(CMOS,NMOS), MOS circuits, two phase inverter, dynamic MOS shift register.

Unit-IV: Condensed Matter Physics

1. Bragg-Laue formulation of X-ray diffraction, atomic and crystal structure, Electron and neutron diffraction by crystal, binding in solids,inert gas solids,ionic crystals, covalent bond.
2. Lattice Dynamics:
Classical theory of lattice vibration under harmonic approximation, vibration of linear mono atomic and diatomic lattices, acoustical and optical modes, optical properties of ionic crystal in the infrared region, normal modes and phonon, inelastic scattering of neutron by phonon, lattice heat capacity, models of Debye and Einstein, An-harmonic effects in crystals-thermal expansion and thermal conductivity.
3. Free Electron Theory:
Free electron theory of metal,one dimensional infinite potential well. electron gas in three dimension, density of states, electronic specific heat, electrical conductivity and Wiedeman-Franz law, Hall effect, cyclotron resonance.
4. Band Theory of Solid:
Bloch equation, empty lattice band, nearly free electron bands, no of states in band, tight binding method, effective mass of electron in the band, concept of holes, classification of metal, semiconductor and insulator, intrinsic and extrinsic semiconductors, intrinsic carrier concentration,

5. Dielectric Properties of solids:
Electronic and ionic polarization of molecules, static dielectric constants of gases, Lorentz internal fields, static dielectric constant of solids, classical theory of electronic polarization and optical absorption, Clausius-Mossotti equation, elementary idea of ferroelectricity.
6. Magnetic Properties of Solids:
Origin of Magnetism, quantum theory of diamagnetism, paramagnetism, Pauli Paramagnetism, Ferromagnetism, Curie-Weiss law, ferromagnetic domain , ferri and anti ferromagnetism.

7. Superconductivity:
Phenomenological description of superconductivity, Meissner effect, Type-I and type-II superconductors, London's equation, outlines of BCS theory, High T_c superconductor.

Unit-V: Nuclear and Particle Physics.

1. Nuclear Properties:
Basic nuclear properties: nuclear size, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magneticdipole moment and electric quadrupole moment,
2. Two body bound state;
Properties of deuteron, Schrodinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces.
3. Two-body scattering:
Partial wave analysis and phase shifts, scattering length,
magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Eeffective range theory, low energy p-p scattering, Nature of nuclear forces, charge independence, charge symmetry and iso-spin invariance of nuclear forces.
4. β-decay :
β- emission and electron capture, Fermi's theory of allowed β-decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment.
5. Nuclear Structure:
Liquid drop model, Bethe-Weizsacker binding energy/mass formula, Fermi model, Shell model and Collective model.
6. Nuclear Reactions and Fission.
Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions, Breit-Wigner dispersion relation; Compound nucleus formation and break-up Optical model; Principle of detailed balance, Transfer reactions. Nuclear fission: Experimental features, spontaneous fission, liquid drop model, barrier penetration, statistical model, Super-heavy nuclei.

7. Particle Physics:

Basic forces, classification of elementary particle, Gellmann-Nishijima scheme, meson and Baryon octet, isospin, strangeness, spin, parity, Lepton and baryon number, conservation, parity conservation and non conservation, time reversal and consequence of time reversal invariance, charge conjugation, G-parity, Statement of CPT theorem and its consequences, Hadron classification by isospin and hypercharge, SU(2) and SU(3) Groups, algebras and generators;Elementary idea of SU(3) symmetry and Quarks model, need for Color; Elementary ideas of electroweak interactions and standard model.

PAPER-I

UNIT-I BIOLOGY OF NON-CHORDATES

Protozoan parasites of man; Reproduction in sponges; Polymorphism in coelenterates; Helminth parasites of man and parasitic adaptations; Coelom in annelids; Vision in insects; Horseshoe crab and its importance; Locomotory organs and locomotion in molluscs; Larval forms in echinoderms and origin of chordates; Comparative study of the excretory organs and excretion in invertebrates.

UNIT-II BIOLOGY OF CHORDATES

Origin of chordates; Biology and affinity of protochordates; Biology and affinities of Cyclostomes and Dipnoi; Migration in fishers; Metamorphosis in amphibians; Poisonous and non-poisonous snakes of India; Flight adaptation in birds; Adaptive radiation in mammals; Aquatic mammals and their adaptations; Dentition in mammals.

UNIT-III ECOLOGY, BIOSTATISTICS, ANIMAL TAXONOMY

Population and its characteristics; Biotic community; Environmental pollution, Green house effect, Acid rain; Wildlife of India and their conservation; Probability and probability distribution (Normal, Binomial and Poisson); Tests of significance (t- and x^2 tests); Simple correlation; Regression and Analysis of variance; Speciation and species concept; Modern trends in taxonomy; Collection, preservation and curetting of animals of taxonomic importance.

UNIT-IV EVOLUTION, ETHOLOGY

Variation and natural selection as underlying mechanisms of evolution; Isolation and isolating mechanisms in relation to origin of species; Patterns of evolution (micro, Macro and Mega); Hardy-Weinberg principle in relation to population genetics; Molecular and genomic evolution; Ancestry of man; Pheromones and behaviour; Social organization in primates; Courtship and mating behaviour in mammals; Biological clock and circadian rhythm.

UNIT-V ECONOMIC ZOOLOGY, MICROBIOLOGY

Biology of silk moth and sericulture; Apiculture; Earthworm and vermicomposting; Induced breeding in fishes; Pearl culture; Transgenic animals and their importance; Structure of bacteria and bacteriophage; Isolation, screening and culture of bacteria related to production of antibiotics and enzymes; Lytic and lysogenic cycles; Transduction, transformation and conjugation in bacteria.

Zoology PAPER-II **SYLLABUS**

UNIT-I CELL BIOLOGY AND GENETICS

Structure, composition and arrangement of biological membranes; Transport across cell membrane; Cytoskeleton- structure and dynamics; Cell cycle and cell signaling; Cell division – Mitosis and Meiosis; Cell necrosis and apoptosis; Linkage, Crossing over and Gene mapping; Gene interaction; Penetrance and expressivity; Human genome project; Chromosomal aberrations and their genetic consequences;

UNIT-II PHYSIOLOGY AND ENDOCRINOLOGY

Blood groups and blood coagulation; structure of hemoglobin and transport of gases of respiratory importance; Ultra filtration in the mammalian kidney and mechanism of urine formation; Osmoregulation in aquatic animals; Cellular organization of neuron and synaptic transmission; Chemistry and biological action of pituitary hormones; Neurosecretion and hypothalamic control of adenohypophysial function; Mechanism of hormone action; Testicular events and biosynthesis of testosterone; Endocrinology of implantation, parturition and lactation; Role of hormones during pregnancy.

UNIT-III BIOCHEMISTRY AND MOLECULAR BIOLOGY

Electron transport chain and ATP synthesis; Carbohydrate metabolism and its regulation; Protein synthesis, three dimensional structure of protein and protein folding; Kinetics and mechanism of enzyme action; Metabolism of amino acids-transamination, oxidative deamination; Oxidation of fatty acids; DNA structure, types and its organization in the chromatin; Synthesis and processing of mRNA; Regulation of gene expression in prokaryotes; Blotting techniques – Southern, Northern and Western; Gene, genome and genetic code.

UNIT-IV IMMUNOLOGY AND DEVELOPMENTAL BIOLOGY

Antigen, antibody and antigen-antibody reactions; Immunoglobulin – structure and function; Humoral and cell mediated immunity; Immunological aspects of transplantation, autoimmunity and immunotolerance; Hypersensitivity, Vaccines, interferon, episomes and toxins; Biochemical aspects of fertilization, Organizer concept and embryonic induction; Differential gene expression during development; In vitro fertilization and embryo transfer; Regeneration in vertebrates; Stem cell biology.

UNIT-V INSTRUMENTATION AND TEHNIQUES

Microscopy – light, fluorescent, electron (Scanning & Transmission) microscopy; Ultra centrifugation (Differential and Density gradient); Electrophoresis (Agarose and PAGE); UV and visible spectrophotometry; Chromatography – Paper, Gas and Liquid chromatography; Principles and technique of PCR; Radioisotopic techniques and scintillation counting; Karyotyping and chromosomal analysis; Tissue fixation and microtomy; Histochemical methods for the demonstration of carbohydrate, protein, lipid and nucleic acids.