5. PATTERN & SCORING OF J.C.E.C.E. (For Agriculture and other allied courses)-2024

i) Pattern of the Entrance Test:-

Subject

Group Subjects No. of Questions Type of Questions

PCM Physics, Chemistry &

Mathematics
Physics – 50
Chemistry – 50
Mathematics - 50
Objective type (four options
with single correct answer)

PCB Physics, Chemistry &
Biology

Physics – 50
Chemistry – 50
Biology – 50
Objective type (four options
with single correct answer)

PCMB Physics – 50
Chemistry – 50
Biology – 50
Mathematics - 50
Objective type (four options
with single correct answer)

Physics, Chemistry,
Biology & Mathematics

ii) Scoring and Marking

Each question carries 1 mark. For each correct response the Applicant will get 1 mark. For each incorrect response, ¼ marks will be deducted from the total score. No deduction from the total score will, however, be made if no response is indicated for a question in the answer sheet. More than one answer indicated against a question will be considered as incorrect response and will be counted as negative marks.

iii) Language of the Question Papers:-

a. Question Paper consists of bi-lingual i.e. in English and Hindi language.

b. In case of any ambiguity in translation of any of the questions, its English version shall be treated as final and correct.

6 J. C. E. C. E. (For Agriculture and other allied courses) – 2024 Information Bulletin6. DATE & TIMING OF THE ENTRANCE TEST

Subject Duration Timing

Biology - 1 hr.
Physics & Chemistry - 2 hrs.
Mathematics - 1 hr.
The Timing of the examination will be printed on the Admit Card.

7. SYLLABUS FOR THE TEST:

The Question Papers for the Examination shall be based on a common syllabus notified by the CBSE for class 11th &12th

BIOLOGY IN DETAILS

Unit-I Diversity of Living Organisms
Chapter-1: The Living World
Biodiversity; Need for classification; three domains of life; taxonomy and systematics; concept
of species and taxonomical hierarchy; binomial nomenclature
Chapter-2: Biological Classification
Five kingdom classification; Salient features and classification of Monera, Protista and Fungi into major groups; Lichens, Viruses and Viroids.
Chapter-3: Plant Kingdom
Classification of plants into major groups; Salient and distinguishing features and a few examples
of Algae, Bryophyta, Pteridophyta, Gymnospermae (Topics excluded – Angiosperms, Plant Life
Cycle and Alternation of Generations)
Chapter-4: Animal Kingdom
Salient features and classification of animals, non-chordates up to phyla level and chordates up
to class level (salient features and at a few examples of each category).
(No live animals or specimen should be displayed.)
Unit-II Structural Organization in Plant s and Animals
Chapter-5: Morphology of Flowering Plants
Morphology of different parts of flowering plants: root, stem, leaf, inflorescence, flower, fruit and
seed. Description of family Solanaceae
Chapter-6: Anatomy of Flowering Plants
Anatomy and functions of tissue systems in dicots and monocots.
Chapter-7: Structural Organisation in Animals
Morphology, Anatomy and functions of different systems (digestive, circulatory,respiratory, nervous and
reproductive) of frog.

Unit-III Cell: Structure and Function

Chapter-8: Cell-The Unit of Life

Cell theory and cell as the basic unit of life, structure of prokaryotic and eukaryotic cells; Plant cell
and animal cell; cell envelope; cell membrane, cell wall; cell organelles - structure and function;
endomembrane system, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles, mitochondria,
ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus.

2**Chapter-9: Biomolecules**

Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, and nucleic acids; Enzyme - types, properties, enzyme action. (Topics excluded: Nature of Bond Linking Monomers in a Polymer, Dynamic State of Body Constituents
– Concept of Metabolism, Metabolic Basis of Living, The Living State)

Chapter-10: Cell Cycle and Cell Division

Cell cycle, mitosis, meiosis and their significance

Unit-IV Plant Physiology

Chapter-13: Photosynthesis in Higher Plants

Photosynthesis as a means of autotrophic nutrition; site of photosynthesis, pigments involved in
photosynthesis (elementary idea); photochemical and biosynthetic phases of photosynthesis; cyclic
and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C3 and C4
pathways; factors affecting photosynthesis.

Chapter-14: Respiration in Plants

Exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; amphibolic pathways; respiratory quotient.

Chapter-15: Plant - Growth and Development

Seed germination; phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a
plant cell; plant growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA.

Unit-V Human Physiology

Chapter-17: Breathing and Exchange of Gases

Respiratory organs in animals (recall only); Respiratory system in humans; mechanism of breathing and its regulation in humans - exchange of gases, transport of gases and regulation of

respiration, respiratory volume; disorders related to respiration - asthma, emphysema, occupational
respiratory disorders.

Chapter-18: Body Fluids and Circulation

Composition of blood, blood groups, coagulation of blood; composition of lymph and its function;
human circulatory system - Structure of human heart and blood vessels; cardiac cycle, cardiac
output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system -
hypertension, coronary artery disease, angina pectoris, heart failure.

3**Chapter-19: Excretory Products and their Elimination**

Modes of excretion - ammonotelism, ureotelism, uricotelism; human excretory system – structure
and function; urine formation, osmoregulation; regulation of kidney function - renin - angiotensin,
atrial natriuretic factor, ADH and diabetes insipidus; role of other organs in excretion; disorders -
uremia, renal failure, renal calculi, nephritis; dialysis and artificial kidney, kidney transplant.

Chapter-20: Locomotion and Movement

Types of movement - ciliary, flagellar, muscular; skeletal muscle, contractile proteins and muscle
contraction; skeletal system and its functions; joints; disorders of muscular and skeletal systems -
myasthenia gravis, tetany, muscular dystrophy, arthritis, osteoporosis, gout.

Chapter-21: Neural Control and Coordination

Neuron and nerves; Nervous system in humans - central nervous system; peripheral nervous system and visceral nervous system; generation and conduction of nerve impulse

Chapter-22: Chemical Coordination and Integration

Endocrine glands and hormones; human endocrine system - hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; mechanism of hormone action (elementary idea);
role of hormones as messengers and regulators, hypo - and hyperactivity and related disorders;
dwarfism, acromegaly, cretinism, goiter, exophthalmic goitre, diabetes, Addison's disease.

Note: Diseases related to all the human physiological systems to be taught in brief.

class 12

Chapter-2: Sexual Reproduction in Flowering Plants

Flower structure; development of male and female gametophytes; pollination - types, agencies and
examples; out breeding devices; pollen-pistil interaction; double fertilization; post

fertilization
events - development of endosperm and embryo, development of seed and formation of fruit; special modes- apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit
formation.

Chapter-3: Human Reproduction

Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis
-spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).

Chapter-4: Reproductive Health

Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control - need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies - IVF, ZIFT, GIFT (elementary
idea for general awareness).

Unit-VII Genetics and Evolution

Chapter-5: Principles of Inheritance and Variation

Heredity and variation: Mendelian inheritance; deviations from Mendelism – incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and
genes; Sex determination - in humans, birds and honey bee; linkage and crossing over; sex linked
inheritance - haemophilia, colour blindness; Mendelian disorders in humans - thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.

Chapter-6: Molecular Basis of Inheritance

Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central Dogma; transcription, genetic code, translation; gene 7expression and regulation - lac operon; Genome, Human and rice genome projects; DNA fingerprinting.

Chapter-7: Evolution

Origin of life; biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidences); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination)
and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy
- Weinberg's principle; adaptive radiation; human evolution.

Unit-VIII Biology and Human Welfare

Chapter-8: Human Health and Diseases
Pathogens; parasites causing human diseases (malaria, dengue, chikungunya, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm) and their control; Basic
concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug and alcohol abuse.
Chapter-10: Microbes in Human Welfare
Microbes in food processing, industrial production, sewage treatment, energy generation and microbes as bio-control agents and bio-fertilizers. Antibiotics; production and judicious use.
Unit-IX Biotechnology and its Applications
Chapter-11: Biotechnology - Principles and Processes
Genetic Engineering (Recombinant DNA Technology).
Chapter-12: Biotechnology and its Applications
Application of biotechnology in health and agriculture: Human insulin and vaccine production,
stem cell technology, gene therapy; genetically modified organisms - Bt crops; transgenic animals;
biosafety issues, biopiracy and patents.
Unit-X Ecology and Environment
Chapter-13: Organisms and Populations
Population interactions - mutualism, competition, predation, parasitism; population attributes -
growth, birth rate and death rate, age distribution. (Topics excluded: Organism and its Environment, Major Aboitic Factors, Responses to Abioitic Factors, Adaptations)
8**Chapter-14: Ecosystem**
Ecosystems: Patterns, components; productivity and decomposition; energy flow; pyramids of
number, biomass, energy (Topics excluded: Ecological Succession and Nutrient Cycles).
Chapter-15: Biodiversity and its Conservation
Biodiversity-Concept, patterns, importance; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, Sacred Groves, biosphere reserves,
national parks, wildlife, sanctuaries and Ramsar sites.

chemistry

Unit I: Some Basic Concepts of Chemistry 12 Periods
General Introduction: Importance and scope of Chemistry.
Nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements,

atoms and molecules.
Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on
stoichiometry.
Unit II: Structure of Atom 14 Periods
Discovery of Electron, Proton and Neutron, atomic number, isotopes and isobars. Thomson's model and its limitations. Rutherford's model and its limitations, Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes
of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.Unit III: Classification of Elements and Periodicity in Properties 08 Periods
Significance of classification, brief history of the development of periodic table, modern periodic
law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, Ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.
Unit IV: Chemical Bonding and Molecular Structure 14 Periods
Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character
of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry
of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and
shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules(qualitative idea only), Hydrogen bond.
Unit VI: Chemical Thermodynamics 16 Periods
Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions.
First law of thermodynamics -internal energy and enthalpy, heat capacity and specific heat, measurement of U and H, Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution. Second law of Thermodynamics (brief introduction)
Introduction of entropy as a state function, Gibb's energy change for spontaneous and non-spontaneous processes, criteria for equilibrium.
Third law of thermodynamics (brief introduction).
Unit VII: Equilibrium 14 Periods
Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass

action, equilibrium constant, factors affecting equilibrium - Le Chatelier's principle, ionic equilibrium- ionization of acids and bases, strong and weak electrolytes, degree of ionization,
ionization of poly basic acids, acid strength, concept of pH, hydrolysis of salts (elementary idea),
buffer solution, Henderson Equation, solubility product, common ion effect (with illustrative examples).

Unit VIII: Redox Reactions 06 Periods

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number, applications of redox reactions.

Unit XII: Organic Chemistry -Some Basic Principles and Techniques 14 Periods

General introduction, methods of purification, qualitative and quantitative analysis, classification
and IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond:
inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic
fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles and nucleophiles,
types of organic reactions.Unit XIII: Hydrocarbons 12 Periods

Classification of Hydrocarbons

Aliphatic Hydrocarbons:

Alkanes - Nomenclature, isomerism, conformation (ethane only), physical properties, chemical
reactions including free radical mechanism of halogenation, combustion and pyrolysis.

Alkenes - Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions: addition of hydrogen, halogen, water,
hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism
of electrophilic addition.

Alkynes - Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of - hydrogen, halogens, hydrogen halides and water.

Aromatic Hydrocarbons:

Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Craft's
alkylation and acylation, directive influence of functional group in monosubstituted benzene.
Carcinogenicity and toxicity.

Unit II: Solutions 10 Periods
Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in
liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapour pressure,
elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular
masses using colligative properties, abnormal molecular mass, Van't Hoff factor.
Unit III: Electrochemistry 12 Periods
Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to
chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic
solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's
Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells,
lead accumulator, fuel cells, corrosion.Unit IV: Chemical Kinetics 10 Periods
Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration,
temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant,
integrated rate equations and half-life (only for zero and first order reactions), concept of collision
theory (elementary idea, no mathematical treatment), activation energy, Arrhenius equation.
Unit VIII: d and f Block Elements 12 Periods
General introduction, electronic configuration, occurrence and characteristics of transition metals,
general trends in properties of the first row transition metals – metallic character, ionization enthalpy,
oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds,
alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.
Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.
Actinoids - Electronic configuration, oxidation states and comparison with lanthanoids.
Unit IX: Coordination Compounds 12 Periods
Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties
and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding,

Werner's
theory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (in
qualitative analysis, extraction of metals and biological system).
Unit X: Haloalkanes and Haloarenes. 10 Periods
Haloalkanes: Nomenclature, nature of C–X bond, physical and chemical properties, optical rotation
mechanism of substitution reactions.
Haloarenes: Nature of C–X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only).
Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane,
iodoform, freons, DDT.
Unit XI: Alcohols, Phenols and Ethers 10 Periods
Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary
alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration,
uses with special reference to methanol and ethanol.
Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of
phenol, electrophillic substitution reactions, uses of phenols.
Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.Unit XII: Aldehydes, Ketones and Carboxylic Acids 10 Periods
Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical
and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses.
Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical
properties; uses.
Unit XIII: Amines 10 Periods
Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical
properties, uses, identification of primary, secondary and tertiary amines.
Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.
Unit XIV: Biomolecules 12 Periods
Carbohydrates - Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-L
configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch,

cellulose,
glycogen); Importance of carbohydrates.
Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins
- primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation
of proteins; enzymes. Hormones - Elementary idea excluding structure.
Vitamins - Classification and functions.
Nucleic Acids: DNA and RNA.

Maths

Unit-I: Sets and Functions
1. **Sets (20) Periods**
Sets and their representations, Empty set, Finite and Infinite sets, Equal sets, Subsets, Subsets of
a set of real numbers especially intervals (with notations). Universal set. Venn diagrams. Union
and Intersection of sets. Difference of sets. Complement of a set. Properties of Complement.
2. **Relations & Functions (20) Periods**
Ordered pairs. Cartesian product of sets. Number of elements in the Cartesian product of two finite
sets. Cartesian product of the set of reals with itself (upto R x R x R).Definition of relation, pictorial
diagrams, domain, co-domain and range of a relation. Function as a special type of relation.
Pictorial representation of a function, domain, co-domain and range of a function. Real valued
functions, domain and range of these functions, constant, identity, polynomial, rational, modulus,
signum, exponential, logarithmic and greatest integer functions, with their graphs. Sum, difference,
product and quotients of functions.
3. **Trigonometric Functions (20) Periods**
Positive and negative angles. Measuring angles in radians and in degrees and conversion from
one measure to another. Definition of trigonometric functions with the help of unit circle. Truth ofcot y ± cot x
the identity sin2x + cos2x = 1, for all x. Signs of trigonometric functions. Domain and range of trigonometric functions and their graphs. Expressing *sin (x±y)* and *cos (x±y)* in terms of sin*x*, sin*y*,
cos*x* & cos*y* and their simple applications. Deducing identities like the following:

tan x ± tan y
cot x cot y ∓ 1
tan(x ± y) =
, cot(x ± y) =
1 ∓ tan x tan y
1
sinα ± sinβ= 2sin
2 (α ± β)cos
1
1
2 (α ∓ β)
1
cosα + cosβ= 2cos
2 (α + β)cos
2 (α– β)
1
1
$cos\alpha - cos\beta$ = –2sin
2 (α + β)sin
2 (α – β)
Identities related to sin2*x*, cos2*x*, tan2 *x*, sin3*x*, cos3*x* and tan3*x*.

Unit-II: Algebra

1. **Complex Numbers and Quadratic Equations (10) Periods**

Need for complex numbers, especially$\sqrt{}$–1, to be motivated by inability to solve some of the quadratic equations. Algebraic properties of complex numbers. Argand plane

2. **Linear Inequalities (10) Periods**

Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation
on the number line.

3. **Permutations and Combinations (10) Periods**

Fundamental principle of counting. Factorial *n*. (n!) Permutations and combinations, derivation of
Formulae for nPr and nCr and their connections, simple applications.

4. **Binomial Theorem (10) Periods**

Historical perspective, statement and proof of the binomial theorem for positive integral indices.
Pascal's triangle, simple applications.

5. **Sequence and Series (10) Periods**

Sequence and Series. Arithmetic Mean (A.M.) Geometric Progression (G.P.), general term of a
G.P., sum of *n* terms of a G.P., infinite G.P. and its sum, geometric mean (G.M.), relation

between
A.M. and G.M.**Unit-III: Coordinate Geometry**

1. Straight Lines (15) Periods

Brief recall of two dimensional geometry from earlier classes. Slope of a line and angle between
two lines. Various forms of equations of a line: parallel to axis, point -slope form, slope-intercept
form, two-point form, intercept form, Distance of a point from a line.

2. Conic Sections (25) Periods

Sections of a cone: circles, ellipse, parabola, hyperbola, a point, a straight line and a pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle.

3. Introduction to Three-dimensional Geometry (10) Periods

Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points.

Unit-IV: Calculus

1. Limits and Derivatives (40) Periods

Derivative introduced as rate of change both as that of distance function and geometrically. Intuitive
idea of limit. Limits of polynomials and rational functions trigonometric, exponential and logarithmic
functions. Definition of derivative relate it to scope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.

Unit-V Statistics and Probability

1. Statistics (20) Periods

Measures of Dispersion: Range, Mean deviation, variance and standard deviation of ungrouped/grouped data.

2. Probability (20) Periods

Events; occurrence of events, ‘not’, ‘and’ and ‘or’ events, exhaustive events, mutually exclusive
events, Axiomatic (set theoretic) probability, connections with other theories of earlier classes.
Probability of an event, probability of ‘not’, ‘and’ and ‘or’ events

Unit-I: Relations and Functions

1. Relations and Functions 15 Periods

Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto
functions.

2. Inverse Trigonometric Functions 15 Periods

Definition, range, domain, principal value branch. Graphs of inverse trigonometric functions.

Unit-II: Algebra

1. Matrices 25 Periods

Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix,
symmetric and skew symmetric matrices. Operations on matrices: Addition and multiplication and
multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication. Non-
commutativity of multiplication of matrices and existence of non-zero matrices whose product is the
zero matrix (restrict to square matrices of order 2). Invertible matrices and proof of the uniqueness of
inverse, if it exists; (Here all matrices will have real entries).

2. Determinants 25 Periods Determinant of a square matrix (up to 3 x 3 matrices), minors, co-factors and applications of
determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency,
inconsistency and number of solutions of system of linear equations by examples, solving system of
linear equations in two or three variables (having unique solution) using inverse of a matrix.

Unit-III: Calculus

1. Continuity and Differentiability 20 Periods

Continuity and differentiability, chain rule, derivative of inverse trigonometric functions, $like$ sin–1 x , cos–1 x and tan–1 x, derivative of implicit functions. Concept of exponential and logarithmic
functions.
Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions
expressed in parametric forms. Second order derivatives.

2. Applications of Derivatives 10 Periods

Applications of derivatives: rate of change of quantities, increasing/decreasing functions, maxima and
minima (first derivative test motivated geometrically and second derivative test given as a provable
tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-
life situations).

3. Integrals 20 Periods

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by

partial fractions and by parts, Evaluation of simple integrals of the following types and problems based
on them.
ax2 + bx + c
dx
, ∫ dx
√ax2 + bx + c
dx, ∫ √a2 ± x2 dx, ∫ √x2 – a2 dx
∫ dx
x2 ± a2, ∫ dx
√x2 ± a2
, ∫ dx
√a2 – x2 , ∫ ∫ px + q
ax2 + bx + c
dx, ∫ px + q
√ax2+bx + c
∫ √ax2 + bx + c dx,
Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation
of definite integrals.

4. Applications of the Integrals 15 Periods

Applications in finding the area under simple curves, especially lines, circles/ parabolas/ ellipses (in
standard form only)

5. Differential Equations 15 Periods

Definition, order and degree, general and particular solutions of a differential equation. Solution of
differential equations by method of separation of variables, solutions of homogeneous differential
equations of first order and first degree. Solutions of linear differential equation of the type:dx
dy
dx + py = q, where p and q are functions of x or constants.
+ px = q, where p and q are functions of y or constants.
dy

Unit-IV: Vectors and Three-Dimensional Geometry

1. Vectors 15 Periods

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a
vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point,

negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar,
position vector of a point dividing a line segment in a given ratio. Definition, Geometrical Interpretation,
properties and application of scalar (dot) product of vectors, vector (cross) product of vectors.

2. Three - dimensional Geometry 15 Periods

Direction cosines and direction ratios of a line joining two points. Cartesian equation and vector equation
of a line, skew lines, shortest distance between two lines. Angle between two lines.

Unit-V: Linear Programming

1. Linear Programming 20 Periods

Introduction, related terminology such as constraints, objective function, optimization, graphical method
of solution for problems in two variables, feasible and infeasible regions (bounded or unbounded),
feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

Unit-VI: Probability

1. Probability 30 Periods

Conditional probability, multiplication theorem on probability, independent events, total probability,
Bayes' theorem, Random variable and its probability distribution, mean of random variable

Physics

Unit I: Physical World and Measurement Chapter–2: Units and Measurements
08 Periods

Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. significant figures. Dimensions of physical quantities, dimensional analysis and its applications.

Unit II: Kinematics 24 Periods

Chapter–3: Motion in a Straight Line

Frame of reference, Motion in a straight line, Elementary concepts of differentiation and integration for describing motion, uniform and non-uniform motion, and instantaneous velocity, uniformly accelerated motion, velocity - time and position-time graphs. Relations for uniformly accelerated motion (graphical treatment).

Chapter–4: Motion in a Plane

Scalar and vector quantities; position and displacement vectors, general vectors and their notations; equality of vectors, multiplication of vectors by a

real number; addition and subtraction of vectors, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors.

Motion in a plane, cases of uniform velocity and uniform acceleration-projectile motion, uniform circular motion.

Unit III: Laws of Motion 14 Periods

Chapter–5: Laws of Motion

Intuitive concept of force, Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion.

Law of conservation of linear momentum and its applications.Equilibrium of concurrent forces, Static and kinetic friction, laws of friction, rolling friction, lubrication.

Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).

Unit IV: Work, Energy and Power 14 Periods

Chapter–6: Work, Energy and Power

Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power.

Notion of potential energy, potential energy of a spring, conservative forces: non-conservative forces, motion in a vertical circle; elastic and inelastic collisions in one and two dimensions.

Unit V: Motion of System of Particles and Rigid Body 18 Periods

Chapter–7: System of Particles and Rotational Motion

Centre of mass of a two-particle system, momentum conservation and Centre of mass motion. Centre of mass of a rigid body; centre of mass of a uniform rod.

Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications.

Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions.

Moment of inertia, radius of gyration, values of moments of inertia for simple geometrical objects (no derivation).

Unit VI: Gravitation 12 Periods

Chapter–8: Gravitation

Kepler's laws of planetary motion, universal law of gravitation.

Acceleration due to gravity and its variation with altitude and depth.

Gravitational potential energy and gravitational potential, escape speed,orbital velocity of a satellite.

Unit VII: Properties of Bulk Matter 24 Periods

Chapter–9: Mechanical Properties of Solids

Elasticity, Stress-strain relationship, Hooke's law, Young’s modulus, bulk

modulus, shear modulus of rigidity (qualitative idea only), Poisson's ratio; elastic energy.

Chapter–10: Mechanical Properties of Fluids

Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes), effect of gravity on fluid pressure.

Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity, Bernoulli's theorem and its simple applications.

Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension ideas to drops, bubbles and capillary rise.

Chapter–11: Thermal Properties of Matter

Heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity; Cp, Cv - calorimetry; change of state - latent heat capacity.

Heat transfer-conduction, convection and radiation, thermal conductivity, qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's law .

Unit VIII: Thermodynamics 12 Periods

Chapter–12: Thermodynamics

Thermal equilibrium and definition of temperature, zeroth law of thermodynamics, heat, work and internal energy. First law of thermodynamics,

Second law of thermodynamics: gaseous state of matter, change of conditionof gaseous state -isothermal, adiabatic, reversible, irreversible, and cyclic processes.

Unit IX:Behavior of Perfect Gases and Kinetic Theory of Gases 08 Periods

Chapter–13: Kinetic Theory

Equation of state of a perfect gas, work done in compressing a gas.

Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equi-partition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

Unit X: Oscillations and Waves 26 Periods

Chapter–14: Oscillations

Periodic motion - time period, frequency, displacement as a function of time, periodic functions and their applications.

Simple harmonic motion (S.H.M) and its equations of motion; phase; oscillations of a loaded spring- restoring force and force constant; energy in S.H.M.

Kinetic and potential energies; simple pendulum derivation of expression for its time period.

Chapter–15: Waves

Wave motion: Transverse and longitudinal waves, speed of travelling wave, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats

Unit I: Electrostatics 26 Periods

Chapter–1: Electric Charges and Fields

Electric charges, Conservation of charge, Coulomb's law-force between two- point charges, forces between multiple charges; superposition principle and continuous charge distribution.

Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric field.

Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).

Chapter–2: Electrostatic Potential and Capacitance

Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two-point charges and of electric dipole in an electrostatic field.

Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarization, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor (no derivation, formulae only).

Unit II: Current Electricity 18 Periods

Chapter–3: Current Electricity

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, temperature dependence of resistance, Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel, Kirchhoff's rules, Wheatstone bridge.**Unit III: Magnetic Effects of Current and Magnetism 25 Periods**

Chapter–4: Moving Charges and Magnetism

Concept of magnetic field, Oersted's experiment.

Biot - Savart law and its application to current carrying circular loop.

Ampere's law and its applications to infinitely long straight wire. Straight solenoid (only qualitative treatment), force on a moving charge in uniform

magnetic and electric fields.
Force on a current-carrying conductor in a uniform magnetic field, force between two parallel current-carrying conductors-definition of ampere, torque experienced by a current loop in uniform magnetic field; Current loop as a magnetic dipole and its magnetic dipole moment, moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.

Chapter–5: Magnetism and Matter

Bar magnet, bar magnet as an equivalent solenoid (qualitative treatment only), magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis (qualitative treatment only), torque on a magnetic dipole (bar magnet) in a uniform magnetic field (qualitative treatment only), magnetic field lines.
Magnetic properties of materials- Para-, dia- and ferro - magnetic substances with examples, Magnetization of materials, effect of temperature on magnetic properties.

Unit IV: Electromagnetic Induction and Alternating Currents 24 Periods

Chapter–6: Electromagnetic Induction

Electromagnetic induction; Faraday's laws, induced EMF and current; Lenz's Law, Self and mutual induction.**Chapter–7: Alternating Current**
Alternating currents, peak and RMS value of alternating current/voltage; reactance and impedance; LCR series circuit (phasors only), resonance, power in AC circuits, power factor, wattless current.
AC generator, Transformer.

Unit V: Electromagnetic waves 04 Periods

Chapter–8: Electromagnetic Waves

Basic idea of displacement current, Electromagnetic waves, their characteristics, their transverse nature (qualitative idea only).
Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Unit VI: Optics 30 Periods

Chapter–9: Ray Optics and Optical Instruments

Ray Optics: Reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and optical fibers, refraction at spherical surfaces, lenses, thin lens formula, lens maker’s formula, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism.
Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Chapter–10: Wave Optics

Wave optics: Wave front and Huygen’s principle, reflection and refraction

of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen’s principle. Interference, Young's double slit experiment and expression for fringe width (No derivation final expression only), coherent sources and sustained interference of light, diffraction due to a single slit, width of central maxima (qualitative treatment only).**Unit VII: Dual Nature of Radiation and Matter 08 Periods**

Chapter–11: Dual Nature of Radiation and Matter

Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Experimental study of photoelectric effect

Matter waves-wave nature of particles, de-Broglie relation.

Unit VIII: Atoms and Nuclei 15 Periods

Chapter–12: Atoms

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model of hydrogen atom, Expression for radius of nth possible orbit, velocity and energy of electron in nth orbit, hydrogen line spectra (qualitative treatment only).

Chapter–13: Nuclei

Composition and size of nucleus, nuclear force

Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion.

Unit IX: Electronic Devices 10 Periods

Chapter–14: Semiconductor Electronics: Materials, Devices and Simple Circuits

Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Intrinsic and extrinsic semiconductors- p and n type, p-n junction Semiconductor diode - I-V characteristics in forward and reverse bias, application of junction diode -diode as a rectifier

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