

Program Learning Outcomes (POs) in 3-year MDC Botany (NEP 2020)

The student who completes 3-year MDC Botany should be able to-

- Generate a strong knowledgebase in the subject of Botany, as well as related subject areas, ensuring their fundamental competency in these fields. The students will demonstrate the capability to categorise primary plant groups and analyse the distinguishing features of lower (e.g. algae and fungus) and higher (angiosperms and gymnosperms) plants, and elucidate diverse plant processes and functions, metabolic activities, concepts of genes and genome, as well as how the functioning of organisms is impacted at the cellular, tissue, and organ levels.
- Learn various hands-on techniques enabling them practically equipped for biotechnological industries.
- Showcase their proficiency in the experimental techniques and methodologies specific to their specialised field of Botany.
- Utilize scientific methodologies to solve varied questions which involves establishing hypotheses, collecting data, and critically analysing the facts to determine the extent to which their scientific work corroborates their hypotheses.
- Improve their ethical and moral views and develop the ability to address psychological vulnerabilities.
- Acquire collaboration and cooperation skills to work as a team thereby effectively contributing to institutions, industry, and society.
- Establish themselves as independent learner by gaining subject-specific abilities. In the field of botany, the programme outcome will provide information and skills that may be applied to pursue higher education, competitive tests, and employment opportunities. An outcomes-based curriculum would guarantee uniform academic standards across and provide a comprehensive assessment of students' abilities.

POs in 3-year MDC Botany (NEP 2020)

- PO 1. Generate a strong knowledgebase in the subject**
- PO 2. Learn hands-on techniques for industrial applications**
- PO 3. Showcase the proficiency in the experimental techniques**
- PO 4. Utilize scientific methodologies to solve varied questions**
- PO 5. Improve their ethical and moral views**
- PO 6. Acquire collaboration and cooperation skills to work as a team**
- PO 7. Establish themselves as independent learner**

Course Learning Outcomes (COs)

Plant diversity (BOT-MD-CC1-1-Th, BOT-MD-CC1-1-P)

- CO 1. Acquire an understanding of various algal and fungal groups including their diagnostic characters, examples and economic value.
- CO 2. Accomplish an idea of lichens, as well as a curiosity for the adaptive characteristics of these organisms.
- CO 3. Demonstrate a grasp of bryophytes, their life history and economic importance.
- CO 4. Gain knowledge of the morphology and reproduction procedures of pteridophytes, and gymnosperms
- CO 5. Develop a foundation on the origin of plant cells and importance of plants as food, fuel etc.
- CO 6. Acquire a grasp of angiosperm morphology, especially of flower and fruits.
- CO 7. Grasp practical knowledges to the collection, systematic study and identification of plants.

COs-POs Mapping

Plant diversity (BOT-MD-CC1-1-Th, BOT-MD-CC1-1-P)

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√		√		√	√	√
CO2	√			√	√	√	√
CO3	√				√	√	√
CO4	√			√	√	√	√

CO5	√				√	√	√
CO6	√		√	√		√	√
CO7	√	√	√	√	√	√	√

Course Learning Outcomes (COs)

Plant systematics (BOT-MD-CC2-2-Th, BOT-MD-CC2-2-P)

- CO 1. The theory of plant systematics and recognize the significance of herbarium and virtual herbarium
- CO 2. Evaluate the importance of herbaria and botanical gardens
- CO 3. Interpret the rules of ICN in botanical nomenclature
- CO 4. Learn the concepts associated with Numerical taxonomy and Phylogenetic classification.
- CO 5. Generalize the characteristics of the families under the classification scheme developed by Bentham and Hooker.
- CO 6. Grasp practical knowledges to the collection, systematic study and identification of plants.

COs-POs Mapping

Plant systematics (BOT-MD-CC2-2-Th, BOT-MD-CC2-2-P)

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√				√	√	√
CO2	√			√	√	√	√
CO3	√			√	√	√	√
CO4	√	√	√	√	√	√	√
CO5	√			√	√	√	√
CO6	√	√	√	√	√	√	√

Course Learning Outcomes (COs)

Economic Botany (BOT-MD-CC3-3-Th BOT-MD-CC3-3-P)

- CO 1. Develop a fundamental understanding of economic botany and be able to link to the environment, populations, communities, and biological ecosystems.
- CO 2. Gain an in-depth comprehension of the development of the concept of organization of apex new crops and varieties, the significance of germplasm diversity, and the problems associated with access and ownership.
- CO 3. Have a fundamental understanding of the taxonomic diversity and notable families of plants that are of practical utility.
- CO 4. Raise people's awareness of and appreciation for the plants and plant products that they come into contact with in their daily lives.
- CO 5. Recognize the wide variety of plant species and the varieties of plant products that are used by humans.

COs-POs Mapping

Economic Botany (BOT-MD-CC3-3-Th BOT-MD-CC3-3-P)

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√				√	√	√
CO2	√	√	√	√	√	√	√
CO3	√		√	√	√	√	√
CO4	√		√	√	√	√	√
CO5	√	√	√	√	√	√	√

Course Learning Outcomes (COs)

Pharmacognosy & Ethnobotany (BOT-MD-CC4-4-Th BOT-MD-CC4-4-P)

- CO 1. Be familiar with the fundamental pharmacognosy and its importance in modern medicine, crude drugs and Classification of drugs.
- CO 2. Have in depth knowledge on pharmacologically active constituents and biosynthesis of various secondary metabolites.
- CO 3. Learn the procedure of chemical, microscopic and histochemical tests for identification of medicinal herbs.
- CO 4. Propose new strategies to implement the knowledges of ethnomedicine, taking into consideration the practical concerns that are relevant to India.

COs-POs Mapping

Pharmacognosy & Ethnobotany (BOT-MD-CC4-4-Th BOT-MD-CC4-4-P)

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√	√	√		√	√	√
CO2	√		√	√	√	√	√
CO3	√		√	√	√	√	√
CO4	√	√	√	√	√	√	√

Course Learning Outcomes (COs)

Plant Geography, Ecology & Evolution (BOT-MD-CC5-4-Th BOT-MD-CC5-4-P)

- CO 1. Understand fundamental concepts of biotic and abiotic systems
- CO 2. Analyze the phytogeography or phytogeographical division of India
- CO 3. Understand the cornerstones of ecological systems and community ecology
- CO 4. Evaluate the process of adaptation of plants, succession stages, and phytoremediation.
- CO 5. Conduct experiments using skills that are appropriate to estimate environmental health.
- CO 6. Acquire an understanding of the ideas of natural selection and the mechanisms that underlie evolution.

COs-POs Mapping

Plant Geography, Ecology & Evolution (BOT-MD-CC5-4-Th BOT-MD-CC5-4-P)

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√	√	√		√	√	√
CO2	√		√	√	√	√	√
CO3	√		√	√	√	√	√
CO4	√		√	√	√	√	√
CO5	√	√	√		√	√	√
CO6	√		√	√	√	√	√

Course Learning Outcomes (COs)

BOT-MD-CC6-5-Th BOT-MD-CC6-5-P Plant anatomy & Embryology

- CO 1. Understand the organization of plant cells, simple and complex tissues, stelar types, and stomata
- CO 2. Analyze the primary internal structure and normal secondary growth of monocot and dicot stems, roots, and leaves
- CO 3. Evaluate the developmental theories of shoot and root apices, and structural adaptations in ecological variants
- CO 4. Comprehend the reproductive biology of angiosperms, including gametogenesis, fertilization, embryogenesis, and apomixis
- CO 5. Demonstrate proficiency in microscopic sectioning, temporary staining, and the identification of anatomical and reproductive structures

COs-POs Mapping

BOT-MD-CC6-5-Th BOT-MD-CC6-5-P Plant anatomy & Embryology

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√						√
CO2	√			√			√
CO3	√			√			√
CO4	√						√
CO5			√	√	√	√	√

Course Learning Outcomes (COs)

BOT-MD-CC7-5-Th BOT-MD-CC7-5-P Cell Biology & Genetics

- CO 1. Compare the structure and function of cells, including the concept that explains the chemical composition and structure of the cell wall and membrane
- CO 2. Have a conceptual understanding of the laws of inheritance, the genetic basis of loci and alleles, and their linkage
- CO 3. Comprehend the effect of chromosomal abnormalities involving numerical as well as structural changes leading to genetic disorders
- CO 4. Develop a critical understanding of the chemical basis of genes, the effect of mutations on gene functions, and their interactions at population and evolutionary levels
- CO 5. Demonstrate proficiency in experimental techniques for cell biology and genetics, such as performing squash preparations to study cell division (mitosis/meiosis)

COs-POs Mapping

BOT-MD-CC7-5-Th BOT-MD-CC7-5-P Cell Biology & Genetics

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√			√			√
CO2	√			√			√
CO3	√			√			√
CO4	√			√			√
CO5	√	√	√	√	√	√	√

Course Learning Outcomes (COs)

BOT-MD-CC8-6-Th BOT-MD-CC8-6-P Plant Physiology & Biochemistry

- CO 1. Understand water relations of plants with respect to various physiological processes, explain chemical properties, and identify mineral deficiency symptoms in plants
- CO 2. Classify aerobic and anaerobic respiration, and explain the significance of photosynthesis and respiration
- CO 3. Assess dormancy and germination in plants, including the synthesis, distribution, and physiological effects of phytohormones
- CO 4. Differentiate anabolic and catabolic pathways of metabolism, and recognize the importance of carbon assimilation in photorespiration
- CO 5. Explain the mechanism of ATP-synthesis and interpret biological nitrogen fixation in metabolism
- CO 6. Demonstrate proficiency in experimental techniques such as quantitative and qualitative estimation of sugars, amino acids, and proteins

COs-POs Mapping

BOT-MD-CC8-6-Th BOT-MD-CC8-6-P Plant Physiology & Biochemistry

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√						√
CO2	√			√			√
CO3	√	√					√
CO4	√			√			√
CO5	√			√			√

CO6	√	√	√	√	√	√	√
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Course Learning Outcomes (COs)

Mushroom Cultivation Technology (BOT-MD-SEC-1-Th, BOT-MD-SEC-1-P)

- CO 1. Recognize multiple types and categories of mushrooms, their health beneficial values and idea of poisonous mushrooms.
- CO 2. Showcasing several kinds of mushroom cultivation technologies including the knowledge and industrial designs and required appliances for cultivation of mushroom.
- CO 3. Explore the procedures of multiple stages of mushroom cultivation and their variability in different types of mushrooms.
- CO 4. Learn the management strategies to overcome the mushroom diseases and the postharvest processing technologies for increasing the shelf life.
- CO 5. Assess the financial aspects related to the production of mushrooms and create innovative techniques and plans to boost the yield of mushrooms.

COs-POs Mapping

Mushroom Cultivation Technology (BOT-MD-SEC-1-Th, BOT-MD-SEC-1-P)

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	√		√	√	√	√	√
CO2	√		√	√	√	√	√
CO3	√	√	√	√	√	√	√
CO4	√		√		√	√	√
CO5	√	√	√	√	√	√	√

CC - 1

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MAJOR)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

Core Course

CC1: Fundamentals of Chemistry - I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

C01: Extra nuclear structure of atoms and Periodicity:

C02: Basics of Organic Chemistry Bonding and Physical Properties, Valence Bond Theory, Electronic displacement, MO Theory, Physical properties, Stereochemistry – I

C03: Thermodynamics -I, Chemical Kinetics-I,

C04: Acid-Base Titrations, Oxidation-Reduction Titrimetry

COs-POs Mapping

CC1: Fundamentals of Chemistry - I

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	√
C03	√	√		√	√				√	√
C04	√	√	√	√	√	√			√	√

CC - 2

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MAJOR)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

Core Course4

CC2: Fundamentals of Chemistry - II

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

C01: Chemical Bonding – I, Theoretical principles of inorganic qualitative analysis

C02: Stereochemistry – II, General Treatment of Reaction Mechanism–I, Reactive intermediates, Reaction thermodynamics, Reaction kinetics, Substitution Reaction

C03: Kinetic Theory and Gaseous state, Real gas and Virial equation,

C04: Qualitative semimicro analysis of mixtures containing three radicals.

COs-POs Mapping

CC2: Fundamentals of Chemistry - II

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	√
C03	√	√		√	√				√	√
C04	√	√	√	√	√	√			√	√

CC - 3

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MAJOR)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

Core Course

Paper: CHEM-MD CC3-3: Organic Chemistry – I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- C01:** Aromatic Substitution, Electrophilic aromatic substitution, Nucleophilic aromatic substitution, Birch Reduction of benzenoid aromatics, General Treatment of Reaction Mechanism –II, Concept of organic acids and bases, Tautomerism
- C02:** Stereochemistry –III, Nucleophilic substitution reactions, Elimination reactions
- C03:** Chemistry of alkenes and alkynes, Addition to $C\equiv C$ (in comparison to $C=C$),
- C04:** Identification of Pure Single organic Compound

COs-POs Mapping

DSCC-3: Organic Chemistry – I

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√					√
C02	√	√		√	√					√
C03	√	√		√	√					√
C04	√	√	√	√	√		√		√	√

CC - 4

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MAJOR)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

Core Course

Paper: CHEM-MD CC4-4: Inorganic Chemistry - I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO1: Chemical bonding-II: Molecular orbital concept of bonding, Metallic Bond, Weak Chemical Forces.**
- CO2: Acids and bases: Acid-Base concept, Acid-base equilibria in aqueous solution..**
- CO3: Radioactivity: Nuclear stability, Nuclear Reactions, Radiocarbon dating**
- CO4: Complexometric Titration: Ca (II) and Mg (II) in a mixture, Hardness of water, Fe (III) and Al (III) in a mixture, Cu (II) and Zn (II) in a mixture, Cu (II) and Ni (II) in a mixture**

COs-POs Mapping

CC-4: Inorganic Chemistry - I

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	√
C03	√	√		√	√				√	√
C04	√	√	√	√	√	√			√	√

CC 5

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MAJOR)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

Core Course

PAPER: CHEM-MD CC5-4
(Credit: Theory -03, Practical – 01)

Physical Chemistry - II

Course learning outcome (COs)

CO1: Thermodynamics – II, Second Law, Systems of Variable Compositions

CO2: Applications of Thermodynamics – I, Chemical Equilibrium

CO3: ELECTROCHEMISTRY-I, Conductance, Ionic Equilibrium

CO4: Chemical Kinetics (Analytical) Experiments

COs-POs Mapping

CC5: Physical Chemistry - I

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	
C03	√	√		√	√				√	√
C04	√	√	√	√	√	√		√	√	√

MDC (CC– 6)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MULTIDISCIPLINARY)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry MDC

Paper: CHEM-MD CC6-5: Organic Chemistry-II

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO1: Stereochemistry – IV: Conformation-II, Concept of prostereoisomerism, Chirality arising out of stereoaxis.**
- CO2: Chemistry of carbonyl Compounds: Nucleophilic Addition to C=O, Exploitation of acidity of α -H of C=O, Nucleophilic addition to α , β -unsaturated carbonyl system, Substitution at sp^2 carbon (C=O system).**
- CO3: Organometallics.**
- CO4: Qualitative analysis of single solid organic compound.**

COs-POs Mapping

CC-6: Organic Chemistry-II

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√	√					√
CO2	√	√		√	√					√
CO3	√	√		√	√					√
CO4	√	√	√	√	√		√		√	√

CHEM-MDC-CC7

PROGRAMME OUTCOME OF THREE YEAR B. SC. CHEMISTRY (MDC)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

CHEMISTRY MDC (CC-7)

PAPER: CHEM-MD-CC7-5 / CHEM-MD-CC7-6

(Credit: Theory -03, Practical – 01)

Physical Chemistry - II

Course learning outcome (COs)

CO1: Transport processes and Liquid State, Diffusion and Viscosity, Surface tension and energy

CO2: Solid State, Bravais Lattice and Laws of Crystallography, Crystal plane

CO3: Application of Thermodynamics – II, Colligative properties, Phase Equilibrium

CO4: ELECTROCHEMISTRY-II, Electromotive Force

CO5: Surface tension measurements using Stalagmometer, Viscosity measurement using Ostwald's viscometer, Conductometric Experiments

COs-POs Mapping

CC7: Physical Chemistry - II

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	
C03	√	√		√	√				√	√
C04	√	√		√	√				√	
C05	√	√	√	√	√	√		√	√	√

MDC (CC– 8)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MULTIDISCIPLINARY)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry MDC

Paper: CHEM-MD-CC8-6: Inorganic Chemistry - II

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO1: Coordination chemistry: Basics of coordination chemistry, Valence bond theory and crystal field theory, Electronic spectra of complexes and magnetic properties.**
- CO2: Supramolecular chemistry.**
- CO3: Redox reactions: Basic principle of redox reactions, Redox titrations,**
- CO4: Estimation of mixtures of metal ions: Fe^{3+} and Cu^{2+} in a mixture, Fe^{3+} and Cr^{3+} in a mixture, Fe^{3+} and $\text{Cr}_2\text{O}_7^{2-}$ in a mixture, Fe^{3+} and Mn^{2+} in a mixture, Cr^{3+} and Mn^{2+} in a mixture.**

COs-POs Mapping

CC-8: Inorganic Chemistry - II

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√	√				√	√
CO2	√	√		√	√				√	√
CO3	√	√		√	√				√	√
CO4	√	√	√	√	√	√			√	√

MDC MINOR (MN – 1)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MINOR)

P01: Core competency

P02: Disciplinary knowledge and skill

P03: Skilled communicator

P04: Critical thinker and problem solver

P05: Sense of inquiry

P06: Team player

P07: Skilled project manager

P08: Digitally literate

P09: Ethical awareness/reasoning

P010: Lifelong learner

Core Course

CC1: Fundamentals of Chemistry - I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

CO1: Extra nuclear structure of atoms and Periodicity:

CO2: Basics of Organic Chemistry Bonding and Physical Properties, Valence Bond Theory, Electronic displacement, MO Theory, Physical properties, Stereochemistry – I

CO3: Thermodynamics -I, Chemical Kinetics-I,

CO4: Acid-Base Titrations, Oxidation-Reduction Titrimetry

COs-POs Mapping

CC1: Fundamentals of Chemistry - I

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	√
C03	√	√		√	√				√	√
C04	√	√	√	√	√	√			√	√

MDC MINOR (MN – 2)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MINOR)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry MDC Minor (MN-2)

Paper: CHEM-MD CC2-4: Fundamentals of Chemistry - II

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO1: Kinetic Theory and Gaseous state, Real gas and Virial equation,**
- CO2: Chemical Bonding – I: i) Ionic bond, ii) Covalent bond; Theoretical principles of inorganic qualitative analysis**
- CO3: Stereochemistry – II, General Treatment of Reaction Mechanism–I: Reactive intermediates, Reaction thermodynamics, Reaction kinetics, Substitution Reaction**
- CO4: Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions (only water /acid soluble salts):**

COs-POs Mapping

MN-2: Fundamentals of Chemistry - II

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√	√				√	√
CO2	√	√		√	√				√	√
CO3	√	√		√	√				√	√
CO4	√	√	√	√	√	√			√	√

MN - 3

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MINOR)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry Minor (MN)

Paper: CHEM-MD CC3-5: Organic Chemistry – I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO1: Aromatic Substitution: Electrophilic aromatic substitution, Nucleophilic aromatic substitution, Birch Reduction of benzenoid aromatics. General Treatment of Reaction Mechanism –II: Concept of organic acids and bases, Tautomerism**
- CO2: Stereochemistry –III: Conformation-I, Substitution and Elimination Reactions: Nucleophilic substitution reactions, Elimination reactions.**
- CO3: Chemistry of alkenes and alkynes: Addition to C=C, Addition to C≡C (in comparison to C=C).**
- CO4: Identification of Pure Single organic Compound: Solid compounds, Liquid compounds**

COs-POs Mapping

MN-3: Organic Chemistry-I

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√	√					√
CO2	√	√		√	√					√
CO3	√	√		√	√					√
CO4	√	√	√	√	√		√		√	√

MDC (MN – 4)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MINOR)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry MDC Minor (MN-4)

Paper: CHEM-MD CC4-5: Inorganic Chemistry - I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO1: Chemical bonding-II: Molecular orbital concept of bonding, Metallic Bond, Weak Chemical Forces.**
- CO2: Acids and bases: Acid-Base concept, Acid-base equilibria in aqueous solution..**
- CO3: Radioactivity: Nuclear stability, Nuclear Reactions, Radiocarbon dating**
- CO4: Complexometric Titration: Ca (II) and Mg (II) in a mixture, Hardness of water, Fe (III) and Al (III) in a mixture, Cu (II) and Zn (II) in a mixture, Cu (II) and Ni (II) in a mixture**

COs-POs Mapping

MN-4: Inorganic Chemistry - I

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√	√				√	√
CO2	√	√		√	√				√	√
CO3	√	√		√	√				√	√
CO4	√	√	√	√	√	√			√	√

MDC (MN– 5)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MULTIDISCIPLINARY)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry MDC MINOR

Paper: CHEM-MD CC5-6: Physical Chemistry-I

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

C01: Thermodynamics - II: Second Law, Systems of Variable Compositions.

C02: Applications of Thermodynamics – I: Chemical Equilibrium,

C03: ELECTROCHEMISTRY-I: Conductance, Ionic Equilibrium.

C04: Chemical Kinetics (Analytical).

COs-POs Mapping

MN-5: Physical Chemistry-I

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
C01	√	√		√	√				√	√
C02	√	√		√	√				√	
C03	√	√		√	√				√	√
C04	√	√	√	√	√	√		√	√	√

MDC (MN– 6)

PROGRAMME OUTCOME OF B. SC. CHEMISTRY (MULTIDISCIPLINARY)

PO1: Core competency

PO2: Disciplinary knowledge and skill

PO3: Skilled communicator

PO4: Critical thinker and problem solver

PO5: Sense of inquiry

PO6: Team player

PO7: Skilled project manager

PO8: Digitally literate

PO9: Ethical awareness/reasoning

PO10: Lifelong learner

Chemistry MDC MINOR

Paper: CHEM-MD CC6-6: Organic Chemistry-II

(Credit: Theory -03, Practical – 01)

Course learning outcome (COs)

- CO5: Stereochemistry – IV: Conformation-II, Concept of prostereoisomerism, Chirality arising out of stereoaxis.**
- CO6: Chemistry of carbonyl Compounds: Nucleophilic Addition to C=O, Exploitation of acidity of α -H of C=O, Nucleophilic addition to α , β -unsaturated carbonyl system, Substitution at sp^2 carbon (C=O system).**
- CO7: Organometallics.**
- CO8: Qualitative analysis of single solid organic compound.**

COs-POs Mapping

MN-6: Organic Chemistry-II

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√	√					√
CO2	√	√		√	√					√
CO3	√	√		√	√					√
CO4	√	√	√	√	√		√		√	√

Program Learning Outcomes (POs) in B.A/B.Sc MDC in Geography

NEP SYLLABUS

The student graduating with the Degree B.A. or B.Sc MDC in Geography should be able to:

- To understand the physical aspects of earth comprising of land, water and air, their structure, composition, classification, distributional patterns and developmental processes. It helps the students to identify and analyse the various facets of geography, geographical features and processes.
- Completion of this course highlights the purpose of enhancing the capability of the students in perceiving, creating and analyzing sound geographical bases and concepts. This is how they have found the different linkages of geographical knowledge with other disciplines.
- To study human population and their activities, distribution of resources and mapping of different types of land use. It also focuses on globalization that affects the settlement as well as the cultural landscape with help of multiple innovations.
- To develop an understanding about the theoretical concepts of the different methodologies in Geography which are mainly necessary in field researches. The main components are identification of problems, data collection and compilation, use of survey instruments, diagrams and maps.
- To provide them an understanding of the basic principles of updated technology based on Remote Sensing, Geographical Information System, Global Navigation Satellite System along with the conventional knowledge of coordinate systems and map projections and applications of basic as well as advanced survey instruments.
- To develop the skill and ability to draw and interpret different types of maps (Land use Map, Thematic Map, Topographical maps, Weather maps and Map making from Satellite Imageries).

- To make the students familiar with different types of geographical data and its analysis for determining growth rate, structure, graphical plotting and interpretation.
- Overall, this entire course has been a shift from teacher centric to student centric study by strengthening the quality of teaching and learning in the present-day real-life scenario of global, regional and local level. It is considered learning as an activity of creativity of innovations and analyzing geographical phenomena.

Program Outcomes (POs) in MDC Geography

PO 1: Fundamental understanding and application of basic the concept

PO 2: Linkages with other disciplines

PO 3: Ability to understand issues related to man-environment relation

PO 4: Developing problem solving techniques

PO 5: Understanding of different kinds of maps and satellite images

PO 6: Map making skills

PO 7: Analysis & interpretation of data

PO 8: Construction, measurements and drawing of diagrams and graphs

PO 9: Theoretical application and use of geographical instruments

PO 10: Understanding the concepts of growth, change and development in geographical perspective

PO 11: Globalization, conservation & management

Physical Geography - GEOG-CC/MD-CC-1/3-Th & P
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

After going through the course, the student should be able to:

CO 1: Understand the concepts related to Cartography, Geotectonics, Geomorphology, Climatology, Soil Geography, Biogeography and Geography of Hazards which are important sub-disciplines of the of Geography.

CO 2: Highlights the structure of the earth's interior and different endogenetic forces like seismic waves.

CO 3: Study the major types of weathering, various exogenetic agents, processes and the evolution of different landforms curved out by river.

CO 4: Study in detail about the atmospheric stratification and circulation in form of planetary winds and jet streams.

CO 5: Understand the factors of soil formation and development of an ideal soil profile.

CO 6: Learn about the different plant adaptations and distribution in terms of water availability.

CO 7: Highlights the nature and classification of the hazards and disasters in reference to Indian subcontinent.

CO 8: The practical part includes graphical construction of scale, delineation of drainage basins from any selected topographical map (R.F = 1:50,000) for determining stream ordering and bifurcation ratio followed by extraction of drainage patterns and channel features along with proper interpretation and lastly, construction and interpretation of wind rose diagram.

COs - POs Mapping
Physical Geography - GEOG-CC/MD-CC-1/3-Th & P

POs \ COs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11
CO 1	√	√	√	x	x	x	x	√	x	x	√
CO 2	√	√	x	x	√	x	x	√	x	x	x
CO 3	√	x	√	x	√	x	x	√	x	x	x
CO 4	√	√	x	x	√	x	x	√	x	x	x
CO 5	√	x	√	x	√	x	x	√	x	x	√
CO 6	√	√	√	x	x	x	x	x	x	x	√
CO 7	√	√	√	√	x	x	x	x	x	x	√
CO 8	x	x	x	x	√	√	√	√	x	x	x

Human Geography - GEOG-CC02/MD-CC02-2/4-Th & P
(Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

The students will acquire knowledge about-

CO 1: Nature, scope, recent trends and elements of Human Geography in special reference to different schools of thought.

CO 2: Evolution of human society in temporal sense and spatially, human adaptation to the environment with a journey focusing post- industrial urban societies.

CO 3: Population Geography with special reference to the concept of Demographic transition and demographic dividend as well as distribution, density and growth of population in India.

CO 4: Characteristics of Urban and Rural settlements with special reference to site, situation, types and patterns of rural settlement as well as morphology and hierarchy of urban settlement after Census of India.

CO 5: In the Laboratory course students learn first-hand-

- i) Measurement of Arithmetic growth rate of population comparing two decadal datasets.
- ii) Representation and interpretation of population density by Choropleth Method.
- iii) Identification of types of settlements from Survey of India 1:50,000 topographical map.
- iv) Construction of Proportional Squares to have a clear concept regarding distribution of households.

COs - POs Mapping
Human Geography - GEOG-CC02/MD-CC02-2/4-Th & P

POs \ COs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11
CO 1	√	√	√	×	√	×	×	×	×	√	×
CO 2	√	√	√	√	×	×	×	×	×	×	×
CO 3	√	√	√	×	×	×	×	×	×	√	√
CO 4	√	×	√	×	√	×	×	×	×	√	√
CO 5	√	√	√	×	×	×	×	√	×	√	×

Economic Geography GEOG-H-CC04/MD-CC03-3/5-Th & P (Credits: 04, Theory-03, Practicals-01)

Course learning outcome (COs):

After going through the course, the student should be able to:

CO 1: Revise the different approaches of Economic Geography and its scope.

CO 2: Acquire knowledge about different economic aspects like goods and services, production, exchange and consumption as well as economic man.

CO 3: Develop concepts about different economic activities like primary, secondary, tertiary, quaternary and quinary.

CO 4: Understand the theories of favourable locational approaches in special reference to Agriculture (after Von Thünen) and industry (after Weber).

CO 5: Learn in detail about different primary activities like agriculture, forestry, fishing, and mining.

CO 6: Learn in detail about different Secondary activities in special reference with classification of manufacturing industries, special economic zones, and technology parks as well as Tertiary activities like transport, trade and services.

CO 7: Develop understanding in contemporary issues and concept about economic globalization.

CO 8: Acquire knowledge about international trade, role of WTO

CO 9: Enhance knowledge about the emergence and significance of economic blocs in special reference to BRICS

CO 10: In Laboratory Course, students will

- Learn how to represent gender-wise work participation rate by using bar graph and its interpretation.
- Learn how to construct proportional divided circles to show state-wise variation in occupational structure and its interpretation.
- Prepare crop calendar and its interpretation.
- Develop concept of Time series analysis and its representation in Industrial production of India by moving average.

COs - POs Mapping
Economic Geography GEOG-H-CC04/MD-CC03-3/5-Th & P

POs \ COs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11
CO 1	√	√	√	×	×	×	×	×	×	×	√
CO 2	√	×	√	√	×	×	×	√	×	√	√
CO 3	√	√	×	√	×	×	×	√	×	√	×
CO 4	√	√	√	×	√	×	×	√	×	×	√
CO 5	√	×	√	×	×	×	×	×	×	√	√
CO 6	√	√	×	×	×	×	×	×	×	√	√
CO 7	√	√	×	√	×	×	×	×	×	√	√
CO 8	×	×	×	×	√	√	√	√	×	×	×
CO 9	√	√	√	√	X	X	X	X	X	√	√
CO 10	√	X	X	√	√	√	√	√	√	√	X

Geomorphology GEOG-MD-CC04-4/5/6-Th & P (Credits: 04, Theory-03, Practicals-01)

Course Learning Outcomes (Cos):

The students will acquire knowledge about-

CO1: Concept of time and space in Geomorphology with special reference to Schumm and Lichty's model as well as clear notion about landform ordering focusing

Ga scale of Tricart and Haggett.

CO2: Basic concept about degradational processes with classification of mass wasting and resultant landforms.

CO3: Clear idea about processes of entrainment, transportation and deposition by different geomorphic agents.

CO4: Development of river network and landforms on uniclinal, folded, faulted structure as well as on Granites, Basalts, and Lime stones.

CO5: Detailed discussion about following geomorphic processes and landforms –

- a) Costal
- b) Glacial and glacio-fluvial
- c) Aeolian and fluvio-aeolian.

CO6: Clear concept about the models on Landscape evolution focusing the views of Davis, Penck, King and Hack along with significance of systems approach.

CO7: Fundamental concept about anthropogenic role in landform development.

CO8: In the laboratory course students learn-

- i) Extraction and interpretation of geomorphic features from Survey of India 1:50000 topographical map of plateau region as well as relevant morphometric analysis of the concerned map.
- ii) Construction of hypsometric curve and derivation of hypsometric integer of a drainage basin of plateau region.
- iii) Determination of Channel Sinuosity Index and braiding index of rivers from topographical maps.

COs - POs Mapping
Geomorphology GEOG-MD-CC04-4/5/6-Th & P

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11
CO 1	√	√	x	√	x	x	x	√	x	x	x
CO 2	√	x	x	x	x	x	x	√	x	x	x
CO 3	√	√	√	x	x	x	x	√	x	x	x
CO 4	√	√	√	x	√	x	x	√	x	x	x
CO 5	√	x	√	x	√	x	x	√	x	x	√
CO 6	√	√	√	x	x	x	x	√	x	x	x
CO 7	√	√	√	√	x	x	x	x	x	x	√
CO 8	√	x	x	√	√	√	√	√	x	x	x

Climatology GEOG-CC06/MD-CC05-4/5/6-Th & P (Credits: 04, Theory-03, Practicals-01)

Course Learning Outcome (COs):

The students will acquire knowledge about-

CO 1: Understand the elements of weather and climate and its controlling factors like horizontal and vertical distribution of temperature, types, causes and consequences of inversion of temperature.

CO 2: Learn about process and forms of condensation; mechanism and forms of precipitation as well as Bergeron-Findeisen theory, Collision, and coalescence theory.

CO 3: Learn about the typology, origin, characteristics, and modification of air mass as well as circulation of the atmospheric winds like Planetary winds, jet streams index cycle.

CO 4: Understand the frontogenesis and frontolyses and atmospheric disturbance like tropical and mid-latitudinal cyclones and thunderstorms.

CO 5: Develop the concept on mechanism of monsoon with special reference to India.

CO 6: Understand the causes and consequences of Climate change in special reference to Greenhouse effect as well as formation, depletion, and significance of the Ozone layer.

CO 7: Comprehend the climatic classification developed by i) Koppen and ii) Thornthwaite.

CO 8: In Laboratory course, the students learn to

- i) measure mean daily temperature, air pressure, relative humidity and rainfall with the help of relevant instruments like Six's maximum and minimum thermometer, Barometer, Hygrometer and Rain Gauge respectively.
- ii) Interpret Pre-monsoon, Monsoon and Post-monsoon daily weather map of India.
- iii) Construction and interpretation of monthly rainfall dispersion diagram (quartile method) as well as water budget.
- iv) Construct and interpret hythergraph and climograph (after Taylor)

COs - POs Mapping

Climatology GEOG-CC06/MD-CC05-4/5/6-Th & P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	√	√	√	X	x	X	X	√	x	X	X
CO2	√	√	X	X	x	X	X	√	x	X	X
CO3	√	√	X	X	x	X	X	√	X	X	X
CO4	√	√	X	X	√	X	X	√	x	X	X
CO5	√	X	√	X	√	X	X	√	X	X	X
CO6	√	√	√	X	x	X	X	√	x	X	√
CO7	√	√	√	X	x	X	X	X	X	X	X
CO8	√	X	X	√	√	√	√	√	√	X	X

Hydrology and Oceanography GEOG-CC09/MD-CC06-5-Th & P (Credits: 04, Theory-03, Practicals-01)

The students will acquire knowledge about-

CO1: The physical and biological role on Global Hydrological cycle and its system approach.

CO2: Controlling factors of different hydrological phenomenon like run-off and ground water recharge and discharge and their circulation.

CO3: Principles of water harvesting and watershed management focusing on drainage basin as a hydrological unit.

CO 4: Physical and chemical properties of ocean water with special reference to the distribution and determinants of temperature and salinity.

CO 5: Ocean circulation, water mass, T-S diagram and wave and tides.

CO 6: Types and causes of sea level changes and its implications.

CO 7: Classification of marine resource and their sustainable utilization and issues related to pollution of ocean water.

CO 8: In laboratory course they can acquire knowledge on-

- i) Construction and interpretation of rating curve, hydrographs and unit hydrographs,
- ii) Construction and interpretation of monthly rainfall dispersion diagram, climatic water budget and Egrograph,
- iii) Construction of Ombrothermic graph and Hyetograph,
- iv) Construction of Thiessen polygon from precipitation data.

COs - POs Mapping
Hydrology and Oceanography GEOG-CC09/MD-CC06-5-Th & P

x	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	√	√	√	X	x	X	X	√	x	X	X
CO2	√	X	√	X	x	X	X	√	x	X	X
CO3	√	√	√	√	x	X	X	√	x	X	√
CO4	√	√	√	X	x	X	X	√	x	X	√
CO5	√	X	√	X	√	X	X	√	X	X	√
CO6	√	X	√	X	x	X	X	√	X	X	√
CO7	√	X	√	X	X	X	X	X	x	X	√
CO8	√	X	X	√	√	√	√	√	X	X	X

Cultural and Settlement Geography GEOG-CC10/MD-CC07-5/6-Th & P (Credits: 04, Theory-03, Practicals-01)

Course Learning Outcomes (COs): -

After completion of the course, the students will have ability to: -

CO1: Gather sufficient knowledge about definition, scope and content of cultural geography.

CO2: Basic concept about components and structure of culture.

CO3: Secure clear concept about the following elements-

- a) Cultural hearths and realms,
- b) Cultural diffusion,
- c) Diffusion of major world religions and languages,
- d) Cultural segregation, diversity and integration

CO4: Obtain true concept about evolution and morphology of rural settlements.

CO5: Procure comprehensible cognizance regarding rural house type of India highlighting the role of social segregation.

CO6: Achieve true perception about following dimensions of urban settlements –

- e) Evolution
- f) Metropolitan concept
- g) Concept of megalopolis
- h) Concept of conurbation and agglomeration

CO7: Access actual concept of urban morphology with special reference to the models of Burgess, Hoyt and Harris & Ullman.

CO8: In laboratory course, students will learn –

- i) The skill of mapping language distribution of India
- ii) The required skill of representing cartograms showing roof materials used in rural houses in any state of India in the Census years 1991, 2002 and 2011.
- iii) Accessibility mapping using detour index from Survey of India 1:50000 topographical maps.
- iv) Nearest neighbor analysis from Survey of India 1:50000 topographical maps of plain region.

COs - POs Mapping
Cultural and Settlement Geography GEOG-CC10/MD-CC07-5/6-Th & P

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11
CO 1	√	√	x	x	x	x	x	x	x	x	√
CO 2	√	√	x	x	x	x	x	x	x	√	x
CO 3	√	x	√	x	x	x	x	√	x	√	√
CO 4	√	x	√	x	√	x	x	√	x	√	x
CO 5	√	x	√	x	√	x	x	√	x	√	x
CO 6	√	√	√	x	√	x	x	√	x	√	√
CO 7	√	x	x	√	√	x	x	√	x	x	x
CO 8	√	x	x	√	√	√	√	√	√	x	x

India and West Bengal GEOG-H-CC14/MD-CC08-6-Th & P (Credits: 04, Theory-03, Practicals-01)

Course Learning Outcomes (COs): -

After completion of the course, the students will have ability to: -

CO 1: Understand the physical and climate related profile of the country.

CO2: Study the resource endowment and its spatial distribution and utilization for sustainable development.

CO 3: Obtain proper knowledge about the different phases of Green revolution, White revolution and its consequences.

CO 4: Attain actual awareness about industrial development in relation to Automobile and information technology

CO 5: Secure thorough knowledge about physiographic and economic regionalization of India following R.L. Singh and P. Sengupta respectively.

CO 6: Acquire complete knowledge about the following aspects of West Bengal-

- i) Physical and demographic perspectives,
- ii) Various dimensions of resources,
- iii) Development of SEZs and changing pattern of industrialization in West Bengal.
- iv) Different aspects of Demography of West Bengal,
- v) Regional issues highlighting Darjeeling Himalaya as physiographic region,

Sundarban as an ecological region and Haldia as Industrial region.

CO 7: In the laboratory course, the students will get an opportunity to attain skills to

- i) Compute and interpret the graphical representation of monthly temperature and rainfall graph for five physiographic regions of India
- ii) Compute and draw annual trend of manufacturing goods over any two decades from India or West Bengal
- iii) Learn to compute Composite Index to compare developed and backward states of India.
- iv) Change in mean center of population of West Bengal over any three census years.

Methods in Geography GEOG-SEC01/MD-SEC01-1/2/3-Th (Credits: 04, Theory-04)

Course learning outcome (COs):

After going through the course, the student should be able to:

CO 1: Understands the concepts and strategies required for conducting any field survey and post-field analysis. This course emphasizes on data collection and compilation and basic and advanced methodologies involved in research in Physical and Human Geography.

CO 2: Learning about how to identify the existing research problems in any field area and based on that, design a primary survey for conducting the research. Students must know the significance of pilot survey prior to any primary survey and also the various methods of sampling necessary to identify the samples before the survey.

CO 3: Discuss the steps of preparing a questionnaire and interview schedule for collecting data from the sample population, followed by data entry into master table in computer platform and forming the tabulation required for statistical analysis of data (frequency, central tendency and dispersion).

CO 4: Highlights the methods of data collection and analysis in Physical Geography using minor survey instruments like Brunton compass, Distometer, smartphone levelling applications and textural analysis of grains using sieves.

CO 5: Studies the topographical maps, satellite imageries and DEM data for extraction and mapping of flooded areas, areal and linear extents of riverbank and coastline shift.

CO 6: Provides the theoretical understanding of the different methods applied in Human Geography like identification of Dominant and Distinctive functions in any region, construction of Ternary Diagram showing distribution of occupational patterns, drawing of accessibility maps and flow charts that uses road and transport data.

COs - POs Mapping
Methods in Geography GEOG-SEC01/MD-SEC01-1/2/3-Th

POs \ COs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11
CO 1	√	√	√	×	√	×	×	×	×	×	×
CO 2	√	√	√	√	×	×	√	×	×	×	×
CO 3	√	√	×	×	×	×	√	×	×	×	×
CO 4	√	×	×	×	×	×	×	√	√	×	×
CO 5	√	√	×	×	√	×	×	√	×	×	√
CO 6	√	√	×	×	√	√	√	√	×	×	×

Geomatics and Spatial Analysis GEO-IDC01-1/2/3-Th & P (Credits: 03, Theory-02, Practicals-01)

Course learning outcome (COs):

After going through the course, the student should be able to:

CO 1: Understands the basic concepts of Cartography, Surveying, Remote Sensing (RS), Geographical Information System (GIS) and Global Navigation Satellite System (GNSS) with their diverse applications in geographical studies.

CO 2: Studies the definition, concept, components and classification of Maps, Scales and Projections with special emphasis on properties and uses of simple conical projection and Universal Transverse Mercator (UTM).

CO 3: Learns about the different types of Bearing and the concept of geoid and spheroid with special reference to WGS-84.

CO 4: Highlights the basic concepts of three survey instruments, their features and uses: Dumpy level, Theodolite and lastly, Total Station which is the most updated survey instrument.

CO 5: Discuss about the definition and principles of Remote Sensing which includes mainly the satellites and sensors with special reference to space missions undertaken by Indian Space Research Organization (ISRO) and National Aeronautics and Space Administration in U.S.A (Landsat missions).

CO 6: Develop the skill to understand and interpret the standard false colour composition of satellite images (FCC) and provide basic knowledge about the principles and significance of supervised image classification.

CO 7: Differentiate between various data structures like spatial and non-spatial, raster and vector and studies the basic principles of preparing an attribute table, data manipulation, query operation and overlay analysis in GIS.

CO 8: The practical part includes construction of simple conical projection with one standard parallel, traverse survey and plotting UTM coordinates using selected smartphone GNSS application, identification of land use / land cover features from satellite imagery and detection of change (in area & perimeter) of riverbank or coastline shift from multi-dated maps and images.

COs - POs Mapping
Geomatics and Spatial Analysis GEO-IDC01-1/2/3-Th & P

POs \ COs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11
CO 1	√	√	×	√	×	√	×	×	√	×	×
CO 2	√	√	×	×	×	√	×	√	×	×	×
CO 3	√	×	×	×	×	√	√	√	×	×	×
CO 4	√	×	×	×	×	×	×	×	√	×	×
CO 5	√	×	×	×	√	×	×	×	×	×	×
CO 6	√	×	×	×	√	√	√	×	×	×	×
CO 7	√	×	×	×	√	×	×	×	×	×	×
CO 8	×	×	×	×	√	√	√	√	×	×	×

UNIVERSITY OF CALCUTTA

Programme Outcome / Programme Specific Outcome / Course Outcome B.Sc. Mathematics — Three-Year Multidisciplinary Course (MDC)

(Under Curriculum and Credit Framework — CCF 2022)

Effective from Academic Year 2023–24

Programme Details

Name of Programme	B.Sc. Mathematics — Three-Year Multidisciplinary Course (MDC)
Programme Type	3-Year Multidisciplinary Course (Semesters I to VI)
Framework	Curriculum and Credit Framework (CCF) 2022 — under NEP 2020
Year of Introduction	2023–24
Core Course Credits	CC1 (8 papers × 4 credits = 32) + CC2 (8 papers × 4 credits = 32)
Other Credits	Minor: $6 \times 4 = 24$ IDC: $3 \times 3 = 9$ AEC: $4 \times 2 = 8$ SEC: $3 \times 4 = 12$
Note on Structure	Mathematics may be chosen as Core Course 1 or Core Course 2. When chosen as CC2, paper CC7 (Mathematical Methods) shifts to Semester VI.

Programme Specific Outcomes (PSOs)

The Programme Specific Outcomes describe what students are specifically expected to gain from the B.Sc. Mathematics (MDC) programme. These are adapted from the official PSOs notified by the University of Calcutta (Ref. No. CUS/183/25, dated 20th June 2025), tailored to the three-year multidisciplinary structure.

PSO	Description
PSO1	The basic objective of the Mathematics MDC is to develop the mathematical reasoning power of students and provide logical support behind assumptions. Throughout the course, students learn different branches of mathematics and are equipped with solutions to various types of problems by framing proper mathematical models, while being able to logically justify computational procedures.
PSO2	Another objective is to enhance the critical thinking power of students by solving a variety of mathematical problems. The programme provides a strong foundation in mathematical concepts, problem-solving skills and the ability to apply mathematical knowledge in various fields of study and professional practice.
PSO3	The syllabus is framed so that after successful completion of the three-year course, students are able to solve mathematical problems with minimum error. They will be equipped with mathematical skills and techniques applicable in both academic and non-academic work settings, and will be able to translate real-world problems into mathematical models, analyse them, and evaluate mathematical arguments.
PSO4	Students will develop an understanding of core areas including Calculus, Algebra (group and ring theory), Mechanics, Probability and Statistics, Mathematical Methods and Discrete Mathematics, along with computational skill using C language. The theory and its applications will motivate students for critical thinking and further study.

PSO5	Students will get a strong foundation in the subject and develop comprehensive knowledge of classical and applied fields of mathematics applicable to engineering sciences, information technology, computer science and social sciences, equipping them for interdisciplinary study.
PSO6	Students will acquire numerical skill, logical thinking and analytical capability applicable in competitive examinations and to resolve day-to-day problems. They will be able to contribute meaningfully in educational institutions, research environments and various service sectors.

Programme Outcomes (POs)

Programme Outcomes are the broad, expected outcomes that all students of the B.Sc. Mathematics (MDC) programme should demonstrate upon completion, aligned with the goals of NEP 2020 and the University of Calcutta.

PO	Description
PO1	Students will gain thorough knowledge in core areas of mathematics and enhance problem-solving skills applicable to real-world situations and day-to-day problems.
PO2	Students will be able to apply mathematical knowledge and skills in professional settings, communicate effectively, collaborate with others, and engage in lifelong learning to adapt to changing circumstances.
PO3	Students will acquire understanding of scientific methods and apply them in solving problems by analysing practical data using qualitative and quantitative mathematical techniques.
PO4	Students will develop scientific, communicative and numerical skills and be equipped to pursue careers in Information Technology, Data Analysis, Industrial Mathematics and related fields.
PO5	Students will be able to develop mathematical models to solve problems in engineering and social sciences, and contribute to research projects independently or in collaboration with institutions.
PO6	In the course of six semesters, students will acquire knowledge of Calculus, Geometry, Vector Analysis, Algebra, Ordinary Differential Equations, Mechanics, Advanced Calculus, Statistics, Numerical Analysis, Mathematical Methods and Discrete Mathematics — gaining a broad and well-rounded view of mathematics together with computational skills in C language.

Programme Structure — Course List

A. Core Courses — Mathematics as Core Course 1

Semester	Course Code	Course Name
I	MATH-MD-CC1-1-TH	Calculus, Geometry & Vector Analysis
II	MATH-MD-CC2-2-TH	Basic Algebra
III	MATH-MD-CC3-3-TH	Ordinary Differential Equations & Group Theory
IV	MATH-MD-CC4-4-TH	Mechanics
IV	MATH-MD-CC5-4-TH	Advanced Calculus
V	MATH-MD-CC6-5-TH	Statistics and Numerical Analysis
V	MATH-MD-CC7-5-TH	Mathematical Methods

VI	MATH-MD-CC8-6-TH	Discrete Mathematics
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B. Core Courses — Mathematics as Core Course 2

Semester	Course Code	Course Name
I	MATH-MD-CC1-1-TH	Calculus, Geometry & Vector Analysis
II	MATH-MD-CC2-2-TH	Basic Algebra
III	MATH-MD-CC3-3-TH	Ordinary Differential Equations & Group Theory
IV	MATH-MD-CC4-4-TH	Mechanics
IV	MATH-MD-CC5-4-TH	Advanced Calculus
V	MATH-MD-CC6-5-TH	Statistics and Numerical Analysis
VI	MATH-MD-CC7-6-TH	Mathematical Methods
VI	MATH-MD-CC8-6-TH	Discrete Mathematics

C. Skill Enhancement Course (SEC)

Semester	Course Code	Course Name
I / II / III	MATH-MD-SEC-TH	C Language with Mathematical Applications

D. Interdisciplinary Course (IDC)

Semester	Course Code	Course Name
I / II / III	MATH-MD-IDC-TH	Mathematics in Daily Life

Course Outcomes (COs) with CO–PO and CO–PSO Mapping

For each course below, the Course Outcomes (COs) are listed, followed by two mapping tables: (1) CO–PO Mapping showing which Programme Outcomes (PO1–PO6) each CO addresses, and (2) CO–PSO Mapping showing which Programme Specific Outcomes (PSO1–PSO6) each CO addresses.

Semester I

MATH-MD-CC1-1-TH: Calculus, Geometry & Vector Analysis

(Syllabus identical to MATH-H-DSCC1-1-TH)

CO	Course Outcome Statement
CO-1	To learn to find higher order derivatives, Leibnitz rule and its applications, and L'Hospital's rule.
CO-2	To learn reduction formulae; to find arc length, area under a curve, and area and volume of surface of revolution.
CO-3	To learn classification of conics, reduction to canonical form, tangent, normal and polar equations of conics.
CO-4	To acquire detailed knowledge of spheres, cylindrical surfaces, central conicoids and different quadric surfaces.
CO-5	To learn application of vector equations to geometry and mechanics, and differentiation and integration of vector functions.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓

Semester II

MATH-MD-CC2-2-TH: Basic Algebra

(Syllabus identical to MATH-H-DSCC2-2-TH)

CO	Course Outcome Statement
CO-1	To learn about exponential, logarithmic, trigonometric and hyperbolic functions of a complex variable.
CO-2	To learn to solve cubic and biquadratic equations.
CO-3	To acquire knowledge of equivalence relations, partial order, linear order and composition of mappings.
CO-4	To learn the well-ordering property of positive integers, division algorithm and congruence relation between integers.
CO-5	To learn about existence and uniqueness of solutions of linear equations, row reduction and echelon forms.
CO-6	To learn algebraic and geometric properties of vectors in n-dimensional space and linear independence.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓		✓	✓	✓
CO-2	✓	✓		✓		✓
CO-3	✓	✓	✓		✓	
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓		✓		✓
CO-6	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓		✓	✓		✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓		
CO-6	✓	✓	✓	✓	✓	✓

Semester III

MATH-MD-CC3-3-TH: Ordinary Differential Equations and Group Theory

(Syllabus identical to MATH-H-DSCC4-3-TH)

CO	Course Outcome Statement
CO-1	To learn formation of differential equations and methods of solution.
CO-2	To learn methods for solving first order, first degree and higher degree differential equations.

CO-3	To learn methods for solving higher order linear and nonlinear differential equations.
CO-4	To study the algebraic structure of groups, elementary properties, subgroups, cyclic groups and alternating groups.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓		
CO-4	✓	✓	✓			✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓		✓

Semester IV

MATH-MD-CC4-4-TH: Mechanics

(Syllabus identical to MATH-H-DSCC6-4-TH: Mechanics – I)

CO	Course Outcome Statement
CO-1	To learn about the principle of forces, resultant forces, resultant couple and coplanar forces.
CO-2	To study rectilinear motion and simple harmonic motion.
CO-3	To learn to solve problems on work, power and energy.
CO-4	To study impulsive forces and collision of elastic bodies.
CO-5	To learn to solve problems of motion of a particle in two dimensions.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓

MATH-MD-CC5-4-TH: Advanced Calculus

CO	Course Outcome Statement
CO-1	To learn sequences of real numbers, convergence, monotone sequences and the Cauchy criterion.
CO-2	To learn infinite series of constant terms, tests for convergence and alternating series.
CO-3	To learn limits, continuity and properties of real-valued functions on closed bounded intervals.
CO-4	To learn Rolle's theorem, Mean Value theorems, Taylor's and Maclaurin's theorems and infinite series expansions.
CO-5	To learn multivariate calculus: partial derivatives, differentiability, chain rule, Euler's theorem and derivative of implicit functions.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓

Semester V**MATH-MD-CC6-5-TH: Statistics and Numerical Analysis**

CO	Course Outcome Statement
CO-1	To learn probability theory: total probability, conditional probability, Bayes' theorem and independence of events.
CO-2	To learn probability distributions (Binomial, Poisson, Uniform, Normal) and bivariate distributions.
CO-3	To learn mathematical expectation, mean, variance, moments, correlation coefficient and regression lines.
CO-4	To learn measures of central tendency, measures of dispersion, and sampling theory including sampling distributions.
CO-5	To learn statistical inference: estimation of parameters, confidence intervals, hypothesis testing and types of error.
CO-6	To learn numerical methods: interpolation, numerical integration (Trapezoidal, Simpson's), and numerical solution of equations (Bisection, Newton-Raphson, Gauss elimination).

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓
CO-6	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓
CO-6	✓	✓	✓	✓	✓	✓

MATH-MD-CC7-5/6-TH: Mathematical Methods

CO	Course Outcome Statement
CO-1	To learn point-wise and uniform convergence of sequences and series of functions, with special reference to power series.
CO-2	To learn applications of differential calculus: tangents, normals, curvature, asymptotes, envelopes and points of inflection.
CO-3	To learn maxima and minima of functions of one and two variables, and Lagrange's method of undetermined multipliers.

CO-4	To learn Fourier series on $[-\pi, \pi]$: Fourier coefficients, Dirichlet's conditions and convergence theorem.
CO-5	To learn Laplace Transforms and their application to solving ordinary differential equations of second order with constant coefficients.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓

Semester VI

MATH-MD-CC8-6-TH: Discrete Mathematics

CO	Course Outcome Statement
CO-1	To learn graph theory: definitions, walks, trails, paths, Eulerian and Hamiltonian graphs, trees and planar graphs.
CO-2	To learn applications of congruences: Fermat's little theorem, Euler's theorem, Wilson's theorem, check digits (ISBN, UPC, VISA) and round-robin tournaments.
CO-3	To learn combinatorics and recurrence relations: fundamental counting principle, linear difference equations and the tower of Hanoi problem.
CO-4	To learn Boolean algebra: Boolean functions, Boolean polynomials, CNF and DNF forms, switching circuits and logic gates.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓		✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓

CO-4	✓	✓	✓	✓	✓	✓
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CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓

SEC — Any of Semester I, II or III

MATH-MD-SEC-TH: C Language with Mathematical Applications

(SEC paper — taught in Semester I, II or III as per college choice)

CO	Course Outcome Statement
CO-1	To learn C language in detail including data types, variables, operators and expressions.
CO-2	To learn different types of control statements, loops and arrays.
CO-3	To learn to write computer programs using C language for mathematical applications.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓

IDC — Any of Semester I, II or III

MATH-MD-IDC-TH: Mathematics in Daily Life

(IDC paper — taught in Semester I, II or III as per college choice)

CO	Course Outcome Statement
CO-1	To learn basics of set theory, subsets and set operations, and their real-life applications.
CO-2	To learn the mathematics of integers behind ISBN, UPC, VISA and MasterCard numbers.

CO-3	To get an idea of propositional logic and logical connectives.
CO-4	To learn basics of linear programming problems and two-person zero-sum games.
CO-5	To learn financial mathematics at an elementary level (simple and compound interest, annuities, income tax).

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	✓	✓	✓		✓	
CO-2	✓	✓			✓	✓
CO-3	✓	✓	✓			
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓			✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓		✓			✓
CO-4	✓	✓	✓		✓	✓
CO-5	✓	✓	✓		✓	✓

Program Learning Outcomes (POs) in Physics, 3 Year B.Sc MDC

The student graduating with the MDC B.Sc degree should be able to

- **Acquire**

- (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics and interdisciplinary areas.

- (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;

- (iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.

- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using

appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

- Demonstrate relevant generic skills and global competencies such as (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries; (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems; (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature; (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them with popular language when needed; (v) ICT skills; (vi) personal skills such as the ability to work both independently and in a group.
- Demonstrate professional behavior such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii) the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment, (v) constitutional values, (vi) Indian Knowledge System

Programme Outcomes (POs)

PO1: Fundamental understanding of the field

PO 2: Application of basic Physics concepts

PO 3: Linkages with related disciplines

PO 4: Procedural knowledge for professional subjects

PO 5: Skills in related field of specialization

PO 6: Ability to use in Physics problem

PO 7: Skills in Mathematical modeling

PO 8: Skills in performing analysis and interpretation of data

PO 9: Develop investigative Skills

PO 10: Skills in problem solving in Physics and related discipline

PO 11: Develop Technical Communication skills

PO 12: Developing analytical skills and popular communication

PO 13: Developing ICT skills

PO 14: Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc

Course Outcomes (COs)
Multidisciplinary Papers

PHS-CC-1-1 / PHS-Minor3-3-1/PHS-Minor4/1-1-1/ PHS-Minor4/2-3-1: BASIC PHYSICS-I
(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

Students will be able to

CO1 : Revise the knowledge of calculus, SI system, plotting, vectors, vector calculus. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.

CO2 : Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.

CO3 : Learn homogenous differential equations, partial derivatives which have applications in all branches of physics.

CO4 : Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. She will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.

CO5 : Understand the dynamics of system of particles and idea about center of mass and laboratory frames and their correlation.

CO6 : Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation, central force.

CO7 : Understand simple principles of fluid flow and the equations governing fluid dynamics.

CO8: In the laboratory course, the student shall perform experiments to measure Modulus of Rigidity, moment of inertia, vertical height using Sextant, determining coefficient of viscosity. Know about the basic theory of errors, their analysis, estimation with examples of simple experiments in Physics.

COs - POs Mapping

Course Code : PHS-CC-1-1 / PHS-Minor3-3-1/PHS-Minor4/1-1-1/ PHS-Minor4/2-3-1: BASIC PHYSICS-I

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√				√
CO2	√	√	√	√	√	√	√		√	√	√			√
CO3	√	√	√	√	√	√	√		√	√		√		√
CO4	√	√	√	√	√	√	√		√	√	√			√
CO5	√	√	√	√	√	√			√	√		√		√
CO 6	√	√	√	√	√	√			√	√				√
CO7	√	√	√	√	√	√	√		√	√	√			√
CO8	√	√	√	√	√			√	√		√	√		√

Course Outcomes (COs)

PHS-CC-2-1 / PHS-Minor3-4-1/PHS-Minor4/1-2-1/ PHS-Minor4/2-4-1: BASIC PHYSICS-II (Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

Students will be able to

CO1 : Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to various systems.

CO2 : Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.

CO3 : Articulate knowledge of electrostatic energy.

CO4 : Basic knowledge of Lorentz force and operational principle of cyclotron.

CO5 : Describe the basics of magnetostatics, Bio-Savart Law.

CO6: Application of Ampere's circuital law, concept of magnetic dipole etc.

CO7: Learn the microscopic and macroscopic description of matter, postulates of kinetic theory of gases, Maxwell-Boltzmann distribution law.

CO8: Comprehend the basic concepts of thermodynamics, the zeroth, first and the second law of thermodynamics, the concept of entropy and the associated theorems.

CO9: In the laboratory course the student will get an opportunity to study the conversion of Ammeter to Voltmeter and vice versa. Should be able to determine the unknown resistance using Carey-Foster bridge, measurement of current using potentiometer. Measure the pressure coefficient and coefficient of thermal expansion.

COs - POs Mapping

Course Code : PHS-CC-2-1 / PHS-Minor3-4-1/PHS-Minor4/1-2-1/ PHS-Minor4/2-4-1

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√		√		√
CO2	√	√	√	√	√	√			√	√	√			√
CO3	√	√	√	√	√	√			√	√				√
CO4	√	√	√	√	√	√			√	√				√
CO5	√	√	√	√	√	√			√	√				√
CO 6	√	√	√	√	√	√	√		√	√		√		√
CO7	√	√	√	√	√	√	√		√	√	√	√		√
CO8	√	√	√	√	√	√	√		√	√		√		√
CO9	√	√	√	√	√			√				√		

Course Outcomes (COs)

PHS-CC-3-1 / PHS-Minor3-5-1/PHS-Minor4/1-5-1/ PHS-Minor4/2-5-1: Waves and Optics (Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

CO1: Learn about the different types of mathematical oscillators and acquire knowledge about the superposition of harmonic oscillations at different conditions both graphically and analytically.

CO2: Learn about the wave motions and superposition of harmonic waves.

CO3: Gain an understanding about wave motions through strings at different conditions and be able to explain several phenomena observed in everyday life.

CO4: Learn about the reflection and refraction of light.

CO5: Understand the wave nature of light through the study of its interference and diffraction properties alongside recognize light as an electromagnetic wave by studying the polarization property.

CO6: In the laboratory course, students will gain hand on experience to perform several experiments like

- (i) Determination of frequency of a tuning fork by sonometer.
- (ii) Measurement of the focal length of concave lens by combination method.
- (iii) Measurement of wavelength of light using Newton's ring experiments.
- (iv) Measurement of thickness of paper by interference pattern created by a Wedge shaped film.
- (v) Study the polarization property of light wave through polarimeter experiment.

COs - POs Mapping

Course Code : PHS-CC-3-1 / PHS-Minor3-5-1/PHS-Minor4/1-5-1/ PHS-Minor4/2-5-1

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√			√	√				√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO 6	√	√	√	√	√			√	√			√		√

Course Outcomes (COs)

**PHS-CC-4-1/PHS-Minor3-6-1/PHS-Minor4/1-6-1/PHS-Minor4/2-6-1: Modern Physics
(Credits: 04, Theory-03, Practical-01)**

Course learning outcome (COs):

CO1 : Understand the nature of black body and Planck's theory of blackbody radiation .

CO2 : To be introduced to the basic concepts of wave mechanics and wave particle duality.

CO3 : Developing of preliminary idea of quantum concepts and corresponding theory of quantum mechanics.

CO4 : Introduction to Schrodinger's equation and its application to solve simple problems involving one dimensional potential well, barriers.

CO5 : Use Schrodinger's equation to study the nature of a harmonic oscillator and hence evaluate the energy levels.

CO6 : Perform simple experiments in the laboratory on Photoelectric effect, tunnel diode , laser cross grating, measurement of e/m of an electron etc.

COs - POs Mapping

Course Code : PHS-CC-4-1/PHS-Minor3-6-1/PHS-Minor4/1-6-1/PHS-Minor4/2-6-1

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√			√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√	√		√	√	√	√		√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO 6	√	√	√	√	√			√	√		√			√

Course Outcomes (COs)
PHS-CC-4-2/PHS-Minor3-6-2: Electromagnetism
(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

CO1:Learners can gather confidence regarding the basic concept of Method of Images and its application to plane Infinite metal sheet, Electric fields inside matter, Electric polarisation, bound charges, displacement density vector, linear dielectric medium, electric susceptibility and permittivity.

CO2: Interpret the Divergence and curl of magnetostatic field using Biot-Savart law, Magnetic vector potential for uniform magnetic field, Magnetic fields inside matter, magnetization, bound currents etc.

CO3:Students' can gather knowledge regarding Non-conservative nature of electric field, Faraday's law of induction and its applications in various simple cases, Self and mutual inductances in simple cases etc.

CO4:They also understand the Maxwell's equations and its applications in various cases.

CO5: They learn about Growth and decay of currents in L-R circuit, charging and discharging of capacitor in C-R circuit.

CO6:They also attain confidence about Mean and r.m.s. values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, power factor, vector diagram, resonance in a series LCR circuit, Q-factor.

CO7: In the laboratory course, students will achieve hand on experience to perform several experiments in the arena of properties of Electromagnetic fields like

1. To draw the resonance curve of a series LCR circuit.
2. Determination of horizontal component of Earth's magnetic field using magnetometer.
3. To study the ac characteristics of a series RC circuit and calculation of capacitance from current reactance graph.
4. Construction of one ohm coil by measuring resistivity of a sample wire using Carey Foster Bridge.
5. To study the variation of the magnetic field with current between pole pieces for different distances of an electromagnet using Gauss meter.

COs - POs Mapping

Course Code : PHS-CC-4-2/PHS-Minor3-6-2

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√	√		√	√	√	√		√
CO3	√	√	√	√	√	√	√		√	√	√	√		√
CO4	√	√	√	√	√	√	√		√	√	√	√		√
CO5	√	√	√	√	√	√	√		√	√	√	√		√
CO 6	√	√	√	√	√	√	√		√	√	√	√		√
CO7	√	√	√	√	√			√	√					√

Course Outcomes (COs)
PHS-CC-5-1: Electronics I
(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

This course will enable the students to

CO1 : get familiar with the basic circuits and networks and to explore the active and passive components.

CO2 : understand the semiconductor diodes and its various applications in the field of electronic devices.

CO3 : learn the various techniques of Bipolar Junction Transistor's biasing and gather the basic knowledge of Q points.

CO4 : learn about regulated power supply and its different characteristics.

CO5: study the various types of JFET and MOSFET characteristics, basic structure and principle of operation.

CO6 : learn about the different number systems, different operations in binary system, de Morgan's theorem etc.

CO7: study the digital systems and their differences and advantages over Analog circuits, fundamental logic gates.

CO8 : synthesize Boolean functions, simplification and construction of digital circuits by employing Boolean algebra and combinational circuits.

CO9 : In Laboratory course they will verify network theorems, study characteristics of different diodes and transistors, construction of basics gates using diodes and transistors and verification of de Morgan's theorems using IC chips.

COs - POs Mapping

Course Code : PHS-CC-5-1

[illegible]

Course Outcomes (COs)
PHS-CC-5-2/PHS-CC-6-1 : Nuclear Physics
(Credits: 04, Theory-03, Tutorial-01)

Course learning outcome (COs):

This course will enable the student to

CO1 : get the idea of Atomic spectra which includes the fine structure of Hydrogen like atom, Stern-Gerlach experiment and concept of intrinsic spin, vector atom model and Zeeman effect.

CO2 : comprehend the basics of molecular spectroscopy including the study of vibrational and rotational spectra of diatomic molecule, Raman effect and its application in molecular spectroscopy.

CO3 : learn about the atomic nucleus, its size, shape, binding energy, nature of nuclear force, liquid drop model and fusion and fission .

CO4 : study about the unstable nuclei, basics of alpha, beta and gamma decay and related laws.

CO5 : get an introductory idea of particle accelerator in particular LINAC and Cyclotron.

CO6: gather a comprehensive knowledge of fundamental particles including symmetry, conservations laws and quark model.

CO7 : understand the concept of Nuclear astrophysics including primordial nucleo-synthesis, p-p chain, CNO cycle and production of elements in a qualitative way.

COs - POs Mapping

Course Code : PHS-CC-5-2/PHS-CC-6-1

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√	√	√	√	√	√	√	√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√	√		√
CO3	√	√	√	√	√	√	√	√	√	√	√	√		√
CO4	√	√	√	√	√	√		√	√	√	√	√		√
CO5	√	√	√	√	√	√		√	√	√	√	√		√
CO 6	√	√	√	√	√	√	√	√	√	√	√	√		√
CO7	√	√	√	√	√	√		√	√	√	√	√		√

Course Outcomes (COs)
PHS-CC-6-2: Electronics II
(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

As the successful completion of the course the student is expected to

- CO1:** learn to design different types of amplifiers and its frequency response.
- CO2 :** understand the concept of usefulness in OPAMP construction and its various applications.
- CO3:** understand the principles of various types of electronic communication systems and its application.
- CO4 :** learn about half adder, full adder etc
- CO5:** gain basic idea about multiplexers, de-multiplexers, encoder and decoder.
- CO6:** gather knowledge of sequential systems by choosing Flip Flop as a building block- construct multivibrators, counters, registers to provide a basic idea about memory including RAM, ROM and also about memory organization.
- CO7 :**In the laboratory the student is expected to construct both combinational circuits and sequential circuits by employing basic gates and universal gates as building blocks and demonstrate Adders, multiplexer, Shift Registers, and different use of OPAMPs.

COs - POs Mapping

Course Code : PHS-CC-6-2

[illegible]

Course Outcomes (COs)
PHS-Minor3-5-2: Electronics I
(Credits: 04, Theory-03, Practical-01)

Course learning outcome (COs):

This course will enable the students to

- CO1** : get familiar with the basic circuits and networks and to explore the active and passive components.
- CO2** : understand the semiconductor diodes and its various applications in the field of electronic devices.
- CO3** : learn the various techniques of Bipolar Junction Transistor's biasing and gather the basic knowledge of Q points.
- CO4** : learn about regulated power supply and its different characteristics.
- CO5** : learn about the different number systems, different operations in binary system, de Morgan's theorem etc.
- CO6**: study the digital systems and their differences and advantages over Analog circuits, fundamental logic gates.
- CO7** : synthesize Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.
- CO8**: In Laboratory course they will verify network theorems, study characteristics of different diodes and transistors, construction of basics gates using diodes and transistors and verification of de Morgan's theorems using IC chips.

COs - POs Mapping

Course Code : PHS-Minor3-5-2

[illegible]

Course Outcomes (COs)

Skill Enhancement Course

**SEC1/ SEC2/ SEC3: Introduction to Computer Programming and Graph Plotting
(Credits: 04, Theory-0, Practicals-04)**

Course learning outcome (COs):

Students will be able to

CO1: Perform 2D graph plotting using GNUPLOT.

CO2: They will have basic idea about Python Programming, its basic operations, conditional statements, built in function etc.

CO3: Idea about different data structures like list, tuple, string, set etc and their usage in writing programmes.

CO4: They will be able to solve simple physical problems involving sorting, matrix operations, and differential equations as well as finding the roots of equations.

COs - POs Mapping
Course Code : SEC 1/ SEC 2/ SEC 3

[illegible]

Course Outcomes (COs)
Interdisciplinary Course
IDC: Frontiers in Physics
(Credits: 03, Theory-02, Tutorial-01)

Course learning outcome (COs):

Students will be able to gain qualitative knowledge about

CO1: Basic Nature of Science, reasoning and universality of physics experimentation.

CO2: The Universe, its creation and evolution, celestial laws.

CO3: Matter and its constitutions, thermodynamics and radioactivity.

CO4: Basic laws of nature, dual property of light and introduction to quantum mechanics and relativity.

COs - POs Mapping
Course Code : IDC 1/ IDC 2/ IDC 3

POs \ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	√	√	√		√				√			√		√
CO2	√	√	√		√				√			√		√
CO3	√	√	√		√				√			√		√
CO4	√	√	√		√				√			√		√