School of Basic and Applied Sciences

Program: B.Sc. – Biotechnology (Three Years Course)

2019-22

Programme Educational Objective (PEO)
Programme Outcomes (POs)
Programme Specific Outcomes (PSOs)
Course Outcomes (COs)
and
Lesson Plans

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Educating stars for tomorrow

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RNB Global City, Ganganagar Road,
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Program: B.Sc. Biotechnology, 2019

1. Vision

Vision of Department of Biotechnology is to be established as advanced research and skill-based centre for students and scholars

2. Mission

Mission of Department of Biotechnology is to cultivate a scholarly mindset and analytical abilities in students, as well as train them in recent technological advancements in Biotechnology, to reach the profession's daunting needs by providing dynamic knowledge in the field of Biotechnology.

3. Program Educational Objectives

PEO1-Professional Development: To develop deep knowledge of the field through a flexible, research and industry-oriented curriculum designed to meet the current demand of academia and industry.

PEO2-Core Proficiency: To identify, formulate, comprehend, analyse, design and solve scientific problems with hands on experience in various technologies using modern tools to satisfy the needs of society and the industry.

PEO3- Technical Accomplishments: To acquire techno-economic aptitude and apply the acquired practical skills and broad biotechnological training in product and process.

4. Program Outcomes (POs)

Biotechnology Graduates will be able to:

PO1. **Biotechnology knowledge**: Apply the knowledge of various domains of Biotechnology including Biodiversity and Chemistry to the human welfare and environment concerns.

PO2. **Problem analysis**: Identify and analyse challenging issues, by employing primary principles of Chemistry, Plant Anatomy, Physiology, Biochemistry, Molecular Biology, Genetics, and Immunology, and review research material to obtain justified findings.

PO3. **Design/development of solutions**: Design scientific principles-based solutions to challenging environmental and health problems.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methodologies such as experiment design, data analysis and interpretation, and information synthesis to obtain reliable outcomes.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, modern tools and databases.

PO6. **The scientist and society**: Apply reasoning by the attained knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.

PO7. **Environment and sustainability**: Understand the impact of the professional scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities.

PO9. Interdisciplinary Approach: Impart better ideas and new thoughts for the sustainable solutions to personal and societal development.

PO10. **Communication**: Communicate effectively with the science community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the chemistry, biology and biotechnology principles and apply these to one's own work, for financial independence.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in life-long learning.

5. Programme Specific Outcomes (PSOs)

Upon completion of the B.Sc. Biotechnology Programme, the graduate will be able to

PSO1: Apply biotechnology aptitudes (including Molecular Biology, Microbiology, Immunology, Biochemistry, Bioprocess Technology, and Bioinformatics) and its applications in core and allied fields.

PSO2: Conceptualize the principles of Biotechnology for research approaches for their higher career in the field of biotechnology and develop scientific interest.

PSO3: Function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities.

Course Outcomes:

Course	Course outcomes: - After completion of these courses students should be able to
6.1 Semester I	
13000401-Chemistry	**CO1:** Understand the use of various 3d transition elements in analysis of ions, **CO2:** Explain various theories about atomic structure **CO3:** Interpret the role of chemical bonds in properties of compounds and isomerism. **CO4:** Identify the compound on the basis of the functional group specific organic reactions **CO5:** Prepare various organic compounds viz; Alkanes, alkenes, Alkines
13003300-Biodiversity	**CO1:** Find the commonness as well as uniqueness existing among microorganisms and lower plants. **CO2:** Classify these organisms in different groups according to their characteristics. **CO3:** Summarize the life cycle of these organisms and their interrelationships. **CO4:** Compare life cycle, morphology, anatomy and reproduction of these organisms with an evolutionary link **CO5:** Identify Different Organism on the basis of morphological and anatomical characters
13003900-Biotechnology and Human Welfare	**CO1:** Understand the basic concepts of Biotechnology; principles, tools and techniques. **CO2:** Apply Biotechnological approaches in agriculture (transgenic Plants), industrial (fermentation and downstream processing) and medical (Recombinant vaccines, gene therapy) fields. **CO3:** Identify solutions to environmental problems through biotechnological methods. **CO4:** Analyze the results of DNA fingerprinting for forensic cases. **CO5:** Use tools and techniques for recombinant product formation.
99002200-Business Communication (AECC)	**CO1:** Explain historical background and the development of communication; Importance and role of communication in everyday life. **CO2:** Understand Mechanics behind the communication process, difficulties experienced in communication. Different types of communication, impedance due to extraneous factors called "barriers" **CO3:** Apply different types of communication, impedance due to extraneous factors called "barriers". **CO4:** Analyze the Important non-verbal parameters in communication. So to make communication effective and attractive. **CO5:** Frame and write stories and novels

13002700- Ability & Skill Enhancement I	**CO1:** Understand the relevance and method of writing impactful and structured resume. **CO2:** Explain the need for right etiquettes to be followed in the professional world. **CO3:** Develop confidence in public speaking and expressing their opinions and ideas clearly and effectively. **CO4:** Build employability skills like critical thinking, team work, conflict management and leadership skills. **CO5:** Communicate effectively in English
99002800 - Workshops and Seminars	**CO1:** Relate to the concept of cognitive development and Big Five personality characteristics. **CO2:** Explain the basic fundamentals of Emotional Intelligence. **CO3:** Develop ability to practice new problem-solving skills in a group and use these skills in personal life. **CO4:** Build coping strategies and adapt balanced self- determined behavior. **CO5:** Prepare and deliver lectures
99002700 - Human Values & Social Service/NCC/NSS	**CO1:** Find about the working and mechanism of human nature. **CO2:** Classify and explain group behavior at organizational level and individual level. **CO3:** Organize and plan organizational change and stress management practices. **CO4:** Discover various human values and their importance in real world. **CO5:** Conduct Social Services

6.2 Mapping: Semester – I

13000401	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1		1	2	2	2	2		2
CO2	3	3	3	3		1	2	2	2	2		2
CO3	3	3	2	1		3	2	2	3	3		3
CO4	3	3	2	3	1	3	2	2	3	3	2	2
CO5	3	3	3	2	1	3	3	3	2	2	3	2

13003300	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2		2	2	2	1	2		2
CO2	3	3	2	2		2	2	2	2	2		1
CO3	3	3	2	2		3	3	3	3	3		3
CO4	3	3	3	3	2	3	3	3	3	3	2	3
CO5	3	3	3	2	2	1	2	2	2	2	3	2

13003900	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	1	1	2	2	2	1	2
CO2	3	3	3	2	2	3	2	3	2	2	2	2
CO3	3	3	1	1	1	2	3	2	2	3	2	2
CO4	3	3	2	2	2	2	2	2	3	2	3	3
CO5	3	3	2	2	3	2	2	1	2	2	2	2

99002200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	3		2	2	2	2	1
CO2	2	3	2	2	2	2		3	3	3	3	2
CO3	3	1	1		2	2		2	3	3	2	2
CO4	2	2	3	3	2	2		2	2	3	2	3
CO5	3	3	2	3	3	2	2	1	2	2	1	2

13002700	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	3		3	2	3	2	1
CO2	2	2	3	3	2	2		2	3	3	2	2
CO3	2	2			1	2		2	2	3	3	3
CO4	2	2	2	3	3	2		2	3	3	2	3
CO5	3	3	2	2	2	2	2	2	2	2	2	2

99002800	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2		1	2	3	1	2
CO2	2	2	2	2	2	3		3	2	3	2	2
CO3	1	1			1	2		2	3	3	3	2
CO4	2	3	2	3	3	3		3	2	3	2	2
CO5	3	3	3	2	2	2	2	2	3	2	3	2

99002700	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2	2	3	2	3	2	2
CO2	2	2	3	3	3	2	2	3	3	3	3	3
CO3	1	1	1		2	3	3	3	3	3	3	2
CO4	2	2	3	3	3	3	3	3	2	3	3	2
CO5	3	3	2	2		2	3	2	2	2	1	2

6.3 Lesson Plan: Semester – I

13000401– Chemistry I

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	ATOMIC STRUCTURE		
UNIT I	Introduction to Atomic Structure	C-1	Lecture
UNIT I	Review of Bohr's theory and its limitations, Hydrogen atom spectra	C-2,3	Lecture
UNIT I	dual behaviour of matter and radiation, de Broglie's relation	C-4	Lecture
UNIT I	Heisenberg Uncertainty principle	C-5	Lecture
UNIT I	TUTORIAL	C-6	Numericals
UNIT I	ASSIGNMENT-I		Home Assignment
UNIT I	Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom.	C-7	Lecture
UNIT I	Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.	C-8,9	Lecture
UNIT I	Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).	C-10,11	Lecture
UNIT I	Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.Term symbols of atoms and ions for atomic numbers < 30	C-12	Lecture
UNIT I	TUTORIAL	C-13	Clarification Class
UNIT-II	CHEMICAL BONDING AND MOLECULAR STRUCTURE		
UNIT-II	Ionic Bond - Types of ionic solids, radius ratio effect and coordination number, limitations of radius ratio,	C-14,15,16	Lecture
UNIT-II	ASSIGNMENT II		Home Assignment
UNIT-II	lattice and lattice defects, lattice energy and Born-Haber cycle, Statement of Born-Landé equation for calculation of lattice energy,	C-17,18	Lecture
UNIT-II	solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules.	C-19	Lecture

UNIT-II	Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond.	C-20	Lecture
UNIT-II	various types of hybridization and shapes of simple inorganic molecules and ions such as NH3, H3O+, SF4, ClF3, $ICl2^-$, and H2O by valence shell electron pair repulsion (VSEPR) theory,	C-21,22	Lecture
UNIT-II	linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals. Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules,	C-23,24	Lecture
UNIT-II	ASSIGNMENT III		Assignment Based On MCQ's
UNIT-II	multi-centre bonding in electron-deficient molecules. Bond Energy: Dissociation and average bond energies – determination, periodic trends and Applications.	C-25	Lecture
UNIT-II	Metallic Bond: Free electron, valence bond and band theories. Weak Interactions: Hydrogen Bond – experimental evidence, van der Waal's forces.	C-26,27	Lecture
UNIT-II	TUTORIAL	C-28	Open Book Assignment In Library
UNIT III	FUNDAMENTALS OF ORGANIC CHEMISTRY		
UNIT III	Electronic Displacements; Inductive, electrometric, resonance and mesomeric effects, hyperconjugation and their applications: Organic acids and bases;	C-29,30,	Lecture
UNIT III	ASSIGNMENT-IV		Home Assignment
UNIT III	PRESENTATION-I	C-31,32	Presentation
UNIT III	Homolytic and heterolytic bond Fission. Types of reagents electrophiles and nucleophiles. Types of organic reaction Addition, Elimination and Substitution reactions, Energy considerations.	C-33,34	Lecture
UNIT III	Reactive intermediates – carbocation, Carbanion, free radicals, carbenes, arynes and nitrenes.	C-35,36,37	Lecture
UNIT III	Curly arrow rules and Assigning formal charges on intermediates and other ionic species	C-38	Lecture
UNIT III	ASSIGNMENT-V		Home Assignment
UNIT III	TUTORIAL	C-39	Numericals
UNIT IV	STEREOCHEMISTRY		
UNIT IV	Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions;	C-40,41	Lecture
UNIT IV	Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution.	C-42,43,44	Lecture
UNIT IV	ASSIGNMENT-VI		Home Assignment
UNIT IV	Relative and absolute configuration: D/L and R/S designations.	C-45	Lecture

UNIT IV	Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.	C-46,47	Lecture
UNIT IV	QUIZ	C-48	Quiz
UNIT IV	ASSIGNMENT-VII		Assignment Based On MCQ's
UNIT-V	ALIPHATIC HYDROCARBON		
UNIT IV	Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.	C-49,50	Lecture
UNIT IV	Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction).	C-51,52	Lecture
UNIT IV	Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and antiMarkownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.	C-53,54	Lecture
UNIT IV	ASSIGNMENT-VIII		Home Assignment
UNIT IV	TUTORIAL	C-55	Clarification Class
UNIT IV	Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinaldihalides.	C-56	Lecture
UNIT IV	Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.	C-57	Lecture
UNIT IV	TUTORIAL	C-58	Clarification Class
	Revision	C-59,60	Revision

13000900 – Chemistry I Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	General Instructions, Record writing, Lab Coat, List of experiments	P1-P2	Practical
2	Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.	P3-P4	Practical
3	Estimation of oxalic acid by titrating it with KMnO4.	P5-P6	Practical
4	Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.	P7-P8	Practical
5	Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.	P9-P10	Practical
6	Estimation of Cu (II) ions iodometrically using Na2S2O3.	P11-P12	Practical
7	Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)	P13-P14	Practical
8	Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography	P15-P16	Practical
9	Identify and separate the sugars present in the given mixture by paper chromatography.	P17-P18	Practical
10	Clarification Class	P19-P20	Clarification Class

13003300– Botany (biodiversity)

Unit	Particulars	Class No.	Pedagogy of Class
Unit 2	Different Classification System	C1	Lecture
Unit 2	Algae	C2	Lecture
Unit 5	General characters of Bryophytes and Introduction	C3	Lecture
Unit 5	Marchantia	C4	Lecture
Unit 5	Funaria Morphology	C5	Lecture
Unit 5	Funaria Reproduction	C6	Lecture
Unit 5	Ecology and economic importance of bryophytes with special mention of Sphagnum	C7	Lecture
	Clarification class	C8	Clarification class
	Home Assignment		
Unit 4	Unifying features of archegoniates, Transition to land habit, Alternation of generations	C9	Lecture
Unit 6	General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family)	C10	Lecture
	Class Assignment	C11	
Unit 6	classification, Early land plants (Cooksonia and Rhynia).	C12	Lecture
Unit 6	Classification (up to family) morphology, anatomy and reproduction of Selaginella	C13	Lecture
Unit 6	morphology, anatomy and reproduction of Equisetum,	C14	Lecture
Unit 6	morphology, anatomy and reproduction of Pteris,	C15	Lecture
	Clarification Class	C16	Clarification class
Unit 6	Heterospory and seed habit, stelar evolution, Ecological and economical importance of Pteridophytes	C17	Lecture
	Quiz	C18	
Unit 7	General characteristics, classification	C19	Lecture
Unit 7	Classification (up to family), morphology, anatomy and reproduction of Cycas	C20	Lecture
Unit 7	Classification (up to family), morphology, anatomy and reproduction of Pinus	C21	Lecture
Unit 7	Ecological and economical importance	C22	Lecture
	Clarification class	C23	Clarification class
	Presentation	C24	Lecture
Unit 2	General characters, Ecological	C25	Lecture
Unit 2	General characters, Ecological Distribution of Algae	C26	Lecture
Unit 2	Range of Thallus organisation and Reproduction	C27	Lecture
Unit 2	Classification of Algae	C28	Lecture
Unit 2	Morphology and life-cycles of the following: Nostoc, Chlamydomonas	C29	Lecture
Unit 2	Morphology and life-cycles of the following: Oedogonium, Vaucheria	C30	Lecture
Unit 2	Morphology and life-cycles of the following: Fucus, Polysiphonia	C31	Lecture
Unit 2	Economic importance of algae	C32	Lecture
	Clarification class	C33	Clarification class
Unit 3	Introduction- General characteristics	C34	Lecture

Unit 3	ecology and significance, range of thallus organization	C35	Lecture
Unit 3	cell wall composition , nutrition	C36	Lecture
Unit 3	reproduction and classification	C37	Lecture
Unit 3	True Fungi- General characteristics, ecology and significance	C38	Lecture
Unit 3	life cycle of Rhizopus (Zygomycota) Penicillium	C39	Lecture
Unit 3	Alternaria (Ascomycota)	C40	Lecture
Unit 3	Puccinia, Agaricus (Basidiomycota)	C41	Lecture
Unit 3	Symbiotic Associations-Lichens	C42	Lecture
Unit 3	General account, reproduction and significance	C43	Lecture
Unit 3	ectomycorrhiza and their significance	C44	Lecture
Unit 3	endomycorrhiza and their significance	C45	Lecture
	Quiz	C46	Lecture
	Guest Lecture	C47	Lecture
Unit 1	general structure, replication (general account)	C48	Lecture
Unit 1	DNA virus (T-phage)	C49	Lecture
Unit 1	Lytic and lysogenic cycle	C50	Lecture
Unit 1	RNA virus (TMV)	C51	Lecture
Unit 1	Economic importance; Bacteria – Discovery	C52	Lecture
Unit 1	General characteristics and cell structure	C53	Lecture
Unit 1	Reproduction – vegetative	C54	Lecture
Unit 1	asexual	C55	Lecture
Unit 1	recombination (conjugation, transformation and transduction)	C56	Lecture
Unit 1	Economic importance	C57	Lecture
Unit 5	All Specimen Study	C58	Lecture
Unit 6	All Specimen Study	C59	Lecture
Unit 7	All Specimen Study	C60	Lecture

13003400 – Botany (biodiversity Lab)

S. No.	Particulars	Class No.	Pedagogy of Class
1	Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).	P1	Practical
2	Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).	P2	Practical
3	Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.	P3	Practical
4	Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.	P4	Practical
5	Selaginella- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).	P5	Practical
6	Equisetum- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).	P6	Practical
7	Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).	P7	Practical
8	Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).	P8	Practical
9	Pinus- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).	P9	Practical
10	Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs),	P10	Practical
11	Study of vegetative and reproductive structures of Oedogonium, Vaucheria, Fucus* and Polysiphonia through temporary preparations and permanent slides.	P11	Practical
13	Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Oedogonium, Vaucheria, Fucus* and Polysiphonia through temporary preparations and permanent slides. (* Fucus - Specimen and permanent slides)	P12	Practical

	Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.		
14	Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.	P13	Practical
15	Alternaria: Specimens/photographs and tease mounts.	P14	Practical
16	Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.	P15	Practical
17	Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.	P16	Practical
18	Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)	P17	Practical
19	Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)	P18	Practical
20	Clarification Class	P19	Clarification Class
21	Gram staining	P20	Practical
22	Presentation	P21	Presentation
23	Binary Fission; Conjugation; Structure of root nodule.	P22	Practical
24	Types of Bacteria from temporary/permanent slides/photographs	P23	Practical
25	EM bacterium	P24	Practical
26	EMs/Models of viruses – T-Phage and TMV	P25	Practical
27	EMs/Models of viruses – Line drawing/Photograph of Lytic	P26	Practical
28	EMs/Models of viruses – Lysogenic Cycle.	P27	Practical
29	Bryophytes Specimen	P28	Practical
30	Pteridophytes specimens	P29	Practical
31	Gymnosperm Specimens	P30	Practical

13003900– Biotechnology and Human Welfare

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Definition & Scope Of Biotechnology, Modern Biotechnology	C-1-C-2	Lecture
Unit-I	Terminologies in Biotechnology	C-3	Lecture
Unit-I	Branches of Biotechnology	C-4,	Lecture
Unit-I	Techniques used in Biotechnology, Instruments, Working and Principles	C-5,C-6,C-7	Lecture
Unit-I	Bioinformatics: Principles and Scope	C-8,C-9	Lecture
Unit-I	Activity	C-10	Activity
Unit-I	Ethical Issues in Biotechnology	C-11	Lecture
Unit-II	Applications of Biotechnology in Agriculture, Animal and Veterinary Sciences	C-12,C-13	Lecture
Unit-I	Pharmaceutical Industrial Applications	C-14	Lecture
Unit-I	Food and Chemical Industry	C-15,C-16	Lecture
Unit-I	Clarification Class	C-17	Clarification Class
Unit-I	Biorremediation and Waste Treatment Biotechnology	C--18	Lecture
Unit-I	Biotechnology Research in India and Developing World	C-19,C-20	Lecture
Unit-I	Safety Guidelines and Risk Assessment in Biotechnology	C-21	Lecture
Unit-I	Ethical Issues in Biotechnology, Current and Future Status of Biotechnology	C-22-C-23	Lecture
Unit-I	Tutorial	C-24	Tutorial
Unit-III	Protein Engineering,	C-25	Lecture
Unit-III	Enzyme and Polysaccharide Synthesis, Activity and Secretion	C-26-C-27	Lecture
Unit-III	Presentation	C-28	Presentation
Unit-III	Alcohol and Antibiotic Formation	C-29	Lecture
Unit-III	Nitrogen Fixation, Transfer of pest resistance genes to plants	C-30-C-31	Lecture
Unit-III	Interaction between Plants and Microbes, Qualitative Improvement of Livestock	C-32,C-33,C-34	Lecture
Unit-III	Clarification Class	C-35	Clarification Class
Unit-III	Activity	C-36	Activity
Unit-IV	Environmental Biotechnology, Chlorinated and non-chlorinated organ pollutant degradation	C-37,C-38,C-39	Lecture
Unit-IV	Agricultural Waste Management, Degradation of Hydrocarbons	C-40,C-41,C-42	Lecture
Unit-IV	Tutorial	C-43	Tutorial
Unit-IV	Stress Management	C-44	Lecture
Unit-IV	Development of Biodegradable polymers such as PHB	C-45,C-46	Lecture
Unit-IV	Clarification Class	C-47	Clarification Class
Unit-V	Forensic Science, solving violent crimes e.g. rape, murder, solving claims of paternity and theft etc.	C-48,C-49	Lecture
Unit-V	DNA Finger printing	C-50	Lecture
Unit-V	Activity	C-51	Activity
Unit-V	Development of non toxic therapeutic agents, Recombinant Live Vaccines, Gene therapy	C-52,C-53,C-54	Lecture

Unit-V	Diagnostics, Monoclonal in E.Coli, Human Genome Project	C-55,C-56,C-57	Lecture
Unit-V	Activity	C-58	Activity
Unit-V	Presentation	C-59	Presentation
Unit-V	Clarification Class	C-60	Clarification Class

13004000 – Biotechnology (Biotechnology and Human Welfare and Lab)

S. No.	Particulars	Class No.	Pedagogy of Class
1	Practical knowledge of various instruments used in Biotechnology Lab	P1-P2	Practical
2	To Know the various working rules in Biotech lab	P3-P4	Practical
3	Isolation of DNA from Plant	P5-P6	Practical
4	Demonstration of Fermentation experiment in lab	P7-P8	Practical
5	Making of compost in Lab	P9-P10	Practical
6	To study the blood smear under microscope	P11-P12	Practical
7	Separation of compounds by Thin Layer Chromatography	P13-P14	Practical
8	Perform of ethanolic fermentation using Bakers yeast	P15-P16	Practical
9	Study of Plant part infected with a microbe	P17-P18	Practical
10	To perform quantitative estimation of residual chlorine in water samples	P19-P20	Practical
11	Calculation of total dissolved solids (TDS) of water sample	P21-P22	Practical
12	Calculation of BOD of water sample	P23-P24	Practical
13	Calculation of COD of water sample	P25-P26	Practical
14	Bacterial examination of water by PMN Method	P27-P28	Practical

99002200– Business Communication (AECC)

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	Process of Communication (What is communication)	C1	Lecture
UNIT I	Importance of Communication	C2	Lecture
UNIT I	Seven C's of Communication	C3	Lecture
UNIT I	Types of Communication - Verbal	C4	Lecture
UNIT I	Types of Communication- Non Verbal	C5	Lecture
UNIT I	Types of Communication (Formal & Informal)	C6	Lecture
UNIT I	Types of Communication (Interpersonal & Interapersonal)	C7	Lecture
UNIT I	Different forms of Communication Barriers to Communication Causes, Linguistic Barriers, Psychological Barriers	C8	Lecture
UNIT I	Interpersonal Barriers, Cultural Barriers	C9	Lecture
UNIT I	Physical Barriers, Organizational Barriers	C10	Lecture
	Classroom Assignment on JAM	C11-C13	Class room Assignment
	Clarification Class	C14	Clarification Class
Unit II	Preparing the Resume	C15	Lecture
Unit II	Job Application Letter	C16	Lecture
	Classroom Exercise	C17	Activity
Unit II	Letter Writing	C18-20	Lecture
Unit II	Inviting quotations, Sending quotations, Placing orders	C21	Lecture
Unit II	CV Preparation	C22	Lecture
Unit II	Claim & Adjustment letters, Inviting tenders, Sales letters	C23	Lecture
Unit II	Social Correspondence	C24	Lecture
Unit II	Memorandum, Inter -office Memo,	C25	Lecture
Unit II	Notices	C26	Lecture
Unit II	Agenda	C27	Lecture
Unit II	Minutes	C28	Lecture
	Group Discussion	C29	Group Discussion
	Class Presentation	C30-C33	Presentation
	Clarification Class	C34	Clarification Class
	Home Assignment		Home Assignment
	Quiz	C35	Quiz
	Classroom Exercise	C36-C37	Activity
Unit III	Business reports	C38	Lecture
Unit III	Business Reports: Types, Characteristics	C39	Lecture
Unit III	Business Reports: Importance	C40	Lecture
Unit III	Business Reports: Elements of structure	C41	Lecture
Unit III	Business Reports: Process of writing, Order of writing	C42	Lecture
Unit III	Business Reports: the final draft	C43	Lecture
Unit III	check lists for reports	C44	Lecture
	Classroom Assignment	C45	Class room Assignment
	Clarification Class	C46	Clarification Class
Unit IV	Words often confused	C47	Lecture

Unit IV	Words often misspelt	C48	Lecture
Unit IV	Common errors in English	C49	Lecture
	Classroom Exercise	C50	Activity
	Group Discussion	C51	Group Discussion
	Clarification Class	C52	Clarification Class
Unit V	Oral Presentation: Importance, Characteristics, Presentation Plan	C53	Activity
Unit V	Power point Presentation Slide Preparation	C54	Lecture
Unit V	Visual aids	C55	Lecture
	Classroom Exercise	C56	Activity
	Clarification Class	C57	Clarification Class
	Guest Lecture	C58	Guest Lecture
	Webinar	C59	Webinar
	Seminar	C60	Seminar

13002700– Ability & Skill Enhancement I

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	Sentence and its types	C-1	Lecture
UNIT I	Story Writing	C-2	Activity
UNIT I	Ice Breaking Session: Introduction to ASE, Introduction and overview of the course	C-3,4	Lecture
UNIT I	Word Classes (Parts of Speech) , Phrases Clauses	C-5	Lecture
UNIT II	Tenses - Present Tense	C-6	Lecture
UNIT II	Present Tenses: Written & spoken exercise	C-7	Activity
UNIT II	Tenses – Past Tense	C-8	Lecture
UNIT II	Past Tenses: Written & spoken exercise	C-9	Activity
UNIT II	Tenses – Future Tense	C-10	Lecture
UNIT II	Future Tenses: Written & spoken exercise	C-11	Activity
	Class Room Assignment	C-12	Class Room Assignment
UNIT II	Modals & Exercises	C-13	Lecture
UNIT II	Articles	C-14	Lecture
UNIT II	Articles: Exercise	C-15	Activity
	Presentation	C-16	Presentation
	Clarification Class	C-17	Clarification Class
UNIT III	Reading Skills: Reading Process, Importance & Types of Reading, Techniques of Reading, and Strategies to Improve Reading Abilities	C-18	Lecture
UNIT III	Reading aloud, Reading News	C-19	Class Room Assignment
UNIT III	Reading Comprehension	C-20	Lecture
UNIT IV	Writing Skills: Generating ideas/gathering data, organizing ideas, Note taking, Outlining, drafting, Editing, and Proof Reading,	C-21	Lecture
UNIT IV	Story Writing (through pictures/videos)	C-22	Class Room Assignment
UNIT IV	Email Writing	C-23	Lecture
UNIT IV	Dialogue Writing	C-24	Lecture
UNIT IV	News Writing	C-25	Activity
	Presentation	C-26	Presentation
UNIT V	Types and Essentials of good listening, Listening Process, Barriers to Listening and Strategies to improve Listening	C-27	Lecture
UNIT V	Listening to Inspirational Movies/Clips	C-28	Activity
UNIT V	Listening News	C-29	Activity
UNIT V	Techniques of Effective Speaking	C-30	Lecture
UNIT V	Introducing Oneself and others	C-31	Activity
UNIT V	Situational Conversations (Practicing Short Dialogues)	C-32	Class Room Assignment
UNIT V	Public Speaking	C-33	Lecture
UNIT V	Extempore	C-34	Lecture
UNIT V	Extempore	C-35	Class Room Assignment
	Webinar	C-36	Webinar
	Guest Lecture	C-37	Guest lecture

Course	Course outcomes: - After completion of these courses students should be able to
7.1 Semester II	
13000700 - Chemistry II	**CO1:** Explain principles of thermodynamics **CO2:** Interpret the ionization process of weak acids **CO3:** List different methods of reagent preparation **CO4:** Simplify change in state of energy **CO5:** Prepare Various Organic compounds
13007300 - Plant Anatomy & Embryology	**CO1:** Define the scope & importance of Plant Anatomy and Embryology **CO2:** Classify different types of plant tissues **CO3:** Summarize fertilization, endosperm and embryogeny process. **CO4:** Identify structures of root, shoot and leaf of monocot and dicot plants **CO5:** Use microscope and identify plant anatomical structures
13005900 - Biochemistry & Metabolism	**CO1:** Classify the types of proteins, carbohydrates and fatty acids **CO2:** Summarize the activity of different co enzymes **CO3:** Interpret the different cycles of Carbohydrates Metabolism **CO4:** Prepare different buffers solution **CO5:** Interpret role of coenzymes and cofactors in metabolism
99001900 - Environmental Studies	**CO1:** Describe the structure and function ecosystem **CO2:** Explain the knowledge about environment and its conservation along with sustainable development. **CO3:** Explain the different types of disasters and their management **CO4:** Classify the different types pollution and their role in ecosystem **CO5:** Aware the society about measures to prevent environmental pollution
13002800 - Ability and Skill Enhancement II	**CO1:** Select the correct phonetic symbols for improving language **CO2:** Operate reading and writing skills in English **CO3:** Prepare listening and speaking skills in English **CO4:** Focus in understanding the ethics, virtues and values **CO5:** Aware about etiquettes and personal branding

7.2 Mapping: Semester – II

13000700	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO0	PO11	PO12
CO1	3	3	2	2	1	2	2	2	2	2	1	2
CO2	3	3	2	2	2	2	2	2	3	2	2	2
CO3	3	3	2	2	2	2	2	2	2	3	1	2
CO4	3	3	2	2	2	2	2	2	2	2	3	3
CO5	3	3	2	2	3	3	2	3	3	3	3	2

13007300	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2		2	2	2	2	2	1	3
CO2	3	3	2	2		2	2	3	2	2		3
CO3	3	3	2	3		2	2	2	2	2	3	2
CO4	3	3	2	2		2	2	2	2	2	3	2
CO5	3	3	2	2		3	3	3	2	2	3	2

13005900	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	3	3	2	2	2		2
CO2	3	3	2	3	1	2	2	2	2	2		2
CO3	3	3	2	2	2	2	3	1	2	2	2	2
CO4	3	3	2	2	3	2	3	3	2	2	2	2
CO5	3	2	3	2	3	2		2	2	3	2	2

99001900	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	1	2	3	2	2	2	2	2
CO2	3	3	1	1	1	2	3	2	2	2	2	2
CO3	3	3	3	2	1	3	3	3	2	2	2	2
CO4	3	3	3	2	1	3	3	3	2	2	2	2
CO5	3	3	2	2	3	2	2	1	2	2	3	2

13002800	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	3	1	3	2	3	3	2
CO2	3	2	2	3	2	2	1	2	2	3	2	2
CO3	3	3		1	2	2	1	3	3	3	2	2
CO4	3	3	3	2	2	2	1	2	3	3	2	2
CO5	3	3	2	3	2	3	3	3	2	2	2	2

7.3 Lesson Plan: Semester – II

13000700 – Chemistry II

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	THERMODYNAMICS		
UNIT I	What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of system and processes.	C1	Lecture
UNIT I	First law of thermodynamics.	C2	Lecture
UNIT I	Calculation of work(w), heat(q), change in internal energy(U), and enthalpy(H) for expansion or compression of ideal gases under isothermal and adiabatic condition for both reversible and irreversible processes. Calculation of w, q, U and H for processes involving changes in physical states.	C3 to C4	Lecture
UNIT I	Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution	C5 to C6	Lecture
UNIT I	Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature - Kirchhoff's equation	C7	Lecture
UNIT I	Calculation of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions, Criteria of spontaneity.	C8	Lecture
UNIT I	Statement of third law of thermodynamics and calculation of absolute entropy of substances.	C9	Lecture
UNIT I	CLARIFICATION CLASS I	C10	Clarification Class
UNIT 2	CHEMICAL EQUILIBRIUM		
UNIT 2	Free energy change in a chemical reaction.	C11	Lecture
UNIT 2	Thermodynamic derivation of the law of chemical equilibrium.	C12 to C13	Lecture
UNIT 2	Distinction between DG and DGo.	C14	Lecture
UNIT I	Le Chatelier's principle.	C15 to C16	Lecture
UNIT 2	Relationships between Kp, Kc and Kx for reactions involving ideal gases.	C17 to C18	Lecture
UNIT 2	CLARIFICATION CLASS II	C19	Clarification Class
	ASSIGNMENT I		Home Assignments
UNIT 3	IONIC EQUILIBRIUM		
UNIT 3	Ionic Equilibria: Strong, moderate and weak electrolytes,	C20	Lecture
UNIT 3	degree of ionization, factors affecting degree of ionization,	C21	Lecture
UNIT 3	ionization constant and ionic product of water. Ionization of weak acids and bases	C22-C23	Lecture
UNIT3	pH scale, common ion effect.	C24	Lecture
UNIT3	Salt hydrolysis-calculation of hydrolysis constant,	C25	Lecture

UNIT3	degree of hydrolysis and pH for different salts.	C26	Lecture
UNIT3	Buffer solutions. Solubility and solubility product of sparingly soluble salts - applications of solubility product principle.	C27 to C28	Lecture
	CLARIFICATION CLASS III	C29	Clarification Class
	ASSIGNMENT II	C30	Class Assignment
	WEBINAR	C31	Webinar
	QUIZ	C32	Quiz
UNIT 4	ORGANIC CHEMISTRY		
UNIT 4	Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.	C33	Lecture
UNIT 4	Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation.	C34	Lecture
UNIT 4	Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene)	C35	Lecture
UNIT 4	Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).	C36	Lecture
UNIT 4	Alkyl Halides (Up to 5 Carbons) Preparation: from alkenes and alcohols.	C37	Lecture
UNIT 4	Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.	C38	Lecture
UNIT 4	Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis.	C39	Lecture
	SEMINAR	C40	Seminar
UNIT 4	Elimination vs substitution	C41	Lecture
UNIT 4	Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions	C42	Lecture
UNIT 4	Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent.	C43	Lecture
UNIT 4	Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3).	C44	Lecture
UNIT 4	Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.	C45	Lecture
UNIT 4	Alcohols, (Up to 5 Carbons) Alcohols: Preparation: Preparation of 1o, 2o and 3o alcohols: using, Grignard reagent Ester hydrolysis. Reduction of aldehydes, ketones, carboxylic acid and esters.	C46	Lecture
UNIT 4	Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3).	C47	Lecture
UNIT 4	Oppeneauer oxidation Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement	C48	Lecture
	ASSIGNMENT III	C49	Class Assignment
	ASSIGNMENT IV		Home Assignments
UNIT 4	GUEST LECTURE Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts.	C50	Guest lecture

UNIT 4	Reactions, Electrophilic substitution: Nitration, halogenation and sulphonation.	C51	Lecture
	PRESENTATION	C52	Presentation
UNIT 4	Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben- Hoesch Condensation, Schotten - Baumann Reaction	C53	Lecture
	QUIZ	C54	Quiz
UNIT 4	Ethers (aliphatic and aromatic): Cleavage of ethers with HI	C55	Lecture
UNIT 4	Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles	C56-C57	Lecture
UNIT 4	Reactions - Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction,	C58	Lecture
UNIT 4	Wittig reaction, Benzoin condensation. Clemensen reduction	C59	Lecture
	CLARIFICATION CLASS	C60	Clarification Class

13001100 – Chemistry - II Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Introduction to Chemistry II Lab, Instructions	P1 to P2	Practical
2	Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide	P3 to P4	Practical
3	Determination of enthalpy of ionization of acetic acid.	P5 to P6	Practical
4	Determination of integral enthalpy of solution of salts (KNO3, NH4Cl)	P7 To P8	Practical
5	Determination of enthalpy of hydration of copper sulphate	P9 to P10	Practical
6	Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.	P11 to P12	Practical
7	Preparation of buffer solutions: (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide Measurement of the pH of buffer solutions and comparison of the values with theoretical values	P13 to P14	Practical
8	Purification of organic compounds by crystallization (from water and alcohol) and distillation	P15 to P16	Practical
9	Criteria of Purity: Determination of melting and boiling points	P17 to P18	Practical
10	Purification of Volatile compounds (phthalic acid, napthalene),; Distillation of solvents	P19 to P20	Practical
11	Preparation: Bromination of Phenol/Aniline	P21 to P22	Practical
12	Preparations: Benzoylation of amines/phenols	P23 to P24	Practical
13	Preparations: Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone	P25 to P26	Practical
14	REVISION	P27 to P30	Clarification Class

13007300 – Plant Anatomy & Embryology

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	THERMODYNAMICS		
UNIT I	What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of system and processes.	C1	Lecture
UNIT I	First law of thermodynamics.	C2	Lecture
UNIT I	Calculation of work(w), heat(q), change in internal energy(U), and enthalpy(H) for expansion or compression of ideal gases under isothermal and adiabatic condition for both reversible and irreversible processes. Calculation of w, q, U and H for processes involving changes in physical states.	C3 to C4	Lecture
UNIT I	Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution	C5 to C6	Lecture
UNIT I	Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature - Kirchhoff's equation	C7	Lecture
UNIT I	Calculation of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions, Criteria of spontaneity.	C8	Lecture
UNIT I	Statement of third law of thermodynamics and calculation of absolute entropy of substances.	C9	Lecture
UNIT I	CLARIFICATION CLASS I	C10	Clarification Class
UNIT 2	CHEMICAL EQUILIBRIUM		
UNIT 2	Free energy change in a chemical reaction.	C11	Lecture
UNIT 2	Thermodynamic derivation of the law of chemical equilibrium.	C12 to C13	Lecture
UNIT 2	Distinction between DG and DGo.	C14	Lecture
UNIT I	Le Chatelier's principle.	C15 to C16	Lecture
UNIT 2	Relationships between Kp, Kc and Kx for reactions involving ideal gases.	C17 to C18	Lecture
UNIT 2	CLARIFICATION CLASS II	C19	Clarification Class
	ASSIGNMENT I		Home Assignments
UNIT 3	IONIC EQUILIBRIUM		
UNIT 3	Ionic Equilibria: Strong, moderate and weak electrolytes,	C20	Lecture
UNIT 3	degree of ionization, factors affecting degree of ionization,	C21	Lecture
UNIT 3	ionization constant and ionic product of water. Ionization of weak acids and bases	C22-C23	Lecture
UNIT3	pH scale, common ion effect.	C24	Lecture
UNIT3	Salt hydrolysis-calculation of hydrolysis constant,	C25	Lecture
UNIT3	degree of hydrolysis and pH for different salts.	C26	Lecture

UNIT3	Buffer solutions. Solubility and solubility product of sparingly soluble salts - applications of solubility product principle.	C27 to C28	Lecture
	CLARIFICATION CLASS III	C29	Clarification Class
	ASSIGNMENT II	C30	Class Assignment
	WEBINAR	C31	Webinar
	QUIZ	C32	Quiz
UNIT 4	ORGANIC CHEMISTRY		
UNIT 4	Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.	C33	Lecture
UNIT 4	Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation.	C34	Lecture
UNIT 4	Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene)	C35	Lecture
UNIT 4	Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).	C36	Lecture
UNIT 4	Alkyl Halides (Upto 5 Carbons) Preparation: from alkenes and alcohols.	C37	Lecture
UNIT 4	Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.	C38	Lecture
UNIT 4	Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis.	C39	Lecture
	SEMINAR	C40	Seminar
UNIT 4	Elimination vs substitution	C41	Lecture
UNIT 4	Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions	C42	Lecture
UNIT 4	Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent.	C43	Lecture
UNIT 4	Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3).	C44	Lecture
UNIT 4	Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.	C45	Lecture
UNIT 4	Alcohols, (Upto 5 Carbons) Alcohols: Preparation: Preparation of 1o, 2o and 3o alcohols: using, Grignard reagent Ester hydrolysis. Reduction of aldehydes, ketones, carboxylic acid and esters.	C46	Lecture
UNIT 4	Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3).	C47	Lecture
UNIT 4	Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement	C48	Lecture
	ASSIGNMENT III	C49	Class Assignment
	ASSIGNMENT IV		Home Assignments
UNIT 4	GUEST LECTURE Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts.	C50	Guest lecture
UNIT 4	Reactions, Electrophilic substitution: Nitration, halogenation and sulphonation.	C51	Lecture

	PRESENTATION	C52	Presentation
UNIT 4	Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben- Hoesch Condensation, Schotten - Baumann Reaction	C53	Lecture
	QUIZ	C54	Quiz
UNIT 4	Ethers (aliphatic and aromatic): Cleavage of ethers with HI	C55	Lecture
UNIT 4	Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles	C56-C57	Lecture
UNIT 4	Reactions - Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction,	C58	Lecture
UNIT 4	Wittig reaction, Benzoin condensation. Clemensen reduction	C59	Lecture
	CLARIFICATION CLASS	C60	Clarification Class

13007400 – Plant Anatomy and Embryology Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Introduction to Practicals	P1	Practical
2	Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)	P2	Practical
3	Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)	P3	Practical
4	Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).	P4	Practical
5	Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).	P5	Practical
6	Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).	P6	Practical
7	Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).	P7	Practical
8	Clarification Class	P8	Clarification Class
9	Leaf: Dicot and Monocot leaf (only Permanent slides).	P9	Practical
10	Leaf: Dicot and Monocot leaf (only Permanent slides).	P10	Practical
11	Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).	P11	Practical
12	Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).	P12	Practical
13	Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).	P13	Practical
14	Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).	P14	Practical
15	Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).	P15	Practical
16	Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous. Female gametophyte: Polygonum (monosporic) type of	P16	Practical

	Embryo sac Development (Permanent slides/photographs).		
17	Study of meristems through permanent slides and photographs.	P17	Practical
18	Study of meristems through permanent slides and photographs.	P18	Practical
19	Study of meristems through permanent slides and photographs.	P19	Practical
20	Ultrastructure of mature egg apparatus cells through electron micrographs	P20	Practical
21	Presentation	P21	Presentation
22	Clarification Class	P22	Clarification Class
23	Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).	P23	Practical
24	Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).	P24	Practical
25	Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).	P25	Practical
26	Power Point Presentation	P26	Presentation
27	Dissection of embryo/endosperm from developing seeds.	P27	Practical
28	Dissection of embryo/endosperm from developing seeds.	P28	Practical
29	Calculation of percentage of germinated pollen in a given medium.	P29	Practical
30	Calculation of percentage of germinated pollen in a given medium.	P30	Practical

13005900– Biochemistry & Metabolism

Unit	Particulars	Class No.	Pedagogy of Class
I	A historical prospective of Biochemistry	C1	Lecture
I	Structure & Function of amino acids	C2-C3	Lecture
I	Properties of Amino acids	C4	Lecture
I	Types of proteins and their classification	C5	Lecture
I	Forces stabilizing protein structure and shape	C6	Lecture
	Presentation	C7	Presentation
I	Different Level of structural organization of proteins	C8-C9	Lecture
I	Protein Purification	C10	Lecture
I	Denaturation and renaturation of proteins	C11	Lecture
	Home Assignment-I		Home Assignment
I	Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides	C12-C13	Lecture
I	Homo & Hetero Polysaccharides and Mucopolysaccharides	C14	Lecture
I	Bacterial cell wall polysaccharides	C15	Lecture
I	Glycoprotein's and their biological functions	C16	Lecture
	Clarification Class-I	C17	Clarification Class
	Classroom Assignment-I	C18	Class Assignment
II	Structure and functions of Lipids	C19	Lecture
II	Classification, nomenclature and properties of fatty acids	C20-C21	Lecture
II	Essential fatty acids	C22	Lecture
II	Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol	C23	Lecture
II	Structure and functions of Nucleic Acids	C24-C25	Lecture
II	Physical & chemical properties of Nucleic acids	C26-C27	Lecture
II	Nucleosides & Nucleotides, purines & pyrimidines and Biologically important nucleotides	C28	Lecture
	Quiz- I	C29	Quiz
II	Double helical model of DNA structure and forces responsible for A, B & Z – DNA and Denaturation and renaturation of DNA	C30,3,C32	Lecture
	Clarification Class- II	C33	Clarification Class
	Home Assignment-II		Home Assignment
III	Nomenclature and classification of Enzymes	C34	Lecture
III	Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes	C35-C36	Lecture
III	Activation energy and transition state, enzyme activity, specific activity	C37	Lecture
III	Common features of active sites, enzyme specificity: types & theories	C38	Lecture
III	Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria	C39-C40	Lecture
III	Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12	C41	Lecture
III	Tetrahydrofolate and metallic ions	C42	Lecture

	Clarification Class-III	C43	Clarification Class
IV	Reactions, energetics and regulation of Carbohydrates	C44-C45	Lecture
IV	Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions	C46-C48	Lecture
	Classroom Assignment-II	C-49	Class Assignment
IV	Pentose phosphate pathway and its significance	C50-C51	Lecture
IV	Gluconeogenesis, Glycogenolysis and glycogen synthesis	C52-C53	Lecture
IV	TCA cycle	C54-C56	Lecture
	Quiz- II	C57	Quiz
IV	Electron Transport Chain	C58	Lecture
IV	Oxidative phosphorylation & ß-oxidation of fatty acids	C59	Lecture
	Clarification Class-IV	C60	Clarification Class

13006000 – Biochemistry & Metabolism Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	To study activity of any enzyme under optimum conditions.	P1 - P2	Practical
2	To study the effect of pH, temperature on the activity of salivary amylase enzyme.	P3 - P4	Practical
3	Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.	P5 - P6	Practical
4	Estimation of blood glucose by glucose oxidase method.	P7 - P8	Practical
5	Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein.	P9 - P10	Practical
6	Principles of Colorimetry: (ii) To study relation between absorbance and % transmission.	P11 - P12	Practical
7	Preparation of buffers.	P13 - P14	Practical
8	Separation of Amino acids by paper chromatography.	P15 - P16	Practical
9	Qualitative tests for Carbohydrates, lipids and proteins.	P17 - P18	Practical

99001900– Environmental Studies

Unit	Particulars	Class No.	Pedagogy of Class
Unit 1	Introduction of Subject	C1	Lecture
Unit 1	Multidisciplinary nature of environmental studies; Scope and importance; Need for public awareness	C2	Lecture
Unit 1	Ecosystems: What is an ecosystem? Structure and function of ecosystem	C3	Lecture
Unit 1	Energy flow in an ecosystem: food chains, food webs	C4	Lecture
Unit 1	ecological succession	C5	Lecture
Unit 1	Forest ecosystem	C6	Lecture
Unit 1	Grassland ecosystem	C7	Lecture
Unit 1	Desert ecosystem	C8	Lecture
Unit 1	Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	C9	Lecture
	Home Assignment		Home Assignment
	Clarification Class	C10	Clarification Class
Unit 2	Renewable and Non-renewable Resources	C11	Lecture
Unit 2	Land resources and land use change; Land degradation, soil erosion and desertification	C12	Lecture
Unit 2	Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.	C13,14	Lecture
Unit 2	Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state)	C15,16	Lecture
Unit 2	Energy resources : Renewable and non-renewable energy sources	C17,18	Lecture
Unit 2	Use of alternate energy sources, growing energy needs, case studies	C19	Lecture
	Home Assignment		Home Assignment
	Quiz	C20	Quiz
Unit 3	Levels of biological diversity : genetic, species and ecosystem diversity	C21	Lecture
Unit 3	Biogeographic zones of India	C22	Lecture
Unit 3	Biodiversity patterns and global biodiversity hot spots India as a mega-biodiversity nation	C23	Lecture
Unit 3	Endangered and endemic species of India	C24	Lecture
Unit 3	Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions	C25	Lecture
	Class Room Assignment	C26	Class Assignment
Unit 3	Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions	C27	Lecture
Unit 3	Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	C28	Lecture
Unit 3	Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value	C29,30	Lecture
	Power Point Presentation	C31	Presentation
	Clarification Class	C32	Clarification Class
Unit 4	Environmental pollution: types, causes, effects and controls	C33	Lecture

Unit 4	Air, water, soil and noise pollution Nuclear hazards and human health risks	C34	Lecture
Unit 4	Solid waste management: Control measures of urban and industrial waste. Pollution case studies	C35,36	Lecture
Unit 4	Environmental Policies & Practices: Sustainability and sustainable development.	C37	Lecture
Unit 4	Clarification Class	C38	Clarification Class
Unit 4	Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act	C39	Lecture
Unit 4	Water (Prevention and control of Pollution) Act	C40	Lecture
Unit 4	Wildlife Protection Act	C41	Lecture
Unit 4	Forest Conservation Act	C42	Lecture
Unit 4	Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context	C43	Lecture
	Class Room Assignment	C44	Class Assignment
	Quiz	C45	Quiz
	Clarification Class	C46	Clarification Class
Unit 5	Human population growth: Impacts on environment, human health and welfare	C47	Lecture
Unit 5	Resettlement and rehabilitation of project affected persons; case studies	C48	Lecture
Unit 5	Disaster management: floods	C49	Lecture
Unit 5	Disaster management: earthquake	C50	Lecture
Unit 5	Disaster management: cyclones	C51	Lecture
Unit 5	Disaster management: landslides	C52	Lecture
Unit 5	Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan	C53	Lecture
Unit 5	Environmental ethics: Role of Indian and other religions and cultures in environmental conservation	C54	Lecture
Unit 5	Environmental communication	C55	Lecture
Unit 5	Public Awarness	C56	Lecture
Unit 5	Case study at local area	C57	Lecture
Unit 5	Environmental communication case studies (e.g., CNG vehicles in Delhi)	C58	Lecture
Unit 5	Environmental conservation	C59	Lecture
	Clarification Class	C60	Clarification Class

13002800– Ability and Skill Enhancement II

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	Phonetic symbols and the International Phonetic Alphabets (IPA)	C1	Lecture
Unit I	The Description and Classification of Vowels (Monophthongs & Diphthong)	C2	Lecture
Unit I	Consonants	C3	Lecture
Unit I	Phonetic Transcription & Phonology	C4	Lecture
Unit I	Syllable	C5	Lecture
Unit I	Stress & Intonations	C6	Lecture
	Reading aloud, recording audio clips	C7	Class Assignment
Unit II	Idioms and Phrases	C8	Lecture
Unit II	Words Often Confused	C9	Lecture
Unit II	One word Substitution	C10	Lecture
Unit II	Word Formation: Prefix & Suffix	C11	Lecture
	Home Assignment		Home Assignments
Unit III	What are ethics, what are values, difference between ethics and morals	C12	Lecture
Unit III	Business ethics, workplace ethics,	C13	Lecture
Unit III	what are virtues for e.g. civic virtues, etc. Human ethics and values- 5 core human values are: right conduct, living in peace, speaking the truth, loving and care, and helping others.	C14	Lecture
Unit III	Etiquette awareness	C15	Lecture
Unit III	Importance of First Impression, Personal Appearance & Professional presence, Personal Branding	C16	Lecture
Unit III	Dressing Etiquette	C17	Lecture
Unit III	Dining Etiquette	C18	Lecture
Unit III	Presentation	C19	Presentation
Unit III	Clarification Class	C20	Clarification Class
Unit IV	Reading Comprehension	C21	Activity
Unit IV	News Reading	C22	Activity
Unit IV	Picture Description	C23	Activity
Unit IV	Paragraph Writing	C24	Lecture
Unit IV	Paragraph Writing	C25	Activity
Unit IV	News Writing	C26	Lecture
Unit IV	Clarification Class	C27	Lecture
Unit V	Public Speaking/Debate	C28	Lecture
Unit V	Debate	C29	Class Assignment
Unit V	Inspirational Movie Screening	C30	Activity
Unit V	Skit Performance	C31	Activity
	Workshop		Workshop

Course	Course outcomes: - After completion of these courses students should be able to
8.1 Semester III	
13001300-Chemistry III	**CO1:** Visualize the Diagrams which are important to materials engineering (specially in alloys). **CO2:** Write about the details of ionic product of water, solubility product, degree of dissociation of electrolytes and performing the different types of titrations **CO3:** Deduce the estimation the thermodynamics of electrochemistry, the structure of the electrode/electrolyte interface and electrode processes. **CO4:** Express the principles, preparation and reactions mechanism associated with carboxylic functional groups, structures of biomolecules like carbohydrates and proteins. **CO5:** Prepare noble Merrifield resin through peptide synthesis which has many research importance etc.
13008700- Plant Physiology and Metabolism	**CO1:** Explain the mechanism of plant water relation i.e. Transpiration, Root pressure and guttation. **CO2:** Discuss and compare the mechanism of photosynthesis and Respiration in Plants. **CO3:** Explain and classify the different types of plant growth regulators. **CO4:** Conclude the response of light and temperature on plant growth **CO5:** Analyze various physiological processes in plants
13007700-Genetics	**CO1:** Express the mechanism of mode of inheritance through Mendelian and Non-Mendelian modes of inheritance that govern passage of genetic traits across generation and to apply this knowledge of inheritance to track alleles through generations **CO2:** Discuss about the genetic organization of prokaryotic and viral genome and also classify the different types of genetic organisation of hereditary disorder patient **CO3:** Classify the process the cell division i.e., mitosis and meiosis **CO4:** Interpret the demonstration of - Barr Body -Rhoeo translocation. **CO5:** Apply principles of Genetics for pedigree analysis of a heredity disease
13028300-Basic Instrumentation Skills for Biotech	**CO1:** Recite the basic knowledge of instruments in biotechnology laboratory **CO2:** Conclude the basic concept of pH and pH meter **CO3:** Establish the knowledge how autoradiography is used in Biotechnology **CO4:** Evaluate the use of chromatography and electrophoresis **CO5:** Use various instruments in Biotechnology laboratory

13002900- Ability & Skill Enhancement III	**CO1:** Classify the different types of reviews i.e. book review, movie review etc. **CO2:** Express his/ her feeling at pressor situation or emotional situation **CO3:** Explain his/her thoughts in group discussion and also build leadership quality **CO4:** Enhance creativity in making documentary etc. **CO5:** Manage negative emotions keeping balance of mental stability, stress and distress.

8.2 Mapping: Semester – III

13001300	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	2	2	2	2	1	3
CO2	3	3	2	2		2	2	2	2	2	1	1
CO3	3	3	2	2	2	2	3	2	2	2		2
CO4	3	3	2	2	3	2	2	3	2	2	3	3
CO5	3	3	2	2	2	2	1	1	2	2	3	2

13008700	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2		2	2	2	2	2		2
CO2	3	3	2	2		2	2	2	2	2		3
CO3	3	3	2	2		2	3	1	2	2	2	2
CO4	3	3	2	2		2	1	3	2	2	2	2
CO5	3	3	2	2	2	2	2	3	2	2	3	2

13007700	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2		2	2	2	2	2	1	2
CO2	3	3	2	2		2	2	2	2	2	1	2
CO3	3	3	2	2		3	2	2	2	3	2	3
CO4	3	3	3	3	2	3	2	2	3	3	2	3
CO5	3	3	3	3	2	3	2	2	3	3	2	3

13028300	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	2	2	2	2	2
CO2	3	3	2	2	3	1	2	2	2	1	2	2
CO3	3	3	1	2	3	3		2	2	3	2	3
CO4	3	3	3	3	3	3	2	2	3	3	2	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3

13002900	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3		2	2	3	3	2
CO2	2	2	3	3	2	2		2	2	3	2	2
CO3	2	2			3	2		3	2	3	2	2
CO4	2	2	2	2	2	2		2	2	3	1	2
CO5	3	3	2	2	2	2	3	3	2	2	3	2

8.3 Lesson Plan: Semester – III

13001300 – Chemistry III

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	SOLUTIONS		
UNIT-I	Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions.	C-1,2	Lecture
UNIT-I	Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Azeotropes.	C-3	Lecture
UNIT-I	Distillation of solutions. Lever rule.	C-4	Lecture
UNIT-I	Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids-Principle of steam distillation.	C-5	Lecture
UNIT-I	Nernst distribution law	C-6	Lecture
UNIT-I	Applications of Nernst distribution law, solvent extraction.	C-7	Lecture
	ASSIGNMENT-I		Take Home Assignments
	CLARIFICATION CLASS I	C-8	Clarification Class
UNIT-II	PHASE EQUILIBRIUM		
UNIT-II	Phases, components and degrees of freedom of a system, criteria of phase equilibrium.	C-9	Lecture
UNIT-II	Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria.	C-10	Lecture
UNIT-II	Phase diagrams of one-component systems (water and sulphur)	C-11	Lecture
UNIT-II	Phase diagrams of two component systems involving eutectics only, lead-silver system	C-12	Lecture
UNIT-II	congruent and incongruent melting points (FeCl3-H2O and Na-K)	C-13	Lecture
	Assignment II	C-14	Class Room Assignment
UNIT-II	CLARIFICATION CLASS II	C-15	Clarification Class
	WEBINAR I	C-16	Webinar
UNIT-III	CONDUCTANCE		
UNIT-III	Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.	C-17	Lecture
UNIT-III	Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility.	C-18,19	Lecture
UNIT-III	Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).	C-20,21	Lecture

	GUEST LECTURE-I	C-22	Guest lecture
UNIT-III	CLARIFICATION CLASS III	C-23	Clarification Class
	Assignment III		Take Home Assignments
UNIT-IV	ELECTROCHEMISTRY		
UNIT-IV	Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series.	C-24,25	Lecture
UNIT-IV	Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data.	C-26	Lecture
	SEMINAR	C-27	
UNIT-IV	Concentration cells with transference and without transference. Liquid junction potential and salt bridge.	C-28,29	Lecture
UNIT-IV	pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations - qualitative treatment (acid-base and oxidation-reduction only).	C-30	Lecture
	ASSIGNMENT-IV	C-31	Class Room Assignment
	WEBINAR II	C-32	WEBINAR
UNIT-IV	CLARIFICATION CLASS IV	C-33	Clarification Class
UNIT-V	ORGANIC CHEMISTRY, CARBOXYLIC ACIDS AND THEIR DERIVATIVES		
UNIT-V	Carboxylic acids (aliphatic and aromatic): Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction.	C-34,35	Lecture
UNIT-V	Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.	C-36,37	Lecture
UNIT-V	Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.	C-38	Lecture
UNIT-V	Amines (Aliphatic and Aromatic): Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.	C-39	Lecture
UNIT-V	Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.	C-40,41	Lecture
UNIT-V	Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.	C-42	Lecture
UNIT-V	CLARIFICATION CLASS V	C-43	Clarification Class
	GUEST LECTURE-II	C-44	Guest lecture

	Assignment V		Take Home Assignments
	PRESENTATION-I	C-45	Presentation
UNIT -VI	AMINO ACIDS, PEPTIDES AND PROTEINS, CARBOHYDRATE		
UNIT -VI	Amino acids, Preparation: Strecker synthesis using Gabriel's phthalimide synthesis.	C-46	Lecture
UNIT -VI	Zwitterion, Isoelectric point and Electrophoresis.	C-47	Lecture
UNIT -VI	Reactions of Amino acids: ester of –COOH group, acetylation of –NH2 group, complexation with Cu2+ ions, ninhydrin test.	C-48	Lecture
UNIT -VI	Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme).	C-49	Lecture
UNIT -VI	Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyland phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.	C-50,51	Lecture
	QUIZ	C-52	Quiz
	PRESENTATION-II	C-53	Presentation
	ASSIGNMENT VI	C-54	Class Room Assignment
UNIT -VI	Carbohydrates: Classification, and General Properties,	C-55	Lecture
UNIT -VI	Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides.	C-56,57	Lecture
UNIT -VI	Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.	C-58,59	Lecture
UNIT -VI	CLARIFICATION CLASS VI	C-60	Clarification Class

13001400 – Chemistry-III Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Study of the equilibrium constant of I2 between CCl4 and water by the distribution method	C-1,2	PRACTICAL
2	Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it	C-3,4	PRACTICAL
3	Study of the equilibrium of the following reactions by the distribution method: $Cu2+(aq) + xNH3(aq) \rightleftarrows [Cu(NH3)x] 2+$	C-5,6	PRACTICAL
4	Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.	C-7,8	PRACTICAL
5	Determination of Cell Constant	C-9,10	PRACTICAL
6	Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid	C-11,12	PRACTICAL
7	Determination of strength of HCl solution by titrating it against NaOH solution conductometrically	C-13,14	PRACTICAL
8	Determination of strength of CH3COOH solution by titrating it against NaOH solution conductometrically	C-15,16	PRACTICAL
9	To Find out the strength of given sample of strong acid Solution with strong base potentimetrically	C-17,18	PRACTICAL
10	To Find out the strength of given sample of weak acid Solution with strong base potentimetrically	C-19,20	PRACTICAL
11	potentiometric titrations of Potassium dichromate vs. Mohr's salt	C-21,22	PRACTICAL
12	Action of salivary amylase on starch Effect of temperature on the action of salivary amylase on starch	C-23,24	PRACTICAL
13	Determination of the concentration of glycine solution by formylation method. Titration curve of glycine	C-25,26	PRACTICAL
14	Differentiation between a reducing and a nonreducing sugar.	C-27,28	PRACTICAL
15	CLARIFICATION CLASS	C-29,30	Clarification Class

13008700 – Plant Physiology and Metabolism

Unit	Particulars	Class No.	Pedagogy of Class
I	Plant Physiology Introduction and application	C-1	Lecture
I	Importance of Water	C-2	Lecture
I	Water Potential and its components	C-3	Lecture
I	Osmosis, Imbition, Diffusion	C-4	Lecture
I	Permeability of Cell membrane	C-5	Lecture
	Home Assignment I		Take Home Assignments
I	Transpiration	C-6	Lecture
I	Factors affecting Transpiration	C-7	Lecture
I	Significance of transpiration	C-8	Lecture
I	Root pressure and Guttation	C-9	Lecture
	Classroom Assignment I	C-10	Class Room Assignment
	Clarification Class Unit-I	C-11	Clarification Class
II	Mineral Nutrition	C-12	Lecture
II	Criteria of essentiality of elements	C-13	Lecture
II	Macro and micronutrients	C-14	Lecture
II	Role of Essential Elements	C-15	Lecture
II	Home Assignment II		Take Home Assignments
II	Transport of ions across cell membrane, Theories for transport of ions	C-16	Lecture
II	Active Transport	C-17	Lecture
II	Passive Transport	C-18	Lecture
II	Carrier Channels and pumps	C-19	Lecture
	Clarification Class Unit-II	C-20	Clarification Class
III	Translocation in phloem, Composition of phloem sap	C-21	Lecture
III	Pathways of translocation	C-22	Lecture
III	Phloem sap loading	C-23	Lecture
III	Phloem unloading	C-24	Lecture
III	Clarification Class for Unit-III	C-25	Clarification Class
	Class Room Assignment II	C-26	Class Room Assignment
IV	Photosynthesis; photosynthesis pigments	C-27	Lecture
IV	photosystem 1 and 2	C-28	Lecture
IV	Quiz	C-29	Quiz
IV	Cyclic Photophosporylation	C-30	Lecture
IV	C3, C4 and CAM pathways of carbon fixation	C-31	Lecture
IV	Electron transport and mechanism of ATP synthesis	C-32	Lecture
	Presentation I	C-33	Presentation
	Clarification Class Unit IV	C-34	Clarification Class
V	Glycolysis Anaerobic Respiration	C-35	Lecture
V	TCA cycle	C-36	Lecture
V	oxidative Phosphorylation, Glyoxylate Cycle	C-37	Lecture
V	Pentose Phosphate Pathway	C-38	Lecture
	Clarification Class Unit V	C-39	Clarification Class
VI	Structure and properties of Enzymes	C-40	Lecture
VI	Mechanisms of enzyme catalysis	C-41	Lecture
VI	Enzyme Inhibition	C-42	Lecture

VI	Classroom Assignment III	C-43	Class Room Assignment
	Clarification Class Unit VI	C-44	Clarification Class
VII	Biological Nitrogen Fixation	C-45	Lecture
VII	Nitrate and Ammonia Assimilation	C-46	Lecture
VII	Nitrogen Cycle	C-47	Lecture
VII	Clarification Class Unit VII	C-48	Clarification Class
VIII	Discovery and physiological roles of auxins	C-49	Lecture
VIII	Discovery and physiological roles of gibberellins	C-50	Lecture
VIII	Discovery and physiological roles of cytokinins	C-51	Lecture
VIII	Discovery and physiological roles of ABA	C-52	Lecture
VIII	Discovery and physiological roles of ethylene	C-53	Lecture
	Take Home Assignment III		Take Home Assignments
VIII	Clarification Class Unit VIII	C-54	Clarification Class
VIII	Presentation II	C-55	Presentation
IX	Photoperiodism (SDP, LDP, Day neutral plants)	C-55	Lecture
IX	Phytochrome discovery and structure	C-56	Lecture
IX	Red and far red light responses on photomorphogenesis	C-57	Lecture
IX	Vernalization	C-58	Lecture
IX	Clarification Class Unit IX	C-60	Clarification Class

13008800– Plant Physiology and Metabolism Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Demonstration of Plasmolysis and Determination of Isotonic Conc. of the Cell Sap.	P1-P2	Practical
2	Determination of Osmotic Pressure of Integrated Plant Tissues.	P3-P4	Practical
3	Measurement of Leaf Area	P5-P6	Practical
4	Determination of the Rate of Transpiration by Simple Method (Conical Flask Method	P7-P8	Practical
5	Determination of the Effect of Environmental Conditions on Transpiration Rates in Plants	P9-P10	Practical
6	Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte	P11-P12	Practical
7	Demonstrate the activity of catalase and study the effect of pH and enzyme concentration	P13-P14	Practical
8	Demonstration of Hill Reaction	P15-P16	Demonstration
9	To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.	P17-P18	Practical
10	Comparison of the rate of respiration in any two parts of a plant.	P19-P20	Practical
11	Separation of amino acids by paper chromatography.	P21-P22	Practical
12	Bolting.	P23-P24	Practical
13	Effect of auxins on rooting.	P25-P26	Practical
14	Suction due to transpiration.	P27-P28	Practical
15	R.Q, Respiration in roots	P29-P30	Practical

13007700 – Genetics

Unit	Particulars	Class No.	Pedagogy of Class
I	Introduction Historical developments in the field of genetics	C-1	Lecture
I	Organisms suitable for genetic experimentation and their genetic significance	C-2	Lecture
I	Cell Cycle: Mitosis and Meiosis	C-3 & C-4	Lecture
I	Control points in cell-cycle progression in yeast	C-5	Lecture
I	Role of meiosis in life cycles of organisms	C-6	Lecture
I	Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment	C-7 & C-8	Lecture
I	Verification of segregates by test and back crosses	C-9	Lecture
I	Chromosomal theory of inheritance	C-10	Lecture
I	Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, Pleiotropy, Multiple allele, pseudoallele, essential and lethal genes, penetrance and expressivity.	C-11	Lecture
	Clarification Class I	C-12	Clarification Class
	Home Assignment I		Home Assignment
II	Non allelic interactions Interaction producing new phenotype, complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes	C-13 & C-14	Lecture
II	Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition– unique & repetitive DNA, satellite DNA	C-15 & C-16	Lecture
II	Centromere and telomere DNA sequences, middle repetitive sequences VNTRs & dinucleotide repeats, repetitive transposed sequences-SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA	C-17 & C-18	Lecture
II	Genetic organization of prokaryotic and viral genome	C-19	Lecture
II	Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin	C-20	Lecture
	Presentation I	C-21	Presentation
II	Packaging of DNA molecule into chromosomes	C-22	Lecture
II	Chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exon, intron, genetic code, gene function	C-23 & C-24	Lecture
	Clarification Class II	C-25	Clarification Class
	Classroom Assignment I	C-26	Classroom Assignment
	Home Assignment II		Home Assignment
III	Definition and types of mutations, causes of mutations, Amestest for mutagenic agents, screening procedures for isolation of mutants and uses of mutants	C-27 & C-28	Lecture

III	variations in chromosomes structure-deletion, duplication, inversion and translocation	C-29	Lecture
III	Position effects of gene expression	C-30	Lecture
III	Chromosomal aberrations inhuman beings, abnormalities– Aneuploidy and Euploidy	C-31	Lecture
III	Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation	C-32 & C-33	Lecture
III	Barr bodies, Dosage compensation, Genetic balance theory	C-34 & C-35	Lecture
III	Fragile X-syndrome and chromosome, Sex influenced dominance, Sex limited gene expression, Sex linked inheritance	C-36 & C-37	Lecture
	Clarification Class III	C-38	Clarification Class
	Quiz-I	C-39	Quiz
	Classroom Assignment II	C-40	Classroom Assignment
IV	Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome, Crossing over, Crossing over at four stand stage, Multiple crossing overs	C-41 & C-42	Lecture
IV	Genetic mapping	C-43	Lecture
IV	Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting	C-44 & C-45	Lecture
	Quiz-II	C-46	Quiz
	Clarification Class IV	C-47	Clarification Class
V	In breeding and out breeding	C-48	Lecture
V	Hardy Weinberg law (prediction, derivation), Selective advantage and Hardy Weinberg equation	C-49 & C-50	Lecture
V	Allelic and genotype frequencies, changes in allelic frequencies	C-51	Lecture
	Classroom Assignment III	C-52	Classroom Assignment III
	Home Assignment III		Home Assignment III
V	Systems of mating	C-53	Lecture
V	Evolutionary genetics, natural selection	C-54	Lecture
V	Genetics; Pedigrees gathering family history, pedigree symbols, construction of pedigrees	C-55 & C-56	Lecture
V	Monogenic traits autosomal inheritance-dominant and recessive; Sex-linked inheritance- dominant and recessive	C-57 & C-58	Lecture
V	Sex limited and sex influenced traits, Y-linked	C-59	Lecture
	Presentation II	C-60	Presentation

13007800 – Genetics Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Permanent and temporary mount of mitosis	P1-P2	Practical
2	Permanent and temporary mount of meiosis	P3-P4	Practical
3	Clarification Class I and II	P5-P6	Clarification Class
4	Clarification Class III and IV	P7-P8	Clarification Class
5	Mendelian deviations in dihybrid crosses	P9-P10 & P11-P12	Practical
6	Demonstration of-Barr Body-Rhoe translocations	P13-P14 & P15-P16	Practical
7	Karyotyping with the help of photographs	P17-P18	Practical
8	Clarification Class V and VI	P19-P20	Clarification Class
9	Clarification Class VII and VIII	P21-P22	Clarification Class
10	Pedigree chart of some common characters like blood groups, colour blindness and PTC testing	P23-P24 & P25-P26 & P27-P28	Practical
11	Study of polyploidy in onion root tip by colchicine treatment	P29-P30	Practical

13028300 – Basic Instrumentation Skills for Biotech

Unit	Particulars	Class No.	Pedagogy of Class
Unit 1	General Biophysical methods		
Unit I	Measurement of pH	C1	Lecture
Unit I	Radioactive labeling & counting	C2	Lecture
Unit I	Autoradiography	C3	Lecture
Unit I	Clarification Class	C4	Clarification Class
	Class Room Assignment	C5	Class Room Assignment
Unit II	Concept of Chromatography - Partition Chromatography, Paper Chromatography, Adsorption Chromatography	C6	Lecture
Unit II	TLC, GLC, Ion Exchange Chromatography,	C7	Lecture
Unit II	Gel Chromatography, HPLC, Affinity Chromatography	C8	Lecture
Unit II	Electrophoresis - Agarose-gel electrophoresis,	C9	Lecture
Unit II	SDS-PAGE	C10	Lecture
Unit II	pulse field gel electrophoresis,	C11	Lecture
Unit II	immuno- electrophoresis, isoelectric focusing	C12	Lecture
Unit II	Gel Electrophoresis	C13	Lecture
Unit II	Paper Electrophoresis	C14	Lecture
Unit II	Clarification Class	C15	Clarification Class
Unit III	Basic Principle of Centrifugation	C16	Lecture
Unit III	Types of Centrifuge (Preparative, Analytical	C17	Lecture
Unit III	Types of Centrifuge (Preparative, Analytical	C18	Lecture
Unit III	Clarification Class	C19	Lecture
	Class Room Assignment	C20	Lecture
Unit IV	Light microscopy, Bright & Dark Field microscopy	C21	Lecture
Unit IV	Fluorescence microscopy, Phase Contrast microscopy	C22	Lecture
Unit IV	TEM & SEM	C23	Lecture
Unit IV	Clarification Class	C24	Clarification Class
	Presentation	C25	Presentation
Unit V	Absorption Spectroscopy – Simple theory of the absorption of light by molecules	C26	Lecture
Unit V	Beer- Lambert law,	C27	Lecture
Unit V	Instrumentation for measuring the absorbance of visible light	C28	Lecture
Unit V	Factors affecting the absorption properties of a Chromophore	C29	Lecture
Unit V	Clarification Class	C30	Clarification Class
	Take Home Assignment		Take Home Assignment

13002900– Ability & Skill Enhancement III

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	What is Book Review, Purpose & Importance of Book Review Types of Book Review, Elements & Steps of Writing Book Review	C-1	Lecture
UNIT I	Book Review Writing	C-2	Lecture
UNIT I	What is Movie Review, Purpose & Importance of Movie Review Types of Movie Review, Elements & Steps of Writing Movie Review	C-3	Lecture
UNIT I	Watch a movie	C-4	Activity
UNIT I	Write the review of the movie shown in the class	C-5	Activity
UNIT I	Clarification Class Unit 1	C-6	Clarification Class
UNITII	Reading Comprehension	C-7	Lecture
UNITII	Debate	C-8	Lecture
UNITII	Rewriting Mythology/Folklore	C-9	Lecture
UNITII	Watch an international greek myth or indian folklore	C-10	Activity
UNITII	Rewriting Mythology/Folklore watched in the class		Home Assignments
UNITII	News Analysis	C-11	Activity
UNITII	Role Plays	C-12	Lecture
UNITII	Role Plays	C-13	Class Assignment
UNIT III	What is emotional intelligence, E.Q. Tests, performing under pressure, how to take right decisions under pressure keeping balance in difficult emotional situations. The science of emotional intelligence, characteristics of emotional intelligence,	C-14	Lecture
UNIT III	Emotions handling- identifying good and bad emotions	C-15	Lecture
UNIT III	how to control emotions, how to manage negative emotions keeping balance of mental stability	C-16	Lecture
UNIT III	stress and distress	C-17	Class Assignment
UNIT III	Activity/Case Study	C-18	Activity
UNIT III	Clarification Class III	C-19	Clarification Class
UNIT IV	What is GD, Types of Group Discussions	C-20	Lecture
UNIT IV	GD: Thinking, Structuring, Group Behaviour	C-21	Class Assignment
UNIT IV	Leadership Skills, Interpersonal Skills, Persuasive Skills, Conceptualization Skills	C-22	Lecture
UNIT IV	Clarification Class	C-23	Clarification Class
UNIT V	What is documentary, aims & objectives	C-24	Lecture
UNIT V	Documentary/Movie Screening & Reviews	C-25	Activity
UNIT V	documentary for social cause	C-26	Presentation
UNIT V	documentary for social cause: Screening and Narration	C-27	Presentation
UNIT V	preparing a documentary		Home Assignments
	Guest Lecture	C-28	Guest lecture
	Webinar	C-29	Webinar
	Seminar	C-30	Seminar

Course	Course outcomes: - After completion of these courses students should be able to
9.1 Semester IV	
13002000-Chemistry- IV	**CO1:** Explain Valence Bond Theory and IUPAC nomenclature system **CO2:** Discuss about transition elements, coordination chemistry, Crystal field theory etc. **CO3:** Evaluate the chemistry of Solids, Liquids, Gases and Chemical Kinetics **CO4:** Estimate the amount of nickel present in a given solution **CO5:** Measure surface tension and viscosity of given fluid.
13015000-Environmental Biotechnology	**CO1:** Conclude the degradation of lignin, cellulose, pesticides and other toxic chemicals by micro-organisms **CO2:** Explain the process of degradation of lignin and cellulose **CO3:** Discuss the significance of genetically modified microbes, plants and animals. **CO4:** Understand the biotic component of environment and their impact in enriching soil. **CO5:** Understand the role of microbes in enrichment of ores.
13009100-Molecular Biology	**CO1:** Discuss the molecular architecture of eukaryotic cells and organelles, including membrane structure and dynamics **CO2:** Compare and contrast the mechanisms of bacterial and eukaryotic DNA replication, DNA repair, transcription, and translation **CO3:** Explain how DNA topology and chromatin structure affects the processes of DNA replication, repair, and transcription **CO4:** Describe mechanisms by which DNA can be damaged and describe the molecular mechanisms by which protein complexes repair different forms of DNA damage **CO5:** Explain the process of regulation of Gene Expression
13011200 Research Methodology in Biotechnology	**CO1:** Understand the Concept of Research and Its Application **CO2:** Design Hypothesis and Experiments **CO3:** present and Interpret data **CO4:** Use statistical tools for data analysis **CO5:** Formulate the research problems and hypothesis to conduct research.
13014500-Renewable Energy and Energy Harvesting	**CO1:** Discuss about the different types of energy like Fossil fuels, Nuclear Energy, Ocean Thermal Energy Conversion and solar energy. **CO2:** Compare and aware of generating energy via various technologies apart from the conventional methods **CO3:** Express about Geothermal Resources and Geothermal Technologies

	CO4: Explain about the environmental issues and renewable sources of energy, sustainability. **CO5:** Spread awareness about renewable energy resources available and their importance for conservation of environment.
13003000- Ability & Skill Enhancement - IV	**CO1:** Design the resume and know about different format **CO2:** Know and classify the different types of interviews i.e. Mock Interview, HR Expert Mock Interview, Telephonic Interviews. **CO3:** Examine the Company Specific Research and Presentation. **CO4:** Build conversation skill **CO5:** Find out Industry suitable for internship or job.

9.2 Mapping: Semester – IV

13002000	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2	2	2	2		3
CO2	3	3	2	3		2	2	2	2	2		3
CO3	3	3	2	3	3	2	3	3	2	2	3	2
CO4	3	3	3	2	3	2	2	3	2	2	2	2
CO5	3	3	2	3	2	2	3	1	2	2	3	2

13015000	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2		2	3	2	3	3	2	2
CO2	3	3	2	2		2	3	2	2	1	3	3
CO3	3	3	3	3	3	3	3	3	2	2	3	2
CO4	3	3	3	3	2	3	3	3	2	2	2	2
CO5	3	3	2	3	3	2	3	3	2	2	3	2

13009100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2	2	2	2		3
CO2	3	3	3	2	2	2	2	2	2	2		1
CO3	3	3	2	3	2	2	3	1	2	2	2	2
CO4	3	3	2	2	2	2	3	3	2	2	3	2
CO5	3	3	1	3	2	2	3	1	2	2	2	2

13011200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	2		2	1	3	3	3
CO2	2	3	2	3	2	3		3	2	3	3	3
CO3	2	3	3	3	2	2		2	2	3	3	3
CO4	2	3	3	3	3	2		2	2	3	3	3
CO5	3	3	2	3	3	2	3	3	3	2	2	2

13014500	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	2	2	3	2	2
CO2	3	3	3	3	2	3	3	2	2	3	3	3
CO3	3	3	2	2	3	3	3	2	2	2	2	2
CO4	3	3	2	2	1	3	3	3	3	2	2	2
CO5	3	3	1	3	2	2	3	1	2	2	1	2

13003000	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2		3	3	3	2	2
CO2	3	3	3	3	3	2		2	2	3	3	2
CO3	2	2			3	2		1	2	3	2	2
CO4	3	3	2	3	2	2		1	2	3	3	2
CO5	3	3	3	3	3	2	3	3	2	2	2	2

9.3 Lesson Plan: Semester – IV

13002000– Chemistry IV

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	Transition Elements		
UNIT I	General trends of transition elements	C1	Lecture
UNIT I	Electronic configuration of transition elements	C2	Lecture
UNIT I	Variable Valency of Transition elements	C3	Lecture
UNIT I	Colour & Magnetic properties	C4	Lecture
UNIT I	catalytic proprty & complex formation	C5	Lecture
UNIT I	Latimer diagrams of Mn, Fe & Cu	C6	Lecture
UNIT I	Lanthanoids Electronic configuration	C7	Lecture
UNIT I	Properties of Lanthanides and actinides	C8	Lecture
UNIT I	Separation of Lanthanides, Ion exchange	C9	Lecture
	Clarification Class	C10	Clarification Class
	Take Home Assignments		Take Home Assignments
UNIT II	Coordination Chemistry		
UNIT II	Valence bond theory, inner orbital complexes	C11	Lecture
UNIT II	Geometry of 6 and 4 coordinated complexes of Cr, Fe, Co, Ni, Cu	C12	Lecture
UNIT II	Limitations of VBT, Ionisation and hydration isomerism	C13	Lecture
UNIT II	Coordination, Linkage, coordination position isomerism, stereoisomerism	C14	Webinar
UNIT II	Geometrical isomerism cis, trans in tetrahedral and Octahedral complexes	C15	Lecture
UNIT II	Optical isomerism in 4 and 6 coordinated complexes	C16	Lecture
UNIT II	IUPAC System of nomenclature	C17	Lecture
	Clarification Class	C18	Clarification Class
	Classroom Assignment	C19	Classroom assignment
UNIT III	Crystal Field Theory		
UNIT III	Cristal Field Theory Crystal field effect, octahedral symmetry	C20	Lecture
UNIT III	Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields.	C21	Lecture
UNIT III	Tetrahedral symmetry. Factors affecting the magnitude of D.	C22	Lecture
UNIT III	Spectrochemical series. Comparison of CFSE for Oh and Td complexes	C23	Lecture
UNIT III	Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination	C24	Lecture
	Presentation	C25	Presentation
	Clarification Class	C26	Clarification Class
	Take Home Assignments		Take Home Assignments
UNIT IV	Kinetic Theory of Gases		

UNIT IV	Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation	C27	Lecture
UNIT IV	Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation.	C28	Lecture
UNIT IV	van der Waals equation of state for real gases. Boyle temperature	C29	Lecture
UNIT IV	Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO2	C30	Lecture
	Guest Lecture	C31	Guest Lecture
UNIT IV	Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation) and their importance	C32	Lecture
UNIT IV	Temperature dependence of the distributions. Most probable, average and root mean square velocities	C33	Lecture
UNIT IV	Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules	C34	Lecture
UNIT IV	Viscosity of gases and effect of temperature and pressure on coefficient of viscosity	C35	Lecture
	Clarification Class	C36	Clarification Class
	Classroom Assignment	C37	Classroom Assignment
UNIT V	LIQUIDS		
UNIT V	Liquids: Surface tension and its determination using stalagmometer	C38	Lecture
UNIT V	Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer.	C39	Lecture
UNIT V	Effect of temperature on surface tension and coefficient of viscosity of a liquid	C40	Lecture
	Clarification Class	C41	Clarification Class
	Quiz	C42	Quiz
	Take Home Assignments		Take Home Assignments
UNIT VI	SOLIDS		
UNIT VI	Forms of solids. Symmetry elements, unit cells, crystal systems	C43	Lecture
	Classroom assignment	C44	Classroom assignment
UNIT VI	Bravais lattice types and identification of lattice planes	C45	Lecture
UNIT VI	Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices	C46	Lecture
UNIT VI	Miller indices. X–Ray diffraction by crystals, Bragg's law	C47	Lecture
UNIT VI	Structures of NaCl, KCl and CsCl	C48	Lecture
UNIT VI	Defects in crystals, Glasses and liquid crystals.	C49	Lecture
	Clarification Class	C50	Clarification Class
	Presentation	C51	Presentation
UNIT VII	CHEMICAL KINETICS		

UNIT VII	The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates	C52	Lecture
UNIT VII	Order and molecularity of a reaction	C53	Lecture
UNIT VII	Derivation of integrated rate equations for zero, first and second order reactions	C54	Lecture
UNIT VII	Half–life of a reaction. General methods for determination of order of a reaction	C55	Lecture
UNIT VII	Concept of activation energy and its calculation from Arrhenius equation.	C56	Lecture
	Clarification Class	C57	Clarification Class
UNIT VII	Theories of Reaction Rates: Collision theory	C58	Lecture
UNIT VII	Activated Complex theory of bimolecular reactions, Comparison of the two theories	C59	Lecture
	Seminar	C60	Seminar

13002100 – Chemistry-IV Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	General instructions, precautions in chemistry lab. Overview of Practicals	P1-P2	Practical
2	Semi-micro qualitative analysis of a salt containing cation and anion	P3-P4	Practical
3	Semi-micro qualitative analysis of a mixture of salts containing two cations and two anions	P5-P6	Practical
4	Estimation of total hardness of water	P7-P8	Practical
5	Estimation of (i) Mg2+ or (ii) Zn2+ by complexometric titrations using EDTA.	P9-P10	Practical
6	Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel (II) or aluminum as oximate in a given solution gravimetrically.	P11-P12	Practical
7	Determination of the surface tension of a liquid or a dilute solution using a stalagmometer	P13-P14	Practical
8	Study of the variation of surface tension of a detergent solution with concentration	P15-P16	Practical
9	Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.	P17-P18	Practical
10	Study of the variation of viscosity of an aqueous solution with concentration of solute.	P19-P20	Practical
11	Initial rate method: Iodide-persulphate reaction	P21-P22	Practical
12	Acid hydrolysis of methyl acetate with hydrochloric acid	P23-P24	Practical
13	Saponification of ethyl acetate	P25-P26	Practical
14	Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methyl acetate	P27-P28	Practical
15	Any Left over experiment	P29-P30	Practical

13015000– Environmental Biotechnology

Unit	Particulars	Class No.	Pedagogy of Class
Unit- 1	Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas	C-1	Lecture
Unit- 1	Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas	C-2	Lecture
Unit- 1	Modern fuels and their environmental impact	C-3	Lecture
Unit- 1	Methanogenic bacteria	C-4	Lecture
Unit- 1	Biogas	C-5	Lecture
Unit- 1	Microbial hydrogen Production	C-6	Lecture
Unit- 1	Conversion of sugar to alcohol Gasohol	C-7	Lecture
	Clarification Class- 1	C-8	Clarification Class
	Take Home Assignments 1		Take Home Assignments
Unit- 2	Bioremediation of soil	C-9	Lecture
Unit- 2	water contaminated with oil spills	C-10	Lecture
Unit- 2	heavy metals and detergents	C11	Lecture
Unit- 2	Degradation of lignin and cellulose using microbes	C-12	Lecture
Unit- 2	Phyto-remediation	C-13	Lecture
Unit- 2	Degradation of pesticides and other toxic chemicals by micro-organisms	C-14	Lecture
	Activity-1	C-15	Activity
	Class Room Assignment- 1	C-16	Class Room Assignment
Unit- 2	degradation aromatic	C-17	Lecture
Unit- 2	chlorinates hydrocarbons and petroleum products-I	C-18	Lecture
Unit- 2	chlorinates hydrocarbons and petroleum products-II	C-19	Lecture
	Clarification Class- II	C-20	Clarification Class
	Presentation-1	C-21	Presentation
Unit- 3	Treatment of municipal waste and Industrial effluents-I	C-22	Lecture
Unit- 3	Treatment of municipal waste and Industrial effluents-II	C-23	Lecture
Unit- 3	Bio-fertilizers-I	C-24	Lecture
Unit- 3	Bio-fertilizers-II	C-25	Lecture
Unit- 3	Role of symbiotic and a symbiotic nitrogen fixing bacteria in the enrichment of soil- I	C-26	Lecture
Unit- 3	Role of symbiotic and a symbiotic nitrogen fixing bacteria in the enrichment of soil- II	C-27	Lecture
	Activity-II	C-28	Activity
	Class Room Assignment- II	C-29	Class Room Assignment
Unit- 3	Algal bio fertilizers-I	C-30	Lecture
Unit- 3	Algal bio fertilizers-II	C-31	Lecture
Unit- 3	fungal bio fertilizers-I	C-32	Lecture
Unit- 3	fungal bio fertilizers-II	C-33	Lecture
	Clarification Class - III	C-34	Clarification Class
	Presentation-II	C-35	Presentation
	Take Home Assignments-II		Take Home Assignments

	Webinar	C-36	Webinar
Unit-4	Bioleaching-I	C-37	Lecture
Unit-4	Bioleaching-II	C-38	Lecture
Unit-4	Enrichment of ores by microorganisms-I	C-39	Lecture
Unit-4	Enrichment of ores by microorganisms-II	C-40	Lecture
Unit-4	Enrichment of ores by microorganisms-Gold	C-41	Lecture
Unit-4	Enrichment of ores by microorganisms-Copper	C-42	Lecture
	Seminar	C-43	Seminar
	Activity-III	C-44	Activity
	Class Room Assignment- III	C-45	Class Room Assignment
Unit-4	Enrichment of ores by microorganisms-Uranium-I	C-46	Lecture
Unit-4	Enrichment of ores by microorganisms-Uranium-II	C-47	Lecture
Unit-4	Environmental significance of genetically modified microbes- I	C-48	Lecture
Unit-4	Environmental significance of genetically modified microbes-II	C-49	Lecture
Unit-4	Environmental significance of genetically modified microbes- Plant-I	C-50	Lecture
Unit-4	Environmental significance of genetically modified microbes- Plant-II	C-51	Lecture
Unit-4	Environmental significance of genetically modified microbes- Plant-III	C-52	Lecture
	Clarification Class- IV	C-53	Clarification Class
Unit-4	Environmental significance of genetically modified microbes-Animal- I	C-54	Lecture
Unit-4	Environmental significance of genetically modified microbes-Animal-II	C-55	Lecture
Unit-4	Environmental significance of genetically modified microbes-Animal-III	C-56	Lecture
	Clarification Class- V	C-57	Clarification Class
	Presentation-III	C-58	Presentation
	Class Room Assignment-IV	C-59	Class Room Assignment
	Activity-IV	C-60	Activity

13015100 – Environmental Biotechnology Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Calculation of Total Dissolved Solids (TDS) of water sample	P1-P2	Practical
2	Calculation of Total Dissolved Solids (TDS) of water sample	P3-P4	Practical
3	Calculation of Total Dissolved Solids (TDS) of water sample	P5-P6	Practical
4	Calculation of BOD of water sample	P7-P8	Practical
5	Calculation of BOD of water sample	P9-P10	Practical
6	Calculation of BOD of water sample	P11-P12	Practical
7	Calculation of BOD of water sample	P13-P14	Practical
8	Calculation of COD of water sample	P15-P16	Practical
9	Calculation of COD of water sample	P17-P18	Practical
10	Calculation of COD of water sample	P19-P20	Practical
11	Bacterial Examination of Water by MPN Method	P21-P22	Practical
12	Bacterial Examination of Water by MPN Method	P23- P24	Practical
13	Bacterial Examination of Water by MPN Method	P25-P26	Practical
14	Bacterial Examination of Water by MPN Method	P27-P28	Practical
15	Activity-I	P 29	Activity
16	Activity-II	P 30	Activity

13009100 – Molecular Biology

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	DNA structure and replication		
Unit I	DNA as genetic material	C1	Lecture
Unit I	Structure of DNA, Types of DNA	C2	Lecture
Unit I	Replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of DNA replication	C3	Lecture
Unit I	Replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of DNA replication	C4	Lecture
Unit I	Bi-directional replication, DNA polymerases	C5	Lecture
Unit I	Bi-directional replication, DNA polymerases	C6	Lecture
Unit I	The replication complex: Pre-primming proteins, primosome, replisome	C7	Lecture
Unit I	Rolling circle replication	C8	Lecture
Unit I	Unique aspects of eukaryotic chromosome replication	C9	Lecture
Unit I	Fidelity of replication.	C10	Lecture
Unit I	Clarification Class I	C11	Lecture
	Take Home Assignment I		Home Assignments
	Class Room Assignment I	C12	Class Assignment
	Presentation I	C13	Presentation
	Take Home Assignment II		Home Assignments
Unit II	DNA damage, repair and homologous recombination	C14	Lecture
Unit II	DNA damage and repair: causes and types of DNA damage	C15	Lecture
Unit II	Mechanism of DNA repair: Photo reactivation, base excision repair	C16	Lecture
Unit II	Mechanism of DNA repair: Photo reactivation, base excision repair	C17	Lecture
Unit II	Mechanism of DNA repair: Photo reactivation, base excision repair	C18	Lecture
Unit II	Mechanism of DNA repair: Photo reactivation, base excision repair	C19	Lecture
Unit II	Nucleotide excision repair, mismatch repair, translation synthesis, re combinational repair, non homologous end joining	C20	Lecture
Unit II	Nucleotide excision repair, mismatch repair, translation synthesis, re combinational repair, non homologous end joining	C21	Lecture
Unit II	Nucleotide excision repair, mismatch repair, translation synthesis, re combinational repair, non homologous end joining	C22	Lecture
Unit II	Nucleotide excision repair, mismatch repair, translation synthesis, re combinational repair, non homologous end joining	C23	Lecture
Unit II	Nucleotide excision repair, mismatch repair, translation synthesis, re combinational repair, non homologous end joining	C24	Lecture
Unit II	Homologous recombination: models and mechanism.	C25	Lecture

Unit II	Homologous recombination: models and mechanism.	C26	Lecture
Unit II	Homologous recombination: models and mechanism.	C27	Lecture
Unit II	Homologous recombination: models and mechanism.	C28	Lecture
Unit II	Clarification Class II	C29	Lecture
	Presentation II	C30	Presentation
	Webinar	C31	Webinar
	Take Home Assignment III		Home Assignments
Unit III	Transcription and RNA processing		
Unit III	RNA structure and types of RNA	C32	Lecture
Unit III	RNA structure and types of RNA	C33	Lecture
Unit III	Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor	C34	Lecture
Unit III	Promoter, Initiation, elongation and termination of RNA chains	C35	Lecture
Unit III	Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation	C36	Lecture
Unit III	Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation	C37	Lecture
Unit III	Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation	C38	Lecture
Unit III	RNA splicing and processing	C39	Lecture
Unit III	RNA splicing and processing	C40	Lecture
Unit III	Processing of pre-mRNA: 5’ cap formation, polyadenylation,	C41	Lecture
Unit III	Processing of pre-mRNA: 5’ cap formation, polyadenylation,	C42	Lecture
Unit III	Splicing, rRNA and tRNA splicing.	C43	Lecture
Unit III	Splicing, rRNA and tRNA splicing.	C44	Lecture
Unit III	Clarification Class III	C45	Lecture
	Class Room Assignment II	C46	Class Assignment
	Presentation II	C47	Presentation
	Activity	C48	Activity
Unit IV	Regulation of gene expression and translation		
Unit IV	Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system)	C49	Lecture
Unit IV	Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system)	C50	Lecture
Unit IV	Genetic code and its characteristics	C51	Lecture
Unit IV	Prokaryotic and eukaryotic translation: ribosome structure and assembly	C52	Lecture
Unit IV	Charging of tRNA, aminoacy lt RNA synthetases	C53	Lecture
Unit IV	Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation	C54	Lecture

Unit IV	Inhibitors of translation	C55	Lecture
Unit IV	Posttranslational modifications of proteins	C56	Lecture
Unit IV	Clarification Class IV	C57	Lecture
	Seminar	C58	Seminar
	Guest Lecture	C59	Guest lecture
	Class Room Assignment III	C60	Class Assignment

13009200 – Molecular Biology Lab (Biotech)

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	Preparation of solutions for Molecular Biology experiments.	P1-P2	Practical
Unit I	Preparation of solutions for Molecular Biology experiments.	P3-P4	Practical
Unit II	Isolation of chromosomal DNA from bacterial cells.	P5-P6	Practical
Unit II	Isolation of chromosomal DNA from bacterial cells.	P7-P8	Practical
Unit III	Isolation of Plasmid DNA by alkaline lysis method.	P9-P10	Practical
Unit III	Isolation of Plasmid DNA by alkaline lysis method.	P11-P12	Practical
Unit IV	Agarose gel electrophoresis of genomic DNA & plasmid DNA.	P13-P14	Practical
Unit IV	Agarose gel electrophoresis of genomic DNA & plasmid DNA.	P15-P16	Practical
Unit V	Preparation of restriction enzyme digests of DNA samples.	P17-P18	Practical
Unit V	Preparation of restriction enzyme digests of DNA samples.	P19-P20	Practical
Unit V	Preparation of restriction enzyme digests of DNA samples.	P21-P22	Practical
Unit VI	Demonstration of AMES test or reverse mutation for carcinogenicity.	P23-P24	Practical
Unit VI	Demonstration of AMES test or reverse mutation for carcinogenicity.	P25-P26	Practical
Unit VI	Demonstration of AMES test or reverse mutation for carcinogenicity.	P27-P28	Practical
	Clarification Class	P29-P30	Practical

13011200 – Research Methodology in Biotechnology

Unit	Particulars	Class No.	Pedagogy of Class
Unit 1	Introduction of Research Methods in Biotechnology	C1	Lecture
Unit 1	Types of Research, Process of Research: Steps Involved in Research Process	C2	Lecture
Unit 1	Research Design: Various Methods of Research Design	C3	Lecture
Unit 1	Hypothesis as a framework for scientific projects	C4	Lecture
	Class Room Assignment	C5	Class Room Assignment- I
Unit 1	Null Hypothesis	C6	Lecture
Unit 1	Collection of Data	C7	Lecture
Unit 1	Experimental Design	C8	Lecture
Unit 1	Control Samples	C9	Lecture
Unit 1	Clarification Class-1	C10	Clarification Class
	Home Assignments- 1		Take Home Assignments-1
Unit 2	Organize data, describe data Tabulation of Data	C11	Lecture
Unit 2	Various Kinds of Charts and Diagrams, Tables	C12	Lecture
Unit 2	Bar Graphs	C13	Lecture
	Class Room Assignment-2	C14	Class Room Assignment-II
Unit 2	Pie charts or circle graphs and Line graphs	C15	Lecture
	Presentation -1	C16	Presentation-1
	Webinar-1	C17	Webinar-1
	Home Assignments- 2		Take Home Assignments-2
Unit 2	Statistical Tests, t- test	C18	Lecture
Unit 2	G-test, Chi-square test	C19	Lecture
	Guest Lecture-1	C20	Guest Lecture-1
Unit 2	Confidence levels	C21	Lecture
	Home Assignments- 3		Take Home Assignments-3
Unit 2	Standard Deviation	C22	Lecture
Unit 2	mean	C23	Lecture
	Seminar-1	C24	Seminar-1
Unit 2	variance	C25	Lecture
Unit 2	Basic Software's for Statistical Analysis	C26	Lecture
	Clarification Class-2	C27	Clarification Class-2
	Class Room Assignment-3	C28	Class Room Assignment-III
	Presentation-2	C29	Presentation
	Activity	C30	Activity

13014500– Renewable Energy and Energy Harvesting

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	FOSSIL FUELS AND ALTERNATE SOURCES OF ENERGY		
UNIT-I	Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, nonconventional energy sources	C-1	Lecture
UNIT-I	An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion	C-2	Lecture
UNIT-I	Solar energy, biomass, biochemical conversion, bio gas generation, geothermal energy tidal energy, Hydroelectricity	C-3	Lecture
UNIT-I	Solar energy, its importance, storage of solar energy, solar pond, nonconvective solar pond, applications of solar pond and solar energy	C-4	Lecture
UNIT-I	Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning	C-5	Lecture
UNIT-I	Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	C-6	Lecture
UNIT-I	Clarification Class	C-7	Clarification Class
UNIT-I	Class Room Assignment	C-8	Class Room Assignment
UNIT-I	Presentation	C-9	Presentation
UNIT-I	Take Home Assignment		Take Home Assignments
UNIT-II	WIND ENERGY HARVESTING: FUNDAMENTALS OF WIND ENERGY		
UNIT-II	Wind Turbines and different electrical machines in wind turbines	C-10	Lecture
UNIT-II	Power electronic interfaces, and grid inter connection topologies	C-11	Lecture
UNIT-II	Ocean Energy Potential against Wind and Solar	C-12	Lecture
UNIT-II	Wave Characteristic sand Statistics, Wave Energy Devices	C-13	Lecture
UNIT-II	Tide characteristics and Statistics	C-14	Lecture
UNIT-II	Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Biomass	C-15	Lecture
UNIT-II	Clarification Class	C-16	Clarification Class
UNIT-II	Class Room Assignment	C-17	Class Room Assignment
UNIT-II	Presentation	C-18	Presentation
UNIT-II	Take Home Assignment		Take Home Assignments
UNIT-III	GEOTHERMAL ENERGY		
UNIT-III	Geothermal Resources, Geothermal Technologies	C-19	Lecture
UNIT-III	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	C-20	Lecture

UNIT-III	Introduction, Physics and characteristics of piezoelectric effect	C-21	Lecture
UNIT-III	Materials and mathematical description of piezoelectricity	C-22	Lecture
UNIT-III	Piezoelectric parameters and modeling piezoelectric generators	C-23	Lecture
UNIT-III	Piezoelectric energy harvesting applications, Human power	C-24	Lecture
UNIT-III	Clarification Class	C-25	Clarification Class
UNIT-III	Class Room Assignment	C-26	Class Room Assignment
UNIT-III	Quiz	C-27	Quiz
UNIT-III	Take Home Assignment		Take Home Assignments
UNIT-IV	ELECTROMAGNETIC ENERGY HARVESTING		
UNIT-IV	Linear generators, physics mathematical models, recent applications	C-28	Lecture
UNIT-IV	Carbon captured technologies, cell, batteries, power consumption. Environmental issues and Renewable sources of energy, sustainability	C-29	Lecture
UNIT-IV	Clarification Class	C-30	Clarification Class

13003000 – Ability & Skill Enhancement – IV

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	Receiving Calls, Placing a call, Ending Calls	C1	Lecture
Unit I	Transferring calls, Taking Message/ Voice Mails, Placing call on hold	C2	Lecture
Unit I	Handling Complaints	C3	Lecture
	Telephonic Conversation	C4	Class Room Assignment
Unit II	How to build confidence by positive thinking,	C5	Lecture
Unit II	identifying negative thoughts, how to control negative thoughts entering our mind, identifying personal talents, and its ways to improve	C6	Lecture
Unit II	how to develop good habits and having principles and follow them at all times	C7	Lecture
Unit II	Need to learn new things, ideas and skills	C8	Lecture
Unit II	what is brain storming, why do we need it,	C9	Lecture
Unit II	what are the different ways of brain storming through logics and reasoning	C10	Lecture
Unit II	Brain Storming Session - Assignment	C11	Activity
	Presentation	C12	Presentation
Unit III	What is resume	C13	Lecture
Unit III	Format of Resume, Formatting	C14	Lecture
	Resume Preparation		Take Home Assignments
Unit III	Covering Letter, PI Kit	C15	Lecture
Unit IV	Mastering the art of giving interviews in	C16	Lecture
Unit IV	selection or placement interviews	C17	Lecture
Unit IV	web /video conferencing	C18	Activity
Unit IV	Mock Interview (Questions)	C19	Lecture
Unit IV	Mock Interview (Questions)	C20	Lecture
	HR Expert Mock Interview	C21	Class Room Assignment
Unit IV	Telephonic Interviews	C22	Activity
	Class Room Assignment	C23	Class Room Assignment
Unit V	Identifying domain specific industries	C24	Lecture
Unit V	Identifying domain specific industries - Assignment	C25	Activity
	researching the industry		Take Home Assignments
Unit V	Industry analysis	C26	Lecture
	Presentation on specific industry/company	C27	Presentation
	Webinar	C28	Webinar
	Guest Lecture	C29	Guest lecture
	Home Assignment		Take Home Assignments
	Clarification Class	C30	Clarification Class

Course	Course outcomes: - After completion of these courses students should be able to
10.1 Semester V	
13007000-Chemistry of Main Group Elements, Theories of Acids and Bases	**CO1:** Explain the concept of acids and bases and its application in whole chemistry **CO2:** Describe the thermodynamic concept of extraction process and various extraction process involved in the elements. **CO3:** Classify various periodic properties of the s and p block elements of the periodic table **CO4:** Understand the preparation, properties and structure of some inorganic polymers which are of industrial importance. **CO5:** Rationalize inertness of Noble gases.
13011500-Immunology	**CO1:** Explain the about the basic concept, principle and components of immunity **CO2:** Recognize the about the components of immune system and their function **CO3:** Express the Basic properties of antigens, B and T cell epitopes, haptens and adjuvants. **CO4:** Explain about the allergic reactions. **CO5:** Perform immunological assays and analyze the results.
13011900-Bioinformatics	**CO1:** Explain the concepts of bioinformatics and familiarize the students with the subject **CO2:** Explain about Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry processes. **CO3:** Express how to deliver descriptions of this rapidly evolving field, and facilitate user access to and manipulation of the biological data and include descriptions of genetic and biological databases and relevant tools available to retrieve and analyze the information within these. **CO4:** Learn about Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene. **CO5:** Search biological databases and retrieve information from these databases
13012100-Biological Databases and their Management	**CO1:** Discuss about the important public data banks that provide details of biological systems and components along with a wide range of topics including open resources in Bioinformatics. **CO2:** Learn about computational sequence analysis, sequence homology searching, gene finding and genome annotation, protein structure analysis and prediction, genomics, proteomics, phylogenetic analysis, biological databases etc. **CO3:** Explain database system technologies; design, concurrency, security and backup/recovery issues of database management systems **CO4:** Express about structure of databases and different types of

	databases. **CO5:** Search and retrieve biological information from databases
13010000- Applications of IT Skills	**CO1:** Know and express expressions statements, compound statements, arithmetic, operators, unary operators, relational and logical operators, **CO2:** Provide exposure to problem-solving through programming. **CO3:** Express the basic concepts of the C-programming language **CO4:** Use functions to solve given problem in C language. **CO5:** Implement file Operations in C programming for a given application
13003100- Ability & Skill Enhancement – V	**CO1:** Express and build leadership quality **CO2:** Recall the traits of Successful Entrepreneurs, and Entrepreneurial qualities **CO3:** Classify the differences between organizational decision making process, entrepreneurial decision making process **CO4:** Create work related skills and prepare effective interview questions to conduct effective interviews. **CO5:** Enhance employability skills
13012200 Summer Internship and Report –	**CO1:** Understand the real-time working of organizations. **CO2:** Demonstrate professional knowledge, skills and attitude along with the experience needed to constitute a successful career. **CO3:** Analyze career opportunities in their areas of interest. **CO4:** Build aptitude for gaining supervised professional experiences. **CO5:** Apply subject knowledge in Industry

10.2 Mapping: Semester – V

13007000	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	2	2	2		2
CO2	3	3	2	2		2	2	2	1	1		1
CO3	3	3	3	3	2	3	2	1	2	3	2	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	2	2	3	2	3	3	3	2	3	2

13011500	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1		2		2	2	2		2
CO2	3	3	1	2		2		2	2	1		2
CO3	3	3	2	2	2	3		2	3	3	2	3
CO4	3	3	3	3	2	3		2	3	3	2	3
CO5	3	3	3	2	3	3	3	3	2	2	3	2

13011900	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	1	2	2	3	3	3	2
CO2	3	3	3	2	3	2	3	2	2	2	2	3
CO3	3	3	1	2	3	2	2	2	2	2	2	2
CO4	3	3	3	2	3	3	3	2	2	2	3	2
CO5	3	3	2	3	2	3	1	3	2	2	2	2

13012100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	2	2	3	2	2
CO2	3	3	2	2	3	2	2	3	2	2	2	2
CO3	3	3	2	2	3	2	1	1	2	3	3	2
CO4	3	3	2	2	3	2	2	2	3	2	1	2
CO5	3	3	2	2	3	2	3	3	2	2	3	2

13010000	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3	2		2	3	1	2	2
CO2	2	2	3	2	3	1		2	1	3	3	2
CO3	2	2	3	3	3	2		2	2	2	2	2
CO4	2	2	2	2	3	2		2	2	2	3	2
CO5	3	3	2	3	2	2	3	2	2	2	1	2

13003100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1		1	1	3	2	2
CO2	2	2	2	3	2	2		2	2	3	2	2
CO3	3	3			1	2		3	2	3	3	2
CO4	1	2	3	3	2	3		3	2	3	1	2
CO5	3	3	2	2	3	2	3	2	3	2	3	2

13012200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1		2	1	3	3	3
CO2	3	3	2	2	3	2		2	1	3	3	3
CO3	3	3	3	3	3	2		3	3	3	3	3
CO4	3	3	3	3	3	2		2	2	3	3	3
CO5	3	3	2	3	2	3	2	2	3	2	1	2

10.3 Lesson Plan: Semester – V

13007000- Chemistry of Main Group Elements, Theories of Acids and Bases

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	ACIDS AND BASES		
UNIT-I	Brönsted–Lowry concept, conjugate acids and bases	C-1,2	Lecture
UNIT-I	Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept.	C-3,4	Lecture
UNIT-I	relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents.	C-5,6	Lecture
UNIT-I	Hard and soft acids and bases (HSAB concept), applications of HSAB process.	C-7,8	Lecture
UNIT-I	CLARIFICATION CLASS-I	C-9	Clarification Class
	ASSIGNMENT-I	C-10	Class Room Assignment
UNIT-II	GENERAL PRINCIPLE OF METALLURGY		
UNIT-II	Chief modes of occurrence of metals based on standard electrode potentials,	C-11	Lecture
UNIT-II	Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents.	C-12	Lecture
UNIT-II	Hydrometallurgy with reference to cyanide process for gold and silver, electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process.	C-13	Lecture
UNIT-II	Methods of purification of Al and Pb	C-14	Lecture
UNIT-II	Methods of purification of Ti, Fe,	C-15	Lecture
UNIT-II	Methods of purification of Cu and Ni	C-16	Lecture
UNIT-II	Methods of purification of Zn and Au	C-17	Lecture
UNIT-II	Methods of purification of Zn and Au	C-18	Lecture
	CLARIFICATION CLASS-II	C-19	Clarification Class
	ASSIGNMENT-II		Home Assignment
	PRESENTATION-I	C-20	Presentation
UNIT III	s AND p BLOCK ELEMENTS		
UNIT III	Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale).	C-21,22	Lecture
UNIT III	General characteristics of s-block metals like density, melting and boiling points, flame colour and reducing nature	C-23	Lecture
UNIT III	Oxidation states of s- and p-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S.	C-24,25	Lecture
UNIT III	Complex forming tendency of s block elements and a preliminary idea of crownethers and cryptates, structures of basic beryllium acetate,	C-26	Lecture

	salicylaldehyde/ acetylacetonato complexes of Group 1 metals.		
UNIT III	Solutions of alkali metals in liquid ammonia and their properties.	C-27	Lecture
UNIT III	Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides,	C-28	Lecture
UNIT III	sulphates and carbonates of s-block metals	C-29	Lecture
	CLARIFICATION CLASS-III	C-30	Clarification Class
	ASSIGNMENT-III	C-31	Class Room Assignment
	PRESENTATION-II	C-32	Presentation
UNIT-IV	Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH3), 14, 15, 16 and 17.	C--33,34	Lecture
UNIT-IV	Oxides of N and P, Oxoacids of P, S and Cl.	C-35,36	Lecture
	Seminar	C-37	Seminar
UNIT-IV	Halides and oxohalides of P and S (PCl3, PCl5, SOCl2 and SO2Cl2)	C-38,39	Lecture
UNIT-IV	Interhalogen compounds.	C-40,41	Lecture
UNIT-IV	A brief idea of pseudohalides	C-42	Lecture
UNIT-IV	CLARIFICATION CLASS-IV	C-43	Clarification Class
	ASSIGNMENT-IV	C-44	Class Room Assignment
	WEBINAR-I	C-45	Webinar
	PRESENTATION-III	C-46	Presentation
UNIT V	NOBLE GASES		
UNIT V	Rationalization of inertness of noble gases, clathrates	C-47	Lecture
UNIT V	preparation and properties of XeF2, XeF4 and XeF6 , bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory	C-48,49	Lecture
UNIT V	CLARIFICATION CLASS-V	C-50	Clarification Class
	QUIZ	C-51	Quiz
	ASSIGNMENT-V		Take Home Assignments
	GUEST LECTURE-I	C-52	Guest lecture
Unit VI	INORGANIC POLYMERS		
Unit VI	Types of inorganic polymers and comparison with organic polymers, structural features,	C-53,54	Lecture
Unit VI	classification and important applications of silicates. Synthesis, structural features and applications of silicones.	C-55,56	Lecture
Unit VI	Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in (NPCl2)3.	C-57,58	Lecture
	CLARIFICATION CLASS-VI	C-59	Clarification Class
	ASSIGNMENT-VI	C-60	Class Room Assignment

13007100 – Chemistry of Main Group Elements, Theories of Acids and Bases Lab (Chemistry)

S. No.	Particulars	Class No.	Pedagogy of Class
1	Iodometric estimation of potassium dichromate and copper sulphate	C-1,2,3,4	Practical
2	Iodometric estimation of antimony in tartar emetic.	C-5,6	Practical
3	Estimation of amount of available chlorine in bleaching powder and household bleaches	C-7,8	Practical
4	Estimation of iodine in iodized salts.	C-9,10	Practical
5	Iodimetric estimation of ascorbic acid in fruit juices.	C-11,12	Practical
6	Estimation of dissolved oxygen in water samples.	C-13,14	Practical
7	Gravimetric estimation of Barium as barium sulphate.	C-15,16	Practical
8	Gravimetric estimation of aluminum as oximato complex	C-17,18	Practical
9	Preparation of the following potassium trioxalatochromate(III) complex	C-19,20	Practical
10	Preparation of the following potassium trioxalato Ferrate (III) complex	C-21,22	Practical
11	Preparation of the tetraamminecopper (II) sulphate monohydrate complex.	C-23,24	Practical
12	Preparation of th potash alum double salt	C-25,26	Practical
13	Preparation of the chrome alum double salts	C-27,28	Practical
14	CLARIFICATION CLASS	C-29,30	Clarification Class

13011500- Immunology

Unit	Particulars	Class No.	Pedagogy of Class
Unit-1	Introduction to basic concepts in immunology	C1	Lecture
Unit-1	components of immune system	C2	Lecture
Unit-1	principles of innate immune system	C3	Lecture
Unit-1	principles of innate immune system	C4	Lecture
Unit-1	principles of Adaptive immune system	C5	Lecture
	Clarification Class-I	C6	Clarification Class
	Classroom Assignment-1	C7	Class Room Assignment
Unit II	Hematopoiesis: Pathway of blood cells formation	C8	Lecture
Unit II	Lymphoid and myeloid progenitor cells	C9	Lecture
Unit II	Factors affecting Hematopoiesis	C10	Lecture
Unit II	Cells of immune system	C11	Lecture
Unit II	Lymphocytes	C12	Lecture
Unit II	Natural Killer Cells	C13	Lecture
Unit II	Mononuclear Phagocytes	C14	Lecture
Unit II	Phagocytosis	C15	Lecture
Unit II	Granulocytic Cells	C16	Lecture
Unit II	Leukocyte Extravasation	C17	Lecture
Unit II	Eosinophils	C18	Lecture
Unit II	Dendritic cell and antigen presentation	C19	Lecture
	Home Assignment -1		Home Assignment
Unit II	Organs of Immune system	C20	Lecture
Unit II	Primary Lympoid Organs	C21	Lecture
Unit II	Thymus and T cell maturation	C22	Lecture
Unit II	Bone Marrow and B cell maturation	C23	Lecture
	Presentation-1	C24	Presentation
Unit II	Secondary lymphoid organs, Spleen and MALT	C25	Lecture
Unit II	Clarification Class II	C26	Clarification Class
Unit III	Antigens	C27	Lecture
Unit III	Properties of Antigen	C28	Lecture
Unit-III	B and T cell epitopes	C29	Lecture
Unit-III	B and T cell epitopes, Haptens and adjuvants.	C30	Lecture
Unit-III	Clarification class III	C31	Clarification Class
	Home Assignment-2		Home Assignment
Unit-IV	Structure, classes and function of antibodies	C32	Lecture
Unit-IV	Structure, classes and function of antibodies	C33	Lecture
Unit-IV	Monoclonal antibodies	C34	Lecture
Unit-IV	Antigen antibody interactions as tools for research and diagnosis	C35	Lecture
Unit-IV	Clarification class IV	C36	Clarification Class
Unit-V	Working of the immune system: Structure and functions of MHC	C37	Lecture
Unit-V	Exogenous and endogenous pathways of antigen presentation and processing	C38	Lecture
Unit-V	Basic properties and functions of cytokines	C39	Lecture
Unit-V	Complement system: Components and pathways	C40	Lecture
Unit-V	Complement system: Components and pathways	C41	Lecture
Unit-VI	Immune system in health and disease: Gell and Coombs' classification	C42	Lecture

	Activity-1	C43	Activity
Unit-VI	Thymus and T cell maturation	C44	Lecture
Unit-VI	Brief description of various types of hypersensitivities,	C45	Lecture
Unit-VI	Introduction to concepts of autoimmunity and immunodeficiency.	C46	Lecture
Unit-VI	Introduction to concepts of autoimmunity and immunodeficiency.	C46	Lecture
	Activity-2	C48	Activity
	Webinar-1	C49	Webinar
	Activity-3	C50	Activity
	Class room Assignment-2	C51	Class room Assignment
Unit-VII	General introduction to vaccines	C52	Lecture
Unit-VII	General introduction to vaccines	C53	Lecture
Unit-VII	Various types of vaccines	C54	Lecture
Unit-VII	Clarification class V	C55	Lecture
	Class Room Assignment-3	C56	Class Room Assignment
	Seminar	C57	Seminar
	Presentation-2	C58	Presentation
	Presentation 3	C59	Presentation
	Classroom Assignmnet-4	C60	Class Room Assignment

13011600 – Immunology Lab (Zoology)

S. No.	Particulars	Class No.	Pedagogy of Class
1	Demonstration of lymphoid organs	C1	Practical
2	Demonstration of lymphoid organs	C2	Practical
3	Demonstration of lymphoid organs	C3	Practical
4	Demonstration of lymphoid organs	C4	Practical
5	Histological study of spleen, thymus and lymph nodes through slides	C5	Practical
6	Histological study of spleen, thymus and lymph nodes through slides	C6	Practical
7	Histological study of spleen, thymus and lymph nodes through slides	C7	Practical
8	Histological study of spleen, thymus and lymph nodes through slides	C8	Practical
9	Preparation of stained blood film to study various types of blood cells	C9	Practical
10	Preparation of stained blood film to study various types of blood cells	C10	Practical
11	Preparation of stained blood film to study various types of blood cells	C11	Practical
12	Preparation of stained blood film to study various types of blood cells	C12	Practical
13	Ouchterlony's double immuno-diffusion method.	C13	Practical
14	Ouchterlony's double immuno-diffusion method.	C14	Practical
15	Ouchterlony's double immuno-diffusion method.	C15	Practical
16	Ouchterlony's double immuno-diffusion method.	C16	Practical
17	Ouchterlony's double immuno-diffusion method.	C17	Practical
18	ABO blood group determination.	C18	Practical
19	ABO blood group determination.	C19	Practical
20	ABO blood group determination.	C20	Practical
21	Cell counting and viability test from splenocytes of farm bred animals/cell lines	C21	Practical
22	Cell counting and viability test from splenocytes of farm bred animals/cell lines	C22	Practical
23	Cell counting and viability test from splenocytes of farm bred animals/cell lines	C23	Practical
24	Demonstration of ELISA	C24	Practical
25	Demonstration of ELISA	C25	Practical
26	Demonstration of ELISA	C26	Practical
27	Activity-I	C27	Activity
28	Activity -II	C28	Activity
29	Activity-III	C29	Activity
30	Activity -IV	C30	Activity

13011900- : Bioinformatics

Unit	Particulars	Class No.	Pedagogy of Class
I	History of Bioinformatics	C-1	Lecture
I	The Notion of Homology	C-2	Lecture
I	Sequence Information Sources, EMBL	C-3	Lecture
I	GENBANK	C-4	Lecture
I	Entrez,	C-5	Lecture
I	Take Home Assignments I		Take Home Assignments
I	Unigene	C-6	Lecture
I	Understanding the structure of each source and using it on the web.	C-7	Lecture
I	Class Room Assignment I	C-8	Class Room Assignment
I	Clarification Class I	C-9	Clarification Class
II	Proteins information Sources	C-10	Lecture
II	PDB; Understanding the structure and using it on the web	C-11	Lecture
II	SWISSPROT; Understanding the structure and using it on the web	C-12	Lecture
II	TREMBL; Understanding the structure and using it on the web	C-13	Lecture
II	UniProt; Understanding the structure and using it on the web	C-14	Lecture
II	Restriction Digestion	C-15	Lecture
II	Presentation I	C-16	Presentation
II	Chromatograms	C-17	Lecture
II	Blotting	C-18	Lecture
II	PCR	C-19	Lecture
II	Quiz I	C-20	Quiz
II	Microarrays	C-21	Lecture
II	Class Room Assignment II	C-22	Class Room Assignment
II	Mass Spectrometry I	C-23	Lecture
II	Mass Spectrometry II	C-24	Lecture
II	Clarification Class II	C-25	Clarification Class
II	Quiz II	C-26	Quiz
III	Sequence Analysis	C-27	Lecture
III	Phylogenetic Analysis Introduction and concepts	C-28	Lecture
III	Detecting Open Reading Frames	C-29	Lecture
III	Outline of sequence Assembly	C-30	Lecture
III	Mutation Matrices, PAM	C-31	Lecture
III	Substitution Matrices, BLOSUM	C-32	Lecture
III	Pair wise Alignments	C-33	Lecture
III	Introduction to BLAST, using it on the web, Interpreting results	C-34	Lecture
III	Multiple Sequence Alignment	C-35	Lecture
III	Phylogenetic Analysis	C-36	Lecture
III	UPGMA	C-37	Lecture
III	NJ Method	C-38	Lecture
III	Maximum Parsimony	C-39	Lecture

III	Maximum Likelihood	C-40	Lecture
III	Clarification Class III	C-41	Clarification Class
III	Class Room Assignment III	C-42	Class Room Assignment
III	Presentation II	C-43	Presentation
IV	Methodology to search Databases	C-44	Lecture
IV	Sequence Retrieval Searches; SRS	C-45	Lecture
IV	Sequence Retrieval Searches; Entrez	C-46	Lecture
IV	Sequence Similarity Searches by BLAST	C-47	Lecture
	Sequence Similarity Searches by FASTA format study	C-48	Lecture
IV	Presentation III	C-49	Presentation
IV	Class Room Assignment IV	C-50	Class Room Assignment
IV	How to submit data Sequin Software	C-51	Lecture
IV	Sequence Submission Tools	C-52	Lecture
IV	Take Home Assignments II		Take Home Assignments
IV	Genome Annotation	C-53	Lecture
IV	Meaning and steps	C-54	Lecture
IV	Pattern Finding in sequences	C-55	Lecture
IV	Pattern Finding in sequences by employing soft wares	C-56	Lecture
IV	Gene Identification Tools	C-57	Lecture
IV	Gene Identification Tools; Ab-initio	C-58	Lecture
IV	Gene Identification Tool; similarity based	C-59	Lecture
IV	Clarification Class IV	C-60	Clarification Class

13012000 – Bioinformatics Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Study different sequence information resources.	P1-P2	Practical
2	To learn how to use Entrez search engine to retrieve nucleotide/protein sequence data.	P3-P4	Practical
3	To obtain the genome sequence of the DEN-1 Dengue virus, which has accession number NC_001477 in NCBI format. Which type of nucleotide sequence you get and of how many bases.	P5-P6	Practical
4	Find the Human Prion Protein In GenBank, retrieve the sequence and save it in Computer in FASTA Format. Find out the GenBank Id.	P7-P8	Practical
5	Search for ZAP 70 at EMBL site and answer following along with the steps of search.	P9-P10	Practical
6	Predict secondary structure of human growth hormone	P11-P12	Practical
7	Predict 3D structure of human growth hormone	P13-P14	Practical
8	Find the sequence published in Nature 460:352-358	P15-P16	Practical
9	To find a DNA sequence published in a research publication using Entrez Search engine	P17-P18	Practical
10	Retrieve nucleic acid sequence of Human Insulin, run BLAST and go for multiple sequence alignment with 10 sequences.	P19-P20	Practical
11	Retrieve amino acid sequence of Human Insulin, run BLAST and go for multiple sequence alignment with 10 sequences and generate phylogenetic tree.	P21-P22	Practical
12	View human growth hormone details in uniprot and go for MSA of 8 retrieved sequences by COBALT.	P23-P24	Practical
13	Perform MSA using Clustal Omega and prepare the Phylogenetic tree also.	P25-P26	Practical
14	Retrieve the amino acid sequence of Human prion protein and find out conserved domains.	P27-P28	Practical
15	Revision	P29-P30	Practical

13012100- Biological Databases and their Management

Unit	Particulars	Class No.	Pedagogy of Class
II	Biological Data Types	C1	Lecture
II	Biological Data bases; types, classification, sequences and structure file formats	C2	Lecture
II	NCBI Data Model, GENBANK	C3	Lecture
II	Submission of sequences to the database Genomic mapping databases	C4	Lecture
II	Information retrieval from biological data bases FASTA sequence data base	C5	Lecture
II	Webinar on Biological Databases	C6	Webinar
II	Nucleic acid sequence databases EMBL/DDBJ	C7	Lecture
II	Class Room Assignment No.1	C8	Class Room Assignment
II	Protein sequence databases Uni Prot KB	C9	Lecture
II	Protein sequence databases PDB	C10	Lecture
II	Presentation	C11	Presentation
II	Structural Biological Databases PD, Microbiological Data bases	C12	Lecture
II	Activity	C13	Activity
II	Quiz	C14	Quiz
II	Clarification Class	C15	Clarification Class
I	Introduction to Database Management System	C16	Lecture
I	Database System vs. File System and Characteristics of Database Approach	C17	Lecture
I	DBMS Architecture, Data Models	C18	Lecture
I	Schema and instances, Data Independence	C19	Lecture
I	Data Modeeing using Entity Relationship Models, ER diagrams, Attributes and Keys	C20	Lecture
I	Introduction to SQL ,Characteristics and advantages, SQL Data types	C21	Lecture
I	SQL commands DDL,DML,DCL	C22	Lecture
I	Basic SQL Queries, Logical opertors	C23	Lecture
I	BETWEEN IN,AND OR and NOT, Null values	C24	Lecture
I	Class Room Assignment No.2	C25	Class Room Assignment
I	Joins, inner, outer joins right, left	C26	Lecture
I	Equijoins Overview of views and indexes	C27	Lecture
I	Relational Data Model: Relational model terminology, domains, Attributes, Tuples, Relations.	C28	Lecture
I	Activity	C29	Activity
I	Clarification Class	C30	Clarification Class
	Take Home Assignment		Take Home Assignment

13010000- Applications of IT Skills

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	Introduction to programming language, History of C language	C1	Lecture
Unit I	Program Structure, C Basics, Character Set, Identifiers and keywords	C2	Lecture
Unit I	Data types, constants, variables, arrays, declarations, expressions statements, symbolic constants	C3	Lecture
Unit I	compound statements, arithmetic operators, unary operators, relational and logical operators, assignment operators, conditional, operators, bit operators program	C4	Lecture
Unit I	If statement, if….else statement, if…..else if….else statement program	C5	Lecture
Unit I	while statement, do….while statement, for statement, Program	C6	Lecture
Unit I	switch statement, nested control statement, break operator, continue operator, Program	C7	Lecture
Unit I	break operator, continue operator, comma operator, program	C8	Lecture
	Class Room Assignment1	C9	Class Room Assignment
	Clarification Class	C10	Clarification Class
Unit II	Functions		
Unit II	C Functions: Functions: declaration, definition & scope,	C11	Lecture
Unit II	recursion, call by value, call by reference	C12	Lecture
Unit II	Storage Classes: automatic, external (global), static & registers.	C13	Lecture
	Webinar	C14	Webinar
	Clarification Class	C15	Clarification Class
	Class Room Assignment2	C16	Class Room Assignment
Unit III	Arrays: Arrays, pointers, array & pointer relationship	C17	Lecture
	Activity	C18	Activity
	Guest Lecture	C19	Guest lecture
Unit III	Pointer arithmetic	C20	Lecture
Unit III	Dynamic memory allocation	C21	Lecture
Unit III	pointer to arrays, array of pointers	C22	Lecture
Unit III	pointers to functions	C23	Lecture
	Take Home Assignment		Take Home Assignments
Unit-III	Clarification Class	C24	Clarification Class
Unit III	array of pointers to functions		
Unit III	Pre-processor directives: #include, #define	C25	Lecture
	Seminar	C26	Seminar
Unit III	macro's with arguments, the operators #and ##	C27	Lecture
	Presentation	C28	Presentation

	Clarification Class	C29	Clarification Class
Unit-III	conditional compilations	C30	Lecture
Unit-III	conditional compilations	C31	Lecture
	Take Home Assignment		Take Home Assignments
Unit-III	array of pointers to functions	C32	Lecture
Unit-III	Clarification Class	C33	Clarification Class
Unit-III	Presentation	C34	Presentation
	Webinar	C35	Webinar
Unit-III	pointer arithmetic	C36	Lecture
Unit-III	Dynamic memory allocation	C37	Lecture
Unit-III	Dynamic memory allocation	C38	Lecture
Unit-III	Class Room Assignment3	C39	Class Room Assignment
	Guest Lecture	C40	Guest lecture
Unit-III	Pointer to arrays	C41	Lecture
Unit-III	Clarification Class	C42	Clarification Class
Unit-III	Presentation	C43	Presentation
Unit-III	Class Room Assignment4	C44	Class Room Assignment
Unit-III	Activity	C45	Activity

13010100– Application of IT Skills in Sciences Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Write a program sum of two numbers	P1-P2	Practical
2	Write a program to check either the number is even or odd	P3-P4	Practical
3	Write a program calculate simple interest.	P5-P6	Practical
4	Write a program to calculate the marks of four subject and percentage.	P7-P8	Practical
5	Write a program to check either the year is leap year or not.	P9-P10	Practical
6	Write a program to find out the grade using if/else if statement.	P11-P12	Practical
7	Write a program to find out the greater number between two number.	P13-P14	Practical
8	WAP to read base and height of a triangle, calculate the area using formula : Area =1/2*base*height	P15-P16	Practical
9	WAP to read marks obtained and maximum marks of a student and calculate its percentage and display it.	P17-P18	Practical
10	Write a program to print even number up to n.	P19-P20	Practical
11	Write a program to print odd number up to n.	P21-P22	Practical
12	Write a program to print table.	P23-P24	Practical
13	Handling numeric data: Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing document	P25-P26	Practical
14	Clarification Class	P27-P28	
15	Quiz	P29-P30	

13003100 – Ability & Skill Enhancement – V

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	What is leadership & Traits of Leadership	C 1	Lecture
Unit I	Movie/ Story/ Interviews of leaders	C 2	Lecture
Unit I	identifying leaders & Identify leadership qualities	C 3	Lecture
Unit I	Debate/ Discussion/ Presentations on leaders	C 4	PPT
Unit I	Class Assignment	C 5	Class Assignment
Unit I	Clarification Class	C 6	Clarification Class
Unit II	What is Entrepreneurship, Traits of Successful Entrepreneurs	C 7	Lecture
Unit II	Movie/ Story/Interviews of Entrepreneurs	C 8	Lecture
Unit II	Identify Entrepreneurial qualities	C 9	Lecture
Unit II	Debate/ Discussion/Presentation on Entrepreneurs	C 10	PPT
Unit II	Class Assignment	C 11	Class Assignment
Unit II	Clarification Class	C 12	clarification Class
Unit III	What are organizational skills, how to develop them	C 13	Lecture
Unit III	the skills needed to become a successful entrepreneur/administrator	C 14	Lecture
Unit III	good communication, ambition, courage, hard work, planning, accountability	C 15	Lecture
Unit III	Organizational skills can be developed by discipline making a system, rules	C 16	Lecture
Unit III	delegation of power at workplace,	C 17	Lecture
Unit III	PPT	C 18	PPT
Unit III	How to enhance employability; skills, why do we need them,	C 19	Lecture
Unit III	different workplaces, having different needs, different skills, how to recognize different work skills	C 20	Lecture
Unit III	Class Assignment	C 21	Class Assignment
Unit III	Clarification Class	C 22	Clarification Class
Unit IV	The process of decision making, its steps,	C 23	Lecture
Unit IV	what are the basics of organizational decision-making process, what are its basics,	C 24	Lecture
Unit IV	entrepreneurial decision making, how to make a right decision at right time, dilemma	C 25	Lecture
Unit IV	Class Assignment	C 26	Class Assignment
Unit IV	Clarification Class	C 27	Clarification Class
Unit V	Conducting Interviews with Leaders/ Entrepreneurs	C 28	Lecture
Unit V	Preparing Questions, Interviewing the fellow person, do's & don'ts while taking interview	C 29	Lecture
Unit V	Clarification Class	C 30	Clarification Class

Course	Course outcomes: - After completion of these courses students should be able to
11.1 Semester VI	
13009700- Organometallics, Bioinorganic Chemistry, Polynuclear, Hydrocarbons and UV, IR Spectroscopy	**CO1:** Interpret the core inorganic chemistry **CO2:** Express the concept of the preparation, structure and bonding in organometallic compounds **CO3:** Explain the functions of various ions like sodium, potassium, magnesium and calcium in our body. **CO4:** Learn the concept of uv-visible and infra-red spectroscopy with the help of which we can determine the structure of the unknown organic compounds **CO5:** Preparation of non hetero molecules having up to 6 carbon
13014800- Economic Botany and Biotechnology	**CO1:** Describe the centers of origin of various economically important crops **CO2:** Discuss about the basic concepts in Biotechnology **CO3:** Understand the basic technique of plant tissue culture **CO4:** Express about of modern techniques and tools used in biotechnology. **CO5:** Analyze operations, production and planning of the various business process,
13015400- Genomics & Proteomics	**CO1:** Describe the recent developments in genetics, epigenetics, small RNAs, proteomics, gene expression, mutagenesis and mapping genes **CO2:** Conclude the different mechanism like signal transduction, regulation of transcription and translation, cancer, aging, drought stress and metabolic pathways. **CO3:** Provide the knowledge and practical skills associated with functional genomics and proteomics. **CO4:** Discuss on pharmacogenomics and the implications of applying personalized medicine' in human health. **CO5:** Perform and analyze results of 2D Gel electrophoresis
13015600- : Intellectual Property Rights	**CO1:** Describe about the importance and types of Intellectual Property **CO2:** Express about the Different International agreements like General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement, General Agreement on Trade related Services (GATS), Madrid Protocol, Berne Convention, Budapest Treaty etc. **CO3:** Learn about role of Judiciary and role of law enforcement agencies. **CO4:** Explain various laws in India for licensing and technology transfer. **CO5:** Differentiate among patent, copyright and trademark.

13003200- Ability and Skill Enhancement – VI	**CO1:** Learn about verbal reasoning & English aptitude **CO2:** Develop a winning attitude **CO3:** Learn the ways to understand news and be a journalist. **CO4:** Learn the ability to prepare reports on major national and international news. **CO5:** Conduct chat shows, panel discussions, parliamentary debates etc.

11.2 Mapping: Semester – VI

13009700	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	2	2	2		3
CO2	3	3	2	2	2	2	2	2	2	2		1
CO3	3	3	2	3	2	2	3	3	2	2		2
CO4	3	3	2	3	3	2	3	1	2	2	3	2
CO5	3	3	2	1	3	2	2	2	2	2	2	2

13014800	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	2	3	3	2	3	2
CO2	3	3	3	3	3	3	2	2	2	3	2	2
CO3	3	3	2	1	3	2	2	3	2	2	1	2
CO4	3	3	2	3	3	2	2	3	2	2	3	2
CO5	3	3	2	2	3	2	3	1	2	2	1	2

13015400	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	3	2	2	2	2	3	2	2
CO2	3	3	3	2	3	2	2	3	2	2	3	3
CO3	3	3	2	1	1	2	3	3	2	2	2	2
CO4	3	3	3	2	3	2	3	1	2	2	1	2
CO5	3	3	2	3	3	2	3	1	2	2	3	2

13015600	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3		2	3	2	2	2	2	2
CO2	3	2	3	2		2	2	2	3	2	3	2
CO3	3	2	2	3		2	3	1	2	3	1	2
CO4	3	2	2	2		2	2	3	2	2	3	2
CO5	3	3	3	1	3	2	2	2	3	2	3	2

13003200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	2	3		3	1	3	2	2
CO2	2	2	3	2	2	2		2	3	3	2	2
CO3	2	2			3	2		3	2	3	3	2
CO4	2	2	3	3	2	2		2	3	3	3	3
CO5	3	3	2	3	3	2	3	3	2	2	2	2

11.3 Lesson Plan: Semester – VI

13009700 – Organometallics, Bioinorganic Chemistry, Polynuclear, Hydrocarbons and UV, IR Spectroscopy

Unit	Particulars	Class No.	Pedagogy of Class
UNIT I	CHEMISTRY OF 3d ELEMENTS		
UNIT I	Oxidation states of Cr, preparation and important properties K2Cr2O7	C-1	Lecture
UNIT I	Peroxo compounds of Cr	C-2	Lecture
UNIT I	Oxidation states of Mn and preparation and important properties of KMnO4,	C-3	Lecture
UNIT I	Oxidation states of Fe and preparation and important properties K4[Fe(CN)6]	C-4	Lecture
UNIT I	Preparation and important properties sodium nitroprusside	C-5	Lecture
UNIT I	preparation and important properties of [Co(NH3)6]Cl3, Na3[Co(NO2)6].	C-6	Lecture
	ASSIGNMENT I		Take Home Assignments
UNIT I	Clarification Class	C-7	Clarification Class
UNIT II	ORGANOMETALLIC COMPOUNDS		
UNIT II	Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal carbon bond (ionic, s, p and multicenter bonds). Nomenclature of organometallic compounds	C-8 to C-9	Lecture
UNIT II	Structures of methyl lithium and Zeiss salt	C-10	Lecture
UNIT II	Structures of ferrocene	C-11	Lecture
	ASSIGNMENT II	C-12	Class Room Assignment
UNIT II	EAN Rule for metal carbonyl	C-13	Lecture
UNIT II	Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals, pi-acceptor behaviour of carbon monoxide.	C-14-15	Lecture
UNIT II	Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).	C-16-17	Lecture
UNIT II	Clarification of topics of Unit II	C-18	Clarification Class
	ASSIGNMENT III		Take Home Assignments
UNIT III	BIO-INORGANIC CHEMISTRY		
UNIT III	Bio-Inorganic Chemistry A brief introduction to bio-inorganic chemistry.	C-19-20	Lecture
UNIT III	Role of metal ions present in biological systems with special reference to Na+ , K+ and Mg2+ ions: Na/K pump;	C-21-22	Lecture
UNIT III	Role of Mg2+ ions in energy production and chlorophyll.	C-23-24	Lecture
UNIT III	Role of Ca2+ in blood clotting, stabilization of protein structures and structural role (bones).	C-25	Lecture
UNIT III	Clarification of topics of Unit III	C-26	Clarification Class

	PRESENTATION I	C-27	Presentation
	QUIZ	C-28	Quiz
	ASSIGNMENT IV	C-29	Class Room Assignment
UNIT IV	POLYNUCLEAR AND HETRONUCLEAR HYDROCARBON		
UNIT IV	Properties of Naphthalene and Anthracene with reference to electrophilic and nucleophilic substitution	C-30-31	Lecture
UNIT IV	Properties of Furan and Pyrrole with reference to electrophilic and nucleophilic substitution	C-32	Lecture
UNIT IV	Properties of Thiophene and Pyridine. with reference to electrophilic and nucleophilic substitution	C-33	Lecture
	Clarification Class	C-34	Clarification Class
	ASSIGNMENT V	C-35	Class Room Assignment
UNIT V	ACTVE METHYLENE COMPOUNDS		
UNIT V	Active methylene compounds: Preparation: Claisen ester condensation. Keto-enol tautomerism.	C-36-37	Lecture
UNIT V	Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).	C-38-39	Lecture
	GUEST LECTURE	C-40	Guest lecture
	Clarification Class oF Unit IV & V	C-41	Clarification Class
	Presentation II	C-42	Presentation
	SEMINAR	C-43	Seminar
UNIT VI	APPLICATION OF UV-VISIBLE & INFRARED SPECTROSCOPY		
UNIT VI	Electromagnetic radiations	C-44	Lecture
UNIT VI	Electronic transitions	C-45	Lecture
UNIT VI	λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts.	C-46	Lecture
UNIT VI	Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β – unsaturated compounds.	C-47-48	Lecture
	WEBINAR II	C-49	Webinar
	ASSIGNMENT-VI	C-50	Class Room Assignment
UNIT VI	Infrared radiation and types of molecular vibrations	C-51-52	Lecture
	QUIZ	C-53	Quiz
UNIT VI	Functional group and fingerprint region. IR spectra of alkanes, alkenes	C-54-56	Lecture
UNIT VI	IR spectra of alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).	C-57-59	Lecture
	CLARIFICATION CLASS V	C-60	Clarification Class

13009800 – Organometallics, Bioinorganic chemistry, Polynuclear, hydrocarbons, and UV, IR Spectroscopy Lab (Chemistry)

S. No.	Particulars	Class No.	Pedagogy of Class
1	Introduction to OBPS Lab, Instructions	C-1 to C-2	Practical
2	Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.	C-3 to C-4	Practical
3	Systematic Qualitative Organic Analysis of Organic Compounds possessing hydrocarbon only preparation of one derivative.	C-5 to C-6	Practical
4	Systematic Qualitative Organic Analysis of Organic Compounds possessing -COOH only preparation of one derivative.	C-7 to C-8	Practical
5	Systematic Qualitative Organic Analysis of Organic Compounds possessing -NO2 group and preparation of one derivative.	C-9 to C-10	Practical
6	Systematic Qualitative Organic Analysis of Organic Compounds possessing carbohydrate only, phenolic only preparation of one derivative.	C-11 to C-12	Practical
7	Systematic Qualitative Organic Analysis of Organic Compounds possessing amide, amine only preparation of one derivative.	C-13 to C-14	Practical
8	Paper chromatographic separation of Fe3+, A13+ and Cr3+	C-15 to C-18	Practical
9	Paper chromatographic separation of Ni2+, Co2+, Mn2+ and Zn2+	C-19 to C-22	Practical
10	Preparation and measurement of the conductivity of tetra ammine carbonato cobalt (III) nitrate. Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl2 and LiCl3.	C-23 to C-26	Practical
11	Preparation and measurement of the conductivity of tetraamminecopper (II) sulphate Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl2 and LiCl3.	C-27 to C-28	Practical
12	Preparation and measurement of the conductivity of potassium trioxalatoferrate (III) trihydrate Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl2 and LiCl3.	C-29 to C-30	Practical
13			

13014800 – Economic Botany and Biotechnology

Unit	Particulars	Class No.	Pedagogy of Class
I	Origin of Cultivated Plants	C-1	Lecture
I	Concept of centers of origin, their importance with reference to Vavilov's work.	C-2	Lecture
II	Cereals	C-3	Lecture
II	Wheat -Origin, morphology, uses	C-4	Lecture
II	Clarification Class I	C-5	Clarification Class
II	Class Room Assignment I	C-6	Class Room Assignment
III	Legumes	C-7	Lecture
III	Gram	C-8	Lecture
III	Soybean	C-9	Lecture
III	Clarification Class II	C-10	Clarification Class
III	Take Home Assignments I		Take Home Assignments
IV	Spices	C-11	Lecture
IV	Clove	C-12	Lecture
IV	Black pepper	C-13	Lecture
V	Beverages	C-14	Lecture
V	Tea (morphology, processing, uses)	C- 15	Lecture
V	Clarification Class III	C-16	Clarification Class
V	Class Room Assignment II	C-17	Class Room Assignment
VI	Oils and Fats	C-18	Lecture
VI	groundnut	C-19	Lecture
VI	Presentation I	C-20	Presentation
VII	Fiber Yielding Plants	C-21	Lecture
VII	Cotton (Botanical name, family, part used, morphology and uses).	C-22	Lecture
VII	Clarification Class IV	C-23	Clarification Class
VII	Quiz I	C-24	Quiz
VIII	Introduction to Biotechnology I	C-25	Lecture
VIII	Introduction to Biotechnology II	C-26	Lecture
IX	Plant tissue culture	C-27	Lecture
IX	Micropropagation	C-28	Lecture
IX	Presentation II	C-29	Presentation
IX	haploid production through androgenesis	C-30	Lecture
IX	haploid production through gynogenesis	C-31	Lecture
IX	embryo culture with their applications	C-32	Lecture
IX	endosperm culture with their applications	C-33	Lecture
IX	Clarification Class V	C-34	Clarification Class
IX	Class Room Assignment III	C-35	Classroom Assignment
X	Recombinant DNA Techniques I	C-36	Lecture
X	Recombinant DNA Techniques II	C-37	Lecture
X	Recombinant DNA Techniques III	C-38	Lecture
X	Quiz II	C-39	Quiz
X	Blotting techniques	C-40	Lecture
X	Northern Blotting	C-41	Lecture
X	Southern and Western Blotting	C-42	Lecture

X	DNA Fingerprinting	C-43	Lecture
X	Presentation III	C-44	Presentation
X	Molecular DNA markers	C-45	Lecture
X	RAPD	C-46	Lecture
X	RFLP	C-47	Lecture
X	SNPs	C-48	Lecture
X	DNA sequencing	C-49	Lecture
X	Class Room Assignment IV	C-50	Class Room Assignment
X	PCR	C-51	Lecture
X	Types of PCR	C-52	Lecture
X	Applications of PCR	C-53	Lecture
X	Reverse Transcriptase -PCR	C-54	Lecture
X	Take Home Assignments II		Take Home Assignments
X	Hybridoma Technology	C-55	Lecture
X	Monoclonal antibodies	C-56	Lecture
X	ELISA	C-57	Lecture
X	Immuno-detection	C-58	Lecture
X	Revision Class	C-59	Lecture
X	Clarification Class VI	C-60	Clarification Class

13014900 – Economic Botany and Biotechnology Lab (DSE II) (Botany)

S. No.	Particulars	Class No.	Pedagogy of Class
1	Study of economically important plants through specimens, sections and micro chemical tests : Wheat	P1-P2	Practical
2	Gram, Soybean	P3-P4	Practical
3	Black pepper, Clove	P5-P6	Practical
4	Tea, Cotton	P7-P8	Practical
5	Groundnut	P9-P10	Practical
6	Familiarization with basic equipment in tissue culture.	P11-P12	Practical
7	Anther culture	P13-P14	Practical
8	somatic embryogenesis	P15-P16	Practical
9	endosperm	P17-P18	Practical
10	embryo culture	P19-P20	Practical
11	Micro propagation	P21-P22	Practical
12	PCR	P23-P24	Practical
13	Blotting techniques	P25-P26	Practical
14	AGE	P27-P28	Practical
15	PAGE	P29-P30	Practical

13015400 – Genomics & Proteomics

Unit	Particulars	Class No.	Pedagogy of Class
I	Introduction to Genomics	C1	Lecture
I	Introduction to Genomics	C2	Lecture
I	DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method	C3	Lecture
I	DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method	C4	Lecture
I	DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method	C5	Lecture
I	Pyrosequencing	C6	Lecture
I	Pyrosequencing	C7	Lecture
I	Genome Sequencing: Shotgun method	C8	Lecture
I	Hierarchical (clone contig) methods	C9	Lecture
I	Computer tools for sequencing projects:	C10	Lecture
I	Genome sequence assembly software.	C11	Lecture
	Clarification Class No1	C12	Clarification Class
II	Managing and Distributing Genome Data	C13	Lecture
	Presentation I	C14	Presentation
	Take Home Assignment I		Take Home Assignments
	Class Room Assignment I	C15	Class Room Assignment
	Webinar	C16	Webinar
II	Web based servers and softwares for genome analysis: ENSEMBL	C17	Lecture
II	Web based servers and softwares for genome analysis: ENSEMBL	C18	Lecture
II	Web based servers and softwares for genome analysis: ENSEMBL	C19	Lecture
II	VISTA	C20	Lecture
II	VISTA	C21	Lecture
	Class Room Assignment II	C22	Class Room Assignment
II	UCSC Genome Browser	C23	Lecture
II	UCSC Genome Browser	C24	Lecture
II	NCBI genome.	C25	Lecture
II	NCBI genome.	C26	Lecture
II	Selected Model Organisms' Genomes and Databases.	C27	Lecture
	Clarification Class No2	C28	Lecture
III	Introduction to protein structure, Chemical properties of proteins.	C29	Lecture
III	Physical interactions that determine the property of proteins.	C30	Lecture
III	Physical interactions that determine the property of proteins.	C31	Lecture
III	Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.	C32	Lecture

III	Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.	C33	Lecture
III	Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.	C34	Lecture
	Class Room Assignment III	C35	Class Room Assignment
	Take Home Assignment II		Take Home Assignments
	Presentation II	C36	Presentation
	Activity I	C37	Activity
	Guest Lecture	C38	Guest Lecture
III	Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE,	C39	Lecture
III	Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE,	C40	Lecture
III	Determination of covalent structures – Edman degradation.	C41	Lecture
III	Determination of covalent structures – Edman degradation.	C42	Lecture
	Clarification Class no 3	C43	Clarification Class
IV	Introduction to Proteomics	C44	Lecture
	Class Room Assignment IV	C45	Class Room Assignment
	Activity II	C46	Activity
	Seminar	C47	Seminar
	Presentation III	C48	Presentation
IV	Introduction to Proteomics,	C49	Lecture
IV	Analysis of proteomes.2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	C50	Lecture
IV	Analysis of proteomes.2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	C51	Lecture
IV	Analysis of proteomes.2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	C52	Lecture
IV	Analysis of proteomes.2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	C53	Lecture
IV	Analysis of proteomes.2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	C54	Lecture
IV	Analysis of proteomes.2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	C55	Lecture
IV	Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.	C56	Lecture
IV	Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.	C57	Lecture

IV	Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.	C58	Lecture
IV	Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.	C59	Lecture
	Clarification Class no 4	C60	Clarification Class

13015500 – Genomics and Proteomics Lab (Biotechnology)

Unit	Particulars	Class No.	Pedagogy of Class
I	Use of SNP databases at NCBI and other sites	P1-P2	Practical
I	Use of SNP databases at NCBI and other sites	P3-P4	Practical
II	Use of OMIM database	P5-P6	Practical
II	Use of OMIM database	P7-P8	Practical
III	Detection of Open Reading Frames using ORF Finder	P9-P10	Practical
III	Detection of Open Reading Frames using ORF Finder	P11-P12	Practical
IV	Proteomics 2D PAGE database	P13-P14	Practical
IV	Proteomics 2D PAGE database	P15-P16	Practical
V	Softwares for Protein localization.	P17-P18	Practical
V	Softwares for Protein localization.	P19-P20	Practical
VI	Hydropathy plots	P21-P22	Practical
VII	Native PAGE	P23-P24	Practical
VII	Native PAGE	P25-P26	Practical
VIII	SDS-PAGE	P27-P28	Practical
VIII	SDS-PAGE	P29-P30	Practical

13015600- : Intellectual Property Rights

Unit	Particulars	Class No.	Pedagogy of Class
I	Introduction to Intellectual Property and its Historical Perspective	1	Lecture
I	Different types of IP and Importance of protecting the Intellectual Property	2	Lecture
I	Copyrights : Introduction, Differences from Patents and Procedure to obtain the Copyright	3	Lecture
I	Class Room Assignment 1	4	Assignment
I	Clarification Class I	5	Clarification Class
II	Trade Marks ; Introduction, How to obtain	6	Lecture
II	Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs	7	Lecture
II	Patents: Historical Perspective, Basic and associated right	8	Lecture
II	Home Assignment 1		Assignment
II	WIPO and the PCT system; Patents and Healthcare – balancing promoting innovation with public health	9	Lecture
II	Traditional Knowledge, Software patents and their importance for India.	10	Lecture
II	Clarification Class II	11	Clarification Class
III	Geographical Indication: Definition, rules for registration, prevention of illegal exploitation, importance to India	12	Lecture
III	Presentation 2	13	Presentation
III	Definition of Industrial Designs, Features, How to obtain it and International design registration	14	Tutorial
III	Definition of Industrial Designs, Features, How to obtain it and International design registration	15	Lecture
III	Presentation 2	16	Presentation
III	Layout design of integrated circuits/ Circuit Boards/ Integrated Chips Importance for electronic industry	17	Lecture
III	Layout design of integrated circuits/ Circuit Boards/ Integrated Chips Importance for electronic industry	18	Assignment
III	Introduction and Historical Perspectives of the Trade Secrets	19	Lecture
III	Clarification Class III	20	Clarification Class
IV	Scope of Protection of the Trade Secrets and the Risks involved therein; Legal aspects of Trade Secret Protection	21	Assignment
IV	IPR- IPR Biodiversity and Plant Breeders Rights	22	Lecture
IV	IPR- IPR Biodiversity and Plant Breeders Rights	23	Tutorial
IV	IP Infringement issue and enforcement	24	Lecture
IV	Home Assignment 2		Clarification Class
IV	Different International agreements: Word Trade Organization (WTO); The General Agreement on Tariffs & Trade (GATT) and the General Agreement on Trade related Services (GATS)	25	Lecture

IV	Different International agreements: Word Trade Organization (WTO); The General Agreement on Tariffs & Trade (GATT) and the General Agreement on Trade related Services (GATS)	26	Assignment
IV	Trade Related Intellectual Property Rights (TRIPS) Agreement; The Madrid Protocol; The Berne Convention	27	Lecture
IV	The Budapest Treaty and the Paris Convention WIPO and TRIPS	28	Lecture
IV	Class Assignment 2	29	Assignment
IV	Role of Judiciary, Role of law enforcement agencies – Police, Customs etc.	30	Lecture
IV	Economic Value of Intellectual Property – Intangible assets and their valuation, Intangible assets and their valuation	31	Lecture
IV	Intellectual Property in the Indian Context, Laws in India regarding Licensing and the technology transfer.	32	Lecture
IV	Webinar	33	Webinar
IV	Clarification Class IV	34	Clarification Class
	Activity	35	Activity

13003200- Ability and Skill Enhancement – VI

Unit	Particulars	Class No.	Pedagogy of Class
Unit I	Logical Sequence of Words	C1	Lecture
Unit I	Verbal Analogy	C2	Lecture
Unit I	Classification	C3	Lecture
Unit I	Blood Relation Test	C4	Activity
Unit I	Syllogism	C5	Activity
Unit I	Reading Comprehension	C6	Class Room Assignment
Unit I	Clarification Class 1	C7	Clarification Class
Unit II	How to develop a winning attitude	C8	Presentation
Unit II	How to have a winning and positive mindset, how to win in difficult situations	C9	Presentation
Unit II	How to have a winning and positive mindset, how to win in difficult situations	C10	Presentation
Unit II	How to have a winning and positive mindset, how to win in difficult situations	C11	Lecture
Unit III	Reading Current News - Assignment	C12	Presentation
Unit III	Comparing & Analysing the news	C13	Presentation
Unit III	Write an editorial	C14	Activity
Unit III	Clarification ClassII	C15	Clarification Class
Unit III	News Vocabulary		Take Home Assignments
Unit III	Presentation on any major news (political/social/sports/economics)	C16	Presentation
Unit III	Presentation on any major news (political/social/sports/economics)	C17	Presentation
Unit IV	Chat Show	C18	Activity
Unit IV	Panel Discussion	C19	Group discussions
Unit IV	Panel Discussion	C20	Group discussions
Unit IV	Parliamentary debate	C21	Activity
Unit IV	News Inspired Theatrical Performance	C22	Activity
Unit IV	Clarification Class III	C23	Clarification Class
Unit V	Preparing a report on major National / International News	C24	Presentation
Unit V	Insights/ review of major news papers and news channels	C25	Lecture
	Take Home Assignment 2		Take Home Assignments
Unit V	Clarification Class IV	C26	Clarification Class
Unit V	Preparing a report on major National/ International News	C27	Activity
Unit V	Insights/ review of major news papers and news channels	C28	Class Room Assignment
Unit V	Insights/ review of major news papers and news channels	C29	Activity
	Clarification Class V	C30	Clarification Class

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