Sunbeam Women's College Varuna

Affiliated to M.G.K. Vidyapith Varanasi

VISION

Sunbeam College envisions to develop culturally rooted, globally oriented, self reliant women committed to achieve excellence through duty, devotion and discipline.

MISSION

- To reinforce duty, devotion towards the society and the Nation, thereafter keeping with the essence of discipline in one's life.
- To make students sensitive about social concerns, human rights and thus help them being an eco conscious individual.
- To educate the women of tomorrow, through teaching- learning exchange programmes, researches and extension activities.
- To pursue student centric learning for self- development & skill development.
- To equip and empower students with relevant knowledge, competence, value and creativity to face global challenges.
- To facilitate young women to come up with leadership, self-pride and identity in order to become the change makers of the society.
- To inculcate skills and practices that help students become culturally rooted, globally oriented and self reliant.

DEPARTMENT OF SCIENCE

VISION

To achieve overall excellence in education by continuously upgrading the teaching learning methodology and incorporating latest scientific aptitude which are currently happening in the worldwide with ethical responsibility and commitment towards humanity.

MISSION

- To provide excellent environment for faculty and students.
- To impart sound scientific quality education and competency.
- Design and implement curriculum that equips student with professional and life skills.
- Promote and undertake quality work in thrust area of science.
- Collaborate with academia to meet the changing needs of society.
- Foster innovation and cultivate the spirit of scientific aptitude amongst students.
- To realize full potential enabling the students to contribute towards the cause of the society.
- To foster and develop scientific temper among new generation.

Program Outcomes (POs):

The B.Sc. undergraduate programme is designed to intend the following outcomes:

PO1	**Critical Thinking**	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO2	**Effective Communication**	Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO3	**Social Interaction**	Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO4	**Effective Citizenship**	Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO5	**Ethics**	Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO6	**Environment and Sustainability**	Understand the issue of environmental contexts and sustainable development
PO7	**Self-directed and Life-long learning**	Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes

COURSE STRUCTURE FOR
BACHELOR OF SCIENCE (B.Sc.)
SEMESTER- V

Paper	Name of Paper	Semester Examination Marks	Internal Examination Marks	Credit
Major 1	Botany I (Theory)	75	25	4
	Botany II (Theory)	75	25	4
	Botany III (Practical)	75	25	2
	Botany (Project)	75	25	3
Major 2	Zoology I (Theory)	75	25	4
	Zoology II (Theory)	75	25	4
	Zoology III (Practical)	75	25	2
Major 3	Chemistry I (Theory)	75	25	4
	Chemistry II (Theory)	75	25	4
	Chemistry III (Practical)	75	25	2
	Chemistry III (Project)	75	25	3
Co- Curricular	Analytic Ability and Digital Awareness	75	25	2

SEMESTER- VI

Paper	Name of Paper	Semester Examination Marks	Internal Examination Marks	Credit
Major 1	Botany I (Theory)	75	25	4
	Botany II (Theory)	75	25	4
	Botany III (Practical)	75	25	2
	Botany (Project)	75	25	3
Major 2	Zoology I (Theory)	75	25	4
	Zoology II (Theory)	75	25	4
	Zoology III (Practical)	75	25	2
Major 3	Chemistry I (Theory)	75	25	4
	Chemistry II (Theory)	75	25	4
	Chemistry III (Practical)	75	25	2
	Chemistry III (Project)	75	25	3
Co- Curricular	Communication Skills and Personality Development	75	25	2

Academic Calendar of the session 2024-25

Date sheet of Mid Term Examination

SEMESTER- V

Name of Subjects		**Mid Term I**	**Shift**
Co-Curricular: Analytic Ability and Digital Awareness		17/11/2025	Shift 1
Major	Botany I (Theory)	17/11/2025	Shift 2
	Botany II (Theory)	18/11/2025	Shift 1
	Botany III (Practical)	18/11/2025	Shift 2
	Zoology I (Theory)	19/11/2025	Shift 1
	Zoology II (Theory)	19/11/2025	Shift 2
	Chemistry I (Theory)	20/11/2025	Shift 1
	Chemistry II (Theory)	20/11/2025	Shift 2
	Zoology III (Practical)	21/11/2025	Shift 1
	Chemistry III (Practical)	21/11/2025	Shift 2

SEMESTER- VI

Name of Subjects		**Mid Term I**	**Shift**
Co-Curricular: Communication Skills and Personality Development		23/03/2026	Shift 1
Major	Botany I (Theory)	23/03/2026	Shift 2
	Botany II (Theory)	24/03/2026	Shift 1
	Botany III (Practical)	24/03/2026	Shift 2
	Zoology I (Theory)	25/03/2026	Shift 1
	Zoology II (Theory)	25/03/2026	Shift 2
	Chemistry I (Theory)	27/03/2026	Shift 1
	Chemistry II (Theory)	27/03/2026	Shift 2
	Zoology III (Practical)	28/03/2026	Shift 1
	Chemistry III (Practical)	28/03/2026	Shift 2

Important Dates:

Semester V

- 17/11/2025: Mid Term begins.
- 29/11/2025: Parents – Professor Meet (PPM) & Report Card Distribution.

Semester VI

- 20/04/2026: Mid Term begins.
- 04/04/2026: Parents – Professor Meet (PPM) & Report Card Distribution.

"All the Best"

SEMESTER V

MAJOR: BOTANY
Course code: B040501T
Paper I (Theory)
Course Title: Plant Physiology, Metabolism & Biochemistry
Credits:4 **Max. Marks: 75+25**

Course outcomes:

After the completion of the course the students will be able to:

1. Understand the role of Physiological and metabolic processes for plant growth and development.
2. Learn the symptoms of Mineral Deficiency in crops and their management.
3. Assimilate Knowledge about Biochemical constitution of plant diversity.
4. Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I: Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model. **Unit V: Plant Development, Movements, Dormancy & Responses** Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization &Senescence.
August'25	**24**	**Unit II:Carbon Oxidation** Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Kerbs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio , cyanide-resistant respiration, factors affecting respiration. **Unit VI: Biomolecules:***Carbohydrates:* Nomenclature and classification; Role of monosaccharides (glucose,fructose, sugar alcohols – mannitol and sorbitol); Disaccharides(sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose,hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin).*Lipids*: Storage lipids: Fatty acids structure and functions, Structural lipids:Phosphoglycerides;

		Lipid functions: cell signals, cofactors, prostaglandins, Introduction oflipid micelles, monolayers, bilayers.
Sepetember'25	**22**	**Unit III: Nitrogen Metabolism** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis. **Unit VII- Proteins**: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, Ramchandran plot,tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins. **Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleic acids, Nucleic acid denaturation &Re-naturation , MiRNA
October'25	**18**	**Unit IV: Lipid Metabolism & Photosynthesis** Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation. ; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance. **Unit VIII: Enzymes** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), enzyme inhibition and factors affecting enzyme activity,Allosteric enzymes & Abzymes. Phytonutrients, Nutraceuticals, dietary supplements and antioxidants.
November'25	**24**	**Revision & Internal Examination**

Activity I**:** *Project on Nitrogen Metabolism in plant system.*
Objective: *To understand concepts underlying various approaches to plant nutrition requirements.*
Methodology: *Inquiry based learning.*
Activity II**:** *Class presentation through PPT on Biomolecules.*
Objective: *To develop the basic structural and functional concepts of Macromolecules present in living system.*
Methodology: *Individual learning.*

Suggested readings:

1. Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
2. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.

3. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
4. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New CentralBook. Agencies.
5. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
6. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
7. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
8. Harborne,J.B.1973 .Phytochemical Methods. John Wiley & Sons, New York.
9. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6thedition. Cold Spring Harbour Lab. Press, Pearson Pub.

Suggested equivalent online courses:

1. https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732
2. https://www.wiziq.com/course/3249-plant-physiology-in-10-live-online-classes
3. https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/
4. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview

MAJOR: BOTANY
Course code: B040502T
Paper II (Theory)
Course Title: Molecular Biology & Bioinformatics

Credits: 4 **Max. Marks: 75+25**

Course outcomes:

After the completion of the course the students will be able to:

1. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
2. Know about Processing and modification of RNA and translation process, function and regulation of expression.
3. Gain working knowledge of the practical and theoretical concepts of bioinformatics

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I: Genetic material** Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi– conservative. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ǿ (theta) mode of replication, replication of linear, dsDNA, replicating the 5′end of linear chromosome including replication enzymes. **Unit V: Bioinformatics & its applications** Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.
August'25	**24**	**Unit II: Transcription & Regulation of gene expression** Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation, (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression in Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes. **Unit VI: Biological databases :** Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss- Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and Meta Cyc), small molecule databases (PubChem,).
Sepetember'25	**22**	**Unit III: Principles &Techniques of genetic engineering** Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and

		Immuno detection. Antibody Engineering. **Unit VII- Data Generation and Data Retrieval** Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)
October'25	**18**	**Unit IV: Applications of Genetic engineering** Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products, Biosafety concerns. **Unit VIII- Phylogenetic analysis:** Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA);Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees. **Revision & Internal Examination**
November'25	**24**	

Activity I*: *Class presentation through PPT on Applications of Genetic engineering.
Objective: *To develop the several of applications of Genetic engineering for human welfare.*
Methodology: *Individual presentation*

Suggested readings:

1. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK..
2. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York.
3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6thedition. Cold Spring Harbour Lab. Press, Pearson Pub.
4. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017.
5. Ghosh, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: OxfordUniversity Press.
6. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
7. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey,U.S.: Wiley Blackwell.

Suggested equivalent online courses:

1. https://www.edx.org/learn/molecular-biology
2. https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering
3. https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090
4. https://www.coursera.org/courses?query=genetics
5. https://www.coursera.org/courses?query=molecular%20biology
6. https://www.edx.org/learn/genetic-engineering
7. https://www.mooc-list.com/tags/genetic-engineering
8. https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907
9. https://nptel.ac.in/courses/102/103/102103013/

MAJOR: BOTANY
Course Code: B040503P
Paper III (Practical)
Course Title: Experiments in physiology, Biochemistry & Molecular biology

Credit: 2 **Max. Marks: 75+25**

Course outcomes:

After the completion of the course the students will be able to:

1. Know and authentic the physiological processes undergoing in plants along with
2. their metabolism
3. Identify Mineral deficiencies based on visual symptoms
4. Understand and develop skill for conducting molecular experiments for genetic engineering

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I- Plant water relation, Mineral Nutrition and translocation in phloem:** 1. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of Rhoeo / Tradescantia. 2. Osmosis – by potato osmoscope experiment 3. Experiment to demonstrate the transpiration phenomenon with the bell jar method 4. Experiment for demonstration of Transpiration by Four-Leaf Experiment 5. Structure of stomata (dicot & monocot) 6. Experiment to measure the rate of transpiration by using Ganong's potometer 7. Study of mineral deficiency symptoms using plant photographs. **Unit II- Nitrogen Metabolism, Photo Synthesis & Respiration** 1. A basic idea of chromatography: Principle, paper chromatography and column chromatography; demonstration of column chromatography. 2. Separation of plastidial pigments by solvent and paper chromatography. 3. Estimation of total chlorophyll content from different chronologically aged leaves (young, mature and senescence) by Arnon method. 4. Determination of the RQ of germinating seeds. 5. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubbler.
August'25	**24**	**Unit III: Plant Development, Movements, Dormancy & Responses** 1. To study the phenomenon of seed germination (effect of light). 2. To study the induction of amylase activity in germinating grains. 3. Test of seed viability by TTC method. **Unit IV: Techniques for biochemical analysis** 1. Weighing and Preparation of solutions -percentage,

		molar & normal solutions, dilution from stock solution etc. 2. Separation of amino acids by paper chromatography. 3. Qualitative Analysis of carbohydrates , 4. Qualitative Analysis of Lipids 5. Qualitative analysis of Amino acids and Proteins 6. Testing of adulterants in food items.
Sepetember'25	**22**	**<u>Unit V:Genetic material</u>** 1. Instruments and equipments used in molecular biology. 2. Preparation of LB medium and cultivating *E.coli* on it. 3. Isolation of DNA from plants 4. Quantification of DNA by UV-spectrophotometer **<u>Unit VI- Preparation of models/ charts:</u>** 1. Study of experiments establishing nucleic acid as genetic material (Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)through photographs 2. Study of DNA replication through photographs: Modes of replication – Rolling circle, Theta and semi-discontinuous ; Semiconservative model of replication (Messelson and Stahl's experiment); Telomerase assisted end-replication of linear DNA 3. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 4. Understanding the regulation of lactose (lac) operon (positive & negative regulation) and tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs.
October'25	**18**	**<u>Unit VII- Genetic Engineering</u>** 1. Isolation of protoplasts. 2. Construction of restriction map of circular and linear DNA from the data provided. 3. Isolation of plasmid DNA. 4. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/ photograph). 5. Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results. 6. Agarose gel analysis of plasmid DNA 7. Restriction digestion of plasmid DNA -Demonstration of PCR **<u>Unit VIII- Applications of Genetic engineering:</u>** 1. ELISA Test 2. Viability tests of cells 3. Study of methods of gene transfer through photographs: *Agrobacterium*mediated, direct gene transfer by electroporation, microinjection, micro-projectile bombardment. 4. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr-Savr tomato through photographs. Create a Bonsai of any plant Develop a miniature garden Plant Propagation methods practice.

November'25	**24**	**Revision & Internal Examination**

Activity II**:** *Visit to CSIR/ICAR Labs in Lucknow/Delhi****.***
Objective: *To develop skills and techniques on Biotechnology and Molecular biology experiments.*
Methodology: *Expeditionary learning.*

Suggested readings:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN : 9788177544589Edition: 01Year : 2012Author : Akhtar InamPublisher : Agrobios (India)
3. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, W V (ed.). CRC Press.
4. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge University Press.U.K.
5. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
6. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London.

Suggested equivalent online courses:

1. https://www.edx.org/learn/molecular-biology
2. https://krishikosh.egranth.ac.in/handle/1/5810039999
3. https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090
4. https://www.coursera.org/courses?query=genetics
5. https://www.coursera.org/courses?query=molecular%20biology
6. https://www.edx.org/learn/genetic-engineering
7. https://www.mooc-list.com/tags/genetic-engineering

MAJOR: BOTANY
Course Code: B040504R
Paper IV (Project I)
Course Title: Project in Botany for Pre-graduation

Credit: 3 **Max. Marks: 75+25**

Course outcomes:

1. Project work will supplement field experimental learning and deviations from classroom and laboratory transactions.
2. Project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes.
3. It will promote creativity and the spirit of enquiry in learners.
4. They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing.
5. It will enhance their abilities, enthusiasm, and interest.

Suggested LIST OF PROJECTS
1. Rural Areas: Flora of a city/ village, Biodiversity of Village, Soil & seed testing service provision to farmers. 2. Industrial waste management 3. Water pollution status of rural water & promotion of WASH in villages. 4. Plant Disease identification in farms, nurseries and orchards. 5. Digital portal for plants: Campus, city or particular area 6. Rare and endangered plants & their conservation & domestication. 7. Air pollution tolerance index (APTI) : Screening of sensitive/tolerant plant species at various locations in particular area 8. Science Communication by creating science documentaries of innovators, Internet Science (Social media, Websites, Blogs, Youtube, Podcast etc.) 9. Science Outreach Talks and Public Sensitization for plant biodiversity conservation sensitization of public. 10. Phytochemistry of medicinal plants & their antimicrobial, nutraceutical and antioxidant properties. 11. Study of pollen grains in different flowers. 12. Study of stomata in different plants. 13. Study of various types of secretory and special tissues in plants.
Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.

MAJOR: CHEMISTRY
Course Code: B020501T
Paper I (Theory)
Course Title: Organic Synthesis A

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

Hydrocarbons are the principal constituents of petroleum and natural gas. They serve as fuels and lubricants as well as raw materials for the production of plastics, fibers, rubbers, solvents and industrial chemicals. This course will provide a broad foundation in for the synthesis of hydrocarbons. Hydroxy and carbonyl compounds are industrially important compounds. The industries of plastics, fibers, petroleum and rubbers will specially recognize this course. Students will gain an understanding of which are used as solvents and raw material for synthesis of drug and other pharmaceutically important compounds.

1. Synthesis and chemical properties of aliphatic and aromatic hydrocarbons
2. Synthesis and chemical properties of alcohols, halides carbonyl compounds, carboxylic acids and esters
3. How to design and synthesize aliphatic and aromatic hydrocarbons.
4. How to convert aliphatic and aromatic hydrocarbons to other industrially important compounds
5. Functional group interconversion.

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I: Chemistry of Alkanes and Cycloalkanes:** **A) Alkanes:** Classification of carbon atom in alkanes, General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity **B) Cycloalkanes**: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Chair, Boat and Twist boat forms of cyclohexane with energy diagrams ring strain in small rings, theory of strain less rings. The case of cyclopropane ring, banana bonds. **Unit II:Chemistry of Alkenes:**Methods of formation of alkenes, Addition to C=C: mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenation, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, epoxidation, syn and anti-hydroxylation, ozonolysis, addition of singlet and triplet carbenes; Simmons-Smith cyclopropanation reaction; electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of NBS; interconversion of E- and Z- alkenes; contra-thermodynamic isomerization of internal alkenes.
August'25	**24**	**Unit III: Chemistry of Alkynes:**Methods of formation of alkynes, Addition to C≡C, mechanism, reactivity, regioselectivity and

		stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and nonterminal alkynes. **Unit IV: Aromaticity and Chemistry of Arenes:**Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism. Directing effects of the groups. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and anthracene.
September'25	**22**	**Unit V: Chemistry of Alcohols:**Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol pinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol. **Unit VI: Chemistry of Phenols:**Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermansyntheis, HaubenHoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.
October'25	**18**	**Unit VII: Chemistry of Ethers and Epoxides:** Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **Unit VIII: Chemistry of Organic Halides :** Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profilediagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.
November'25	**24**	**Revision & Internal Examination**

Activity: *To prepare a project on comparative analysis of reactivity of alkane, alkene, alkyne and arynes.*

Objective: *To learn the chemistry of alkane, alkene, alkyne and arynes.*
Methodology: *Inquiry based learning.*

Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.

Suggested online links:

1. http://heecontent.upsdc.gov.in/Home.aspx
2. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
3. https://nptel.ac.in/courses/104/103/104103071/#
4. https://nptel.ac.in/courses/104/106/104106096/

MAJOR CHEMISTRY

Course Code: B020502T

Paper II (Theory)

Course Title: Rearrangements and Chemistry of Group Elements

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

This paper provides detailed knowledge of synthesis of various classes of organic compounds and functional groups inter conversion. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries.

1. It relates and gives an analytical aptitude for synthesizing various industrially important compounds.
2. This paper also provides a detailed knowledge on the elements present in our surroundings, their occurrence in nature. Their position in periodic table, their physical and chemical properties as well as their extraction. This paper also gives detailed understanding of the s, p, d and f block elements and their characteristics.

Month	Working Days	Topics to be covered
July'25	**19**	**Unit I: Rearrangements:** A detailed study of the following rearrangements: Pinacol-pinacolone, Demjanov, BenzilBenzilic acid, Favorskii, Hoffman, Curtius, Schmidt, Baeyer-Villiger and Fries rearrangement **Unit II: Catalysis:** General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts. Enzyme catalysis; Michaelis-Menten equation, Lineweaver-Burk plot, turn-over number.
August'25	**24**	Unit III: Chemistry of Main Group Elements: s-Block Elements: Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls. p-Block Elements: Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides. Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds. Unit IV: Chemistry of Transition Elements: Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination

		number and geometry. Chemistry of Elements of Second and Third Transition Series- General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.
September'25	**22**	**Unit V: Chemistry of Lanthanides:** Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses. **Unit VI: Chemistry of Actinides:** Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.
October'24	**18**	**Unit VII: Metal Carbonyls:** Metal carbonyls: 18-electron rule, preparation, Structure and nature of bonding in the mononuclear and dinuclea carbonyls. **Unit VIII: Bioinorganic Chemistry:** Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen fixation.
November'24	**24**	**Revision & Internal Examination**

Activity: *Demonstration of periodic properties using periodic table.*

Objective: *To analyze the classification of elements in different block based on their chemical properties*

Methodology: *Individual learning.*

Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2 nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
9. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
10. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006
11. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
12. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
13. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

14. Francis, P. G. Mathematics for Chemists, Springer, 1984
15. Prakash Satya,Tuli G.D.,Basu S.K., Madan R.D.,Advanced inorganic Chemistry,S.Chand publishing.

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by theUniversity

Suggested online links:

1. http://heecontent.upsdc.gov.in/Home.aspx
2. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
3. https://nptel.ac.in/courses/104/103/104103071/#
4. https://swayam.gov.in/

MAJOR CHEMISTRY
Course Code: B020503P
Paper III (Practical)
Course Title: Qualitative Analysis

Credits: 2 **Max. Marks: 75 +25**

Course outcomes:

Upon completion of this course the students will have the knowledge and skills to understand the laboratory methods and tests related to inorganic mixtures and organic compounds.

1. Identification of acidic and basic radicals in inorganic mixtures
2. Separation of organic compounds from mixture
3. Elemental analysis in organic compounds
4. Identification of functional group in organic compounds
5. Identification of organic compound

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I: Inorganic Qualitative Analysis:** Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+
August'25	**24**	**Unit II: Elemental analysis and identification of functional groups:** Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
September'25	**22**	**Unit III: Separation of Organic Mixture:** Analysis of an organic mixture containing two solid components using water, NaHCO3, NaOH for separation and preparation of suitable derivatives.
October'25	**18**	**Unit IV: Identification of organic compounds :** Identification of an organic compound through the functional group analysis Determination of melting point and preparation of suitable derivatives.
November'25	**24**	**Revision & Internal Examination**

Suggested Readings:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical
4. Organic Chemistry, Prentice-Hall, 5th edition, 1996.
5. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links:

1. https://www.labster.com/chemistry-virtual-labs/
2. https://www.vlab.co.in/broad-area-chemical-sciences

MAJOR: ZOOLOGY
Course Code: B050501T
Paper I (Theory)
Course Title: Diversity of Non-Chordates and Economic Zoology
Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

The student at the completion of the course will be able to:

1. demonstrate comprehensive identification abilities of non-chordate diversity
2. explain structural and functional diversity of non-chordate
3. explain evolutionary relationship amongst non-chordate groups
4. Get employment in different applied sectors
5. Students can start their own business i.e. self employments.
6. Enable students to take up research in Biological Science.

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I: Protozoa to Coelenterate** • Protozoa – *Paramecium* (Morphology and Reproduction) • Porifera – *Sycon*(Canal System) • Coelenterata – *Obelia* (Morphology and Reproduction **Unit II: Ctenophora to Nemathelminthes** • Ctenophora - Salient features • Platyhelminthes - *Taenia* (Tape worm) (Morphology and Reproduction) • Nemathelminthes –*Ascarislumbricoides* (Morphology and Reproduction)
August'25	**24**	**Unit III: Annelida** • Annelida –*Hirudinaria* (Leech) (Morphology and Reproduction) **Unit IV: Arthropoda** • Arthropoda – *Palaemon* (Prawn) (Morphology, Appendages, Nervous System and Reproduction)
September'25	**22**	**Unit V: Mollusca to Hemichordata** • Mollusca – *Pila*(Morphology, Shell, Respiration, Nervous System and Reproduction) • Echinodermata –*Pentaceros* (Morphology and Water Vascular System) **Unit VI: Vectors and pests** • Life cycle and their control of following pests: Gundhi bug,Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control
October'25	**18**	**Unit VII: Economic Zoology-1** • Animal breeding and culture: Pisciculture **Unit VIII: Economic Zoology- 2** • Sericulture, Apiculture, Lac-culture, Vermiculture
November'25	**24**	**Revision & Internal Examination**

Activity I: *Power point presentation on lower invertebrates*
Objective: *To understand invertebrate classification, morphology and systems.*
Methodology: *Individual learning.*

Activity II: *Visit to Chauka Ghat Fish Market, Varanasi*
Objective: *To identify locally available edible fishes.*
Methodology: *Expeditionary learning.*

Suggested Readings:

1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
2. Hunter: Life of Invertebrates (1979, Collier Macmillan)
3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
5. Brusca and Brusca (2016) Invertebrates. Sinauer
6. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
7. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford
8. Parasitology- Chatterjee
9. Parasitology- Chakraborty
10. Thomos C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd. Asia, New Delhi.
11. Gerard D. Schmidt and Larry S Roberts. Foundations of Parasitology. McGraw Hill.
12. Bisht. D.S., Apiculture, ICAR Publication.
13. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
14. Jhingran. V.G. Fish and fisheries in India.,
15. Khanna. S.S, An introduction to fishes
16. Boyd. C.E. & Tucker.C.S, Pond aquaculture water quality management,
17. Biswas.K.P, Fish and prawn diseases,
18. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
19. Lee, Earthworm Ecology
20. Stevenson, Biology of Earthworms
21. Destructive and Useful Insects by C. L. Metcalf
22. Sericulture for Rural Development : Hanumappa (1978), Himalaya Publication,
23. Sericulture in India Sarkar, D.C. (1988), CSB, Bangalore

MAJOR: ZOOLOGY
Course Code: B050502T
Paper II (Theory)
Course Title: Diversity of Chordates and Comparative Anatomy

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

The student at the completion of the course will be able to:

1. Demonstrate comprehensive identification abilities of chordate diversity
2. Explain structural and functional diversity of chordates
3. Explain evolutionary relationship amongst chordates
4. Take up research in biological sciences.

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I: Origin of Chordates & Hemichordata** • Origin of Chordates. Classification of Phylum Chordata upto the class. • Hemichordata: General characteristics, classification and detailed study of *Balanoglossus* (Habit and Habitat, Morphology, Anatomy, Physiology and Development) **Unit II: Cephalochordata and Urochordata** • Cephalochordata: General characteristics, classification and detailed study of Branchiostoma (*Amphioxus*) (Habit and Habitat, Morphology, Anatomy, Physiology). • Urochordata: General characteristics, classification and detailed study of *Herdmania* (Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development).
August'25	**24**	**Unit III: Classification and General Characteristics of Vertebrates :** • General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples. • Poisonous and Non Poisonous Snakes and biting mechanism. • Neoteny and Paedogenesis • Migration in birds • Dentition in Mammals **Unit IV: Comparative Anatomy and Physiology of Vertebrates:** • Integumentary System Structure, functions and derivatives of integument • Skeletal System Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches
September'25	**22**	**Unit V: Digestive System:** • Alimentary canal and associated glands, dentition **Unit VI: Respiratory System**: • Skin, gills, lungs and air sacs; Accessory respiratory organs

October'25	**18**	**Unit VII: Circulatory System:** • General plan of circulation, evolution of heart and aortic arches • **Urinogenital System** • Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri **Unit VIII: Nervous System:** • Comparative account of brain • Autonomic nervous system, Spinal cord, Cranial nerves in mammals **Sense Organs** • Classification of receptors • Brief account of visual and auditory receptors in man
November'25	**24**	**Revision & Internal Examination**

Activity I: *Power point presentation on Comparative Anatomy and Physiology of Vertebrates*
Objective: *To understand integumentary and skeletal systems of different vertebrates.*
Methodology: *Individual learning.*

Activity II: *Visit to Zoology Museum, Department of Zoology, BHU, Varanasi*
Objective: *To identify lower and higher chordates and understand their classification.*
Methodology: *Expeditionary learning.*

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002,Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life(1979, Macmillan Publishing)
6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

MAJOR: ZOOLOGY

Course Code: B050503P

Paper III (Practical)

Course Title: Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology

Credits: 2 **Max. Marks: 75 +25**

Course outcomes:

At the completion of the course students will learn Hands-on:

1. demonstrate comprehensive identification abilities of chordate and non-chordates diversity
2. explain structural and functional diversity of chordates and non- chordates
3. explain evolutionary relationship amongst chordates and non- chordates
4. Generate self employment
5. Enable students to take up research in biological sciences.

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I:** Study of animal specimens of various animal phyla. 1. To prepare permanent stained slide of septal nephridia of earthworm. 2. To take out the nerve ring of earthworm. 3. To take out hastate plate from *Palaemon*. **Unit II:** 1. Study of animal specimens of various animal phyla 2. Study on use and ethical handling of model organisms (Mice, rats, rabbit and pig). 3. To prepare stained/unstained slide of placoid scales. 4. Comparative study of bones of different vertebrates. 5. Comparative study of histological slides of different tissues of vertebrates.
August'25	**24**	**Unit III:** 1. Permanent Preparation of: *Euglena*, *Paramecium* 2. Study of prepared slides/specimens of *Entamoeba*, *Giardia*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Fasciola*, *Cotugnia*, *Taenia*, *Rallietina*, *PolystomaSchistosoma*, *Echinococcus*, *Enterobius*, *Ascaris* and *Ancylostoma* 3. Permanent Preparation of *Cimex* (bed bug)/ *Pediculus* (Louse), *Haematopinus* (cattle louse), fresh water annelids, arthropods; and soil arthropods. 4. Larval stages of helminths and arthropods. 5. Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly.

September'25	**22**	**Unit III:** 6. Identification of pests. 7. Life history of silkworm, honeybee and lac insect. 8. Different types of important edible fishes of India. 9. Slides of plant nematodes. 10. Study of an aquatic ecosystem, its biotic components and food chain. 11. Project Report/ model chart making. 12. Dissections : through multimedia / models 13. Cockroach : Central nervous system 14. Wallago: Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.
October'25	**18**	**Unit IV:** Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu
November'25	**24**	**Revision & Internal Examination**

Activity I: *Visit to Indian Institute of Vegetable Research, Varanasi*
Objective: *To identify non-chordates, lower and higher chordates.*
Methodology: *Expeditionary learning.*

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002,Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
6. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
10. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
11. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
12. Brusca and Brusca (2016) Invertebrates. Sinauer

13. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
14. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home
15. Robert Leo Smith Ecology and field biology Harper and Row publisher
16. Handbook of Practical Sericulture: Ullal, S.R. and Narasimhanna, M.N. (1987),Central Silk Board Publication, Bangalore.
17. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
18. Bisht. D.S., Apiculture, ICAR Publication.
19. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
20. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB,Bangalore
21. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
22. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co.
23. Santanam, B. et al, A manual of freshwater aquaculture
24. Boyd. C.E. & Tucker.C.S, Pond aquaculture water quality management
25. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
26. Ranganathan L.S, Vermi-composting technology- soil health to human health

CO- CURRICULAR

Course Code: Z050501

Course Title: Analytic Ability and Digital Awareness

Credit: 2 **Max. Marks: 75+25**

Course outcomes:

CO1: Familiarize with analogy, number system, set theory and its applications, number system and puzzles.

CO2: To understand the basics of Syllogism, figure problems, critical and analytical reasoning.

CO3: Familiarize with word processing application and worksheet.

CO4: To understand the basics of web surfing and cyber security.

Month	Working Days	Topics to be covered
July'25	**21**	**Unit I:** Alphabet test, Analogy, Arithmetic Reasoning, Blood relations, Coding and Decoding, Inequalities, Logical Venn diagram, Seating Arrangements, Puzzles and Missing numbers

Activity*: Analytics project*
Objective: *To make students know how to make real time knowledge of working on data*
Methodology: *Inquiry based learning.*

Month	Working Days	Topics to be covered
August'25	**24**	**Unit II:** Syllogism, Pattern completion and figure series, Embeded Figure and counting of figures, Cube & Dice, Paper cutting and folding, Data sufficiency, Course of Action, Critical Reasoning, Analytical and decision making
September'25	**22**	**Unit III:** **Computer Basics:** Block diagram of Digital Computer, Classification of Computers, Memory System, Primary storage, Auxiliary memory, Cache memory, Computer Software (System/Application Software), **MS Word Basics:** The word screen, Getting to word documents, typing and Revising text, Finding and Replacing, Editing and Proofing tools, Formatting text characters, Formatting Paragraph, Document templates., Page set up, tables, Mail Merge, Macros, protecting documents, printing a document. **MS-Excel** Introduction, Worksheet basics, Creating worksheet, Heading information, Data & Text, Date & Time, Alphanumeric values, Saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Excel shortcut and function keys, Working with single and multiple workbook, Working with formulae & cell referencing, Auto sum, coping formulae, Absolute & relative addressing, Worksheet with

		ranges, Formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and using macros, Multiple worksheets- concepts **Introduction of Open Source Applications:** Libre Office, Open Office and Google Docs etc
October'25	**18**	**Unit IV:** **Web Surfing:** An Overview: working of Internet, Browsing the Internet, E-Mail, Components of E-Mail, Address Book, Troubleshooting in E-Mail, Browsers: Netscape Navigator, Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Tor, Search Engines lik Google, DuckDuckGo etc, Visiting web sites: Downloading. **Cyber Security:** Introduction to Information System, Type of information system, CIA model of Information Characteristics, Introduction to Information Security, Need of Information Security, Cyber Security, phishing, spamming, fake news, general issues related to cyber security, Business need, Ethical and Professional issues of security.
November'25	**24**	**Revision & Internal Examination**

Suggested readings:

1. Sharma, A., "How to prepare for Data Interpretation and Logical Reasoning for the CAT" McGraw Hill Education Pvt. Ltd., New Delhi, India, 2011, Ed. 5, ISBN 978 2007 070 481
2. Aggarwal, R.S., "A Modern Approach to Verbal and Non-verbal Reasoning" S. ChandPublishers New Delhi, India, 2010, ISBN 10: 8121905516
3. Madan , Sushila, Introduction to Essential tools, Jain Book Agency, New Delhi/India, 2009, 5th ed..
4. Goel, Anita, Computer Fundamentals, Pearson Education, India, 2012
5. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security," Sixth Edition, Cengage Learning, 2017

SEMESTER VI

MAJOR: BOTANY
Course code: B040601T
Paper I (Theory)
Course Title: Cytogenetics, Plant Breeding & Nanotechnology
Credits: 4 **Max. Marks: 75+25**

Course outcomes:
After the completion of the course the students will be able:

1. Acquire knowledge on ultrastructure of cell.
2. Understand the structure and chemical composition of chromatin and concept of cell division.
3. Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex linked inheritance.
4. Understand the concept of 'one gene one enzyme hypothesis' along with molecular mechanism of mutation.
5. Interpret the concept of Lemarkism, Neo Lamarkism, Darwinism and also understand the concept of naturalselection.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Cell biology:** Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus. Chromosomal nomenclature- chromatids, centromere, telomere, satellite, secondary constriction. Organization of chromosomes- Nucleic acid and histones- types and classification. Lampbrush chromosomes and polytene chromosomes- Karyotype and idiogram. Cell cycle: G0, G1, S and G2 phases – mitosis: open and closed mitosis – amitosis meiosis. Variation in Chromosome number (Numerical aberrations)- anueploidy and Euploidy-haploidy , polyploidy-significance (Structural aberrations) - deletion, duplication, inversion and translocation. **Unit IV: Biostatistics:** Definition, statistical methods, basic principles, variables-measurements, functions, limitations and uses of statistics. Biometry: Data, Sample, Population, random sampling, Frequency distribution- definition only, Central tendency– Arithmetic Mean, Mode and Median; Measurement of dispersion–Coefficient of variation, Standard Deviation, Standard error of Mean; Test of significance: chi- square test for goodness of fit. Computer application in biostatistics - MS Excel and SPSS
February'26	**23**	**Unit II: Genetics:** Chromosome theory of inheritance, crossing over and linkage; Incomplete dominance and codominance; Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing over , Concept of sex determination and Sex chromosomes; Patterns of Sex determination in plants

		Unit V: Plant tissue culture: Principles, components and techniques of in vitro plant cultures, Callus cultures, Cell culture, cell suspension cultures, Embryogenesis and organogenesis , Protoplast- isolation and culturing of protoplast- principle and application, regeneration of protoplasts, protoplast fusion and somatic hybridization- selection of hybrid cells, Somaclonal variation, , Plant secondary metabolites production.
March' 26	**20**	**Unit III: Plant breeding:** Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization – Achievements, Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods, Hybridization: Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties, Male sterility , Heterosis and its exploitation in plant breeding, Mutation, Molecular Breeding (use of DNA markers in plant breeding) , achievements in India, Breeding for pest, pathogenic diseases and stress resistance. **Unit VI: Nanotechnology:** Fundamentals of nanoscale self-assembly process involved in important functional biomolecules such as Nucleic acid (DNA and RNA), Proteins, Enzymes. Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus). Nano-particles synthesis, Biological synthesis of Nanoparticles, Advantages and applications of biologically synthesized nanomaterials. Introduction to biological nanomaterials.,Biomineralization, Magnetosomes, nano-pesticides, nano-fertilizers, nano-sensors.
April' 26	**24**	**Unit VII- Artificial Intelligence in Plant Sciences:** Big Data Analytics, Blockchain Technology, 3-D Printing, Machine learning , Algorithms of Machine Learning, Expert systems and Fuzzy logic , Artificial Neural Networks and Genetic algorithms, Predictive Analytics, Agents and Robotics, IoT Sensors, Object Image capture & analysis ; Applications of Artificial Neural Networks in Plant Science. **Unit VIII-Introduction to use of Digital technologies – AI, IoT & ICT in Botany:** Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repository google scholar, science direct. resource management, weather forecasting. IoT Database management ,IoT platforms , IoT Graphical user interface • IoT application development for Android Mobile phones, ICT Applications for different crops and horticulture **Revision & Internal Examination**

Activity I*: *Project on Fundamentals aspects and applications of Nanotechnology in Life sciences /Artificial Intelligence in Plant Science.

Objective: *To inculcate the concepts and application of nanotechnology in sustainability of life processes.*

Methodology: *Inquiry based learning.*

Suggested readings:

1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
2. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman andCompany.
3. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th edition.
5. M K Razdan,An Introduction to Plant Tissue Culture –; Oxfird & IBH Publishing Co.Pvt. Ltd.,New Delhi
6. BD Singh (2003) Plant Breeding. Kalyani Publishers
7. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
8. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
9. S S Purohit and S K Mathur; Biotechnology-Fundamentals and Application-Agrobotanica, India.
10. A. J. Nair Introduction to Genetic Engineering & Biotechnology.Jones & Bartlett Publishers, Boston,USA.
11. H D Kumar Modern concept of Biotechnology, Vikas Publishing House, Pvt. Ltd., New Delhi.
12. P C Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
13. Du, C., and S. A. Jackson. 2019. Machine learning and complex biological data. Genome Biology 20: 76.https://doi.org/10.1186/s13059- 019- 1689- 0
14. Plant R. E., Stone N. D. (1991). Knowledge-based systems in agriculture. McGraw-Hill, Inc. 1221 Avenue of theAmericas, New York, NY 10020.
15. Lucci S., Kopec D. (2013). Artificial intelligence in the 21st century. 22841 Quicksilver Drive Dulles, VA20166.
16. NigamA.K. andGupta,V.K.(1979). Hand book on Analysis of Agricultural Experiments.. IASRI Publication, NewDelhi.
17. V.K. Kapoor (2007) Fundamentals of Applied statistics by Sultan Chand and Sons, New Delhi- 110 002
18. K. K. Chattopadhyay and A. N. Banarjee. 2009. Introduction to Nanoscience and Nanotechnology. PHIPublication.
19. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.

Suggested equivalent online courses:

1. https://www.cytology-iac.org/educational-resources/virtual-slide-library
2. https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
3. https://www.mooc-list.com/tags/genetics
4. https://www.coursera.org/learn/genetics-evolution
5. https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

MAJOR: BOTANY
Course code: B040602T
Paper II (Theory)
Course Title: Ecology & Environment

Credits:4 **Max. Marks: 75+25**

Course outcomes:

1. Acquaint the students with complex interrelationship between organisms and environment;
2. Make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
3. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Natural resources & Sustainable utilization**: Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water , Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy , Contemporary practices in resource management : EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting. **Unit V: Phytogeography:**Biogeographic regions of India & world, Agroecological & Floristic zones of India .Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Phytogeographical regions of India,Vegetational types in Uttar Pradesh.
February'26	**23**	**Unit II: Ecology & Ecosystem:** Definition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem – Concept of an ecosystem-structure and function of an ecosystem. Abiotic and biotic com-Energy flow in an ecosystem Ecological Succession-Definition &types. Processes and types (autogenic,allogenic,autotrophic,heterotrophic,primary&secondary), Hydrosere and Xerosere. Food chains and food webs, Ecological pyramids, production and productivity; And components. Types of ecosystems: Forest Ecosystem, Grass land ,Crop land, aquatic Ecosystems Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites. **Unit VI: Environmental audit & Sustainability:**Concept of environmental audit; Guidelines of environmental audit; Methodologies adopted along with some industrial case studies; Environmental standards: ISO 14000 series; Scheme of labelling of environment friendly products (Ecomark); Life cycle analysis; Concept of energy and green audit, Sustainability indices; Strategies and debates on sustainable development; Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards

		Sustainability; Sustainable development in practice; Urbanization; Concept and characteristics of smart city; Urban resources and environmental problems; Carrying capacity analysis; Concept of ecological footprints.
March' 26	**20**	**Unit III: Soil Formation, Properties & Conservation:** Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, Soil Erosion, Biogeochemical cycles, Soil Conservation: Biological– Contour farming, Mulching, Strip cropping, Terracing and Crop rotation. Mechanical–Basin Listing, Construction of dams, Water Shed Management, Soil reclamation **Unit VII- Pollution ,Waste management & Circular Economy:**Environmental pollution, Environmental protection laws, Bioremediation, ActivatedSludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors,membrane bioreactor, neutralization, ETP sludge management; digesters, up flowanaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybridreactors, bioscrubbers, biotrickling filters; regulatory framework for pollutionmonitoring and control; case study: Ganga Action Plan; Yamuna Action Plan;implementation of CNG ;Waste- Types , collection and disposal, Recycling of solidwastes (hazardous & non-hazardous) - classification, collection and segregation ,Incineration, Pyrolysis and gasification , Sanitary landfilling ; composting, Biogasproduction ,Circular Economy & sustainability.
April' 26	**24**	**Unit IV: Biodiversity and its conservation:**Definition -genetic, species, and ecosystem diversity. Value of biodiversity: : social, ethical, aesthetic and option values hot spots of Biodiversity &threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, ecological indicators. *Conservation of Biodiversity:* Ex-situ and in-situ conservation, Red data book, botanical gardens, National park, Sanctuaries, hot & hottest spots and Bioreserves. Role of Seed Bank and Gene Bank Valuing plant resources, ecotourism, Role of NBPGR, FAO, BSI. **Unit VIII- Environmental ethics, Carbon Credits &Role of GIS:**Carbon credit: concept, exchange of carbon credits.Carbon sequestration, importance, meaning and ways.Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents andholocaust.Wasteland reclamation. Consumerism and waste products.Clean development mechanism.Geographical Information Systems: definitions and components; spatial and non-spatialdata; GIS software packages; GPS survey, data import, processing, and mapping.Applications and case studies of remote sensing and GIS in land use planning, forestresources & agriculture studies. **Revision & Internal Examination**

Activity I*: *Class presentation through PPT on Biodiversity conservation.
Objective: *To make aware students about plant and animal wealth of India.*
Methodology: *Individual learning.*

Suggested readings:

1. Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
2. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
3. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
4. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
5. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications
6. Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors
7. Krishnamurthy, K.V. An Advanced Text Book on Biodiversity, 2003, Oxford & IBH Publishing Co. Ltd.
8. Primack, R.B. Essentials of Conservation Biology, 1993, Sinauer Associates.
9. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. AnamayaPublications, New Delhi.
10. Abbasi, S. A. (1998). Environmental Pollution and its Control. Cogent International, Pondicherry.
11. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentarieswith Policy and Science Considerations. Martinus Nijhoff Publishers.
12. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
13. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.

Suggested equivalent online courses:

1. https://community.plantae.org/tags/mooc
2. uturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
3. https://www.coursera.org/courses?query=plants
4. http://egyankosh.ac.in/handle/123456789/53530

MAJOR: BOTANY
Course Code: B040603P
Paper III (Practical)
Course Title: Lab on Cytogenetics, Conservation & Environment management

Credit:2 **Max. Marks: 75+25**

Course outcomes:

After the completion of the course the students will be able:

1. To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding onfield, conserving and depolluting the environment.
2. Can be employed in environment impact assessment companies & start his own venture.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I- Cell biology** 1. Study of plant cell structure with the help of epidermal peal mount of Onion/Rhoeo/Crinum. 2. Counting cells per unit volume with the help of haemocytometer (Yeast/pollen grains) 3. Determination of mitotic index and frequency of different mitotic stages in pre-fixed root tips of Allium cepa. **Unit II- Genetics** 1. Spotting of Monohybrid cross (Dominance and incomplete dominance), Dihybrid cross (Dominance and incomplete dominance), Gene interactions (All types of gene interactions mentioned in the syllabus) a) Recessive epistasis 9: 3: 1. b) Dominant epistasis 12: 3: I c) Complementary genes 9: 7 d) Duplicate genes with cumulative effect 9: 6: 1 e) Inhibitory genes 13: 3 2. Observe the genetic variations among inter and intra specific plants. 3. Demonstration of Breeding techniques-Hybridization, case studies of mutation, polyploidy , emasculation experiment.
February'26	**23**	**Unit III: Biostatistics:** 1. Univariate analysis of statistical data: Statistical tables, mean, mode, median, standard deviation and standard error (using seedling population / leaflet size). 2. Calculation of correlation coefficient values and finding out the probability. 3. Determination of goodness of fit in Mendellian and modified mono-and dihybrid ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1, 9:7, 13:3, 15:1) by Chi-square analysis and comment on the nature of inheritance. 4. Computer application in biostatistics - MS Excel and SPSS. **Unit IV: Plant tissue culture:**

		1. Spotting of instruments and special equipments used in the plant tissue culture experiments. 2. Preparation of plant tissue culture medium, and sterilization, Preparation of stock solutions of nutrients for MS Media. 3. Surface sterilization of plant materials for inoculation (implantation in the medium). 4. Micropropagation of potato/tomato/ - Demonstration
March' 26	**20**	**Unit V: Ecology & environment** 1. Spotting of Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites. 2. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b) Study of biotic interactions of: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants). 3. Field visit to familiarize students with ecology of different sites. **Unit VI- Soil Formation, Properties & Conservation** 1. Determination of pH of various soil and water samples (pH meter, universal indicator and pH paper) 2. Analysis for carbonates, nitrates, sulphates, and base deficiency from two soil samples by rapid field tests. 3. Determination of organic matter of different soil samples by Walkley & Black rapid titration method. 4. Soil Profile study.-spotting 5. Soil types of India-Map study
April' 256	**24**	**Unit VII- Biodiversity and Phytogeography:** 1. Study of community structure by quadrat method and determination of (i) Minimal size of the quadrat, (ii) Minimum number, Frequency, density and abundance of components (to be done during excursion/field visit). 2. Marking of vegetation types of India, World & Uttar Pradesh on maps. 3. Phytogeographical areas of India. **Unit VIII- Pollution &Waste management:** 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter (photograph/video) 2. Estimation of chloride and dissolved oxygen content in water sample. 3. Measurement of dissolved O_2(by azide modification of Winkler's method)of water samples from polluted and unpolluted sources. 4. Microbiological assessment of drinking water using MPN technique- water from well, river, water supply department and packaged drinking water. 5. Making kitchen waste from compost/vermicompost by Enzymes/Bio decomposer/ Whey with dung. **Climate Change, Carbon Credits &Role of GIS** 1. Conducting Waste Audit of your Institution -Demo

		2. Green auditing of the College/University –Demo **Revision & Internal Examination**

Activity I**:** *Project on pollution measurement instruments-principle and working.*

Objective: *To make students aware by pollution control methods and strategies.*

Methodology: *Inquiry based learning.*

Suggested readings:

1. Practical Botany (Part III) Author: Sunil D Purohit, Anamika Singhvi & Kiran Tak 2013 ApexPublishing House,Raj.
2. Practical Botany (Part II) Author: N. C. Aery, Sunil D Purohit & Gotam K Kukda 2013 ApexPublishing House,Raj.
3. A Handbook Of Soil, Fertilizer And Manure (2nd Ed.) (pb) ISBN : 9788177544152Edition :02Year : 2017Author : Gupta PKPublisher : Agrobios (India)
4. Green Technology: An Approach For Sustainable Environment ISBN : 9788177543438Edition :01Year : 2021Author : Dr. Purohit SSPublisher : Agrobios (India)
5. Laboratory Manual Of Chemical And Bacterial Analysis Of Water And SewageISBN :9788177540802Edition : 01Year : 2011Author : Theroux FR , Eldridge EF , MallmannWLPublisher : Agrobios (India)
6. Methods In Environmental Analysis: Water Soil And Air (2nd Ed.) ISBN :9788177543087Edition : 02Year : 2021Author : Gupta PKPublisher : Agrobios (India)
7. Water Treatment And Purification Technology ISBN : 9788177540024Edition : 01Year :2009Author : Ryan WJPublisher : Agrobios (India

Suggested equivalent online courses:

1. https://www.cytology-iac.org/educational-resources/virtual-slide-library
2. https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
3. https://www.mooc-list.com/tags/genetics
4. https://www.coursera.org/learn/genetics-evolution
5. https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

MAJOR: BOTANY

Course Code: B040604R

Paper IV (Project II)

Course Title: Project in Botany for Pre-graduation

Credit: 3 **Max. Marks: 75+25**

Course outcomes:

After completing this course a student will have:

1. Project work will supplement field experimental learning and deviations from classroom and laboratory transactions.
2. project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes
3. It will promote creativity and the spirit of enquiry in learners.
4. They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing
5. It will enhance their abilities, enthusiasm, and interest.

Suggested LIST OF PROJECTS
1. Prepare beds for growing nursery for herbs, shrubs and trees. 2. Develop Green house facility in college and grow plants 3. Develop hydroponics facility in college and grow plants. 4. Develop botanical garden in the college with labelling 5. Vertical gardens, roof gardens. 6. Culture & art of making bonsai. 7. Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer 8. Aided Designing) 9. Phytochemical Analysis of Medicinal plants 10. Bio composting and Vermicomposting. 11. Performing Aromatherapy by essential Oils
Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.

Suggested equivalent online courses:

1. https://ndl.iitkgp.ac.in/
2. *http://heecontent.upsdc.gov.in/Home.aspx*
3. *(http://epathshala.nic.in/, http://epathshala.gov.in/)*
4. *nptel.iitm.ac.in*
5. https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5JQhBITSyPnvj3r8yeio-
6. L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD_BwE
7. http://www.dli.ernet.in/, http://www.ulib.org/
8. http://www.tkdl.res.in/, http://www.vigyanprasar.gov.in/digilib
9. Directory of Open Access Repositories (DOAR)http://www.opendoar.org
10. Registry of Open Access Repositories (ROAR)http://roar.eprints.org/
11. http://www.iscnagpur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf

MAJOR: CHEMISTRY
Course Code: B020601T
Paper I (Theory)
Course Title: Organic Synthesis B

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

This paper provides detailed knowledge of synthesis of various class of organic compounds and functional groups inter conversion. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries. The study of natural products and heterocyclic compounds offers an excellent strategy toward identifying novel biological probes for a number of diseases. Historically, natural products have played an important role in the development of pharmaceutical drugs for a number of diseases including cancer and infection.

1. It relates and gives an analytical aptitude for synthesizing various industrially important compounds.
2. Learn the different types of alkaloids, & terpenes etc and their chemistry and medicinal importance.
3. Explain the importance of natural compounds as lead molecules for new drug discovery.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Reagents in Organic Synthesis**: A detailed study of the following reagents in organic transformations Oxidation with DDQ, CAN and SeO_2, mCPBA, Jones Oxidation, PCC, PDC, PFC, Collin's reagent and ruthenium tetraoxide. Reduction with $NaBH_4$,$LiAlH_4$,Meerwein-Ponndorf-Verley (MPV) reduction, Wilkinson's catalyst, Birch reduction, DIBAL-H **Unit II: Organometallic Compounds:** Organomagnesium compounds: The Grignard reagents, formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: Formation and chemical reactions.
February'26	**23**	**Unit III: Chemistry of Aldehydes and ketones:** Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Oxidation of aldehydes, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones An introduction to α, β unsaturated aldehydes and Ketones. **Unit IV: Carboxylic acids and their Functional Derivatives:** Nomenclature and classification of aliphatic and aromatic

		carboxylic acids. Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation, Reactions: Mechanism ofreduction, substitution in alkyl or aryl group. Preparation and properties of dicarboxylic acids such as oxalic, malonic, succinic, glutaric, adipic and phthalic acids and unsaturated carboxylic acids such as acrylic, crotonic and cinnamic acids, Reactions: Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, stereospecific addition to maleic and fumaric acids. Preparation and reactions of acid chlorides, acid anhydrides, amides and esters, acid and alkaline hydrolysis of esters, trans-esterification.
March' 26	**20**	**Unit V: Organic Synthesis via Enolates:** Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines. **Unit VI: Organic Compounds of Nitrogen:** Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substituton in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling
April' 26	**24**	**Unit VII: Heterocyclic Chemistry**: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles, Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, Mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline **Unit VIII: Natural Products : Alkaloids & Terpenes:** Natural occurrence, General structural features, their physiological action, Hoffmann's exhaustive methylation, Emde's modification;. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. Natural Occurrence and classification of terpenes, isoprene rule. **Revision & Internal Examination**

Activity: *To prepare a project on comparative analysis of reactivity of aldehyde, ketone, and carboxylic acid. (Unit III & IV)*
Objective: *To learn the chemistry of alkane, alkene, alkyne and arynes.*
Methodology: *Inquiry based learning.*

Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003
3. Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
9. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Welly& Sons (1976).
10. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
11. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
12. Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Pragati Prakashan (2010).

Suggested online links:

1. http://heecontent.upsdc.gov.in/Home.aspx
2. https://nptel.ac.in/courses/104/103/104103111/
3. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
4. https://nptel.ac.in/courses/104/103/104103071/#
5. https://swayam.gov.in/

MAJOR CHEMISTRY
Course Code: B020602T
Paper II (Theory)
Course Title: Chemical Energetics and Radio Chemistry

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

Upon successful completion of this course students should be able to describe laws of thermodynamics and its applications, phase equilibria of one and two component system, electro chemistry ,ionic equilibrium applications of conductivity and potentiometric measurements

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Thermodynamics-I**: **First Law of Thermodynamics:** Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. **Thermochemistry:** Standard state, standard enthalpy of formation – Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation **Unit II: Thermodynamics II**: Second Law of Thermodynamics, Need for the law, different statements of the law, Carnot cycleand its efficiency. Carnot theorem. Thermodynamic scale of temperature. Concept of Entropy, Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality ,entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Helmholtz Functions, Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. Third Law of Thermodynamics ; Nernst heat theorem , statement and concept of residual entropy. Nernst distribution law – Thermodynamic derivation, application.
February'26	**23**	**Unit III: Electrochemistry:**Electrical transport:- Conduction in metals and inelectrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation

		of molar, equivalent and specific conductances with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes. Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method. **Unit IV: Ionic Equilibrium:** Types of reversible electrodes – Gas-metal ion, metal-metal ion, and metal insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, Electrolytic and Galvanic cells–Reversible and irreversible cells, conventional representation of electrochemical cells . EMF of a cell and its measurement. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers – Mechanism of buffer action,n Henderson-Hazel equation, application of buffer solution. Hydrolysis of salts.
March' 26	**20**	**Unit V: Photo Chemistry:** Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples),kinetics of photochemical reaction. **Unit VI: Colligative Properties:**Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.

April' 26	**24**	**Unit VII: Surface Chemistry:** **Adsorption:** Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isotherm and surface excess; Heterogenous catalysis (single reactant); **Colloids:** Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids,Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Stability of colloids and zeta potential; Micelle formation **Dipole moment and polarizability:** Polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation (both without derivation) and their application; Determination of dipole moments**.** **Unit VIII: Radiochemistry:** Natural and induced radioactivity; radioactive decay-a-decay, b-decay, g-decay; neutrom emission, positrom emission, electron capture; unit of radioactivity (Curie); half life period; Geiger-Nuttal rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters, scintillation counters. Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, nuclear medicine-99mTc radiopharmaceuticals **Revision & Internal Examination**

Activity: *Demonstration of experiment on Galvanic cell and generation of potential by Electrochemical reaction. (Unit IV)*

Objective: *To analyze how theory works on practical ground and make assignment of observation.*

Methodology: *Inquiry based learning.*

Suggested Readings:

1. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B..I. Waverly Pvt. Ltd. New Delhi
2. Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press (2010).
3. Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill (2009)
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
5. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6. Castellan, G. W. Physical Chemistry 4th Edn. Narosa (2004).
7. Allen Bard, J Larry. Faulkner R, Fundamentals of Electrochemical methods – fundamentals and applications, new York John, Wiley &sons, 2001
8. H. J. Arnikar, Essentials of Nuclear Chemistry, 4th ed., New Age International, New Delhi, 1995.

Suggested online links:

1. http://heecontent.upsdc.gov.in/Home.aspx
2. https://swayam.gov.in/
3. https://www.coursera.org/learn/physical-chemistry
4. https://www.mooc-list.com/tags/physical-chemistry
5. https://www.openlearning.com/courses/introduction-to-physical-chemistry

MAJOR CHEMISTRY
Course Code: B020603P
Paper III (Practical)
Course Title: Analytical Methods

Credits: 2 **Max. Marks: 75 +25**

Course outcomes:

Upon successful completion of this course students should be able to quantify the product obtained through gravimetric method; determination of R*f* values and identification of organic compounds through paper and thin layer chromatography laboratory techniques: perform thermo chemical reactions.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Gravimetric Analysis:** 1. Analysis of Cu as CuSCN 2. Analysis of Ni as Ni (dimethylgloxime)
February'26	**23**	3. Analysis of Ba as BaSO4. **Unit II: Paper Chromatography:** Ascending and Circular. Determination of R*f* values and identification of organic compounds: Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid Leucine and glutamic acid. Spray reagent – ninhydrin. Separation of a mixture of D, L – alanine, glycine, and L-leucine using n-butanol:acetic acid: water (4:1:5). Spray reagent– ninhydrin. Separation of monosaccharaides – a mixture of D- galactose and D –fructose using n- butanol: acetone: water (4:5:1). Spray reagent – aniline hydrogen phthalate.
March' 26	**20**	**Unit III: Thin Layer Chromatography**: Determination of R_f values and identification of organic compounds: Separation of green leaf pigments (spinach leaves may be used) Preparation of separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).
April' 26	**24**	**Unit IV: Thermochemistry:** 1. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process 2. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base

		3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born-Haber cycle **Revision & Internal Examination**

Suggested Readings:

1. Skoog .D.A., West.D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia,(2010).
2. Larry Hargis.G" Analytical Chemistry: Principles and Techniques" Pearson©(1988)

Suggestive digital platforms web links:

1. https://www.labster.com/chemistry-virtual-labs/
2. https://www.vlab.co.in/broad-area-chemical-sciences
3. http://chemcollective.org/vlabs
4. https://www.labster.com/chemistry-virtual-labs/
5. https://www.vlab.co.in/broad-area-chemical-sciences
6. http://chemcollective.org/vlabs

MAJOR: ZOOLOGY
Course Code: B050601T
Paper I (Theory)
Course Title: Evolutionary and Developmental Biology

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

1. The student at the completion of the course will be able to:
2. Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.
3. Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.
4. Understand how the single cell formed at fertilisation forms an embryo and then a full adult organism.
5. Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.
6. Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.
7. Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Theories of Evolution** • Origin of Life • Historical review of evolutionary concept: • Lamarckism, Darwinism (Natural, Sexual and Artifical selection) • Modern synthetic theory of evolution • Patterns of evolution (Divergence, Convergence, • Parallel, Coevolution) **Unit II: Population Genetics** • Population Genetics • Microevolution and Macroevolution: allele • frequencies, genotype frequencies, Hardy- Weinberg equilibrium and conditions for its maintenance • Forces of evolution: mutation, selection, genetic drift
February'26	**23**	**Unit III: Direct Evidences of Evolution** • Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse **Unit IV: Species Concept and Extinction** Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric) Mass extinction (Causes, Names of five major extinctions

March' 26	**20**	**Unit V: Gamete Fertilization and Early Development** • Gametogenesis, Fertilization • Cleavage pattern • Gastrulation, fate maps • Developmental mechanics of cell specification • Morphogenesis and cell adhesion **Unit VI: Developmental Genes** • Genes and development • Molecular basis of development • Differential gene expression
April' 26	**24**	**Unit VII: Early Vertebrate Development** • Early development of vertebrates (fish, birds & mammals) • Metamorphosis, regeneration and stem cells • Environmental regulation of development **Unit VIII: Late Developmental Processes** • The dynamics of organ development • Development of eye, kidney, limb • Metamorphosis: the hormonal reactivation of development in amphibians, insects • Regeneration: salamander limbs, mammalian liver, Hydras Aging: the biology of senescence **Revision & Internal Examination**

Activity I: *Power point presentation on Evolutionary Theories*
Objective: *To understand the different theories of evolution.*
Methodology: *Individual learning.*

Activity II: *Visit to Chauka Ghat Fish Market, Varanasi*
Objective: *To identify locally available edible fishes.*
Methodology: *Expeditionary learning.*

Suggested Readings:

1. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
4. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
5. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
6. Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi (2013).
7. Essential Developmental Biology: Jonathan M. W. Slack, (3rd ed.), Wiley-Blackwell. (2012).
8. Developmental Biology: From a Cell to an Organism (Genetics & Evolution) eBook: Russ Hodge, Infobase Publishing. (2009).
9. Current Topics in Developmental Biology: Roger A. Pedersen, Gerald P. Schatten, Elsevier. (1998).

MAJOR: ZOOLOGY
Course Code: B050602T
Paper II (Theory)
Course Title: Ecology, Ethology, Environmental Science and Wildlife

Credits: 4 **Max. Marks: 75 +25**

Course outcomes:

The student at the completion of the course will be able to:

1. Complexities and interconnectedness of various environmental levels and their functioning.
2. Global environmental issues, their causes, consequences and amelioration.
3. To understand and identify behaviours in a variety of taxa.
4. The proximate and ultimate causes of various behaviours.
5. About the molecules, cells, and systems of biological timing systems.
6. Conceptualizing how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons.
7. To interpret the cause and effect of lifestyle disorders contributing to public understanding of biological timing.
8. To understand the importance of wildlife conservation.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I: Introduction to Ecology** • History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors **Unit II: Organization of Ecosystem** • Levels of organization, Laws of limiting factors, Study of physical factors, • Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion ,Exponential and logistic growth, • Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, • Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle.
February'26	**23**	**Unit III: Community Ecology** • Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with one example **Unit IV: Environmental Hazards** • Sources of Environmental hazards, Climate changes • Greenhouse gases and global warming • Acid rain, Ozone layer destruction
March' 26	**20**	**Unit V: Effects of Climate Change** • Effect of climate change on public health, Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical

		waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, • Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath. **Unit VI: Behavioural Ecology and Chronobiology**: • Origin and history of Ethology, Instinct vs. Learnt Behaviour, Associative learning, classical and operant conditioning, Habituation, Imprinting, Circadian rhythms; Tidal rhythms and Lunar rhythms Chronomedicine
April' 26	**24**	**Unit VII: Introduction to Wild Life:** • Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies. **Unit VIII: Protected areas:** • National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve • **Revision & Internal Examination**

Activity I: *Power point presentation on Environmental Pollution*
Objective: *To understand impact and outcome of major pollutants.*
Methodology: *Individual learning.*

Activity II: *Visit to Zoology Museum, Department of Zoology, BHU, Varanasi*
Objective: *To identify lower and higher chordates and understand their classification.*
Methodology: *Expeditionary learning.*

Suggested Readings:

1. Ecology: Theories & Applications. Peter D. Stiling, 2001, Prentice Hall.
2. Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell.
3. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.
4. Elements of Ecology. T.M. Smith and R.L. Smith, 2014, Pearson Education Inc.
5. Environmental Chemistry. 2010. Stanley and Manahan, E. CRC, Taylor & Francis. London.
6. Environment. Raven, Berg, Johnson, 1993, Saunders College Publishing.
7. Essentials of Ecology. G.T. Miller, Jr. & Scott. E. Spoolman, 2014, Brooks/Cole, Cengage Learning.
8. Freshwater Ecology: A Scientific Introduction. 2004. Closs, G., Downes, B. and Boulton, A. Wiley- Blackwell publisher, Oxford.
9. Fundamental Processes in Ecology: An Earth system Approach. 2007. Wilkinson, D.M. Oxford

MAJOR: ZOOLOGY

Course Code: B050603P

Paper III (Practical)

Course Title: Lab on Ecology, Environmental Science, Behavioral Ecology & wildlife

Credits: 2 **Max. Marks: 75 +25**

Course outcomes:

At the completion of the course students will learn Hands-on:

1. To understand the basic concepts, importance, status and interaction between organisms and environment.
2. Get employment in forest services, sanctuaries, conservatories etc.
3. Enable students to take up research in wildlife.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I:** 1.Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. 2.Study of population dynamics through numerical problems. 3.Study of circadian functions in humans (daily eating, sleep and temperature patterns). **Unit II:** 1. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary
February'26	**23**	**Unit III:** 1. Demonstration of basic equipments needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses) 2. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc. 3. Demonstration of different field techniques for flora and fauna.
March' 26	**20**	**Unit IV:** 1. Virtual Labs (Suggestive sites) 2. https://www.vlab.co.in 3. https://zoologysan.blogspot.com 4. www.vlab.iitb.ac.in/vlab.
April' 26	**24**	**Revision & Internal Examination**

Activity : *Visit to Indian Institute of Vegetable Research, Varanasi*
Objective: *To identify non-chordates, lower and higher chordates.*
Methodology: *Expeditionary learning.*

Suggested Readings:

1. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.
2. Fundamentals of Ecology. E.P. Odum& Gray. W. Barrett, 1971, Saunders.
3. Robert Leo Smith Ecology and field biology Harper and Row publisher
4. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.
5. Methods and Practice in biodiversity Conservation by David Hawks worth, Springer publication

CO- CURRICULAR

Course Code: Z060601

Course Title: Communication Skills and Personality Development

Credit: 2 **Max. Marks: 75+25**

Course outcomes:

1. To understand the concept of Personality.
2. To learn what personal grooming pertains.
3. To learn to make good resume and prepare effectively for interview.
4. To learn to perform effectively in group discussions.
5. To explore communication beyond language.
6. To learn to manage oneself while communicating.
7. To acquire good communication skills and develop confidence.

Month	Working Days	Topics to be covered
January' 26	**19**	**Unit I:** • Understanding Personality • Definition and Meaning of Personality • Types of Personality • Components of Personality • Determinants of Personality • Assessment of Personality Grooming Self • Dress for success • Make up & skin care • Hair care & styles for formal look • Art of accessorizing • Oral Hygiene
February'26	**23**	**Unit II:** • INTERVIEW PREPARATION AND GROUP DISCUSSION • Meaning and Types of Interview [Face to Face, Telephonic, Video] • Interview procedure [Opening, Listening, Closure] • Preparation for Interview • Resume Writing • LinkedIn Etiquette • Meaning and methods of Group Discussion Procedure of Group Discussion. • Group Discussion simulation • Group discussion common error

March' 26	**20**	**Unit III:**
		• BODY LANGUAGE AND BEHAVIOUR
		• Concept of human behavior
		• Individual and group behavior
		• Developing Self-Awareness
		• Behaviour and body language
		• Dimensions of body language:
		  • Proxemics
		  • Haptics

		• Oculesics • Paralanguage • Kinesics • Sign Language • Chromatics • Chronemics • Olfactics • Cultural differences in Body Language • Business Etiquette & Body language • Body Language in the Post Corona Era • Virtual Meeting Etiquette • Social Media Etiquette
April' 26	**24**	**Unit IV:** • ART OF GOOD COMMUNICATION • Communication Process • Verbal and Non-verbal communication 7 C's of effective communication • Barriers to communication • Paralinguistics Pitch Tone Volume Vocabulary Word stress Pause • Types of communication Assertive Aggressive Passive Aggressive • Listening Skills • Questioning Skills • Art of Small Talk • Email Writing **Revision & Internal Examination**

Activity*: Implementation of ANOVA Analysis, Z-Test & T-Test of data through Data Analysis Module in Advance Excel*

Objective: *Student will learn Real-time implementation of data manipulation & calculations*

Methodology: *Presentation*

Suggested readings:

1. Cloninger, S.C., "Theories of Personality: Understanding Person", Pearson, New York, 2008, 5th edition.
2. Luthans F, "Organizational Behaviour", McGraw Hill, New York, 2005, 12th edition.
3. Barron, R.A. & Brian D, "Social Psychology", Prentice Hall of India, 1998, 8th edition.
4. Adler R.B., Rodman G. & Hutchinson C.C., "Understanding Human Communication", Oxford University Press: New York, 2011.

Details of Activities/Field Visit/Outreach Program
Department of Science
2025-26

Class	Subject	Field Work/Visit	Faculty In-Charge
B.Sc. I/III/V SEM	Botany	Field Plant Collection & CSIR Institute Visit	Dr. Rishi & Dr. Ritu
	Zoology	In-situ or Ex-situ conservation site	Dr. Soumik
	Chemistry	Department of Material Science, IIT BHU	Dr. Ragini & Dr. Anju
	Physics	Department of Physics, IIT BHU	Dr. Ragini
	Mathematics	Department of Mathematics, IIT BHU	Dr. Anju
Activity			
Date	**Events/ Outreach Program**		**Faculty In-Charge**
11.03.2025	Organic color preparation & distribution (In collaboration with BHUMI)		Dr. Soumik
14.04.2025	Mosquito awareness rally & cleaning (World Malaria Day), in collaboration with BHUMI & NSS		Dr. Soumik & Dr. Ritu
16.05.2025	International Day of Light		Dr. Ragini & Dr. Bhupendra
Aug'2025	Outreach Program of Mathematics		Dr. Anju
16.09.2025	World Ozone Day (Lecture) in collaboration with BHUMI & APEIRON		Dr. Soumik
Oct'2025	DAAN Utsav (World Food day) in collaboration with BHUMI		Dr. Soumik
10.11.2025	Presentation on world Science Day for peace & Development		Dr. Rishi & Dr. Ritu
01.12.2025	Blood Donation on World AIDS Day		Dr. Ragini & Dr. Soumik
22.12.2025	Role Play on National Mathematics Day		Dr. Anju
22.04.2026	Special assembly on the occasion of Earth Day		Dr. Ragini & Dr. Bhupendra