Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: V

Course Code	US05CBOT51(T)	Title of the Course	MICROBIOLOGY AND PHYCOLOGY
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To study the basics about microorganisms. 2. To understand the prokaryotic and eukaryotic systems. 3. To study the similarities and differences among bacteria, cyanobacteria and viruses.

Course Content		
Unit	Description	Weightage* (%)
1.	**MICROBIOLOGY:** Discovery of Microorganisms, Structure and classification of microbes, Systematic position of microorganisms in biological world; classification of microorganisms and characteristic features of different groups. Methods in Microbiology: Basic principles of staining of Bacteria and Fungi, sterilization methods, culture media, pure culture methods, methods for population estimation, growth determination.	25%
2.	**VIRUSES AND BACTERIA:** Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Bacteria: Discovery, general characteristics; Types-archaebacteria, eubacteria, wallless forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).	25%
3.	**CYANOPHYTA:** General characters, Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and classification of cyanophycean algae, Heterocysts, Nitrogen fixation by blue green algae, Culturing of algae, Algal bloom.	25%
4.	**PHYCOLOGY-AN OVER-VIEW:** General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food ,flagella; methods of reproduction; Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar), Role of algae in the environment, agriculture, biotechnology and industry.	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Permanent slides, Charts, quiz, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand about micro-organisms and basic principles of staining.
2.	Understand cellular organization and reproduction in prokaryotes and Eukaryotes
3.	Able to identify and compare the characteristics of viruses, Bacteria, Cyanobacteria and algae.

Suggested References:	
Sr. No.	References
1.	Lee, R. E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition
2.	Wiley J M, Sherwood L M and Woolverton C J. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3	Kumar, H. D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi
4	Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5	Campbell, N. A., Reece J. B., Urry L. A., Cain M. L., Wasserman S. A. Minorsky P. V., Jackson
6	R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
7	Pelczar, M. J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
8	Singh, Pande and Jain, A text book of Botany.
9	Botany for degree students-Algae: B.R.Vashistha

On-line resources to be used if available as reference material
On-line Resources

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: V

Course Code	US05CBOT52(T)	Title of the Course	MOLECULR BIOLOGY AND BIOINFORMATICS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	• The structure of the present core course on Molecular Biology has been magnificently designed with the perspective to achieve following key objectives: • To provide comprehensive background of Salient features of Nucleic Acids – DNA and RNA and their history as carriers of genetic information to course learners. • To impart detailed understanding of key events of molecular biology comprising of mechanism of DNA Replication, Transcription and Translation in Prokaryotes and Eukaryotes and basic knowledge about biological databases.

Course Content

Unit	Description	Weightage* (%)
1.	**Nucleic acids: Carriers of genetic information** Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.) **The Structures of DNA and RNA / Genetic Material** DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNA- Prokaryotes, Viruses, Eukaryotes.RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.	25%
2.	**Molecular Biology:** Replication of DNA: Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi conservative and semi discontinuous replication, RNA priming; Enzyme and proteins involved in replication. Various models of DNA replication, including rolling circle, □ (the	25%

	DNA repair mechanisms.	
3.	**Molecular Biology:** Transcription of DNA, post transcriptional modifications of RNA and control of transcription. Genetic code and its properties. Translation: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.	25%
4.	**Biological Sequence Databases** National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST),Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, Preserved specimens, quiz, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Have knowledge of history of carriers of genetic information and their structure
2.	Basics of molecular biology.
3.	Basics of biological sequence databases.

Suggested References:	
Sr. No.	References
1.	Watson J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2.	Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3	Klug, W. S., Cummings, M. R., Spencer, C. A. (2009). Concepts of Genetics. Benjamin Cummings.U.S.A. 9th edition
4	Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5	Griffiths, A.J.F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis.W. H. Freeman and Co., U.S.A. 10th edition.
6	Genetics, Verma and Agarwal, 9th edition

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: V

Course Code	US05CBOT53(T)	Title of the Course	PLANT ECOLOGY AND PHYTOGEOGRAPHY
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the basic concepts of ecology and its interactions. 2. To study the local and geographical distribution, structural adaptations of organisms in particular environmental factors.

Course Content

Unit	Description	Weightage* (%)
1.	**Plant Ecology:** Introduction, Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis. Soil: Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.	25%
2.	Water: Importance; States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table. Light, temperature, wind and fire. Variations; adaptations of plants to their variation.	25%
3.	**Biotic interactions:** Trophic organization, basic autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop. Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts. Ecosystems: Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Biogeochemical cycles: Carbon, Nitrogen and Phosphorus..	25%
4.	**Phytogeography:** Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, quiz, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand ecological concepts, with significance of its interrelationships.
2.	Do analysis of various components of ecosystems.
3.	Learn the concepts of phytogeography at large scale.

Suggested References:	
Sr. No.	References
1.	Odum, E. P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2.	Singh, J. S., Singh, S. P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India
3	Sharma, P. D. Ecology and Environment. Rastogi Publications, Meerut, India. 13th edition.
4	Wilkinson, D. M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5	Kormondy, E. J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: V

Course Code	US05CBOT54(T)	Title of the Course	ANGIOSPERM PLANT SYSTEMATICS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To study the concepts and importance of Plant systematic. 2. To learn the importance of herbarium preparation. 3. To learn describing plant, its classification and identification with classical as well as advanced methods.

Course Content		
Unit	Description	Weightage* (%)
1.	**Significance of Plant systematics:** Introduction to systematics; Plant identification, Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora. Documentation: Flora, Monographs, Journals; Identification Keys: Single access and Multi-access.	25%
2.	**Taxonomic hierarchy:** Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary). Botanical nomenclature: Principles and rules (ICBN); Ranks and names; typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.	25%
3.	**Systems of classification:** Plant classification approach (cladistics, phenetics, phyletics). Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist. Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series).	25%
4.	**Phylogeny of Angiosperms:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, quiz, Herbaria, Preserved specimens, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the significance of angiosperm plant Systematics with their taxonomic hierarchy.
2.	Learn nomenclature, systems of classification and phylogeny of angiosperm plants.
3.	Understand classical and modern taxonomical studies.

Suggested References:	
Sr. No.	References
1	Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition
2	Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3	Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4	Shah G. L. (1978); Flora of Gujarat State.Part I & II. Pub. By Sardar Patel University, Gujarat.
5	Singh, Pandey and Jain: A Text Book of Botany-Angiosperms.
6	B. P. Pandey, A text book of botany-Angiosperms.
7	Heywood (ed.) Modern Methods in Plant Taxonomy..

8	Jeffery, C. An Introduction to Plant Taxonomy
9	Jones, S.B., Luchsinger, A.L.1987. Plant Systematics
10	Judd, W.S; Campbell, C.S., Kellogg, E.A; Stevens, P.F. 1999. Plant Systematics: A Phylogenetic approach
11	Lawrence, G.H.M. Vascular Plant Systematics.
12	Gurucharn Singh, (1999), Plant Systematics; Oxford & IBH pub. New Delhi

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: V

Course Code	US05CBOT55(P)	Title of the Course	BOTANY PRACTICAL
Total Credits of the Course	6	Hours per Week	12

Course Objectives:	1. To study the diversity and activity of microorganisms in natural environments, their mutual interactions, survival and adaptation. 2. To understand the distribution and abundance of living things in physical environment. 3. To understand the affinities among organisms.

Course Content		
Unit	Description	Weightage* (%)
1.	**Microbiology and Phycology** 1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle. 2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule. 3. Gram staining: Endospore staining with malachite green using the (endospores taken from soil bacteria). 4. Phycology: Study of vegetative and reproductive structures of *Blue green algae, Green algae, Brown algae and Red algae* through electron micrographs, temporary preparations and permanent slides	33.33%
2.	**Ecology** 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter. 2. Determination of pH of various soil and water samples (pH meter, universal indicator and pH meter) 3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests. 4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method. 5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats. 6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. 7. Study of morphological adaptations of hydrophytes and xerophytes (four each). 8. Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*); Epiphytes, Predation (Insectivorous plants).	33.33%

	9. Determination of minimal quadrate size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed). 10. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. 11. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus. 12. Field visit to familiarize students with ecology of different sites.	
3.	**Molecular biology, Bioinformatics and Plant systematics** 1. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 2. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. 3. Establishing nucleic acid as genetic material through photographs/charts/models (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel &Conrat's experiments) 4. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing. 6. Exploration of the resources available in NCBI and PUBMED 7. Retrieval of a Genbank Entry using an accession number 8. Retrieval and analysis of a gene sequence in FASTA format 9. Retrieval and analysis of a protein sequence from protein database 10. Primary structure analysis of a protein 11. Conversion of Gene Sequence into its Corresponding Amino Acid Sequence 12. To find the similarity between sequences using BLAST 13. Morphological studies of the representatives of angiosperm families growing in the college campus. 14. Learn the how to identify taxa using local/regional Flora as reference. 15. Preparation of the report of the assigned project.	33.33%

Teaching-Learning Methodology	Field visits, Charts, Permanent slides, Herbaria, Preserved specimens, Photographs, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%

2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn the basic principles of inheritance at the molecular, cellular and organism levels.
2.	Abiotic and biotic factors that affect, the distribution, dispersal, and behavior of organisms, how ecological systems work at different spatial and temporal scales.
3.	Biodiversity and evolution of organisms from single cell structures.

Suggested References:	
Sr. No.	References
1	Sharma, P. D. Ecology and Environment. Rastogi Publications, Meerut, India. 13th edition
2	Wilkinson, D. M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3	Griffiths, A.J.F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
4	Genetics, Verma and Agarwal, 9th edition
5	Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.
6	Shah G. L. (1978); Flora of Gujarat State.Part I & II. Pub. By Sardar Patel University, Gujarat.
7	Singh, Pandey and Jain: A Text Book of Botany-Angiosperms.
8	B. P. Pandey, A text book of botany-Angiosperms
9	Kumar, H. D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi
10	Lawrence, G.H.M. Vascular Plant Systematics.
11	Gurucharn Singh, (1999), Plant Systematics; Oxford & IBH pub. New Delhi

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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