PROGRAM SPECIFICATIONS OF THE
B.Sc. (Hon.) Biotechnology
(UNDER GRADUATE PROGRAMS OFFERED BY THE DEPARTMENT)

1. Name of the program: Bachelor of Science in Biotechnology

2. Program Specifications

School of Studies:	Previously School of Life Sciences, presently Department of Biotechnology comes under School of Studies of Interdisciplinary Education and Research
Department:	Biotechnology
Program:	B.Sc. (Biotechnology) CBCS Scheme
Head of the Department:	Dr. Renu Bhatt
Date of Approval in Board of Studies:	13.04.2018
Date of Last revision:	2018
Next revision due:	2020

3. Mode of Study: Full time (Semester system):
Class room teaching; experiential learning; tutorials; experimental laboratory training; one semester major project (dissertation) in final semester, and industrial training.

Back ground and purpose of the course:
Creativity is the rule of nature based on innovative thoughts. Biotechnology has the potential to combine the knowledge of basic biology of the natural diversity and innovative technologies to create or evolve novel processes or novel products beneficial for human welfare. Biotechnology has emerged as the most important vehicle for solving the problem of health, food and agricultural issues. The need for qualified human resource for various biotechnology based industries is the driving force to design and implement B.Sc. program in Biotechnology. A sound knowledge of biotechnology is thought to play an important role in the upcoming years to encourage the modern biology driven developmental efforts. There is a need for qualified and competent students with sound knowledge of Biotechnology in general and specialized technology such as recombinant DNA technology, fermentation technology, bioinformatics, cell and tissue culture, etc in particular. The Department of biotechnology offers the B.Sc. (Biotechnology) course with an outcome based curriculum emphasizing the Critical, Analytical and Problem Solving skills to equip the students to pursue their academic, scientific and research career with better preparedness and matured professional outlook. The presence of other allied Faculties of the University provides additional exposure to students the multi-disciplinary approach which is emerging as a key differentiator in the success of modern biology and biotechnology based endeavours. The overall purpose of the course is to impart quality education in the field of biotechnology and to create trained biotechnologist.

Program Objectives
The programme also aims to develop the following abilities:
1. Read, understand and interpret technological approaches applied in modern biological research and development
2. Equip students in methodology related to molecular biology and recombinant DNA technology, microbiology, fermentation technology, plant, animal and environmental biotechnology
3. Impart skills required to gather information from resources (biological databases, library and communication skills)
4. To give need based education in biotechnology of the highest quality at the undergraduate level.
5. Offer courses to the choice of the students with skill based courses having interdisciplinary approach.
6. Perform experiments and interpret the results of observation, including making an assessment of experimental uncertainties.
7. Provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.
8. Use biotechnology for the societal benefit.
9. Attract outstanding students from all backgrounds.

Learning outcome
B.Sc. Biotechnology is a six-semester course spread over the period of three years. It is designed to offer in depth knowledge of the subject starting from its basic concepts of biotechnology to the state of art technologies used in

molecular biology, recombinant DNA technology, microbial technology, animal and plant tissue culture and genomics. Students are also provided extensive laboratory training on the course content and the current requirements of industries as well as research and development sectors. In the final semester every student has to undertake a dissertation project, which is essential for strengthening the hands on skill and analytical thinking in designing and solving a problem relevant to modern biology. In addition the course caters to the requirements of providing exposure to NET/SET syllabus for Life Sciences.

Knowledge gained

After completing the program, a student is expected to attain

- Substantial knowledge in biotechnology, basic knowledge in molecular biology, recombinant DNA technology, microbial technology and knowledge in supported fields like bioinformatics, biostatistics, animal and plant tissue culture etc.
- Has some research experience within a specific field of biotechnology, through a faculty supervised dissertation (project).
- Has advanced knowledge in some areas in biotechnology (Field of specialization).
- Gets significant exposure of various domains and contemporary research within various fields of biotechnology.

Skills

The students are inculcated

- The background and experience required to design, analyze, and solve advanced problems in biotechnology.
- Is able to apply advanced theoretical and/or experimental methods, including the use in applied fields of modern biology.
- Can combine and use knowledge from several disciplines (multidisciplinary approach).
- Can critically and independently assess and evaluate research methods and results.
- Has the ability to develop and renew scientific competence independently
- Is able to enter new problem areas that require an analytic and innovative approach.
- Can disseminate subject matter and results to both specialists and a broader audience.

General competence

The candidate

- Understands the role of biotechnology in society and has the background to consider ethical problems.
- Knows the historical development of biotecnology, its possibilities and limitations, and understands the value of lifelong learning.
- Is able to gather, assess, and make use of new information.
- Has the ability to successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines.
- Has an adequate background for pursuing pedagogic education.
- Has an international perspective on her/his discipline.

B.Sc. (Biotechnology)

PROGRAMME SPECIFIC OBJECTIVES

- To develop strong student competencies in biotechnology and its applications in a technology-rich, interactive environment.
- To develop strong student skills in research, analysis and interpretation of problems and information relevant to modern biology.
- To prepare the students to successfully compete for employment in biotechnology based research and development sectors, manufacturing sectors and teaching, and to offer a wide range of experience in research methods, data analysis to meet the industrial needs.

PROGRAMME OUTCOMES

On completion of program, the graduates will

- Apply knowledge and skill in the design and development of solutions for problems relevant to modern biology to cater the needs of biotechnology industries.
- Become professionally trained in the area of molecular biology, recombinant DNA technology, microbial technology, animal and plant tissue culture, bioinformatics etc.
- Excel in the research related to biotechnology and quality control of biologicals.
- Demonstrate highest standards of critical, interpersonal and communication skills as well as a commitment to life-long learning.

Course Specific Objectives & Learning Outcomes		
Course Code	**Course name**	**Objectives and Learning outcomes**
LS/BT/C-101L	Cell Biology (core-1)	**Course Specific Objective** • The objective of this course is to provide a guide in the basic, fundamental and detailed concepts of Cell Biology. This B.Sc. course is designed for introducing students the ideas and techniques of cell biology that are applicable in all the areas of life sciences. As cell is the basic unit of life, it is essential to understand its biology for students of biotechnology as well as other life science subjects. The aim of this subject is to strengthen the knowledge of the candidate desired to work on the basic as well as applied aspects of biology. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction and classification of organisms by cell structure • Cell membrane and permeability • cytoskeleton and cell motility • Composition of extracellular Matrix • Cellular organelles • Cell cycle • Characteristics and biological basis of cancer
LS/BT/C-101P	Laboratory-1 based on core-1	**Course Specific Objective** • The objective of this course is to provide hands on training of experiments of Cell Biology **Course Specific Outcome:** After successful completion of the course student will be able to perform • Experiment showing the effect of temperature and organic solvents on semi permeable membrane. • Plasmolysis and de-plasmolysis

		• Structural observation of prokaryotic cell and eukaryotic cells
LS/BT/C-102L	Biochemistry and Metabolism (core-2)	**Course Specific Objective** • The objective of this course is to provide a guide in the basic, fundamental and detailed concepts of biochemistry. • To understand the metabolism and its regulation in living world **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction and scope of biochemistry • Structure, classification, functions, properties and biosynthesis of amino acids, proteins, carbohydrates and lipids • Metabolism of biomolecules • Nomenclature, classification and activity of enzymes
LS/BT/C-102P	Laboratory-2 based on core-2	**Course Specific Objective** • The objective of this course is to provide hands on training of experiments of Biochemistry **Course Specific Outcome:** After successful completion of the course student will be able • To calculate the molarity, molality, normality and their relationship of given sample. • To prepare the buffers (acetate and phosphate buffers). • To maintain the pH of different types of buffer using pH meter. • To study the qualitative tests for carbohydrates (for reducing and nonreducing sugars), lipids (Zak's test for cholesterol) and proteins (ninhydrin test, biuret test). • To estimate the content of protein by using Lowery method/Bradford method.
LS/BT/GE-101/B&B-L	Bioethics and Biosafety (GE-1)	**Course Specific Objective** • The objective of this course is to provide a guide in ethical issues taken to be in consideration during biological research. • The objective of this course is to make aware about safety measures that must be followed during biological research. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Necessity and different paradigms of bioethics • Introduction and different levels of biosafety • Biosafety guidelines in India • Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) • Ethical, legal and social implications of biological research
LS/BT/GE-101/B&B-P	Laboratory-GE1 based on GE-1	**Course Specific Objective** • The objective of this course is to provide practical exposure about Bioethics and Biosafety **Course Specific Outcome:** After successful completion of the course student will be able to

		• Understand guidelines for good laboratory practice • Identify the different hazardous symbols for different chemicals/reagents used in laboratory • Perform biomedical case studies
LS/BT/AE-101/EC	English Communication / MIL (Hindi Communication)	The course is offered by Department of Hindi and English for the student **Course Specific Objective** • To train the students on the basic communication skills. **Course Specific Outcome** • After successful completion of the course student will be able to improve upon their oral and written communication skills.
ECA	ECA- Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	**Course Specific Objective** • To provide industrial and societal exposure to the students **Course Specific Outcome** • After successful completion of the course student will have firsthand experience of the industrial functioning and scaling up operations. It also connects students with society and imbibes in them the values and responsibilities towards society and nation.
LS/BT/C-203L	General Microbiology (core-3)	**Course Specific Objective** • To introduce the concepts of microbiology in a stimulating and explanatory manner • To aware students about history and scope of microbiology • To learn the method of cultivation and enumeration of microbes from environment • To understand the nutritional requirements of micro-organisms • To understand microbial growth and population kinetics • To understand mechanism of gene transfer and genetic recombination in bacteria **Course Specific Outcome:** After successful completion of the course student will be able to understand • History and scope of microbiology • Microbial diversity and microbial taxonomy • Cultivation and maintenance of microorganisms • Microbial growth, reproduction and metabolism • Genetic recombination in bacteria (Transformation, Transduction and Conjugation) • Harmful and beneficial activities of microbes
LS/BT/C-203P	Laboratory-3 based on core-3	**Course Specific Objective** • The objective of this course is to provide practical exposure of microbiological techniques and experiments **Course Specific Outcome:** After successful completion of the course student will be able to perform • Sterilization (autoclave and hot air oven) techniques followed in microbiology laboratory • Isolation of bacteria from different sources • Preparation of media for cultivation of bacteria/fungi. • Biochemical characterization of isolated bacteria.

		• Staining of isolated bacteria using different methods (Gram staining, Spore staining, Negative staining). • Determination of the bacterial cell size by micrometry • Enumeration of the total & viable cell count of microorganism by using haemocytometer.
LS/BT/C-204L	Genetics (core-4)	**Course Specific Objective** • To introduce the concepts of genetics in a stimulating and explanatory manner. • To introduce the structure and organization and consequences of alteration of genes and chromosomes • To introduce the concepts of evolution and population genetics **Course Specific Outcome:** After successful completion of the course student will be able to understand • Mendelian genetics • Allelic and non-allelic gene interactions • Chromosome and genomic organization • Chromosomal aberrations and gene mutations • Evolution and population genetics
LS/BT/C-204P	Laboratory-4 based on core-4	**Course Specific Objective** • The objective of this course is to provide practical exposure of simple experiments used in genetic laboratory **Course Specific Outcome:** After successful completion of the course student will be able to perform/study • Mendelian Genetics in monohybrid and dihybrid crosses using checker board • Human traits • Identification of Barr body in human sample. • Karyotyping with the help of photographs • Analysis of autosomal and sex linked disease using Pedigree charts. • Polyploidy induction in onion root tips by colchicine treatment.
LS/BT/GE-202/B&HW-L	Biotechnology and Human Welfare (GE-2)	**Course Specific Objective** • The objective of this course is to introduce the scope of biotechnology for human welfare **Course Specific Outcome:** After successful completion of the course student will be able to understand • Development of non-toxic therapeutic agents, recombinant live and DNA vaccines and gene therapy • Molecular diagnosis of diseases using monoclonal antibodies, DNA probes and microarrays • Advantageous transgenic animals and transgenic plants • DNA based methods used in forensic science laboratory • Biotechnology in agriculture and protection of environments • Biotechnological approaches beneficial for industries
LS/BT/GE-202/B&HW-P	Laboratory-GE2 based on GE-2	**Course Specific Objective** • The objective of this course is to provide practical exposure of simple experiments that will complement the course "Biotechnology in Human Welfare" **Course Specific Outcome:** After successful completion of the

		course student will be able to • Perform ethanolic fermentation using Baker's yeast • Study the plant parts (leaves and stems) infected with a microbes • Perform quantitative estimation of residual chlorine in water samples • Isolate and analyse the DNA from different biological samples • Understand the PCR in biological samples
LS/BT/AE-201/EVS	Environmental Science	**Course Specific Objective** • To introduce the concepts of Environmental Science in a stimulating and explanatory manner. • To introduce the structure and organization of environment • To introduce the environmental pollution and its management strategies **Course Specific Outcome:** After successful completion of the course student will be able to understand • Structure and composition of environment. • Human and other activities that deteriorate the environment • Strategies that can restore the environment
ECA	ECA- Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	**Course Specific Objective** • To provide industrial and societal exposure to the students **Course Specific Outcome** • After successful completion of the course student will have firsthand experience of the industrial functioning and scaling up operations. It also connects students with society and imbibes in them the values and responsibilities towards society and nation.
Summer Internship: 15 days	Swayam / Swachhta / NSS / Industrial/ others	To be opted by students as per availability during summer break
LS/BT/C-305L	Molecular Biology	**Course Specific Objective** • To introduce the concepts of molecular biology in a stimulating, elegant, exhaustive and explanatory manner. • To aware students about history and scope of molecular biology **Course Specific Outcome:** After successful completion of the course student will be able to understand • The role of DNA as genetic material • Structure, types and replication mechanism of DNA • Mechanism and consequences of DNA damage and repair • Transcription and translation in prokaryotes and eukaryotes • Regulation of gene expression
LS/BT/C-305P	Laboratory-5 based on core-5	**Course Specific Objective** • The objective of this course is to provide practical exposure of basic molecular biology experiments **Course Specific Outcome:** After successful completion of the course student will be able • To isolate the chromosomal DNA from bacterial

		cells/plant cells/ animal cells • To isolate the plasmid DNA by alkaline lysis method • To quantify the genomic DNA & plasmid DNA with the help of Spectrophotometer • To check the quality of isolated genomic DNA & plasmid DNA with the help of agarose gel electrophoresis. • To isolate the RNA from plant cells/ animal cells • To quantify the RNA with the help of spectrophotometer • To check the quality of isolated RNA with the help of agarose gel electrophoresis.
LS/BT/C-306L	Bio-analytical Tools (core-6)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of tools and techniques used in biological research and industries. Learning bio-analytical tools and techniques is important for students of all fields of life sciences **Course Specific Outcome:** After successful completion of the course student will be able to understand • History, background, principle and applications of microscopy • Types of microscopes • Principles and applications of spectrophotometer and spectroscopes • Principle and application of centrifugation in biological research • Principle, types and application of chromatography • Electrophoresis and blotting techniques
LS/BT/C-306P	Laboratory-6 based on core-6	**Course Specific Objective** • The objective of this course is to provide practical exposure of analytical tools and techniques used in biological laboratories. **Course Specific Outcome:** After successful completion of the course student will be able • To study relation between absorbance and % transmission using spectrophotometer • To separate different types of amino acids by paper chromatography (ascending method). • To separate the proteins by SDS-polyacrylamide gel electrophoresis. • To identify the lipids in a given sample by TLC. • To verify the validity of Beer's law and determine the molar extinction coefficient of NADH. • To separate the plant pigments by adsorption column chromatography
LS/BT/C-307L	Chemistry-1 (core-7)	Offered by Department of Chemistry
LS/BT/C-307P	Laboratory-7 based on core-7	Offered by Department of Chemistry
LS/BT/GE-303/IPRE-L	Intellectual Property Right and Entrepreneurship (GE-3)	**Course Specific Objective** • The objective of this course is to aware students about intellectual property rights and their protection in research and development • To introduce about patent law

		• To teach students about strategies of becoming entrepreneur in the field of biotechnology **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction to Indian Patent Law • Intellectual/Industrial property and its legal protection in research and development • Essential requirements for patenting, types of patent, things that are patentable and non-patentable • Concept of entrepreneurship, nature and function of entrepreneur, entrepreneurial characteristics • Role of entrepreneurship in developing economy
LS/BT/GE-303/IPRE-P	Laboratory-GE3 based on GE-3	**Course Specific Objective** • The objective of this course is to provide practical exposure of Intellectual Property Right and Entrepreneurship especially in the field of biotechnology. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Filing of Indian product patent • Filing of Indian process patent • Planning of establishing a biotechnology industry in India • Patent search on internet • The outline for project proposal related to biotechnology
LS/BT/SEC-301/MT-L	Molecular techniques in disease diagnosis (SEC-1)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of techniques of diagnosis and treatment of disease at molecular level. This elective course is designed for those who wish to work in biomedical research and development. • To aware good laboratory practices followed in diagnostic laboratories **Course Specific Outcome:** After successful completion of the course student will be able to understand • Handling, storage and transportation of biomedical samples • Hematological tests • Immunodiagnostic tests • Polymerase chain reaction (PCR) • Restriction fragment length polymorphism (RFLP) • Nucleic acid hybridization methods • Single nucleotide polymorphism • DNA finger printing
LS/BT/SEC-301/MT-P	Laboratory-SEC1 based on SEC-1	**Course Specific Objective** • The objective of this course is to provide practical exposure of techniques used in disease diagnosis laboratory **Course Specific Outcome:** After successful completion of the course student will be able to • Perform/demonstrate RFLP and its analysis on biological sample • Identify microorganisms for different diseases • Perform kit-based detection of microbial infection

		• Study the electron micrographs of biological sample • Perform immuno diagnostic test • Study the genetic disorders using molecular diagnostic tools
LS/BT/C-408L	Mammalian Physiology (core-8)	**Course Specific Objective** • To introduce the concepts of mammalian physiology in a stimulating, elegant and explanatory manner. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Physiology of respiration • Mechanism of digestion & absorption • Mechanism of working of heart • Mechanism of blood circulation • Haematopoiesis • Muscle physiology and muscle contraction • Excretion and osmoregulation • Nervous and endocrine coordination
LS/BT/C-408P	Laboratory-8 based on core-8	**Course Specific Objective** • The objective of this course is to provide practical exposure of some haematological techniques **Course Specific Outcome:** After successful completion of the course student will be able • To find the coagulation time of blood sample • To determine the blood groups • To count the mammalian RBCs using haemocytometer • To prepare the peripheral blood smear • To determine the TLC and DLC in prepared blood smear using giemsa/ Leishman stain • To determine the haemoglobin in blood sample • To demonstrate the action of an enzyme
LS/BT/C-409L	Immunology (core-9)	**Course Specific Objective** • The objective of this course is to provide a guide in the basic and detailed concepts of immunology. Understanding the concept of immunology is essential to strengthen the knowledge of the candidate desired to work on the field of health care research, development and manufacturing. **Course Specific Outcome:** After successful completion of the course student will be able to understand • An overview of immune response • Cells and organs of immune system • molecular structure of immunoglobulins • antigens, antigenicity and immunogenicity • Regulation of immunoglobulin gene expression • Major Histocompatibility complexes • passive & active immunization • Vaccines & Vaccination
LS/BT/C-409P	Laboratory-9 based on core-9	**Course Specific Objective** • The objective of this course is to provide practical exposure of basic immunological techniques **Course Specific Outcome:** After successful completion of the course student will be able • To perform total RBC count of blood sample using haemocytometer • To analyse the haemagglutination assay

		• To analyse the haemagglutination inhibition assay • To separate the serum and plasma from blood sample • To study the double immunodiffusion test using specific antibody and antigen. • To study the different types of ELISA
LS/BT/C-410L	Chemistry-2	Offered by Department of Chemistry
LS/BT/C-410P	Laboratory-10 based on core-10	Offered by Department of Chemistry
LS/BT/GE-404/BME-L	Bio-management of Environment (GE-4)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of environmental biotechnology and management and restoration of environment through biological approaches. Environmental pollution is increasing day by day which demands for implementation of strategies that can detoxify the hazardous pollutants and restore the environment. This course will teach about the biological and biotechnological measures for restoring environment. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Bio-management of soil • Biomanagement of Petroleum Contaminants • Environmental significance of genetically modified microbes, plants and animals • Biosurfactants • Iological treatment of municipal waste and Industrial effluents • Bioremediation, Biomining, and Bioleaching • Genetic engineering of bacteria and their potential for bioremediation
LS/BT/GE-404/BME-P	Laboratory-GE4 based on GE-4	**Course Specific Objective** • The objective of this course is to provide practical exposure of basic experiments of environmental biotechnology **Course Specific Outcome:** After successful completion of the course student will be able to perform • The biodegradation of a dye/ xenobiotic • Assay for biosurfactant production and bioemulsification index of selected microorganisms • Assessment of bioleaching of metals from ore • Calculation of Total Dissolved Solids (TDS) of water sample • Calculation of BOD of water sample • Calculation of COD of water sample • Bacterial Examination of Water by MPN Method
LS/BT/SEC-402/ACC -L	Animal Cell Culture (SEC-2)	**Course Specific Objective** • The objective of this course is to provide basic knowledge of animal cell culture. This course is designed to make students aware about techniques of animal cell and tissue culture. This course will also teach how cultured cells can be used as a factory for production of useful products specifically for health care. **Course Specific Outcome:** After successful completion of the course student will be able to understand

		• History, scope and application of animal cell culture technology • Basic requirements of animal cell culture laboratory • Good laboratory practices to prevent contamination • Culture media and buffers used in animal cell and tissue culture laboratory • Cell culture techniques, primary and secondary culture, cell lines, monolayer culture, suspension culture, organ culture, cryopreservation of cell lines • Behaviour of cultured cells in terms of growth, differentiation and metabolism, apoptosis, necrosis and senescence, appearance of viable and non-viable cells
LS/BT/SEC-402/ACC -P	Laboratory-SEC2 based on SEC-2	**Course Specific Objective** • The objective of this course is to provide practical exposure of basic experiments of animal cell culture **Course Specific Outcome:** After successful completion of the course student will be able to understand/perform • Preparation of media for animal cell culture • Sterilization and filtration of cell culture medium • Trypsinization of cell lines • Passaging of cell lines available in department laboratory • Counting the viable cells using haemocytometer • Cryopreservation of cell lines/cells/tissues • Thawing of cryopreserved cell lines
Summer Internship: 15 days	Swayam Swachhta / NSS / Industrial/ others	To be opted by students as per availability during summer break
LS/BT/C-511L	Plant Physiology and Anatomy (core-11)	**Course Specific Objective** • The objective of this course is to provide knowledge of Physiology and anatomy of plants **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction of plant physiology and plant anatomy • Plant water relations • mechanism of nutrient uptake and transport in plants • Molecular mechanism of nitrogen fixation • Molecular mechanism of photosynthesis • Growth and development in plants • physiological role and mode of action of growth hormones
LS/BT/C-511P	Laboratory-11 based on core-11	**Course Specific Objective** • The objective of this course is to provide practical exposure of basic experiments of plant physiology and anatomy **Course Specific Outcome:** After successful completion of the course student will be able to understand/perform • Separation of photosynthetic pigments by paper chromatography • The growth rings in plants • Opening & closing of stomata • Guttation on leaf tips • Aerobic respiration in plants • Root nodules isolation from a leguminous plant.

		• Effect of a hormones on plant growth
LS/BT/C-512L	Recombinant DNA Technology (core-12)	**Course Specific Objective** • To introduce the concepts of recombinant DNA technology in a stimulating, elegant, exhaustive and explanatory manner. • To understand the technique of gene manipulation and gene cloning **Course Specific Outcome:** After successful completion of the course student will be able to understand • History and scope of recombinant DNA technology • Cloning and expression of vectors • Gene transfer methods • Expression of foreign genes in *E.coli* and Yeast • Production of protein, artificial insulin gene, recombinant vaccine and other therapeutics from cloned genes • Genetic engineering in plants and animals
LS/BT/C-512P	Laboratory-12 based on core-12	**Course Specific Objective** • The objective of this course is to provide hands on training of experiments of Biochemistry and Recombinant DNA Technology. **Course Specific Outcome:** After successful completion of the course student will be able to perform • Isolation of the chromosomal DNA from plant cells/human cells /bacterial cells • Isolation of the plasmid DNA from bacterial cells • Qualitative and quantitative analysis of DNA using agarose gel electrophoresis and spectrophotometer • Preparation of the competent cells • Transformation of the of competent cells • Demonstration of different types of PCR • Restriction digestion of DNA using different restriction enzymes
LS/BT/DSE-501L	Bioinformatics (DSE-1)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of bioinformatics. Learning bioinformatics is also necessary as modern biological research is greatly accelerated by use of computers. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction, scope and application of bioinformatics • Introduction of biological databases • Introduction of data generating techniques in genomics and proteomics • Nucleotide and amino acid sequence alignments • Genome annotation • Phylogenetic analysis tools
LS/BT/DSE-501P	Laboratory-DSE1 based on DSE-1 (Bioinformatics)	**Course Specific Objective** • The objective of this course is to provide hands on training of experiments of bioinformatics **Course Specific Outcome:** After successful completion of the course student will be able • To understand and use various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)

		• To understand and use PDB, Swissprot, TREMBL • To retrieve the gene from Genbank in the output file format • To retrieve the protein from PDB in the output file format • To align nucleic acid sequence using BLASTN • To align protein sequence using BLASTP • To align multiple sequence using Clustal W
LS/BT/DSE-501L	Biostatistics (DSE-1)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of biostatistics. Understanding the concept of statistics is necessary for researchers to test their hypothesis and to analyse their experimental data to make firm conclusions. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Scope and applications of biostatistics • collection, processing and presentation of data • Measures of central tendency • Measures of dispersion • Correlation analysis and regression analysis • Testing of hypothesis
LS/BT/DSE-501P	Laboratory-DSE1 based on DSE-1 (Biostatistics)	**Course Specific Objective** • The objective of this course is to provide hands on training of experiments of bioinformatics **Course Specific Outcome:** After successful completion of the course student will be able • To study the data based on graphical representation (Bar, multiple bars, histogram, pie chart etc.) • To determine the mean, median, mode and standard deviation of given sample/data • To determine the probability of given sample/data • To perform the t-test/F-Test of given data • To perform the Chi-square test of given data
LS/BT/DSE-502L	Industrial Fermentations (DSE-2)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of fermentation processes and products generated from it at industrial scale. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Production of industrial chemicals, biochemicals and chemotherapeutic products • Microbial products of pharmacological interest • Metabolic engineering of secondary metabolites • Upstream and downstream processing • Batch and continuous culture operations • different methods of scaling up product formation
LS/BT/DSE-502P	Laboratory-DSE2 based on DSE-2	**Course Specific Objective** • The objective of this course is to provide practical exposure of fermentation process relevant for industries **Course Specific Outcome:** After successful completion of the course student will be able to perform • Comparative analysis of design of a batch and continuous fermenter.

		• Calculation of mathematical derivation of growth kinetics. • Ethanol production using fruit juice as the carbon source. • Solvent extraction & analysis of a metabolite from a bacterial culture.
LS/BT/C-613L	Bioprocess Technology (core-13)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of bioprocess technologies used in industries **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction to bioprocess technology • Design and types of bioprocess vessels • Oxygen requirement and mass transfer in bioprocesses • Bioprocess measurement and control system • Introduction to downstream processing, product recovery and purification • Effluent treatment • Microbial production of ethanol, amylase, lactic acid and single cell proteins
LS/BT/C-613P	Laboratory-13 based on core-13	**Course Specific Objective** • The objective of this course is to provide practical exposure of bioprocess technologies relevant for industries **Course Specific Outcome:** After successful completion of the course student will be able to perform/study • The bacterial growth curve • Calculate the thermal death point of a microbial sample. • Production and analysis of ethanol. • Isolation of industrially important (amylase producing) microorganism from natural resource • Production and analysis of amylase • Production and analysis of lactic acid
LS/BT/C-614L	Genomics and Proteomics (core-14)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of genomics and proteomics. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction and scope of genomics and proteomics • DNA and protein sequencing methods • Genome sequencing, human genome project • Genomic databases and genome analysis • Analysis of proteomes • Mass spectrometry based methods for protein identification
LS/BT/C-614P	Laboratory-14 based on core-14	**Course Specific Objective** • The objective of this course is to provide practical exposure of genomics and proteomics **Course Specific Outcome:** After successful completion of the course student will be able to perform/study • Use of SNP databases at NCBI and other sites • Use of OMIM database • Detection of Open Reading Frames using ORF finder

		• Proteomics 2D PAGE database • Analyse of the Protein localization by using different softwares
LS/BT/DSE-603L	Microbial Technology (DSE-3)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of microbial technology. The course is designed considering the fact that microbes are the simplest and cheapest biological factory for production of industrially important products. **Course Specific Outcome:** After successful completion of the course student will be able to understand • Introduction to microbial biotechnology • Bio-prospecting of microbial diversity • Isolation and preservation of industrially important microorganisms • Production of proteins, enzymes, recombinant vaccines, and polysaccharides in microbes • Microbes as biocontrol agents • Microbial biomass production • Application of ligninolytic microorganisms and enzymes in biodegradation
LS/BT/DSE-603P	Laboratory-DSE3 based on DSE-3 (Microbial Technology)	**Course Specific Objective** • The objective of this course is to provide hands on training of experiments of Plant Biotechnology and Microbial Biotechnology. **Course Specific Outcome:** After successful completion of the course student will be able • To isolate microbes for bio-prospecting from soil • To preserve microbes using glycerol • To produce protein in *Escherichia coli* • To isolate microbes with the ability to secrete microbial polysaccharide • To isolate microbes having the bio-control potential
LS/BT/DSE-603L	Biodiversity and Bioprospecting (DSE-3)	**Course Specific Objective** • The objective of this course is to provide detailed knowledge of diversity in biological world, impact of biodiversity loss, and biotechnological measures to conserve it. • To make students aware about scope of bio-prospecting (i.e. the search for microbial, plant and animal species from which medicinal drugs and other commercially valuable compounds can be obtained) **Course Specific Outcome:** After successful completion of the course student will be able to understand • Components of biodiversity • Biodiversity crisis and biodiversity loss • India as mega biodiversity nation • Modern tools in the study of biodiversity • Application of biotechnology for conservation of biodiversity • Introduction to bioprospecting • Bio-prospecting from microbes, plants and animals
LS/BT/DSE-603P	Laboratory-DSE3 based on DSE-3 (Biodiversity and	**Course Specific Objective** • The objective of this course is to provide practical exposure of Biodiversity and Bioprospecting

	Bioprospecting)	**Course Specific Outcome:** After successful completion of the course student will be able • To study the faunal composition (insects and mites) of soil samples • To study faunal composition of water samples • To study the microbial diversity from soil sample/ water sample • To make report on visit to National Park/Wild life sanctuary/Botanical garden • To study source of immunosuppresive and other therapeutic agents, botanicals for biocontrol, and sacred flora (havan materials etc.) through specimens/photographs/slides • Study the characteristic features of flowers of Malvaceae, Fabaceae, Cruciferae, Ranunculaceae and Compositae family
LS/BT/DSE-604/PD	Dissertation	**Course Specific Objective** • The hands on training through one full semester project with thesis gives special expertise within one of the research areas represented at The Department of Biotechnology, GGV **Course Specific Outcome:** • This dissertation programme provides the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consultancy, education and research

Course Structure of B.Sc. Biotechnology Department of Biotechnology, Guru Ghasidas Vishwavidyalaya, Bilaspur 495009 (C.G.)			
Semester	**Course code**	**Subject**	**Marks**
I	LS/BT/C-101L	Cell Biology	100
	LS/BT/C-101P	Laboratory-1 based on core-1	100
	LS/BT/C-102L	Biochemistry and Metabolism	100
	LS/BT/C-102P	Laboratory-2 based on core-2	100
	LS/BT/GE-101/B&B-L	Bioethics and Biosafety	100
	LS/BT/GE-101/B&B-P	Laboratory-GE1 based on GE-1	100
	LS/BT/AE-101/EC	English Communication / MIL (Hindi Communication)	100
	ECA	ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	100
II	LS/BT/C-203L	General Microbiology	100
	LS/BT/C-203P	Laboratory-3 based on core-3	100
	LS/BT/C-204L	Genetics	100
	LS/BT/C-204P	Laboratory-4 based on core-4	100
	LS/BT/GE-202/B&HW-L	Biotechnology and Human Welfare	100
	LS/BT/GE-202/B&HW-P	Laboratory-4 based on core-4	100
	LS/BT/AE-201/EVS	Environmental Science	100
	ECA	ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	100
	Summer Internship: 15 days	Swayam / Swachhta / NSS / Industrial / others	100
III	LS/BT/C-305L	Molecular Biology	100
	LS/BT/C-305P	Laboratory-5 based on core-5	100
	LS/BT/C-306L	Bio-analytical Tools	100
	LS/BT/C-306P	Laboratory-6 based on core-6	100
	LS/BT/C-307L	Chemistry-1	100
	LS/BT/C-307P	Laboratory-7 based on core-7	100
	LS/BT/GE-303/IPRE-L	Intellectual Property Right and Entrepreneurship	100
	LS/BT/GE-303/IPRE-P	Laboratory-GE3 based on GE-3	100
	LS/BT/SEC-301/MT -L	Molecular techniques in disease diagnosis	100
	LS/BT/SEC-301/MT-P	Laboratory-SEC1 based on SEC-1	100
IV	LS/BT/C-408L	Mammalian Physiology	100
	LS/BT/C-408P	Laboratory-8 based on core-8	100
	LS/BT/C-409L	Immunology	100
	LS/BT/C-409P	Laboratory-9 based on core-9	100
	LS/BT/C-410L	Chemistry-2	100
	LS/BT/C-410P	Laboratory-10 based on core-10	100
	LS/BT/GE-404/BME-L	Bio-management of Environment	100
	LS/BT/GE-404/BME-P	Laboratory-GE4 based on GE-4	100
	LS/BT/SEC-402/ACC -L	Animal Cell Culture	100
	LS/BT/SEC-402/ACC -P	Laboratory-SEC2 based on SEC-2	100
	Summer Internship: 15 days	Swayam / Swachhta / NSS / Industrial / others	100
V	LS/BT/C-511L	Plant Physiology and Anatomy	100
	LS/BT/C-511P	Laboratory-11 based on core-11	100
	LS/BT/C-512L	Recombinant DNA Technology	100
	LS/BT/C-512P	Laboratory-12 based on core-12	100
	LS/BT/DSE-501L	Bioinformatics / Biostatics	100
	LS/BT/DSE-501P	Laboratory-DSE1 based on DSE-1	100
	LS/BT/DSE-502L	Industrial Fermentations	100
	LS/BT/DSE-502P	Laboratory-DSE2 based on DSE-2	100
VI	LS/BT/C-613L	Bioprocess Technology	100

	LS/BT/C-613P	Laboratory-13 based on core-13	100
	LS/BT/C-614L	Genomics and Proteomics	100
	LS/BT/C-614P	Laboratory-14 based on core-14	100
	LS/BT/DSE-603L	Microbial Technology / Biodiversity and Bioprospecting	100
	LS/BT/DSE-603P	Laboratory-DSE3 based on DSE-3	100
	LS/BT/DSE-604/PD	Dissertation	100

Proposed Syllabus for
B.Sc. (Hons.) Biotechnology based on CBCS System
(Three years/Six semesters)

(To be implemented from the academic session 2018-2019)

Department of Biotechnology
School of Life Sciences
Guru Ghasidas Vishwavidyalaya
Bilaspur (C.G.) 495009

13/4/18

School of Sciences :(Life Science) B.Sc. Biotechnology Hon's

Semester	Course Opted	Course Code	Name of the course	Credit	Hour / weak
I	Core-1	LS/BT/C-101L	Cell Biology	4	4
	Core -1 Practical	LS/BT/C-101P	Laboratory-1 based on core-1	2	4
	Core -2	LS/BT/C-102L	Biochemistry and Metabolism	4	4
	Core -2 Practical	LS/BT/C-102P	Laboratory-2 based on core-2	2	4
	Generic Elective - 1 (GE- 1)	LS/BT/GE-101/B&B-L	Bioethics and Biosafety	4	4
	Generic Elective - Practical	LS/BT/GE-101/B&B-P	Laboratory-GE1 based on GE-1	2	4
	Ability Enhancement Compulsory Course (AECC)	LS/BT/AE-101/EC	English Communication / MIL (Hindi Communication)	4*	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
			TOTAL	24	28

II	Core-3	LS/BT/C-203L	General Microbiology	4	4
	Core -3 Practical	LS/BT/C-203P	Laboratory-3 based on core-3	2	4
	Core -4	LS/BT/C-204L	Genetics	4	4
	Core -4 Practical	LS/BT/C-204P	Laboratory-4 based on core-4	2	4
	Generic Elective -2 (GE-2)	LS/BT/GE-202/B&HW-L	Biotechnology and Human Welfare	4	4
	Generic Elective - Practical	LS/BT/GE-202/B&HW-P	Laboratory-4 based on core-4	2	4
	Ability Enhancement Compulsory Course (AECC)	LS/BT/AE-201/EVS	Environmental Science	4*	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)

1

			Total	24	28
SUMMER Internship: 15 days			**SwayamSwachhta / NSS / Industrial/ others**	**2**	**100**
III	Core-5	LS/BT/C-305L	Molecular Biology	4	4
	Core -5 Practical	LS/BT/C-305P	Laboratory-5 based on core-5	2	4
	Core -6	LS/BT/C-306L	Bio-analytical Tools	4	4
	Core -6 Practical	LS/BT/C-306P	Laboratory-6 based on core-6	2	4
	Core – 7	LS/BT/C-307L	Chemistry-1	4	4
	Core – 7 Practical	LS/BT/C-307P	Laboratory-7 based on core-7	2	4
	Generic Elective - 3 (GE-3)	LS/BT/GE-303/IPRE-L	Intellectual Property Right and Entrepreneurship	4	4
	Generic Elective - Practical	LS/BT/GE-303/IPRE-P	Laboratory-GE3 based on GE-3	2	4
	Skill Enhancement Course (SEC - 1)	LS/BT/SEC-301/MT -L	Molecular techniques in disease diagnosis	4*	2 (4)
			Total	28	34
IV	Core-8	LS/BT/C-408L	Mammalian Physiology	4	4
	Core -8 Practical	LS/BT/C-408P	Laboratory-8 based on core-8	2	4
	Core -9	LS/BT/C-409L	Immunology	4	4
	Core -9 Practical	LS/BT/C-409P	Laboratory-9 based on core-9	2	4
	Core – 10	LS/BT/C-410L	Chemistry-2	4	4
	Core -10 Practical	LS/BT/C-410P	Laboratory-10 based on core-10	2	4
	Generic Elective - 4 (GE-4)	LS/BT/GE-404/BME-L	Bio-management of Environment	4	4
	Generic Elective - Practical	LS/BT/GE-404/BME-P	Laboratory-GE4 based on GE-4	4	4
	Skill Enhancement Course (SEC-2)	LS/BT/SEC-302/ACC -L	Animal Cell Culture	4*	2 (4)
			TOTAL	28	34
SUMMER Internship: 15 days			**Swayam Swachhta / NSS / Industrial/ others**	**2**	**100**
V	Core-11	LS/BT/C-511L	Plant Physiology and	4	4

			Anatomy		
	Core -11 Practical	LS/BT/C-511P	Laboratory-11 based on core-11	2	4
	Core -12	LS/BT/C-512L	Recombinant DNA Technology	4	4
	Core -12 Practical	LS/BT/C-512P	Laboratory-12 based on core-12	2	4
	Discipline Specific Elective (DSE-1)	LS/BT/DSE-501L	Bioinformatics / Biostatics	4	4
	DSE-1 - Practical	LS/BT/DSE-501P	Laboratory-DSE1 based on DSE-1	2	4
	Discipline Specific Elective (DSE-2)	LS/BT/DSE-502L	Industrial Fermentations	4	4
	DSE-2 - Practical	LS/BT/DSE-502P	Laboratory-DSE2 based on DSE-2	2	4
			TOTAL	24	32

VI	Core-13	LS/BT/C-613L	Bioprocess Technology	4	4
	Core -13 Practical	LS/BT/C-613P	Laboratory-13 based on core-13	2	4
	Core -14	LS/BT/C-614L	Genomics and Proteomics	4	4
	Core -14 Practical	LS/BT/C-614P	Laboratory-14 based on core-14	2	4
	Discipline Specific Elective (DSE-3)	LS/BT/DSE-603L	Microbial Technology / Biodiversity and Bioprospecting	4	4
	DSE-3 – Practical	LS/BT/DSE-603P	Laboratory-DSE3 based on DSE-3	2	4
	Discipline Specific Elective (DSE-4) Dissertation	LS/BT/DSE-604/PD	Dissertation	6	8
			TOTAL	24	32
			TOTAL CREDITS	**152 + 4 (SI)**	

As per UGC CBCS guidelines, University / departments have liberty to offer GE and SEC courses offered by any department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each. In present scheme it is proposed to have minimum two GE courses (from one subject) in first two semester after which student shall change two GE for another subject in IIIrd and IVth semester, so that the entire student can have exposure of one additional subject. **(Subject to approval by the competent authority)**

NOTE:

- **ECA (I and II Semester): The 2 credit allotted for these courses will be addition credit.**
- **Continuous Internal assessment should be evaluated by two component test and assignment.**
- **Marks distribution as proposed End semester: continuous internal assessment (70:30) according to final ordinance.**

3

B.Sc. (Hon's) Biotechnology

Semester	Course Opted	Course Code	Name of the course	Credit	Hour / weak
I	Core-1	LS/BT/C-101L	Cell Biology	4	4
	Core -1 Practical	LS/BT/C-101P	Laboratory-1 based on core-1	2	4
	Core -2	LS/BT/C-102L	Biochemistry and Metabolism	4	4
	Core -2 Practical	LS/BT/C-102P	Laboratory-2 based on core-2	2	4
	Generic Elective -1 (GE- 1)	LS/BT/GE-101/B&B-L	Bioethics and Biosafety	4	4
	Generic Elective - Practical	LS/BT/GE-101/B&B-P	Laboratory-GE1 based on GE-1	2	4
	Ability Enhancement Compulsory Course (AECC)	LS/BT/AE-101/EC	English Communication / MIL (Hindi Communication)	4*	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
			TOTAL	24	28
II	Core-3	LS/BT/C-203L	General Microbiology	4	4
	Core -3 Practical	LS/BT/C-203P	Laboratory-3 based on core-3	2	4
	Core -4	LS/BT/C-204L	Genetics	4	4
	Core -4 Practical	LS/BT/C-204P	Laboratory-4 based on core-4	2	4
	Generic Elective -2 (GE-2)	LS/BT/GE-202/B&HW-L	Biotechnology and Human Welfare	4	4
	Generic Elective - Practical	LS/BT/GE-202/B&HW-P	Laboratory-4 based on core-4	2	4
	Ability Enhancement Compulsory Course (AECC)	LS/BT/AE-201/EVS	Environmental Science	4*	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
			Total	24	28
Summer Internship: 15 days			**SwayamSwachhta / NSS / Industrial/ others**	**2**	**100**
III	Core-5	LS/BT/C-305L	Molecular Biology	4	4
	Core -5 Practical	LS/BT/C-305P	Laboratory-5 based on core-5	2	4
	Core -6	LS/BT/C-306L	Bio-analytical Tools	4	4
	Core -6 Practical	LS/BT/C-306P	Laboratory-6 based on core-6	2	4
	Core – 7	LS/BT/C-307L	Chemistry-1	4	4

	Core – 7 Practical	LS/BT/C-307P	Laboratory-7 based on core-7	2	4
	Generic Elective -3 (GE-3)	LS/BT/GE-303/IPRE-L	Intellectual Property Right and Entrepreneurship	4	4
	Generic Elective - Practical	LS/BT/GE-303/IPRE-P	Laboratory-GE3 based on GE-3	2	4
	Skill Enhancement Course (SEC - 1)	LS/BT/SEC-301/MT -L	Molecular techniques in disease diagnosis	4*	2 (4)
	Skill Enhancement Course (SEC-1) Practical	LS/BT/SEC-301/MT-P	Laboratory-SEC1 based on SEC-1	2	4
			Total	28	34
IV	Core-8	LS/BT/C-408L	Mammalian Physiology	4	4
	Core -8 Practical	LS/BT/C-408P	Laboratory-8 based on core-8	2	4
	Core -9	LS/BT/C-409L	Immunology	4	4
	Core -9 Practical	LS/BT/C-409P	Laboratory-9 based on core-9	2	4
	Core – 10	LS/BT/C-410L	Chemistry-2	4	4
	Core -10 Practical	LS/BT/C-410P	Laboratory-10 based on core-10	2	4
	Generic Elective -4 (GE-4)	LS/BT/GE-404/BME-L	Bio-management of Environment	4	4
	Generic Elective - Practical	LS/BT/GE-404/BME-P	Laboratory-GE4 based on GE-4	4	4
	Skill Enhancement Course (SEC-2)	LS/BT/SEC-302/ACC -L	Animal Cell Culture	4*	2 (4)
	Skill Enhancement Course (SEC-2) Practical	LS/BT/SEC-402/ACC -P	Laboratory-SEC2 based on SEC-2	2	4
			TOTAL	28	34
Summer Internship: 15 days			**Swayam Swachhta / NSS / Industrial/ others**	**2**	**100**
V	Core-11	LS/BT/C-511L	Plant Physiology and Anatomy	4	4
	Core -11 Practical	LS/BT/C-511P	Laboratory-11 based on core-11	2	4
	Core -12	LS/BT/C-512L	Recombinant DNA Technology	4	4
	Core -12 Practical	LS/BT/C-512P	Laboratory-12 based on core-12	2	4
	Discipline Specific Elective (DSE-1)	LS/BT/DSE-501L	Bioinformatics / Biostatics	4	4
	DSE-1 - Practical	LS/BT/DSE-501P	Laboratory-DSE1 based on DSE-1	2	4
	Discipline Specific Elective (DSE-2)	LS/BT/DSE-502L	Industrial Fermentations	4	4
	DSE-2 - Practical	LS/BT/DSE-502P	Laboratory-DSE2 based on DSE-2	2	4
			TOTAL	24	32

VI	Core-13	LS/BT/C-613L	Bioprocess Technology	4	4

	Core -13 Practical	LS/BT/C-613P	Laboratory-13 based on core-13	2	4
	Core -14	LS/BT/C-614L	Genomics and Proteomics	4	4
	Core -14 Practical	LS/BT/C-614P	Laboratory-14 based on core-14	2	4
	Discipline Specific Elective (DSE-3)	LS/BT/DSE-603L	Microbial Technology / Biodiversity and Bioprospecting	4	4
	DSE-3 – Practical	LS/BT/DSE-603P	Laboratory-DSE3 based on DSE-3	2	4
	Discipline Specific Elective (DSE-4) Dissertation	LS/BT/DSE-604/PD	Dissertation	6	8
			TOTAL	24	32
			TOTAL CREDITS	**152 + 4 (SI)**	

As per UGC CBCS guidelines, University / departments have liberty to offer GE and SEC courses offered by any department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each. In present scheme it is proposed to have minimum two GE courses (from one subject) in first two semester after which student shall change two GE for another subject in IIIrd and IVth semester, so that the entire student can have exposure of one additional subject. **(Subject to approval by the competent authority)**

NOTE:

- **ECA (I and II Semester): The 2 credit allotted for these courses will be addition credit.**
- **Continuous Internal assessment should be evaluated by two component test and assignment.**
- **Marks distribution as proposed End semester: continuous internal assessment (70:30) according to final ordinance.**

COURSE CONTENT B.Sc. (Hons.) BIOTECHNOLOGY

FIRST SEMESTER

CORE-1: CELL BIOLOGY (C1)

UNIT I

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation types: Differential and Density Gradient Centrifugation. Cell Membrane and Permeability: Chemical components of biological membranes, their organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport

UNIT II

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, microfilaments, intermediate filaments. Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, regulation of receptor expression and function

UNIT III

Structure, biogenesis and functions of endoplasmic reticulum, Golgi complex, Lysosomes, Vacuoles and micro bodies, Ribosomes, Mitochondria, Chloroplastsand Nucleus

UNIT IV

Cell Cycle, mitosis & meiosis, Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and biological basis of cancer

LABORATORY-1 BASED ON CORE-1 (LAB1)

- To study the effect of temperature and organic solvents on semi permeable membrane.
- To study the plasmolysis
- To study the de-plasmolysis
- To study the structure of Prokaryotic cell (Bacteria).
- To study the structure of Eukaryotic cell (Plant, Animal).

SUGGESTED READING

1. Karp, G. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. The World of the Cell. Pearson Benjamin Cummings Publishing, San Francisco.

CORE-2: BIOCHEMISTRY AND METABOLISM (C2)

UNIT I

Introduction to Biochemistry: Amino acids & Proteins**:** Structure and properties of Amino acids, Synthesis of aromatic and aliphatic amino acids, amino acid oxidation and production of urea. Types of protein and their classification structure and shape. Different levels of structural organization of proteins (primary, secondary, tertiary and quaternary).

UNIT II

Structure, classification, functions and properties of carbohydrates Glycolysis, fate of pyruvate under aerobic and anaerobic conditions, Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis, TCA cycle, Electron Transport Chain, Oxidative phosphorylation.

UNIT III

Structure, classification, functions and properties of fatty acid, Biosynthesis of saturated and unsaturated fatty acids. ß-oxidation of fatty acids. Structure, functions, and properties of DNA, double helical model of DNA structure and forces responsible for A, B & Z – DNA. Structure, functions, and properties of RNA

UNIT IV

Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric &oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity.

LABORATORY-2 BASED ON CORE-2 (LAB2)

1. To calculate the molarity, molality, normality and their relationship of given sample.
2. To preparethe buffers (acetate and phosphate buffers).
3. To maintain the pH of different types of buffer using pH meter.
4. To study the Qualitative tests for carbohydrates (for reducing and nonreducing sugars), lipids (Zak's test for cholesterol) and proteins (ninhydrin test, biuret test).
5. To estimate the content of protein by using Lowery method/Bradford method.

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L Biochemistry. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry, WH Freeman and Company,New York, USA.
4. Hopkins, W.G. and Huner, P.A. Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. Plant Physiology, Wadsworth Publishing Co. Ltd.

GE-1: BIOETHICS AND BIOSAFETY (GE1)

UNIT I

Bioethics: Necessity of Bioethics, different paradigms of Bioethics: National & International, Universal Declaration on Bioethics and Human Rights, Ethical issues against the molecular technologies.

UNIT II

Biosafety: Introduction, different levels, applications, protocol (UN Cartagena Biosafety Protocol) and health hazards related to Biotechnology, guidelines of Biosafety in India.

UNIT III

Introduction to the concept of containment level and Good Manufacturing Practices (GMP), OECED guidelines of Good Laboratory Practices (GLP), Quality assurance programme, apparatus material and reagents used for GLP.

UNIT IV

Ethical, Legal and Social Implication program of Human Genome project, Bioethics in Biodiversity and recourses management, genetically modified foods: steps for genetically modified food technology regulations, ethical issues and present scenario in consumption of Genetically Modified Organisms

LABORATORY-GE1 BASED ON GE-1 (LAB-GE1)

1. To study the guidelines for good laboratory Practice
2. To identify the different hazardous symbols for different chemicals/reagents used in laboratory
3. A case study on clinical trials of drugs in India with emphasis on ethical issues
4. Case study on women health ethics
5. Case study on handling and disposal of radioactive waste
6. Case study on medical errors and negligence

SUGGESTED READING

1.Sateesh MK Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V Bioethics and Biosafety in Biotechnology, New age international Publishers
3. Fleming, D.A., Hunt, D.L., Biotechnology and Safety Assessment, Academic press.
4. Thomas, J.A., Fuch, R.L. Biotechnology and safety assessment CRC press, Washington. patents by Sibley. Butterworth publication
5. Biotechnology - A comprehensive treatise. Legal economic and ethical dimensions VCH.

SECOND SEMESTER

CORE-3: GENERAL MICROBIOLOGY (C3)

UNIT I

History and scope of microbiology, Microbial taxonomy, Classification of microorganisms: criteria used including molecular and polyphasic approaches, microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization of Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Viruses

UNIT II

Cultivation and maintenance of microorganisms: methods of isolation, purification and preservation. Nutritional categories of micro-organisms, Control of microorganisms by physical, chemical and chemotherapeutic agents

UNIT III

Microbial growth: Growth curve, Generation time, synchronous, batch and continuous culture, methods of measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Asexual reproduction (binary fission, endospores and sporulation in bacteria), Genetic recombination (Transformation, Transduction and Conjugation).

UNIT IV

Bacteria, fungi, algae and cyanobacteria pollutants of water, sewage composition and its disposal
Important microorganisms in food: moulds, yeasts, bacteria, major food born infections and intoxications in humans, food spoilage and preservation of various types of foods.

LABORATORY-3 BASED ON CORE-3 (LAB3)

1. To study the methods of sterilization (autoclave and hot air oven)
2. To study the methods of isolation of bacteria from different sources
3. To prepare the media for cultivation of bacteria/fungi.
4. To perform the biochemical characterization of isolated bacteria.
5. To perform the staining of isolated bacteria using different methods (Gram staining, Spore staining, Negative staining).
6. To determine the bacterial cell size by micrometry.
7. To enumerate the total & viable cell count of microorganism by using haemocytometer.

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (Introductory Mycology. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. Modern Food Microbiology. CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. Introductory Phycology. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. Brock Biology of Microorganisms. Pearson/ Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan.
7. Tortora GJ, Funke BR, and Case CL. Microbiology: An Introduction. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's microbiology McGraw Hill Higher Education.

CORE-4: GENETICS (C4)

UNIT I

Mendelian genetics: Mendel's law, test and back crosses, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, pleiotropy, polygenic inheritance, multiple allele, pseudo-allele, essential and lethal genes. Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive).Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over

UNIT II

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA. Eukaryotic chromosome: chromosome morphology, concept of euchromatin and heterochromatin, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, genetic code.

UNIT III

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames tests for mutagenic agents, variations in chromosomes structure, point mutation. Chromosomal aberrations in human beings, abonormalities: Aneuploidy (Down, Turner, Klienfelter syndrome) and Euploidy, non-disjunction.

UNIT-IV

Sex determination and sex linkage: Mechanisms of sex determination, Barr bodies, genetic balance theory, Fragile-X-syndrome and chromosome, sex linked diseases and inheritance, Pedgree analysis. Evolution and population genetics: Hardy Weinberg law, allelic and genotype frequencies,

LABORATORY-4 BASED ON CORE-4 (LAB4)

1. To study the Mendelian Genetics in monohybrid and dihybrid crosses using checker board
2. To study the human traits
3. To identification of Barr body in human sample.
4. To study the Karyotyping with the help of photographs
5. To analyse the autosomal and sex linked disease using Pedigree charts.
6. To study the polyploidy in onion root tip by colchicine treatment.

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. Principles of Genetics. John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. Principles of Genetics. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. Concepts of Genetics. Benjamin Cummings.
4. Russell, P. J. Genetics- A Molecular Approach. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis, W. H. Freeman & Co.

GE-2: BIOTECHNOLOGY AND HUMAN WELFARE (GE2)

UNIT I
Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, Enzyme immobilization: methods and application.

UNIT II
Agriculture and Environments: Plant Tissue culture, N_2 fixation, transgenic plants: insect resistance, bacterial/ fungal stress tolerance, drought/salt tolerance, bioremediation, biofertilizers, biopesticides, biofuels and bioleaching.

UNIT III
Forensic science: solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing, Polymerase chain reaction, Restriction fragment length polymorphism.

UNIT IV
Health: development of non- toxic therapeutic agents, recombinant live and DNA vaccines, gene therapy, Molecular diagnosis: (monoclonal antibodies, DNA probes, Microarrays), transgenic animals.

LABORATORY-GE2 BASED ON GE-2 (LAB-GE2)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. To perform ethanolic fermentation using Baker's yeast
2. To study the plant parts (leaves and stems) infected with a microbes.
3. To perform quantitative estimation of residual chlorine in water samples
4. To isolate and analyse the DNA from different biological samples
5. To demonstrate the PCR in biological samples

SUGGESTED READING

1. Sateesh MK Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V Bioethics and Biosafety in Biotechnology, New age international publishers
3. Gupta, Elements of Biotechnology
4. Dubey, T. B. of Biotechnology
5. Kumar H. Modern Concept of Biotechnology
6. Jogdand, Advances in Biotechnology
7. Chatwal, T. B. of Biotechnology
8. Primrose, Molecular Biotechnology

THIRD SEMESTER

CORE-5: MOLECULAR BIOLOGY (C5)

UNIT I

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semi-conservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombination repair. Homologous recombination: models and mechanism, nonhomologous end joining.

UNIT III

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing

UNIT IV

Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation.
Regulation of gene expression in prokaryotes: Lac Operon and eukaryotes: tryptophan eukaryote.

LABORATORY-5 BASED ON CORE-5 (LAB5)

PRACTICALS

1. To isolate the chromosomal DNA from bacterial cells/plant cells/ animal cells
2. To isolate the Plasmid DNA by alkaline lysis method
3. To quantify the genomic DNA & plasmid DNA with the help of Spectrophotometer '
4. To check the quality of isolated genomic DNA & plasmid DNA with the help of Agarose Gel Electrophoresis.
5. To isolate the RNA from plant cells/ animal cells
6. To quantify the RNA with the help of Spectrophotometer
7. To check the quality of isolated RNA with the help of Agarose gel Electrophoresis.

SUGGESTED READING

1. Karp, G Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. PThe World of the Cell. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., Molecular Biology of the Gene Cold Spring Harbour Lab. Press, Pearson Pub.

CORE-6: BIO-ANALYTICAL TOOLS (C6)

UNIT I

History and Background of microscope, various types of microscope, principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), absorption and emission spectroscopy

UNIT II

Centrifugation: principle and mechanism, types of rotors, types and techniques of centrifugation (differential and density gradient). Micro-techniques, Types cell fractionation techniques, isolation of sub-cellular organelles and particles

UNIT III

Principle of chromatography, Paper chromatography, thin layer, chromatography, column chromatography: silica and gel filtration, affinity and ion exchange, chromatography, gas chromatography, HPLC.

UNIT IV

Introduction to electrophoresis: Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Southern, Northern, Western blotting and South-Western blotting

LABORATORY-6 BASED ON CORE-6 (LAB6)

1. To study relation between absorbance and % transmission using spectrophotometer
2. To separate different types of amino acids by paper chromatography (ascending method).
3. To separate the proteins by SDS-polyacrylamide gel electrophoresis.
4. To identify the lipids in a given sample by TLC.
5. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.
6. To separate the plant pigments by adsorption column chromatography

SUGGESTED READING

1. Karp, G. Cell and Molecular Biology: Concepts and Experiments. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. The World of the Cell. Pearson Benjamin Cummings Publishing, San Francisco.

GE-3: INTELLECTUAL PROPERTY RIGHT AND ENTREPRENEURSHIP (GE3)

UNIT-I
Introduction to Indian Patent Law, World Trade Organization and its related intellectual property provisions, Intellectual/Industrial property and its legal protection in research, design, development in Biotechnology

UNIT II
Essential requirements for patenting, types of patent, things that are patentable and non-patentable, Drug patents in India, various types of patent application in India, patenting of living organism, traditional knowledge, commercial exploitation and protection.

UNIT III
Concept of entrepreneur, nature of entrepreneur, entrepreneurial characteristics, functions of an entrepreneur, role of entrepreneurship in developing economy.

UNIT - IV
Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

LABORATORY-GE3 BASED ON GE-3 (LAB-GE3)

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. Patent search on internet
5. To draw the outline for project proposal related to biotechnology

SUGGESTED READING
1. Holt DH. Entrepreneurship: New Venture Creation.
2. Kaplan JM, Patterns of Entrepreneurship.
3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.
4. P. C. Tripathi, P.N. Reddy, Principles of Management
5. Vasant Desai, Dynamics of Entrepreneurial Development & Management
6. Poornima. M. Charantimath, Entrepreneurship Development
7. Robers Lusier, Thomson Management Fundamentals
8. SS Khanka, Entrepreneurship Development
9. Stephen Robbins, Management

SEC-1: MOLECULAR TECHNIQUES IN DISEASE DIAGNOSTIC (SEC-1)

UNIT- I

Transportation of different clinical materials to distant Laboratories, Proper storage of samples, Chemicals, antibodies and enzymes, common anticoagulants used-composition, amount, mechanism of action and methods of preparation of different types of vials, Biosafety measures and disposal of laboratory waste. Basics of quality control methods and Laboratory accreditation

UNIT – II

Composition of blood and its function, drawing of peripheral blood smear, staining & stain preparation, Methods of estimation of Haemoglobin, Methods of total counts of WBC, RBC, Platelets & fluids used, Blood Group (ABO & Rh), Cytochemical stain for diagnosis/differential diagnosis of leukemia/other diseases

UNIT- III

Susceptibility tests: Diffusion test procedures, Tests for bactericidal activity, Immunodiagnostic tests,Immuno florescence, Enzyme Immunoassays: Enzyme linked immunosorbent assay, Radioimmunoassay, Immunophenotyping, Flouresence activated cell sorter, Magnetic cell sorter, FTR, Spectrophotometry

UNIT - IV

Molecular techniques to detect genetic disorders: Polymerase chain reaction, Restriction fragment length polymorphism, Nuclear hybridization methods, Single nucleotide polymorphism and DNA finger printing

LABORATORY-SEC1 BASED ON MOLECULAR TECHNIQUES IN DISEASE DIAGNOSTIC (SEC-1)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Perform/demonstrate RFLP and its analysis on biological sample
2. To identify the microorganisms for different diseases
3. A kit-based detection of a microbial infection (Widal test)
4. To study the electron micrographs of biological sample
5. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue)
6. To study the genetic disorders using molecular diagnostic tools

SUGGESTED READING

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. J.F. Van Impe, Kluwer Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes,
3. Ananthanarayan R and Paniker CKJ. Textbook of Microbiology. University Press Publication.
4. Brooks GF, Carroll KC, Butel JS and Morse SA. Jawetz, Melnick and Adelberg's Medical Microbiology. McGraw Hill Publication.
5. Goering R, Dockrell H, Zuckerman M and Wakelin D. Mims' Medical Microbiology.
6. Joklik WK, Willett HP and Amos DB. Zinsser Microbiology. Appleton Centuary-Crofts publication.
7. Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
8. Michael Hoppert, Microscopic Techniques in Biotechnology

FORTH SEMESTER

CORE-8: MAMMALIAN PHYSIOLOGY (C8)

UNIT I

Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift. Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice

UNIT II

Circulation: Composition of blood, Plasma proteins & their role, blood cells and their functions, Haematopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT III

Muscle physiology and osmoregulation: Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT IV

Nervous and endocrine coordination: Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids), Different endocrine glands–Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions

LABORATORY-8 BASED ON CORE-8 (LAB8)

1. To find the coagulation time of blood sample
2. To determine the blood groups
3. To Count the mammalian RBCs using haemocytometer
4. To prepare the peripheral blood smear
5. To determine the TLC and DLC in prepared blood smear using giemsa/ Leishman stain
5. To determine the haemoglobin in blood sample
6. To demonstrate the action of an enzyme

SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. John wiley & sons,Inc.
3. Chatterjee A. G. Human Physiology
4. Berry. T. B. of Animal Physiology
5. H. R. Singh Introduction to Animal Physiology and Related Biotechnology
6. Arora M.P. Animal Physiology
7. Hurkat and Mathur T. B. of Animal Physiology
8. Nahbhushan and kodarkar Animal Physiology
9. Thakur & Puranik T. B. of Animal Physiology & General Biology

CORE-9: IMMUNOLOGY (C9)

UNIT I

Immune Response - An overview, Cells and organs of immune system, molecular structure of immunoglobulins, antigens, antigenicity and immunogenicity, humoral & cellular immune responses, T-lymphocytes (cytotoxic T-cell, helper T-cell, suppressor T-cells), B-lymphocyte and immune response, T-cell receptors B-cell receptors, genome rearrangements during differentiation of B cells.

UNIT II

Regulation of immunoglobulin gene expression–clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, Antibody affinity maturation class switching, assembly of T-cell avidity receptor genes by somatic recombination.

UNIT III

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Complement activation, autoimmune diseases, hypersensitivity, immunodeficiency-AIDS.

UNIT IV

Immunity to infection: immunity to different organisms, pathogen defense strategies. Vaccines & Vaccination: adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization, Introduction to immunodiagnostics – RIA, ELISA.

LABORATORY-9 BASED ON CORE-9 (LAB9)

1. Total RBC count of blood sample using haemocytometer
2. To analyse the haemagglutination assay
3. To analyse the haemagglutination inhibition assay
4. To separation the serum and plasma from blood sample
5. To study the double immunodiffusion test using specific antibody and antigen.
6. To study the different types of ELISA

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. Cellular and Molecular Immunology. Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. Roitt's Essential Immunology. Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. Kuby's Immunology. W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. Janeway's Immunobiology. Garland Science Publishers, New York.
5. Peakman M, and Vergani D. Basic and Clinical Immunology. Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S Immunology. Wiley Blackwell Publication.

GE4: BIOMANAGEMENT OF ENVIRONMENT (GE4)

UNIT I

Biomanagement of soil: An overview of global market and available technologies local gain, global loss: The Environmental cost of action, bioavailability of contaminants in soil,microbial remediation of metals in soils

UNIT II

Biomanagement of Petroleum Contaminants: benzene-contaminated underground aquifers. Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals,
Molecular aspects and applications in biotechnology

UNIT III

Biosurfactants, strategies based on the use of fungal enzymes, anaerobic Metabolism and bioremediation of BTEX Hydrocarbons (Benzene, Toluene, Ethylbenzene, and Xylene), Treatment of municipal waste and Industrial effluents, Bio-fertilizers, Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilizers (VAM)

UNIT IV

Heavy metal phytoremediation: Microbial indicators of soil health for the assessment of remediation efficiency. Environment and the tools in rhizo- and bioremediation of contaminated soil molecular tools for monitoring and validating bioremediation, genetic engineering of bacteria and their potential for bioremediation

LABORATORY-GE4 BASED ON GE-4 (LAB-GE4)

1. To study the biodegradation of a dye/ xenobiotic
2. Assay for biosurfactant production and bioemulsification index of selected microorganisms
3. Assessment of bioleaching of metals from ore
4. Calculation of Total Dissolved Solids (TDS) of water sample
5. Calculation of BOD of water sample
6. Calculation of COD of water sample
7. Bacterial Examination of Water by MPN Method

SUGGESTED READING

1. S.C. Santra, Environmental Science
2. Pradipta Kumar Mohapatra, Environmental Biotechnology
3. Hans-Joachim Jordening and Jesef Winter, Environmental Biotechnology – Concepts and Applications
4. Metcalf and Eddy, Tata McGraw hill, Waste Water Engineering
5. S.S. Purohit, Agricultural Biotechnology
6. Alicia L. Ragout De Spencer, John F.T. Spencer, Environmental Microbiology : Methods and Protocols
7. Milton Wainwright, Introduction to Environmental Biotechnology
8. Gilbert Masters, Principles of Environmental Engineering
9. Metcalf & Eddy, Wastewater Engineering
10. Sibley, Law and Strategy of biotechnological patents. Butterworth publication
11. Ganguli-Tat McGrawhill, Intellectual property rights.
12 Wattal, Intellectual Property Right. Oxford Publication

SEC2: ANIMAL CELL CULTURE (SEC-2)

UNIT I

History and scope of animal cell culture technology. Basic requirements of animal cell culture laboratory (Laminar air flow, CO_2 incubator, centrifuge, microscope) biological containment and biosafety levels**,** good laboratory practices to prevent contamination, common cell culture contaminants

UNIT II

Culture media and buffers, natural and defined media, basal media, serum supplemented media, serum free media, growth supplements, balanced salt solution, sterilization and filtration of media.

UNIT III

Cell culture techniques, primary and secondary culture, cell lines, monolayer culture, suspension culture, organ culture, cryopreservation of cell lines

UNIT IV

Behaviour of cultured cells in terms of growth, differentiation and metabolism, apoptosis, necrosis and senescence, appearance of viable and non-viable cells, application of cell culture, in-vitro fertilization

LABORATORY-SEC2 BASED ON ANIMAL CELL CULTURE (SEC2)

1. To prepare the media for animal cell culture
2. Sterilization and filtration of cell culture medium
3. Trypsinization of cell lines
4. Passaging of cell lines available in department laboratory
5. To count the viable cells using haemocytometer
6. Cryopreservation of cell lines/cells/tissues
7. Thawing of cryopreserved cell lines

SUGGESTED READING

1. Butler, M and Dawson, M. (eds.).: Cell Culture Lab Fax, Eds., Bios Scientific Publications Ltd., Oxford. Clynes, M. (ed).: Animal Cell Culture Techniques. Springer.
2. Glick, B.R. and Pasternak, J.J. Molecular biotechnology- Principles and applications of recombinant DNA. ASM press, Washington, USA.
3. Sambrook & Russel. Molecular Cloning: A laboratory manual.
4. Freshney, Culture of Animal cell: A mannual of Basic Techniques
5. Masters, J. R. W. (ed): Animal Cell Culture – Practical Approach, Oxford Univ. Press.
6. Basega, R. (ed): Cell Growth and Division: A Practical Approach. IRL Press.
7. Mather, J.P and Barnes, D. (eds). : Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Academic Press.

FIFTH SEMESTER

CORE-11: (PLANT PHYSIOLOGY AND ANATOMY (C11)

UNIT I
Plant Anatomy: The shoot and root apical meristem, simple & complex permanent tissues, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

UNIT II
Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, different types of mechanism of food transport in plants

UNIT III
Photosynthesis: photosynthetic pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photorespiration, N_2 cycle, inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants, mechanism.

UNIT IV
Growth and development: phases of growth, growth curve, physiological role and mode of action of growth hormones; auxins, gibberlins, cytokinins, abscisic acid, ethylene, seed dormancy and seed germination, concept of photo-periodism and vernalization

LABORATORY-11 BASED ON CORE-11 (LAB11)

1. To demonstrate the growth rings in plants.
2. To demonstratethe opening & closing of stomata
3. To demonstratethe guttation on leaf tips of grass and garden Nasturtium.
4. To separatethe photosynthetic pigments by paper chromatography.
5. To demonstrate the aerobic respiration in plants.
6. To isolate the root nodules from a leguminous plant.
7. To demonstrate the effect of a hormone on plant growth

SUGGESTED READING
1. Dickinson, W.C. Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. Plant Anatomy. The Benjammin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. Lehninger Principles of BiochemistryW.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. Plant Physiology, Sinauer Associates Inc .MA, USA

CORE-12: RECOMBINANT DNA TECHNOLOGY (C12)

UNIT - I

History of recombinant DNA technology, Host controlled restriction modification system, restriction endonucleases, cutting and joining of DNA molecules *in vitro*. Phosphatases, ligases and polymerases. Southern and Northern hybridization, Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription, Genome mapping, Restriction mapping, DNA fingerprinting, Principle applications and types of Polymerase chain reaction (PCR).

UNIT – II

Cloning vectors: plasmid, bacteriophage, cosmids, phagemid, expression vectors, Gene transfer methods: microinjection, electroporation, microprojectile bombardment, shot gun method, ultrasonication, lipofection, micro laser, RNA-interference, selection and screening of recombinants by genetic and immunochemical

UNIT - III

Expression of foreign genes in *E.coli* and Yeast, application of gene cloning for the analysis of gene structure and function, expression of foreign genes using strong promoters, production of protein, artificial insulin gene, recombinant vaccine and other therapeutics from cloned genes

UNIT - IV

Genetic engineering in plants: use of *Agrobacterium tumefaciens* and *Agrobacterium rhizogenes*, Ti plasmids, application of recombinant DNA technology. Genetic engineering in animals: production of transgenic mice, embryonic stem cells for gene targeting in mice, applications of gene targeting.

LABORATORY-12 BASED ON CORE-12 (LAB12)

1. To Isolate the chromosomal DNA from plant cells/human cells /bacterial cells
2. To isolate the plasmid DNA from bacterial cells
3. Qualitative and quantitative analysis of DNA using agarose gel electrophoresis and spectrophotometer
4. To prepare the competent cells
5. To transform the of competent cells
6. To demonstrate the different types of PCR
7. To study the Restriction digestion of DNA using different restriction enzymes

SUGGESTED READING

1. Brown TA. Gene Cloning and DNA Analysis. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. Principles of Gene Manipulation and Genomics, Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. Molecular Cloning-A Laboratory Manual. Cold Spring Harbor Laboratory Press.

DSE1: BIOINFORMATICS (DSE1)

UNIT -I

Introduction to bioinformatics, Applications of Bioinformatics, General Introduction of Biological Databases: Flat files, relational, object oriented databases and controlled vocabularies File Format (Genbank, FASTA). Introduction of Data Generating Techniques for Genomics: shotgun sequencing, clone contig, Nucleic acid databases

UNIT-II

Introduction of Data Generating Techniques in proteomics: Mass spectroscopy. Protein databases (PDB, Swiss Prot, TREMBL). File Format (PDB). Searching Databases: SRS, Entrez

UNIT-III

Pairwise sequence alignments, Local alignment and Global alignment, Mutation/Substitution Matrices. Introduction to BLAST and interpretation of result, Multiple Sequence Alignment

UNIT-IV

Genome Annotation: Gene identification, Detecting Open Reading Frames, Phylogenetic analysis tools

LABORATORY-DSE1 BASED ON BIOINFORMATICS (LAB-DSE1)

1. To understand and use various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
2. To understand and use PDB, Swissprot, TREMBL
3. To retrievethe gene from Genbank in the output File format
5. To retrievethe protein from PDB in the output File format
6. To align nucleic acid sequence using BLASTN
7. To align protein sequence using BLASTP
8. To align multiple sequence using Clustal W

SUGGESTED READING

1. Ghosh Z. and Bibekanand M. Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. Bioinformatics and Functional Genomics. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (Discovering Genomics, Proteomics and Bioinformatics. Benjamin Cummings.
4. Des Higgins and Willie Taylor, Bioinformatics: Sequence, Structure and Databanks. Oxford University Press.
5. Rashidi H. H. and Buehler. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
6. Gibas Cynthia and Jambeck P. Developing Bioinformatics Computer Skills: Shroff Publishersand Distributors Pvt. Ltd. (O'Reilly), Mumbai.

DSE1: BIOSTATISTICS (DSE1)

UNIT I
Scope and applications of Biostatistics, samples and population concept, collection, processing and presentation of data, frequency distribution

UNIT II
Measures of central tendency: Arithmetic, Harmonic and Geometric Mean, Mode and Median, their applications, merits and demerits

UNIT III
Measures of dispersion, Variance, Standard Deviation, Coefficient of Variance, their applications, merits and demerits, Correlation analysis and Regression analysis, Concept of Probability

UNIT IV
Comparison of two data sets: testing of hypothesis, Student's t-test, Chi square test, F-test- introduction and application in biology, comparison of three and more data sets: ANOVA test.

LABORATORY-DSE1 BASED ON BIOSTATISTICS (DSE1)

1. To study the data based on graphical representation (Bar, multiple bars, histogram, pie chart etc.)
2. To determine the mean, median, mode and standard deviation of given sample/data
3. To determine the probabilityof given sample/data
4. To perform the t-test/F-Test of given data
5. To perform the Chi-square testof given data

SUGGESTED READING
1. Le CT Introductory biostatistics. John Wiley, USA
2. Glaser AN High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D Advanced Biology Statistics, Oxford University Press.
4. Danial W Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.
5. Mishra BN and Mishra SN, Principles of Biostatistics.
6. Marcello pagano, Principle of Biostatistics.

DSE-2: INDUSTRIAL FERMENTATIONS (DSE-2)

UNIT I

Production of industrial chemicals, biochemicals and chemotherapeutic products.,butyric acid, gluconic acid, microbial insecticides, microbial flavours and fragrances, newer antibiotics, anti cancer agents

UNIT II

Microbial products of pharmacological interest, steriod fermentations and transformations, Secondary metabolism: its significance and products, Metabolic engineering of secondary metabolism for highest productivity, enzyme immobilization in industrial processing

UNIT III

Purification & characterization of proteins, Upstream and downstream processingcentrifugation, filtration of fermentation broth, ultra-centrifugation, liquid extraction, ion-exchange recovery of biological products, Process optimization and recovery of product

UNIT IV

Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; masstransfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up.

LABORATORY-DSE-2 BASED ON INDUSTRIAL FERMENTATIONS (LAB-DSE-2)

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Ethanol production using fruit juice as the carbon source.
4. Solvent extraction & analysis of a metabolite from a bacterial culture.
5. Perform an enzyme assay demonstrating its hydrolytic activity. protease/peptidase/glucosidase etc.)

SUGGESTED READING

1. Casida LE. Industrial Microbiology. Wiley Eastern Limited.
2. Crueger W and Crueger A Biotechnology: A textbook of Industrial Microbiology. Panima Publishing Co. New Delhi.
3. Patel AH. Industrial Microbiology. Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology. Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology

SIXTH SEMESTER

CORE-13: BIOPROCESS TECHNOLOGY (C13)

UNIT I

Introduction to bioprocess technology, Range of bioprocess technology and its chronological Development, Basic principle components of fermentation technology, Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II

Design and types of bioprocess vessels: Significance of Impeller, Baffles, Sparger; Types of culture/production vessels: Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing: Media preparation, Inocula development and sterilization from straw dust.

UNIT III

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV

Introduction to downstream processing, product recovery and purification, effluent treatment, Microbial production of ethanol, amylase, lactic acid and single cell proteins

LABORATORY-13 BASED ON CORE-13 (LAB13)

1.To study the bacterial growth curve.
2. To calculate the thermal death point of a microbial sample.
3. Production and analysis of ethanol.
4. Isolation of industrially important (amylase producing) microorganism from natural resource.
5. Production and analysis of amylase.
6. Production and analysis of lactic acid.

SUGGESTED READING

1. Casida LE. (Industrial Microbiology. Wiley Eastern Limited.
2. Crueger W and Crueger A. Biotechnology: A textbook of Industrial Microbiology. Panima Publishing Co. New Delhi.
3. Patel AH. Industrial Microbiology. Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology. Elsevier Science Ltd.

CORE-14: GENOMICS AND PROTEOMICS (C14)

UNIT I

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam& Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clonecontig) methods, Human genome project

UNIT II

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases

UNIT III

Introduction to protein structure: Chemical properties of proteins. Physical interactions that determine the property of proteins, Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Sedimentation analysis, gel filteration, SDS-PAGE, Native PAGE, Determination of covalent structures, Edman degradation

UNIT IV

Introduction to Proteomics: Analysis of proteomes, 2D-PAGE, Sample preparation, solubilization, reduction, resolution. Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data

LABORATORY-14 BASED ON CORE-14 (LAB14)

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. To analyse the Protein localization by using different Softwares.
6. Hydropathy plots

SUGGESTED READING

1. Benjamin Lewin, Johns, Genes Bartlett Publisher
2. S.B. Primrose, Modern Biotechnology Blackwell Publishing.
3. B.R. Glick, J.J. Pasternak and C.L. Patten Molecular Biotechnology: Principles and Applications of Recombinant DNA ASM Press, Washington.
4. Sambrook and Russell Molecular Cloning: A Laboratory Manual.
5. S.B.Primrose, R.M.Twyman and R.W. Old Principles of Gene Manipulation Blackwell Science.
6. Snustad, D.P., Simmons, M.J Principles of Genetics. John Wiley and Sons Inc.
7. Klug, W.S., Cummings, M.R., Spencer, C.A. Concepts of Genetics. Benjamin Cummings.
8. Russell, P. J,Genetics- A Molecular Approach. Benjamin Cummings.
9. Pevsner, J. Bioinformatics and Functional Genomics. John Wiley & Sons.

DSE3: MICROBIAL TECHNOLOGY (DSE3)

UNIT I
Introduction to Microbial biotechnology, Definition, Bioprospecting of microbial diversity, Isolation and preservation of industrially important microorganisms

UNIT II
Production of proteins and enzymes in bacteria, recombinant vaccines, polysaccharides from microbes

UNIT III
Microbes as biocontrol agents: microbial insecticides: their mode of action (Metarhiziumanisopliae, Bacillus thuringiensis, Nuclear Polyhedrosis Virus), requirements of biopesticide registration, insect resistance transgenic plants

UNIT IV
Microbial biomass production, lignocellulose biodegradation, application of ligninolyticmicrorganisms and enzymes in biodegradation

LABORATORY-DSE3 BASED ON MICROBIAL TECHNOLOGY (DSE3)

1. To isolate microbes for bio-prospecting from biological soil
2. To preserve microbes using glycerol
3. To produce protein in *Escherichia coli*
4. To isolate microbes with the ability to secrete microbial polysaccharide
5. To isolate microbes having the bio-control potential

SUGGESTED READING
1. Clark DP and Pazdernik NJ. Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
2. Glick, B.R., Pasternak, J.JMolecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
3. Glazer Hiroshi Nikaido W.H.Freeman and Company Microbial Biotechnology Alexandern.
4. Bernaral R Molecular Biotechnogy: Principles and Applications of Recombinant DNA.
5. Fungal Ecology and Biotechnogy, Rastogi Publicaions, Meerut.

DSE3: BIODIVERSITY AND BIO-PROSPECTING (DSE3)

UNIT I

Components of biodiversity, Biodiversity crisis and biodiversity loss, Importance of biodiversity in daily life, Biodiversity and climate change, Types of Ecosystems, India as mega biodiversity Nation, Hot spots and biodiversity in India, Biodiversity and Ecosystem functioning, Plant and Animal systematic, Species concept in biodiversity studies

UNIT II

Modern Tools in the study of Biodiversity, endemism, endemic plants and animals, assessment of mapping of biodiversity; GIS/Remote sensing; Biotechnology and Conservation, IUCN, Germplasm banks, National Parks, Botanical Gardens, Wild life Sanctuaries, Bioresources, Health and biodiversity

UNIT III

Introduction to bioprospecting, bioprospecting from plants, plant derived drugs, botanicals for biocontrol, bioprospecting from animal sources, scope and examples

UNIT IV

Bio-prospecting from microbes, micro organisms as a source of novel enzymes, antibiotics, antiviral agents, immunosuppressive agents and other therapeutic agents

LABORATORY-DSE3 BASED ON BIODIVERSITY AND BIO-PROSPECTING (DSE3)

1. To study the faunal composition (insects and mites) of soil samples (Berley's funnel)
2. To study faunal composition of water samples (Lucky drop method)
3. To study the microbial diversity from soil sample/ water sample
3. Report on visit to National Park/Wild life sanctuary/Botanical garden
4. Study through specimens/photographs/slides of : Source of Immunosuppresive and other therapeutic agents, Botanicals for biocontrol, Sacred flora (havan materials etc.)
5. Study of the characteristic features of any two flowers for each family
(a) Malvaceae/ Fabaceae/Cruciferae/Ranunculaceae (any one family)
(b) Compositae

SUGGESTED READINGS

1. Aber, J.D.and Melillo J.M., Terrestrial Ecosystems, W.B.Saunders
2. Ingrowille, M Diversity and Evolution of land plants chapman and Hall
3. Arora, R.K. and Nayar, E.R. Wild relatives of crop plants in India, NBPGR Science
4. Baker, H.G. Plants and civilization (A. Wadsworth, Belmount).
5. Bole, P.V. and Vaghani, Y. Field guide to common Indian trees, Oxford University Press, Mumbai.
6. Thakur, R.S., Puri, H.S. and Husain, A. Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.
7. Swaminathan, M.S. and Kocchar, S.L. (Es.) Plants and Society, MacMillan Publication Ltd.,

DISCIPLINE SPECIFIC ELECTIVE (DSE-4) LS/BT/DSE-604/PD

DISSERTATION

The Dissertation will be prepared by the students under the supervision of faculty member. The dissertation will include a collection of literature, review writing, hypothesis or a survey or Industrial tour. The write-up/report has to be submitted for evaluation.