B.Sc. (Biotechnology) Semester-3

Course Code	US03CBIT51	Title of the Course	Fundamentals of Biotechnology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To educate the students on conceptand scope of biotechnology 2. To understand the tools in used in biotechnology 3. To educate the students on nucleotides structe and chemistry

Course Content		
Unit	Description	Weightage* (%)
1.	Biotechnology-Definition, history, concept of old and new biotechnology, Major areas of Biotechnology(Red, white, Green, Blue & Gold), Scope and importance of Biotechnology, commercial potential of Biotechnology, Various GOI schemes for Biotechnology in India-BIRAC, BioNEST, DBT, GSBTM, Bio-incubators, Biotech Parks, Biopharma mission, Biotech KISAN programme, Challenges faced by Biotechnology. Concept and definitions- cloning vectors, transgenic animal/ plant, GMO	25%
2.	Composition of DNA-Concept of nucleoside and nucleotides. DNA double helix structure (Watson and Crick model). , Chargaff's rule. Genetic code, Wobble's hypothesis. RNA –Structure, types and function (t-RNA, m-RNA, r-RNA ,sn-RNA, micro RNA) .RNA isolation: principle and methodology(LiCl, Guanidium thiocynate)	25%
3.	Extra chromosomal DNA(mitochondria & chloroplast,)- basic structure, properties and use to the host, Plasmid DNA-basic properties, classification, types- natural (Ti, F, R, Col, Ri) artificial (pBR322and PUC8) plasmid competency and transformation	25%
4.	Instrument in Biotechnology: Incubator, Agarose gel electrophoresis, U.V.Transilluminator, Laminar air flow hoods (LAF), Centrifuge-Types, principle and use, differential and isopycnic centrifugation. Methodology & role of reagents in Genomic DNA isolation in plant & yeast	25%

Teaching-Learning Methodology	Chalk board, Power point presentation,quizzes, Videos available on NPTEL and BISAG

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the scope and career option in Biotechnology
2.	Understand the chemical, structure and function of nucleotides
3.	Understand the extra chromosomal DNA and plasmid vectors
4.	Understand the various instruments workings used in Biotechnology lab

Suggested References:	
Sr. No.	References
1.	Biotechnology- Expanding Hoirizon- B D Singh
2.	Molecular Biology of Gene- Watson, Hopkins & Roberts
3.	Genomics- T A Brown
4.	Principles of Biochemistry- Lehninger and Cocks
5.	Text book of Biotechnology- R C Dubey

On-line resources to be used if available as reference material
On-line Resources
Nptel.ac.in
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B.Sc. (Biotechnology) Semester-3

Course Code	US03CBIT52	Title of the Course	Fundamentals of Microbiology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand basic concepts, classification method and structure of Microbial world. 2. To understand instruments and technique for studying microorganism …

Course Content		
Unit	Description	Weightage* (%)
1.	Define Prokaryotes, Difference between Eukaryotes and Prokaryotes, Distribution of Prokaryotes in Nature, Pioneers of Microbiology (Antony van Leewanhock, Louis Pasteur, Robert Kotch), Major groups of microorganism (Bacteria, Fungi, Algae, Protozoa and virus). Major characteristic for classifying bacteria, General methods of classifying Bacteria (intuitive method, numerical method, genetic relatedness), introduction of Bergey's Manual.	25
2.	Size, shape, arrangement of Bacterial cell, Bacterial structure: External (cell wall, Envelope, Pili, flagella, Capsule/sheath/prostheca) Internal (cytoplasmic membrane, cytoplasmic inclusion, nuclear material, ribosome). Specific structure Endospore. Nutritional requirement of bacteria, Nutrional type of bacteria. Physical condition required for bacteria growth (pH and temperature). Normal Growth curve.	25
3.	Principle of Microscopy (magnification and resolution), Bright field microscopy (simple and compound), Principle and working of Autoclave. Importance of staining dyes and stain, preparation of smear, fixation, mordent decolourizer. Simple staining(Monochrome and negative staining, Differential staining(Gram's staining), Special staining (endospore , cell wall)	25
4.	Definition Pure culture and Axenic culture, Media: general ingredients used in media classification media on basis of nature and consistency types of media (differential media, selective media, assay media, enrichment media. Technique for isolation of Pure culture. Concept of sterilization, characteristic of antimicrobial agent, Physical antimicrobial agent(heat, radiation ,filtration, osmotic pressure) , chemical antimicrobial agent(phenol, alcohol, halogen, surfactants heavy metals)	25
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Teaching-Learning Methodology	

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the major group of microbes and microbial classification and taxonomy.
2.	Understand the morphology and nutrional criteria of bacteria.
3.	Understand microscopy and various staining techniques.
4.	Understand concept and isolation of pure culture, and antimicrobial agents.

Suggested References:	
Sr. No.	References
1.	Microbiology ,Pelczar, Chan, and kreig , 5^{th} edition
2.	Elementary microbiology, H A Modi
3.	Prescott's microbiology
4.	Microbiology R M Atlas

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

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B.Sc. (Biotechnology) Semester-3

Course Code	US03CBIT53	Title of the Course	Practicals
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	The main purpose of study of laboratory instruments and laboratory work is to provide students with conceptual, practical, and theoretical knowledge to help them learn scientific concepts and through scientific methods to understand the science
	To learn about different tests used for identification of bacterial species based on the differences in biochemical activities of different bacteria.
	To have hands of experiments in isolation of DNA and plasmid DNA.

Course Content

Unit	Description
	SECTION 1
1	Study of lab instruments: Microscope ,Centrifuge, Autoclave and Incubator
2	Biochemical test (E.coli) Carbohydrate fermentation test, IMViC & TSI test.
3	Effect of heavy metals on the growth of bacteria.
4	Extraction of protein by TCA method.
5	Quantitative and qualitative analysis of soil microflora. (TVC)
6	Isolation of genomic DNA from E.coli.
	SECTION 2
1	Isolation of microorganisms from soil sample by streak/spread and pour plate method.
2	Gram's staining
3	Use of selective and differentiatial media
4	Effect of pH and temperature on the growth of microorganisms.
5	UV absorption of isolated DNA and determine its purity.
6	Monochrome staining
7	Negative staining

Teaching-Learning Methodology	Chalk board, Power point presentation,quizzes, Videos available on NPTEL and BISAG

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	To gain basic knowledge of various practical work and learn about use of laboratory instruments.
2.	Gain basic knowledge on various pure culture techniques for the isolation of microorganisms from various samples and effect of different environmental factors on growth of organisms.
3.	Characterize and differentiate various types of bacteria using different staining techniques.
4.	To gain basic knowledge of various practical work and learn about use of laboratory instruments.

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

On-line Resources
Nptel.ac.in
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(Bachelor of Science)
(B.Sc.) (Biotechnology) Semester IV

Course Code	US04CBIT51	Title of the Course	Molecular Biology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To acquaint students to Chromosomes and genome organization To familiarize students to the process of replication, transcription and translation in prokaryotes To understand DNA damage , DNA repair and operon concept

Course Content		
Unit	Description	Weightage* (%)
1.	Chromosome structure, types and banding (G, C, Q, R, T) - Nucleosome, chromatin, DNA binding proteins Histones & Non-histones DNA protein interaction. Genome organization- Unique sequence, repetitive sequence. Denaturation, renaturation and Cot curve. Introduction to Transposons.	25%
2.	Prokaryotic Replication- definition, property and features of prokaryotic DNA replication. Unidirectional and bidirectional replication. Initiation, elongation and termination of replication. Enzymes and proteins involved in replication. Closed clamp and rolling circle model of replication. Regulation of prokaryotic replication.	25%
3.	DNA mutation at chromosome and gene level, DNA- damage & repair, mismatch repair, direct repair, excision repair, SOS repair.	25%
4.	Prokaryotic Transcription- Definition, Initiation, elongation, termination of transcription. Prokaryotes translation- Definition , aminoacylation of tRNA , Initiation , elongation and termination of translation. Gene regulation- - lac and trp operon	25%

Teaching-Learning Methodology	Classroom interaction, Use of blackboard and chalk ICT tools involving smart boards, power point presentation, videos, animations & models. Assignments Seminar, unit test, and quiz

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand genetic material and its mechanism to copy, and decode the information at molecular level
2.	Understand the chromosome and genome organization
3.	Understand the DNA damage and various types of DNA repair.
4.	Understand the gene regulation.

Suggested References:	
Sr. No.	References
1.	Genes—Benjamin Lewin.
2.	Molecular biology of the gene-Watson et al
3	Molecular biology of the cell- Alberts et al
4	Cell and Molecular Biology: Concepts and Experiments. Karp, G. (2010). VI Edition. John Wiley & Sons. Inc.

5	Cell and Molecular Biology. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). VIII Edition. Lippincott Williams and Wilkins, Philadelphia

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

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B.Sc.—Biotechnology Semester—IV

Course Code	US04CBIT52	Title of the Course	Plant and Animal Biotechnology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1.To know about Plant Tissue Culture, its methodologies, and its applications. 2.To understand about Animal Tissue Culture its methodologies, and its applications. 3. To understand about Stem Cells and its applications.

Course Content		
Unit	Description	Weightage* (%)
1.	• Introduction to plant tissue culture, totipotency of plant cells (Dedifferentiation, redifferentiation, regeneration of whole plant) • Nutritional requirements for plant tissue culture: nutrient media – macronutrients and micronutrients, media additives (carbon source, vitamins, amino acids) • Plant growth regulators structure, analogs& functions(cytokinins, auxins, gibberellins). • Preparation of media, selection and surface sterilization of explants, inoculation, incubation (temperature and light regime), regeneration of plants. • Initiation of callus cultures and cell suspension cultures • Regeneration (shoot regeneration and somatic embryogenesis).	25%
2.	Applications of Plant Tissue Culture • Meristem culture and production of disease-free plants • Micropropogation of elite ornamental plants, encapsulation, and production of synthetics seeds • Cell suspension cultures (batch and continuous culture) for production of secondary metabolites • Embryo culture and embryo rescue; Protoplast culture and fusion, Development of somatic hybrids and cybrids and their applications • Somaclonal variation and their applications; production of haploids, Anther, pollen, ovary& ovule culture	25%
3.	• Introduction of animal cell culture and tissue culture- basic	25%

	concepts. Historical landmarks. Laboratory facility. Culture Media-Natural and artificial. Substrate and suspension culture, Initiation of Cell cultures, Primary culture, secondary culture, subculturing. Concept of cell line- finite and continuous. • Organ culture, Bioreactors for large scale culture of cells.	
4.	• Introduction to Transgenic animals, Objectives of Gene Transfer, Gene transfer methods in Animals (Calcium Phosphate precipitation, Lipofection, Fusion with Bacterial Protoplasts, Electroporation, Retroviral Infection, Microinjection). • Applications of transgenics animals (Fish, Cattle, Sheep and Mice) • Cell culture products (interferons) • Stem cells-types, and its applications.	25%

Teaching-Learning Methodology	Classroom lectures and uses of chalk and blackboard. ICT tools involving smart boards, power point presentations, videos, animations, and models.

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the terms and different definitions used in plant tissue culture.
2.	Understand about requirements and methodologies used in PTC.
3.	Understand terms and definitions used in animal tissue culture.
4.	Understand about requirements and methodologies used in animal tissue culture
5.	Understand about stem cells and its applications.

Suggested References:	
Sr. No.	References
	• Plant tissue culture – Kalyan Kumar De (1st Edition) • Plant tissue culture and organ culture – Reinert and Bajaj (1st Edition) • Culture of Animal Cells, R.I Freshney, Wiley-Leiss. • Animal Cell Culture – A Practical approach, J.R.W. Masters, Oxford. • Animal Cell Culture Techniques, M. Clynes, Springer Verlag. • Cell Culture Lab Fax, M. Butler and M. Dawson, Bios scientific Publications Ltd. • Cell Growth and Division – A Practical approach, R. Basega, IRL Press. • Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima publication. • Biotechnology in crop improvement – Harvinder Singh Chawla (1st Edition) • Plant Tissue culture- Rajdhan • Genetics – P K Gupta • Cell biology, genetics, molecular biology, evolution, and ecology- P.S. Verma and R.S. Agarwal • Expanding horizons of Biotechnology – B D Singh

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

B.Sc. (Biotechnology) Semester-4

Course Code	US04CBIT53	Title of the Course	Practicals
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To acquaint students with molecular techniques & different instruments used in biotechnology lab
	To enrich the students to have practical experience on molecular biology and genetic engineering
	To have hands on experience in isolation of DNA and plasmid DNA

Course Content

Unit	Description
	SECTION 1
1	Study of lab instruments LAF, electrophoresis unit and UV transilluminator
2	Isolation of plasmid DNA from Ecoli by alkali lysis method
3	Restriction digestion
4	Isolation of DNA from plant by CTAB method
5	Effect of UV as a mutagen on the given culture.
6	Study of renaturation of DNA and Cot Curve
	SECTION 2
1	Chromosome banding (Giemsa & Q banding)
2	Preparation of MS media
3	Study of callus culture
4	Study of embryo culture
5	Study of stem culture
6	Agarose Gel electrophoresis
7	Encapsulation of embryo

Teaching-Learning Methodology	Chalk board, Power point presentation,quizzes, Videos available on NPTEL and BISAG

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Extending the hands on experience on media preparation
2.	Able to demonstrate the various types of culture used in plant tissue culture.
3.	Developing and applying the skills gained through the molecular and plant tissue culture techniques for research as well as in various fields of applied science
4.	To give hands on experience in isolation of DNA

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