Course code 22BBTA1	Allied -IA	T/P	C	H/W
	BIOINSTRUMENTATION	**T**	**3**	**3**
Objectives	The major objective of this course ➢ develop understanding of the key concepts of basic and advanced experimental techniques used across biological sciences ➢ focus on principle and design of the instruments.			
Unit - I	Separation Methods: Diffusion: Translational diffusion, Rotational diffusion. Sedimentation, Osmosis, Viscosity, Chromatographic methods: Thin layer chromatography, Column chromatography (LC, Adsorption chromatography, Size-exclusion chromatography, Ion exchange chromatography and affinity chromatography), Gas chromatography. Electrophoretic methods: Gel electrophoresis, 2-D electrophoresis.			
Unit - II	Spectroscopy: Principles, Methodology and applications of Ultraviolet (UV) spectroscopy, Infrared spectroscopy, Raman Spectroscopy, Atomic absorption chromatography, ESR spectroscopy, Mass spectroscopy and NMR.			
Unit - III	Microscopy: Features and applications of Optical microscopy: Compound microscope, Dark-field microscopy, Phase contrast microscopy, Polarized-light microscopy, Fluorescence microscopy. Electron microscopy: Types: Transmission and Scanning transmission electron microscopy. Confocal microscopy, Scanning probe microscopy (STM and ATM). Diagnostic imaging: Endoscopy, MRI and Sonography.			
Unit - IV	X-ray Diffraction: Diffraction of X-rays, Structure determination, Phase determination procedures, Structure refinement, Application in determination of structure and function of small molecules, globular molecules and fibrous macromolecules.			
Unit - V	PCR: Types of PCR, principles and applications of PCR. Blotting hybridization: Western blotting, Northern Blotting and Southern Blotting and autoradiography.			

Reference and Textbooks:

Bialek, W. (2012). *Biophysics: searching for principles*. Princeton University Press.

Cotterill, R. (2014). *Biophysics: An Introduction*. John Wiley Publication.

Glaser, R. (2012). *Biophysics: an introduction*. Springer Science & Business Media.

Upadhyay, A. (2020). *Biophysical Chemistry-4th edition.* Himalaya Publishing House Pvt. Ltd.

Webster, J.G. (2007). *Bioinstrumentation*. Wiley Publications.

Wilson, K., & Walker, J. (Eds.). (2010). *Principles and techniques of biochemistry and molecular biology*. Cambridge university press.

Outcomes	Upon successful completion of the course, the student ➢ learn basic concepts of various techniques used to analyze nucleic acids, proteins and other biomolecules.

Course code	Allied Practical-IA	T/P	C	H/W
22BBTAP1	**LAB IN BIOINSTRUMENTATION**	**P**	**2**	**2**

Objectives

The course will introduce students about

- Knowledge and skills in analysis of samples including extraction, sample preparation and instrumentations analysis,
- learn techniques in quantitative and qualitative methods.

1. Separation of amino acids by Paper chromatography
2. Separation of lipids by TLC
3. Separation of DNA fragments by Agarose gel electrophoresis
4. Separation of Proteins by SDS-PAGE
5. Checking Nucleic Acid Purity using absorbance at A260/A280
6. Gram Staining and visualization of Gram positive and Gram-negative bacteria
7. Southern Blotting.

Reference and Textbooks:

Christian, G.D.(2001). *Analytical Chemistry, 5th edition*. John Wiley and Sons Inc., India

Gakhar, S.K., Monika Miglani, & Ashwani Kumar. (2021). *Molecular Biology: A Laboratory Manual*. Dreamtech Press.

Goel, P.K. (2006). *Water Pollution Causes, Effects and Control*. New Age International Publishers.

Rao, B. S., & Deshpande, V. (2005). *Experimental biochemistry: a student companion*. Anshan. I.K International Publishing House.

Wilson, K, & Walker, J. (2010). *Principles and Techniques of Biochemistry and Molecular Biology, 7th edition*. Cambridge University Press.

Outcomes

On successful completion of the course, students can

- Understand the instrumental techniques and methods of analysis
- Use spectroscopic and chromatographic techniques to quantify various samples
- Collect, analyze, validate the instrumental data and conclude the analytical data.
- Demonstrate the ability to communicate results effectively

Course code 22BBTA2	Allied–IB	T/P	C	H/W
	PLANT AND ANIMAL BIOTECHNOLOGY	**T**	**3**	**3**

Objectives	The course aims to ➢ Realize the basic concepts of animal cell culture. ➢ Understand the basic properties of cancer cells. ➢ Describe the principle and application of gene manipulation. ➢ Illustrate how transgenic animals can be produced with a specific gene of interest and their clinical advantages
Unit - I	Plant tissue culture: Types of cultures – Callus, Cell suspension, Protoplast, and Anther culture. Plant regeneration: Somatic embryogenesis and organogenesis. Different types of culture media.
Unit - II	Culture Methods for animal cells, tissue and organs: Introduction – Culture media: serum media & serum free media – biology of cultured cells – cell growth kinetics – primary culture– subculture
Unit - III	Gene transfer techniques in plants: Methods of transformation – Direct (microinjection and microlaser) and Indirect – selectable markers, reporter genes and promoters used in plant expression vectors. Mechanism of T-DNA transfer to plants. Ti-plasmid vectors for plant transformation – agroinfection.
Unit - IV	Gene transfer techniques in animals – Transfection – liposuction – electroporation, biolistics, microinjection, embryonic cell transfer – targeted gene transfer.
Unit - V	Tissue Engineering – Skin, Liver, Pancreas. Xenotransplantation – terminology, technology behind it, organ donors.

Reference and Textbooks:

Freshney, E. D. (2010). *Culture of Animal Cells*. John Wiley Publication.

Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). *Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control.* With STUDENT CONSULT Online Access. Elsevier Health Sciences.

Johnvennison. (2010). *Laboratory manual for Genetic Engineering*. PHI Learning publication.

Joseph Sambrook, & Michael R. Green. (2015). *Molecular cloning: A Laboratory Manual*. Cold Spring Harbor publication.

Maloy, S. R., Stewart, V. J., & Taylor, R. K. (1996). *Genetic analysis of pathogenic bacteria: a laboratory manual*. Cold Spring Harbor Laboratory Press.

Sambrani, S. (2013). *Plant & Animal Tissue Culture*. Vision Publications.

Outcomes	On successful completion of the course, students can ➢ Realize the basic concepts of plant and animal cell culture. ➢ Describe the principle and application of gene manipulation. ➢ Illustrate how transgenic organisms can be produced with a specific gene of interest and their advantages.

Course code 22BBTAP2	Allied Practical-IB	T/P	C	H/W
	LAB IN PLANT AND ANIMAL BIOTECHNOLOGY	**P**	**2**	**2**

Objectives

The course aims to impart

- Familiarization with practical knowledge about the basic principles and application of plant tissue culture.
- Understanding of the use of molecular markers in assessing the genetic similarity and diversity of plants

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. Demonstrate various steps of Micropropagation.
4. Demonstrate use of growth hormones in plant culture medium
5. Preparation of Hanks Balanced salt solution
6. Preparation of Minimal Essential Growth medium
7. DNA isolation from animal tissue
8. Quantification of isolated DNA.
9. Analysis of DNA on Agarose Gel electrophoresis.

Reference and Textbooks:

Bob B. Buchanan. (2015). *Biotechnology and Molecular Biology of Plants 2nd Edition*. Edited by American Society of Plant Biologists, Berkeley, USA

Chawla, H.S.(2020). *Introduction to Plant Biotechnology*. 3rd Edition. OXFORD & IBH Publication.

Holland, A.J, & Johnson, A, (1998). *Animal Biotechnology and Ethics*. Springer US.

Purohit, S.S. (2004). *Biotechnology: Fundamentals and Applications*. Students Edition

Sandy Primrose, Richard Twyman & Bob Old. (2006). *Principles of Gene Manipulation- 7th Edition*. Blackwell Science

Singh, B.D. (2015). *Plant Biotechnology. 3rd Edition.* Kalyani Publishers.

Slater**.** (2008). *Plant Biotechnology: The Genetic Manipulation of Plants*. Oxford Publication.

Outcomes

On successful completion of the course, Students can

- Narrate the gene function and regulation is used in modern plant and animal biotechnology for plant or animal improvement.
- Gain knowledge to Identify the basic methods and approaches used in molecular biology to utilize molecular markers
- Differentiate the pros and cons of transgenic plants and animals

Course code 22BBTA3	Allied -IIA	T/P	C	H/W
	BIODIVERSITY	**T**	**3**	**3**

Objectives	The course aims to provide knowledge on the ➢ relationship between biodiversity and ecosystem functions ➢ direct and indirect values of biodiversity resources and their bioprospecting opportunities
Unit - I	Biodiversity: Concepts, significance and magnitude. Levels of biodiversity: Genetic, species, population, community, ecosystem and landscape. Biodiversity and its uses: Source of food, medicine.
Unit - II	World's major gene banks of plant genetic resources, methodology of gene banking, control of gene banks. India's biodiversity richness: plant, animal, marine and human diversity.
Unit - III	Threats to biodiversity: Exotics, Impact of green revolution. Climate change and habitat loss. Carbon emissions, carbon credit and carbon trading. RED DATA book.
Unit - IV	Global biodiversity: Conservation of biodiversity, endangered species, conservation strategies for plant diversity: *In situ* strategies – biosphere reserves, reserve forests, national parks and sanctuaries. *Ex situ* strategies – collection gardens, seed storage, tissue culture and cryopreservation. Role of IUCN in the conservation of Biodiversity.
Unit - V	Conservation of animal diversity: gene banks, captive breeding and *in vitro* technologies. Ecotourism and Wild life trade.

Reference and Text books:

Alonso A. Aguirre & Raman Sukumar. (2017). *Tropical Conservation. Perspectives on Local and Global Priorities*. Oxford University Press, USA.

Chaudhuri, A.B & Sarkar, D.D. (2003). *Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hot Spots*. Daya Publishing House, New Delhi.

Dadhich, L.K., & Sharma, A.P. (2002). *Biodiversity –Strategies for Conservation*. APH Publishing Corporation, New Delhi.

Kala, C.P., & Silori, C.S. (2013). *Biodiversity Communities and Climate Change*. TERI, New Delhi.

Marselle, M. R., Stadler, J., Korn, H., Irvine, K. N., & Bonn, A. (2019). *Biodiversity and health in the face of climate change* (p. 481). Springer Nature.

Outcomes	On successful completion of the course, Students can understand the significance ➢ Value of biodiversity and drivers of its loss ➢ Measure Efforts taken to conserve biodiversity ➢ Practical issues with local conservation for sustainable management of bio resources

Course code 22BBTAP3	Allied Practical-IIA	T/P	C	H/W
	LAB IN BIODIVERSITY	**P**	**2**	**2**

Objectives

The course makes students to

- Understands the concept of biodiversity, its types, values and its conservation methods.
- Empower the students to think critically about biodiversity and conservation
- Understand the existing novel technologies used for conserving plant and animal biodiversity

1. Examination of morphology and anatomy of vegetative and reproductive parts of Selaginella, Equisetum
2. Examination of morphology and anatomy of vegetative & reproductive parts of - Cycas & Pinus
3. Plant collection (pteridophytes & gymnosperms)
4. Preparation of a permanent mount of Salpa, Placoid scales, spicules of Herdmania, Pharynax of Amphioxus, Tadpole Larva of frog
5. Identification of endoskeletons of frog and rabbit.

Reference and Textbooks:

Alonso A. Aguirre & Raman Sukumar. (2017). *Tropical Conservation. Perspectives on Local and Global Priorities.* Oxford University Press, USA

Chaudhuri, A.B. & Sarkar, D.D. (2003). *Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hot Spots*. Daya Publishing House, New Delhi.

Dadhich, L.K., & Sharma, A.P.(2002). *Biodiversity –Strategies for Conservation*. APH Publishing Corporation, New Delhi.

Kala, C.P., & Silori, C.S. (2013). *Biodiversity Communities and Climate Change*. TERI, New Delhi.

Marselle, M. R., Stadler, J., Korn, H., Irvine, K. N., & Bonn, A. (2019). *Biodiversity and health in the face of climate change* (p. 481). Springer Nature.

Outcomes

On successful completion of the course, students

- Evaluate prospects for future management of Biodiversity.
- Evaluate the successes and failures of past National and International efforts to address conservation of Biodiversity.

Course code 22BBTA4	Allied -IIB	T/P	C	H/W
	BIOINFORMATICS	**T**	**3**	**3**

Objectives	The course aims to empower the learners with ➢ Scope of Bioinformatics ➢ Introduction to sequence alignment and programming ➢ Database and their use ➢ Protein analysis using bio informatics tools ➢ DNA mapping and other special topics in bio informatics
Unit-I	Introduction and history of bioinformatics – Internet, World Wide Web, Web browser, EMB net, NCBI. File transfer protocol. Search engines.
Unit-II	Database – Definition, DBMS – Biological Databases – FASTA, BLAST, Genbank, DNA sequence databases, Protein databases. Entry formats, carbohydrate databases, Enzyme databases
Unit -III	Tools for Bioinformatics:Pairwise alignment – Dotplots – scoring matrices – Blosum Matrices – PAM Matrix – Gap Penalty.
Unit -IV	Pairwise Sequence Analysis Tools:BLAST – Steps involved in using BLAST – Interpreting BLAST results; FASTA – Alignment Scores – Multiple Alignment – ClustalW. Phylogenetic Tree.
Unit-V	Application aspects of Bioinformatics– Target identification– Drug designing– Cheminformatics.

Reference and Textbooks

Andreas D Baxevanis & Francis, B.F.(2002). *Bioinformatics- A practical guide to analysis of Genes & Proteins",* John Wiley.

Attwood, T.K., & Parry-Smith, D J. (2005). *Introduction to Bioinformatics*. Pearson Education.

Campbell, A. M., & Heyer, L.J.(2006). *Discovering Genomics, Proteomics and Bioinformatics. II Edition.* Benjamin Cummings.

Ghosh, Z., & Bibekanand, M. (2008). *Bioinformatics: Principles and Applications*. Oxford University Press.

Pevsner, J. (2009). *Bioinformatics and Functional Genomics- II Edition*. Wiley-Blackwell.

Outcomes	On successful completion of the course, students will gain knowledge about ➢ nucleotide Databases. ➢ Protein databases. ➢ Literature survey through Pubmed. ➢ Local similarity search. ➢ Global similarity search. ➢ Gene prediction and translation. ➢ Protein sequence analysis.

Course code 22BBTAP4	Allied Practical-IIB	T/P	C	H/W
	LAB IN BIOINFORMATICS	**P**	**2**	**2**

Objectives

The course deals with the study involves

- Gene feature identification
- Gene Annotation and analysis of transcription and translation
- Post-translational analysis and Protein interaction.

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

Reference and Textbooks:

Andreas D Baxevanis, & Francis, B.F.(2002). *Bioinformatics- A practical guide to analysis of Genes & Proteins*. John Wiley.

Attwood, T.K., & Parry-Smith, D.J. (2005). *Introduction to Bioinformatics*. Pearson Education.

Campbell, A.M., & Heyer,L.J. (2006).*Discovering Genomics, Proteomics and Bioinformatics- II Edition.* Benjamin Cummings.

Ghosh, Z., & Bibekanand, M. (2008) *Bioinformatics: Principles and Applications*. Oxford University Press.

Pevsner, J. (2009). *Bioinformatics and Functional Genomics-II Edition*. Wiley-Blackwell.

Outcomes

On successful completion of the course, Students gain skills about

- different biological database that provides information about protein and nucleic acid
- sequence similarity and alignment
- Gene feature identification
- Gene Annotation and analysis of transcription and translation
- Post-translational analysis and Protein interaction.