DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
RESEARCH PROGRAM – M. Phil / PhD in Biotechnology
(2019–2020 Batch and onwards)

Code	Course	Objectives and Outcomes		Ins*	Marks	Exam Hrs	Credit
		PEO´s	PO´s & PSO´s	hours / week	Total		
19RBT101	**Paper – I:** Research Methodology and Pedagogy	I, II, III	a, c, e	4	100	3	4
19RBT201	**Paper – II:** Recent Trends in Biotechnology	I,II	b, d	4	100	3	4
Paper – III *							
19RBT301	Paper – III: Animal Biotechnology	II, III	d, f, g				
19RBT302	Paper – III: Biotechnology for crop improvement	II, III	d, f, g				
19RBT303	Paper – III: Environmental Biotechnology	II, III	d, f, g				
19RBT304	Paper – III: Immunology	II, III	d, f, g	4	100	3	4
19RBT305	Paper – III: Medicinal Plant Biotechnology	II, III	d, f, g				
19RBT306	Paper – III: Plant Tissue Culture	III, IV	f, g, h, i				
19RBT307	Paper – III: Food Technology	III, IV	f, g, h, i				
19RBT308	Paper – III: Structural Biology	III, IV	f, g, h, i				
	G. total			**12**	**300**	**9**	**12**

Blue – Employability Green – Entrepreneurship Red- Skill Development

PROGRAMME OUTCOMES (POs)

a) Research Graduates will be able to spread over the basic knowledge of applied theories in practical research.

b) Providing necessary broad analytical knowledge to make the scholar for appearing in competitive examinations

c) Ability to design and conduct experiments as well as to interpret the results.

d) A skilled to work on biotechnological concepts and allied fields (immuno, medical, microbial, Food, agricultural, environmental, plant and animal) with recent tools and techniques towards academic, industrial and research application.

e) Scholars will be able to visualize and work on multidisciplinary laboratory problems with standard operating methodologies.

f) With professional, societal and ethical responsibilities, the research scholars with be able to identify, formulate and solve to deliver process/product.

g) Research Graduates will be able to update the current knowledge of interdisciplinary subjects of biotechnology

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

To enable the scholar to emerge as:

h) Professional Biotechnologist with lifelong learning with recognized the societal need.

i) Proficient entrepreneurial and leadership qualities with life-long learning**.**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I: The research graduates of Biotechnology will able to acquire in-depth research knowledge in various fields of Biotechnology and become competent in competitive exams

PEO II: The research graduates of Biotechnology are able to design, analyze, conduct and interpret the experimental data for process/product development in all sub areas of biotechnology

PEO III: The research graduates of Biotechnology will able to use the concept of theories, research practical skills and recent technological tools in solving any technological and professional issues independently in a global and societal context

PEO IV: The research graduates of Biotechnology will continue learning to update and to become an entrepreneur in a competitive world of technology and contribute to all forms of life

MAPPING OF PEOs AND POs

PEOs			Programme Outcome (s)						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PEO I	×	×		`					
PEO II			×	×					
PEO III					×	×			
PEO IV							×	×	×

19RBT101 **Paper – I: Research Methodology and Pedagogy** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on Identification of research requirements
- To apply the state of art knowledge for dissertation writing
- To become familiarize with Experiment design
- To understand the methods of data collection and analysis
- To grasp knowledge on Objective and roll of higher education
- The students will learn overall the basic concept in Characteristics of instructional design

Course Outcomes

On completion of the course, students are able

1. To understand principles of formulation of objectives and hypothesis
2. To explain Guidelines for review of literature
3. To get insight to Use of software for graphics
4. To production of therapeutic proteins in transgenic animals
5. To explain the Ethical issues in animal biotechnology
6. To explain the methods of teaching and learning

Unit I Analysis and Identification of research requirements:

Prioritization of research area. Review of work done in identified area - time scheduling - laboratory facilities, Research duration –choice of research topic – formulation of objectives- formulation of hypothesis– Methodology – Procedure, experiment design.

Unit II Dissertation writing:

Guidelines for review of literature - Materials and methods, results and discussion. Interpretation of results, presentation of results, summary, presentation of references and appendix.

Unit III Experiment design:

Regarding observation. Types of observation. Laboratory setting sample; Data collection – Presentation of and analysis of collected data. Preparation of result reports and Publication of research findings in prier reviewed journals, impact factor.

Unit IV Methods of data collection and analysis:

classification and tabulation. Frequency distribution. Measures of central tendency – Mean, median and mode; Measures of dispersion – Standard deviation, standard error, and variance. Correlation and regression – simple correlation, correlation co-efficient, simple and linear regression analysis. Test of significance (F, t test), chi-square test, ANOVA, DMRT, SPSS. Introduction to computer, MS office. Data handling – Use of software for graphics, slide making, scanning gels, photography X-ray photography and autoradiogram perspective.

Unit V Objective and roll of higher education:

Important characteristics of an effective Lecture - Quality teaching and learning – Lecture Preparation - Characteristics of instructional design – Methods of teaching and learning: Large group – Technique – Lecture, Seminar, Symposium, Team teaching, Project, Small Group Technique – Simulation, role playing Demonstration, Brain storing, case Discussion, and assignment, Methods of evaluation – Self evaluation, Student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education : 'e' learning researches – web based learning.

SUGGESTED READINGS

1. Sandhu,T. (1990). Research Techniques in Biological Sciences. Anmol Publishers, New Delhi.
2. Palanivelu, P. (1999). Analytical Biochemistry and Separation Technique. 3rd Ed, 21st Century Publications, Madurai.
3. Sundar Rao, P.S.S and Richard, J. (2006). Introduction to Biostatistics and Research Methods. PHI Publications, New Delhi.
4. Kothari, C. R. (2004). Research Methodology – Methods and Techniques. 2nd Ed. New Age International Pvt. Ltd, New Delhi.
5. Attwood, T. K. and Parry Smith, D. J. (2002). Introduction to Bioinformatics. Pearson Education Ltd, Singapore.

19RBT201 **Paper – II: Recent Trends in Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on UPGMA based analysis
- To apply the state of art knowledge for Molecular cloning
- To become familiarize with Protein engineering
- To understand the methods of Pharmaceutical and Nano Biotechnology
- To grasp knowledge on Upstream and downstream processes
- The students will learn overall Stem cells research

Course Outcomes

On completion of the course, students are able

1. To understand principles of cloning in microorganisms and higher organisms
2. To explain Metabolic engineering
3. To get insight to Use the Transgenic plants
4. To production of therapeutic proteins in transgenic animals
5. To explain the organic synthesis in drug discovery
6. To explain Stem cell therapy

Unit I Biotechnological tools:

UPGMA based analysis –RFLP, RAPD, AFLP, STS, ISSR. Protein and Nucleic acid sequencing and Micro-array. New generation sequencing approaches, Basic Principles and applications. Bioinstrumentation: Microscopy, Electrophoresis, Centrifugation, ELISA, RIA, FISH. Separation techniques: HPLC, GC, HPTLC, LC-MS and application. Spectrophotometry – UV-VIS, FT-IR, Flame photometry, Fluorimetry, Flow cytometry and AAS.

Unit II Molecular cloning:

Vectors in gene cloning: Types of plasmids, vectors; modifying enzymes, polymerase chain reaction, DNA/Protein sequencing, Genomic/cDNA library construction and screening, cloning in microorganisms and higher organisms: Direct and indirect gene delivery systems.

Unit III Applications of Genetic Engineering:

Protein engineering – Site Directed Mutagenesis; Recombinant protein; *De novo* designs; computational design and rational design. Metabolic engineering – Metabolic Flux Analysis, production of secondary metabolites; Molecular breeding of plants – Production of interferon – rDNA vaccines. Transgenic plants – disease- and virus resistance. Transgenic animals- Production, application.

Unit IV Pharmaceutical and Nano Biotechnology:

Biotechnology as a new frontier in health; drug design and discovery; drug development; random screen up, target identification and validation; organic synthesis in drug discovery. Drug delivery; Protein targets for drug design. Molecular modeling using computers. Nucleic acid, Protein - based Nano structure; Lab-on-a-chip; Micro contact printing.

Unit V Advances in Biotechnology:

Fermentation - Types of fermenters- Upstream and downstream processes. Gene targeting; Gene splicing; Gene pool; Genome mapping; Human genome project; Stem cells research- Fundamentals of stem cells- Stem cell therapy.

SUGGESTED READINGS

1. Bernald R Glick, and Jack J Paternack (1996) Molecular Biotechnology, Panima Publication, New Delhi.
2. Brown TA (2000) "Gene cloning - An introduction, 3rd Edition, Stanley thrones Publishers Ltd, New York.
3. Brown TA (1999). "Genomes", John Wiley and Sons Asia Pvt Ltd, New York.
4. Daan J A Crommelin and Robert D Sindelar (2002). Pharmaceutical Biotechnology, 2nd Edition, Routledge Taylor and Francis Inc, New York
5. James D Watson, Michael Gilman, Jan Witkowski. (2000). Recombinant DNA, 2nd edition, Freeman Publication, New York.
6. Palanivelu P. (2004). Analytical Biochemistry and Separation Techniques, 21st Century Publications, Madurai, India.
7. Primrose SB, Twyman, R. M. and Old, R. W. (2001). Principles of gene manipulation, 6th Edition, Blackwell Science Publishing Company, Germany.
8. Ratner and Daniel Ratner (2005). Nanotechnology a Gentle Introduction to the Next Big idea by Mark, Pearson Education, Inc.
9. Stanbury P F., A Whitaker and S J Hall, (1997). Principles of Fermentation Technology, Adithya Book Pvt Ltd, Chennai.

19RBT301 **Paper – III: Animal Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on basic animal tissue culture techniques
- To apply the state of art knowledge of subject for the production of tissues, introducing modern drug delivery or vaccination methods.
- To become familiarize with the ethical practices in animal biotechnology
- To understand the laboratory design and requirements for animal tissue culture
- To grasp knowledge on molecular techniques in animal cell culture
- The students will learn overall the basic concept in embryology

Course Outcomes

On completion of the course, students are able to

1. To understand principles of animal culture, media preparation
2. To explain Invitro fertilization and embryo transfer technology
3. To get insight in applications or recombinant DNA technology
4. To production of therapeutic proteins in transgenic animals
5. To explain the Ethical issues in animal biotechnology
6. To handle and maintain the animal models in animal houses

Unit I Laboratory design and requirements for animal tissue culture

Animal tissue culture media, Physical, chemical and metabolic functions of different constituents of culture medium serum free defined media and their applications. Types of tissue culture; disaggregation of tissue and primary cell culture, established culture, suspension culture, organ culture, three-dimensional culture

Unit II Cell separation

Cell counting Cell synchronization. cryopreservation. Cell lines - cell banks. Tissue engineering. Biology and characterization of cultured cells, tissue typing; cell – cell interaction; measuring parameters of growth; measurement of cell death – apoptosis and its determination; cytotoxicity assays.

Unit III Characterization

Need for characterization, Morphology, Chromosome analysis, DNA Content, RNA, Protein, Enzyme and Antigenic Markers. Lymphocyte preparation, Somatic cell fusion.

Unit IV Molecular cell techniques in cell culture

Cell transformation- physical, chemical and biological methods; manipulation of genes; cell cloning and micro manipulation; hybridoma technology and its applications; gene targeting. Gene Therapy. Green fluorescent protein and its application, Oncogenes and tumor suppressor genes and their regulation

Unit V Embryology

Collection and preservation of embryos; culturing of embryos; gametogenesis and fertilization in animals; types of cleavage pattern. *In vitro* fertilization and stem cell research. Transgenesis: Transgenic animals; production and application; transgenic animals as models for human diseases, transgenic in industry; Vaccine production. Ethical issues in animal biotechnology.

SUGGESTED READINGS

1. Ranga, M. M. (2003). Animal Biotechnology. 2nd Edition, Agrobios (India), Jodhpur.
2. Primrose, S. B., Twyman, R. M. and Old, R. W. (2001). 6th Ed, Principles of Gene Manipulation. Blackwell Science Publishing Company, Germany.
3. Freshney, R.I. (2000). Culture of Animal cell: A practical approach, 4th Edition, John Wiley Publications, New York.
4. Jennie, P. Mather and David Barnes. (2001). Methods in Cell Biology. Academic Press, New York.

19RBT302 **Paper – III: Biotechnology for Crop Improvement** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To learn about Molecular Markers
- To learn the strategies for gene transfer in plants and animals
- To acquire knowledge on genome mapping
- To familiarize the student with emerging field of biotechnology
- To acquaint the students to techniques employed in Molecular breeding
- To learn the history and recent developments in Molecular genetics

Course Outcomes

On completion of the course, students are able to

1. Outline the fundamental steps in a genetic engineering procedure
2. Describe the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production
3. Explain the usefulness of Molecular breeding in crop development
4. Discuss about the Molecular genetics
5. Conceptualize C-DNA clones, gene libraries, cloning of DNA sequencing.
6. Summarize various applications of cloning of DNA sequencing.

Unit I Molecular Markers:

Morphological, Biochemical and DNA based markers (RAPD, RFLP, AFLP, SSLP, SSR, VNTRS, and SNP). Development of maps, mapping populations, (F2'S Back crosses, RILs, NILs, and DHs) marker assisted selection, bioinformatics tools in mapping and comparative mapping.

Unit II Genetic Engineering:

Tools of genetic engineering, transformation techniques, gene transfer systems: - *Agrobacterium*-mediated gene transfer, vector mediated gene transfer, micro injuction, Electroporation, direct DNA - uptake, gene gun technique, selectable markers and reporter system., evaluation of transgenics, stabilization and release, biosafety and regulatory issues, intellectual property rights, bioinformatics and bioinfirmation tools.

Unit III Genetic engineering and biotechnology:

Introduction to plant genetic engineering and biotechnology, gene identification, gene isolation, synthesis of gene and gene cloning, restriction enzymes and vectors, regeneration in crop plants, application of plant genetic engineering and biotechnology, transgenic crops, application of rDNA technology - current status and future prospects, regulation mechanism for genetically modified crops, biosafety issues of transgenic crops

Unit IV Molecular breeding:

Molecular mapping and tagging of agronomically-important traits, QTL analysis in crop plants, marker assisted selection for qualitative and quantitative traits, gene pyramiding, genetic engineering, Application in crop improvement.

Unit V Molecular genetics:

Recombination in bacteria and viruses, molecular mechanism of recombination and repair, episomic and transposable elements, genomes in prokaryotes and eukaryotes, genome organization - euchromatin and heterochromatin, DNA

content variation. Types of DNA sequences - unique and repetitive sequences, C-DNA clones, gene libraries, cloning of DNA sequencing.

SUGGESTED READINGS

1. Bernald R Glick, and Jack J Paternack (1996). Molecular Biotechnolog" Panima Publication, New Delhi.
2. Brown TA. (1999). Genome John Wiley and Sons Asia Pvt. Ltd, New York.
3. Brown TA. (2000). Gene Cloning-An Introduction 3rd Edition, Stanley thrones Publishers Ltd, New York.
4. James D Watson, Michael Gilman, Jan Witkowski. (2000). Recombinant DNA" 2nd edition, Freeman Publication, New York.
5. Joshi P. (2007). Genetic Engineering and it's Application 2nd Edition, Agro Bios, India.
6. Primrose SB, Twyman, R.M. and Old R.W. (2001). Principles of gene Manipulation 6th Edition, Blackwell Science Publishing Company, Germany.
7. Purohit S.S. (2008). Biotechnology, Fundamentals and Applications 4th Edition, Agro Bios, India.
8. Varma P.S and Agarwal V.K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand Publications.

19RBT303 **Paper – III: Environmental Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain basic concepts of biotechnology to solve the environmental pollution problems
- To ascertain the knowledge about solid waste management and wastewater treatment.
- To gain information about Environmental nanotechnology.
- To gain knowledge about the biological and biotechnological measures for restoring environment.
- To involve in the present scenarios and find valuable solutions for remedy
- To update about the management strategies followed up by the industries and government.

Course Outcomes

On completion of the course, students are able to apply their knowledge on

1. Water Pollution Monitoring
2. Pollution and pollution control
3. Environmental significance of genetically modified microbes, plants and animals
4. Solid waste management systems
5. Treatment of municipal waste and Industrial effluents
6. Biotechnologically important intracellular products

Unit I Environmental Pollution:

Concept of Environmental Pollution; Origin of pollution; Classification and nature of Environmental Pollutants; Major sources; Environmental Pollution at local regional and global level. Environmental Quality Assessment and Monitoring, Deterioration of environmental quality with reference to anthropogenic impact; Environmental Impact Assessment (EIA)

Unit II Water Pollution Monitoring:

Pollutant analysis in water – Physiochemical parameters, Microbiological examination, APDC and MIBK analyses. Methods of monitoring; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors to monitor pollution.

Unit III Effluent treatment and Solid waste management systems:

Sewage and waste water treatments systems; Primary, secondary and tertiary treatments- Pycoremediation; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments; Reactors types and design; Solid waste management – types of solid waste; Disposal methods – Sanitary, incineration, land-fill, composting, vermicomposting; recovery of energy from solid waste.

Unit IV Environmental Nanotechnology:

Techniques for synthesis of nanomaterials and nanocomposite; mobility of nanomaterials in aqueous environments, surface chemistry of mineral oxide and carbon nanoparticles, development of nanostructured membranes, mechanisms of nanoparticle bio- degradation, development of nanostructured ceramic bodies for environmental separations and

catalysis, nanomaterial-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation.

Unit V Environmental Microbiology:

Microbes in the environment, measurement of bacterial growth, collection and processing of environmental samples. Media Formulation; Sterilization; Thermal death kinetics Primary and secondary metabolites; Extracellular enzymes; biotechnologically important intracellular products; exopolymers; biopolymer production.

Suggested Readings:

1. Agarval, S. K (2002). Environmental Biotechnology. APH Publishing Corporation, New Delhi.
2. Mark J Hammer (2000). Water and Waste Water Technology. 4th Edition, Prentice Hall of India Pvt Ltd, New Delhi.
3. Yadav, P. R. and Shubhrata R Mishra. (2004). Environmental Biodiversity. Discovery Publishing House, New Delhi.
4. Singh, M. P., Soma Dey and Bijay S Singh. (2004). Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
5. Bailey J E and D F Ollis (1986). Biochemical Engineering fundamentals. 2nd Ed. Chapters 13 & 14, McGraw – Hill.
6. Charles P Poole Jr., Frank J Owens. (2007). Introduction to Nanotechnology. John Wiley & sons Asia Pvt. Ltd. New Delhi.
7. Alans Scragg (2005). *Environmental Biotechnology*. Oxford University Press. Inc. New York.

19RBT304 **Paper – III: Immunology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic concepts of immunology
- To expose students to use these principles of immune system to combats infections
- To gain the information about the auto immune diseases
- To identify the cellular and molecular basis of immune responsiveness
- To describe the roles of the immune system in both maintaining health and contributing to disease
- To demonstrate a capacity for problem-solving about immune responsiveness

Course Outcomes

On successful completion of the course the students will be able to

1. Gain about the various cells and organs involved in the immune system
2. Understand the molecular mechanisms of antigen-antibody interactions
3. And also, the molecular mechanisms behind the immune response evoked after infection by various pathogens
4. Learn the theoretical basis for the various immunological techniques
5. Apply immunological laboratory techniques to understand principles of antigen-antibody reaction
6. Use different immunological test to study the immune effector function and immune development

Unit I Immune System:

Origin and formation of blood cells. Structure, Classification of blood cells. Primary and secondary immune response. Lymphoid organs**:** Primary and secondary lymphoid organs. antigen- antibody interactions. Humoral and cell mediated immunity**.**

Unit II Cellular Defenses:

Blood Coagulation, Phagocytosis, Nodule formation, Encapsulation, Cytotoxicity reactions. Lysins, Hemagglutinins, Lymphokine-like substances, Antimicrobial Factors.

Unit III Hybridoma technology:

Hybridoma technology and monoclonal antibodies, immuno-diagnosis and application of monoclonal antibodies in biomedical research, human monoclonal antibodies and catalytic antibodies, Xeno transplantation from various species.

Unit IV Vaccine technology:

DNA vaccines, identification of B and T epitopes for vaccine development. Immunodiagnosis of infectious diseases, immuno screening of recombinant library. recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents.

Unit V Introduction to immunodiagnostics:

Passive & active immunization– RIA, ELISA and their types, Haemagglutination assay, Double immunodiffusion test. Rocket immunoelectrophorosis.

SUGGESTED READINGS

1. Rockstein, M. (Ed). (1974). The Physiology of Insecta, Vol 5. Academic Press, New York.
2. Gupta, A.P. (Ed). (1979). Insect Hemocytes. Cambridge University Press, Cambridge.
3. Ratcliffe, N.A. and A.F. Rowley. (1981). Invertebrate Blood Cells, Vol. I & II. Academic Press.
4. Kerkut, G.A. and L.I. Gilbert (Eds). (1985). Comprehensive Insect Physiology, Biochemistry and Pharmacology, Vol 3. Pergamon Press, Oxford.
5. Cohen, W.D. (Ed). (1985). Blood Cells of Marine Invertebrates: Experimental Systems in Cell Biology & Comparative Physiology.
6. Brehèlin, M. (Ed). (1986). Immunity in Invertebrates. Springer-Verlag, Berlin.
7. Brey, P.T. and D. Hultmark (Eds). (1998). Molecular Mechanisms of Immune Responses in Insects. Chapman & Hall, London.

19RBT305 **Paper – III: Medicinal Plant Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0 External**: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic concepts of phytochemistry
- To expose students to use these principles of general extraction and isolation techniques
- To gain the information about production of secondary metabolites
- To identify the bioactive molecules in the plants
- To describe the roles of plant products and herbal formulations.
- To demonstrate the organic cultivation of medicinal plants

Course Outcomes

On successful completion of the course the students will be able to

1. Gain knowledge about the major secondary metabolites from plants
2. Understand the techniques involved in extraction of phytochemicals
3. Learn the theoretical basis for the Chemical fingerprinting
4. Apply Authentication of medicinal plants to understand the variation
5. Use the knowledge in DNA bar coding

Unit I Phytochemistry:

Screening of major secondary metabolites from plants. Biosynthesis of primary and secondary metabolites - alkaloids, terpenoids, Phenolic compounds and coumarins. Classification and sources of alkaloids. Major classes in phenolic compounds – carotenoids, flavonoids, tannins and phenolic acids. Classification of terpenoids.

Unit II General extraction and isolation techniques:

Alkaloids, sesquiterpenoids, flavonoids and other phenolic compounds from plants. Techniques involved in extraction of phytochemicals – Perculation, Soxhlet extraction, reflux and other methods. Isolation and purification techniques – Thin layer- and Column chromatography, HPLC and HPTLC.

Unit III Biotechnology of medicinal plants:

Production of secondary metabolites from cultured plant cells, elicitation, immobilization, biotransformation, continuous culture and product recovery. DNA bar coding. DNA fingerprinting of medicinal plants – DNA isolation and fingerprinting techniques. Chemical fingerprinting by HPTLC.

Unit IV Bioactive studies:

Anticancer, antidiabetic, anti-inflammatory, hepatoprotectives, antimicrobials from medicinal plants. Antioxidants of plant origin – Reactive Oxygen Species (ROS), antioxidant polyphenols. Toxicity studies on medicinal plants, plant products and herbal formulations.

Unit V Pharmacognosy:

Authentication of medicinal plants – Organoleptic and other pharmacognostic studies. Anatomical studies. Intellectual Property rights (IPR) - patents, copy rights, trade marks. Patenting of biological material. Organic cultivation of medicinal plants. Recent advancements.

SUGGESTED READINGS

1. Harborne, J.B. (1998). Phytochemical methods to modern techniques of plant analysis Chapman and Hall, London.
2. Trease GE, Evans, M.C. (1979). Textbook of Pharmacognosy 12th ed. Balliere-Tindal, London.
3. Irfan A. Khan and Atitya Khanum. (2004). Role of Biotechnology in medicinal and Aromatic plants, Vols. I-X. Ukaaz Publications, Hyderabad.

19RBT306 **Paper – III: Plant Tissue Culture** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To introduce biotechnological methods for Plant Tissue Culture
- To give knowledge about various methods of Shoot and Root induction.
- To cognize and get the knowledge on Suspension Culture in generating plants.
- To explain the basics of the Secondary Metabolites
- To use basic biotechnological techniques to explore general extraction and isolation techniques
- To understand the processes involved in Molecular docking

Course Outcomes

On completion of the course, students are able to

1. Understand the growth conditions required to culture the plants in *invitro* conditions.
2. Inculcate the deep understanding of generating plants in PTC labs
3. Acquire knowledge on Solvent Extraction Methods
4. Inculcate the deep knowledge the processes involved in Structure Prediction
5. Learn the structure and organization of plant genome
6. Learn the basic techniques for hybridization in producing plantlets

Unit I Introduction to Plant Tissue Culture:

Laboratory organization, Sterilization techniques. Plant cell culture media - Media preparation, Plant growth regulators, Role of hormones in plant morphogenesis. Choice of explants. Plant Genome Organization - Chloroplast, Mitochondria, and Nucleus.

Unit II Shoot and Root induction:

Callus culture- types, organ culture, Plant regeneration, Micropropagation, Embryogenesis, Organogenesis, Somatic hybridization and cybridization, haploid Production, Protoplast isolation, Protoplast fusion, Cryopreservation, Synthetic seeds, Somoclonal selection. Hardening of plants Biotransformation- Agrobacterium mediated gene transformation, Ti - plasmid, Ri -Plasmid, Transgenic plant, Resistant plants, Strategies in bioconversion. Production of pharmaceutical compounds.

Unit III Suspension Culture:

Cell suspension - Types of cell suspension- Uses of cell suspension culture - Culture methods- Mass cultivation of plant cells in small Laboratory Scale and Industrial. Secondary metabolite Production from Suspension Culture, Bioreactors - Photo bioreactor. Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques in secondary metabolites, uses of secondary metabolites elicitation.

Unit IV General extraction and isolation techniques:

Alkaloids, sesquiterpenoids, flavonoids and other phenolic compounds from plants. Techniques involved in extraction of phytochemicals -perculation, Soxhlet extraction, reflux and other methods. Secondary Metabolites Isolation and Purification - Solvent Extraction - TLC, GLC, HPLC, HPTLC, GC-MS Methods. Production of secondary metabolites from cultured plant cells, elicitation, immobilization and biotransformation. Structure Prediction - UV, IR, NMR, Mass Spectroscopy.

Unit V Bioactive studies:

Antiulcer, Anticancer, Antidiabetic, Anti-inflammatory, Hepatoprotectives, Antimicrobials from Medicinal Plants. Antioxidants of Medicinal Plant. plant products and herbal formulations. Clinical Application of Medicinal Plant. Organic cultivation of medicinal plants. Drug utilization, Nucleotide database, Molecular docking - Types of docking, Pubchem Compound.

SUGGESTED READINGS

1. Sam Brook, J., E.F Fritsch and T. Maniatis. (2000). Molecular Cloning: A Laboratory manual, Cold Spring Harbor Laboratory Press, New York.
2. Glick, B.R and J.J. Patemack. (1996). Molecular Biotechnology, Panima, New Delhi,
3. Brown, T.A. (1999). Genome, John Wiley and Sons Asia Pvt Ltd. New York.
4. Slater,A., N.W. Scott and M. R. Fowler (2008). Plant Biotechnology, Oxford University Press, Oxford.
5. Nigel Halford and N.G.Halford (2006). Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. Wiley, John & Sons, Incorporated, New Jersey.
6. Maliga, P. (1995). Methods in Plant Molecular Biology. A Laboratory Course, New Age Enterprises. New Delhi.
7. Martin J Chrispeels, David E. Sadava and David E. Sadava (2002). Plants, Genes, and Crop Biotechnology Jones & Bartlett Publishers, Inc., New Jersey.

19RBT307 **Paper – III: Food Technology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0**External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- Understand the concepts of food biotechnology related to food industry
- Attain strong knowledge on primary sources of microorganisms in food
- Explore the methods for development and preservation of fermented foods
- Recognize the nutritive values of fermented foods
- Understand the concepts of product performance testing
- Obtain strong knowledge on FASSI, Packaging and labelling

Course Outcomes

On successful completion of the course, students will be able to

1. Understand the beneficial role of microorganisms in fermented foods and in food processing
2. Understand the role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
3. Know the baking technology
4. Recognize and describe the characteristics of planning therapeutic diets and dietary management
5. Learn various methods of Manufacturing strategies in food industries
6. Identify diet related diseases

UNIT I Fundamentals of Food Science & Technology:

Definition, scope and current trends in food science and technology. Definition and meaning of food, nutrition, nutrient, health, concept and characteristics of a balanced diet. Different types of food processing technology.

UNIT II Fish processing technology:

Pre-treatment of fish washing, gutting, filleting, beheading, peeling, deveining etc. Filleting of fish, treatments, glazing, packaging and freezing. Processing of prawns, lobster, squid, cuttle fish, crab etc. Canning process, steps involved, process flow, additives. FISH PROCESSING PLANTS: Plant design: Fundamentals of processing plant design: Site selection, design and preparation of layout of processing plants.

UNIT III Baking Technology:

Production of cakes and cookies/biscuits. Types of biscuit dough‘s –Developed dough, short dough‘s, semi-sweet, enzyme modified dough‘s and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking.

UNIT IV Therapeutic Nutrition:

Planning therapeutic diets and dietary management in case of fever, typhoid, influenza, rheumatic fever, nephritis, peptic ulcer, hypertension, atherosclerosis, liver cirrhosis and hepatitis. Diet in diseases (metabolic disorders, febrile conditions, surgical & other stress conditions) - causes, symptoms, physiological changes and dietary management.

UNIT V Employability Skills:

Manufacturing of indigenous frozen dessert- Ice-Cream and fat rich dairy products. (a) kulfi (b) malai ka burf (c) milk ices and lollies. (d) milk shake. Manufacturing of skim milk & whole milk powder. product performance testing; market positioning, FASSI, Packaging and labelling, costing; Marketing.

SUGGESTED READINGS

1. Rees, Andy (2006). Genetically Modifies Food: A Short Guide for the Confused. Pluto Press.
2. Davidson S.R, Passmore and J.F. Brock (1986). Human Nutrition and Dietetics. London Churchill, Livingstone.
3. Halford, Nigel G. (2003). Genetically Modified Crops. Imperial College Press.
4. Suri S and Malhotra A. (2014). Food Science, Nutrition and Safety, Pearson India Ltd.

19RBT308 **Paper – III: Structural Biology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- Understand fundamental principles of Stereochemical analysis of proteins
- Comprehend the optical activities of biological macromolecules.
- Recognize the concepts on Structural characterizations of proteins
- Obtain key knowledge on Molecular Modelling methods
- Understand key concepts on NMR structures of proteins – Calculations and validations.
- Attain strong knowledge on Computational Methods in Structural Biology

Course Outcomes

On successful completion of the course, students will be able to

1. Demonstrate an understanding the detection methods for enzyme kinetics
2. Identify, explain and judge safety issues related to biomedical instrumentation
3. Apply the principles in analyzing structural interactions and structural transitions
4. Define the principal concepts about Proteins in solution state
5. Recognize the definition of protein crystallography and related concepts
6. Apply the Phylogenetics in Structural Biology

Unit I Biomolecular Chemistry:

Electronic configurations – Quantum numbers – Chemical bondings – Isomerisms – Buffers in biological systems – Stereochemical analysis of proteins – Protein folding and biological significance – Thermodynamic estimation of protein stability – Biological functions - Allosteric effect - Detection methods for enzyme kinetics – DNA structures – Types – Helical transitions – *Syn/Anti* conformations - Sugar puckering – Optical activities of biological macromolecules.

Unit II Structural Characterizations of Biomolecules:

Analyzing structural interactions and structural transitions of biological macromolecules under thermodynamic and as well kinetic environments through advanced techniques – SF-Ultraviolet spectroscopy - SF-Fluorescence spectroscopy - SF-Circular Dichroism spectroscopy - QF-Nuclear Magnetic Resonance techniques in conjunction with Hydrogen-Deuterium exchange (EX1/EX2) methods.

Unit III NMR of Proteins:

Proteins in solution state - Basic principles of NMR - Chemical shift - Inductive effects - Anisotropic effects - Spin-spin splitting - Double resonance method - Structural characterizations of proteins by 1D NMR methods - 2D NMR experiments: COSY, TOCSY, NOESY - Assignment strategies - 3D NMR experiments (HNCA, HNCOCA, HNCACB, CBCACONH, CCH-TOCSY, HCCH-TOCSY) – NMR structures of proteins – Calculations and validations.

Unit IV Structures of Proteins in Solid and Gaseous states:

Mass spectrometry – Basic principles – EI-MS of small molecules - Structural characterizations and folding pathways of proteins by ESI-MS and MALDI-MS - Structures of proteins in gaseous state by IM-MS - Protein crystallography - Bragg's law - Space groups - Miller indices - Collecting X-ray data - Unit cell determination - Matthew's coefficient - Phase problem - Obtaining Model Structures.

Unit V Computational Methods in Structural Biology:

Local and global sequence alignment algorithms - Multiple-sequence alignment strategies – Phylogenetics – Molecular Modelling methods - Classification of proteins using CATH & SCOP - Process of drug discovery - Structure-based lead design – Ligand-based lead design – Molecular docking – HTVS - Small molecular libraries – Pharmacophores - QSAR methods - Lead optimisation – ADMET.

SUGGESTED READINGS

1. Morrison RT, Boyd RN and Bhattacharjee SK. (2011). Organic Chemistry (Pearson India).
2. Rodwell VW, Bender D, Botham KM, Kennelly PJ and Weil PA. (2015). Harper's Illustrated Biochemistry (McGraw-Hill Medical).
3. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2013). Molecular Biology of the Gene (Benjamin Cummings).
4. Freeman WH (1999). Structure and mechanism in protein science.
5. Kurt W (1986). NMR of proteins and nucleic acids (Wiley, New York).
6. Keith W and John MW. (2010). Principles and Techniques of Biochemistry and Molecular Biology (Cambridge University Press).-
7. David W.M. (2005). Bioinformatics – Sequence and Genome Analysis. (CSHL Press).