

MANONMANIAM SUNDARANAR UNIVERSITY

M.Phil Biotechnology

Effective from the Academic year 2018 - 2019

S. No	Semester	Subject	Credit	Hours/ week
1	I	Research & Teaching Methodology	4	4
2	I	Applied Biotechnology	4	4
3	I	Microbial Biotechnology	4	4
		Stem Cell Biology		
		Applied Plant Biotechnology		
4	II	Project and Viva-Voce	12*	-
Total			24*	

* as per the direction / UGC Guidelines

Research & Teaching Methodology

Preamble:

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To equip the students with the updated methodologies, techniques and instruments.

Outcome:

To obtain a thorough knowledge regarding the reagent preparations, experimental protocols and instruments.

Unit: I: Preparation of Solutions

Types of Solutions - Standard Solutions, Stock Solution, Saturated Solution, Solution of Acids, Expression of Concentration - Molarity (M), Molality (m), Preparation of one Molar (1M) Solutions, Normality (N), Mass Percent % (w/w), Percentage by Volume or % (v/v), Volume/Weight (V/W), Parts per Million (ppm), Parts per Billion (ppb), pH; Buffers and their preparation. (14L)

Unit: II: Microscopy & Microtechnique

Microscopy - Principle, Working Mechanism and applications of Light, Phase Contrast, Fluorescent, Darkfield, SEM, TEM and STEM. Preparation of Whole mount and sections, staining, mounting and preparation of permanent slides; Cyto and Histochemical techniques. (11L)

Unit: III: Quantitative & Molecular Techniques

Quantification of carbohydrate, protein, lipid, fatty acids and aminoacids (Proximate composition), Estimation of hydrolytic and detoxication enzymes. Molecular Techniques - Principle, mechanism and application of SDS, PAGE, AGE, PCR, RT-PCR; Basic principle and applications of chromatography, UV spectrophotometer. (12L)

Unit: IV: Manuscript, Thesis and Project Writing

Research Processing, Writing of Report, Research paper and Review Articles, Project, Proof Correction - symbols, MS word review option and other tools; Plagiarism Checking, Impact Factor, h index, citation index, Funding agencies - DST, DBT, CSIR, ICMR, ICAR, MoEF, MoEs. (13L)

Unit: V: Methodology Of Teaching

Teaching - Objectives of Teaching, Phases of Teaching - Teaching Methods: Lecture Method, Discussion Method, Discovery Learning, Inquiry, Problem Solving Method, Project Method, Seminar - Integrating ICT in Teaching: Individual Instruction, Ways for Effective Presentation with Powerpoint - Documentation - Evaluation: Formative, Summative &

Continuous and Comprehensive Evaluation - Later Adolescent Psychology: Meaning, Physical, Cognitive, Emotional, Social and Moral Development - Teaching Later Adolescents. (10L)

(Total: 60L)

References:

1. Rodney F. Boyer, 2012. Biochemistry laboratory: Modern Theory & Techniques, Second Edition, Prentice Hall.
2. Rajan Katoch, 2011. Analytical Techniques in Biochemistry & Molecular Biology, Springer, New York.
3. Sampath, K., Pannerselvam, A. & Santhanam, S. (1984). Introduction to educational technolog. (2nd revised ed.). New Delhi: Sterling Publishers.
4. Sharma, S. R. (2003). Effective classroom teaching modern methods, tools & techniques. Jaipur: Mangal Deep.
5. Vedanayagam, E. G. (1989). Teaching technology for college teachers. New York: Sterling Publishers.

Applied Biotechnology - Core

Preamble:

To have an insight on animal models, vaccines, improved genetic crops, products from marine sources and patent procedures.

Outcome:

The paper will end up with knowing animal models, informations on vaccines, provide a widespread knowledge on genetically improved crops along with patenting procedures which will enrich the students in filing of innovative products in the form of patents.

Unit I : Animal Model

Mouse, Zebra fish, Drosophila, earthworm, *C. elegans*, *E. coli*, Arabidopsis, Knock out, Knock-in, knockdown (RNAi), Next Generation Sequencing, Transcriptome. (13L)

Unit II: Vaccines and Therapeutic Agents

Subunit vaccines - Live and recombinant vaccines- Attenuated vaccines- anti-idiotypic vaccines - genetically engineered immuno therapeutic agents - International standard of vaccines. (12L)

Unit III: Crop Genetic Enhancement

Cloning of improved agricultural crops for productivity and quality. Agrobacterium mediated genetic transformation, Gen gun, Terminator gene technique, role of Ti and Ri plasmids in transfer of novel genes into crop plant, screening of transgenics, evolutions of genetic stability, ethical issues related to transgenic plant, molecular markers, genomic assisted cropping, golden rice, indicator plants, synthetic biology. (12L)

Unit IV: Products from marine sources

Marine life, food, medicine and raw materials - seaweeds, sea grass and marine animals and associated microorganisms, isolation and identification of bioactive compounds from marine organisms using advanced techniques, pharmaceutically impotent compounds from natural sources. (12L)

Unit V : Patent ability of inanimate products of nature

Vectors, FDA, FPA, Patent office practice - Trade secrets, copy rights, infringements problems, harmonization of patent laws, patenting and IPR, plant genetic resources, patent - legislation, patenting products and protocols, International Scenario. Awareness among the public. TRIPS, GATT, CBD, EPA. (11L)

(Total : 60L)

References:

1. Kuby Immunology, 4th edition, R.A. Goldsby, Thomas J. Kindt, Barbara A. Osbarne (Freeman).
2. 2. Immunology- A short course, 4th edition Eli Benjamin, Richard Coico, Goeffrey Sunshine. (Wiley-Liss).
3. Fundamentals of Immunology, William Paul.
4. Immunology by Roitt and Others.
5. J. Hammond, P. Mc Garey and V. Yusibov (Eds.): Plant Biotechnology, Springer Verlag, 2000.
6. T.J.Fu, G. Singh and W.R. Curtis (Eds.): Plant Cell and Tissue Culture for the production of food ingredients. Kulwer Academic /Plenum Press, 1999.

Microbial Biotechnology (Optional)

Preamble:

The paper briefs about the strains and their isolation to be used in producing products to be used by humankind. It also deals with the biodegradation and bioremediation concepts to clean our environment.

Outcome:

The paper focuses in production of different products from microbes with an aim to create a clean, pollution free environment.

Unit I: History and Scope of Microbial Biotechnology

Screening of strains -Isolation - Preservation, Classification and Characterization of Microbes, Media, Physical and chemical parameters, Registration of Microbes. (13L)

Unit II: Products from Microbes

Fermentation Techniques, uses and mode of action - enzymes - vitamins - B₂,B₁₂ - antibiotics- penicillin, tetracycline, streptomycin, amino acids and organic acids- lactic, acetic and citric acid. (12L)

Unit III Food products from microbes

Baker's yeast, single cell protein- beverages: Beer, wine, milk products - cheese - edible mushroom cultivation - manufacture, packing and storage, Agricultural Products: Biofertilizer - blue green algae, Azospirillum, Azolla, Biocontrol: *Bacillus thuringiensis*, *Trichoderma* and NPVs. importance of biocontrol agents, Archaeobacteria - Extremozyme: Role of Halobacteria in salt production - halophilic microalgae-products from halophilic bacteria. (12L)

Unit IV: Microbial genetic improvement

Conventional Methods, Recombinant Technology based Methods, Protoplast Fusion, Recombination, Alternation in metabolic pathways, immobilization techniques of cells, enzymes. (12L)

Unit V: Biodegradation and Bioremediation

Biodegradation of Xenobiotics - microbes in mining, oreleaching, oil recovery, microbes in waste water treatment, biodegradation of non cellulosic waste from environmental conservation, bioconservation of cellulose waste into ethanol. (12L)

(Total 60L)

References:

1. Marine ecological Processes by Ivan Valieli, 1984, Springer-Verlag publishers.
2. Microbial Biotechnology - Fundamentals of Applied Microbiology by A.N. Glazer and H. Nikaido, W.H. Freeman and Company.
3. Principles of Fermentation Technology, P.F. Stanbury & Whittaker, Pergamon Press.
4. Microbial Process Development, H.W. Woelle, World Scientific.
5. Product Recovery in Bioprocess Technology, J. Krijgsman, BIOTOL, Bullerworth Heinsmann.

Stem Cell Biology (optional)

Preamble:

Stem cells have remarkable ability to grow into any type of somatic cells. A lot of therapeutic applications have been developed using the science of stem cells.

Outcome:

The paper will definitely provide basic informations about stem cells, techniques involved in isolating stem cells and give updated informations on the therapeutic approached developed to till date using stem cells.

Unit I: Stem Cell

Types of Stem Cells - pluripotent stem cell, progenitor or precursor cell, embryonic germ cell, embryonic stem cells, Adult stem cells, Differentiation, Plasticity, haematopoietic Stem Cell, Cancer stem cells, ES/iPS cells, similarities and differences between embryonic and adult stem cells, potential uses of human stem cells. Introduction to concepts in stem cell biology (renewal, potency). (12L)

Unit II: Embryonic development

Early embryonic development, lymphoidal differentiation and maturation, Pluripotency and reprogramming, Epigenetic controls of stem cells. (12L)

Unit III: Stem cell characterizations

Isolation & Characterizations, markers & their identification, FACS, Fluorescent microscope, Growth factor requirements and their maintenance in culture, Feeder an Feeder free cultures, Cell cycle regulators in stem cells, Asymmetric cell division. (12L)

Unit IV: Generation and manipulation

Generation and manipulation of Mouse Embryonic Stem Cells & Human Embryonic Stem Cells. Molecular mechanisms of self-renewal, pluri/multipotency and lineage differentiation. Molecular basis of pleuripotency and stem cell niche, migration of stem cell. Stem cell signalling pathways. Animal models of regeneration, Types of regeneration. (12L)

Unit V: Cell Development

Primordial Germ Cells & Germ Cell Development, Epigenetics & Reprogramming in Stem Cell Biology, Stem Cell Gene Therapy, Stem Cell therapy for neurodegenerative diseases, cardiac regeneration, leukemia, ethical issues. (12L)

(Total: 60 L)

References:

1. T.J.kindt, R.A. Goldsby and B.A. Osborne, Kuby, Immunology, 2007, W.H. Freeman & Company.
2. P.Delves S. Martin, D. burton and I. Roitt, Roitt's Essential Immunology, latest Edition, 2006. Wiley-Blackwell.
3. A.K. Abbas, A. Lichtman and J.S. Pober, Cellular and Molecular Immunology, 2000, W.B.Saunders Company.
4. C.A. Janeway, Jr. P. Travers, M. Walport and M.J.Shlomahik, Immunology, 2001, Garland Science.

Applied Plant Biotechnology (Optional)

Preamble:

The paper focuses on plant tissue culture, genetic transformations, molecular markers and plant microbe interactions.

Outcome:

The paper will definitely enrich the student minds with the basic techniques involved in plant tissue culture and also will definitely end with the usage of different molecular markers and give a better understanding of the plant microbe interactions.

Unit I: Plant Tissue Culture

Practical aspects of plant tissue culture, Totipotency, Somatic embryogenesis, Callus, Cell suspension Culture, Micropropagation, protoplast, Anther and Ovary Culture, Somaclonal Variation, Germplasm Conservation, Hairy root Culture & applications (secondary metabolic production). (12L)

Unit II: Genetic Transformation

Agrobacterium mediated genetic transformation, vectors, Ti and Ri plasmids, mechanisms of T-DNA transfer, role of virulence genes, use of reporter genes, multiple gene transfers. BT cotton, molecular aspects of herbicide resistance. Vectors-less or direct DNA transfer, particle bombardment, Electroporation, microinjection, transformation of monocots. Transgene stability and gene silencing. Application and limitations. (12L)

Unit III: Molecular Markers

Genetic and physical maps, DNA fingerprinting techniques RFLP, RAPD and AFLP, SSR markers, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism). Molecular markers linked to disease and pest resistant genes, application of molecular markers in breeding of crop plants, marker assisted plant breeding. (12L)

Unit IV: Functional Genomics

Strategies for identification and Characterization of genes, Factors influencing the gene expression, Elicitors, Gene expression mechanism, cDNA preparation and cloning, Characterization of gene sequences. Application of functional genomics in plant genetic improvement. IPRs. Mechanism of gene silencing, virus mediated gene silencing, functional genomics. (12L)

Unit V: Plant microbe interaction

plant pathogens, resistance, mechanism against bacteria, fungi, virus, Molecular farming: plantibodies, plant based vaccines and transgenic plants and plant viruses. (12L)

(Total:60L)

References:

1. J. Hammond, P. McGarvey and V. Yusibov (Eds.): Plant Biotechnology, Springer Verlag.
2. T.J. Fu, G. Singh and W.R. Curtis (Eds.): plant Cell and Tissue Culture for the production of Food Ingredients, Kluwer Academic/ Plenum Press, 1999.

Project & Viva-Voce