

MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI - 627 012
DEPARTMENT OF BIOTECHNOLOGY
UNIVERSITY DEPARTMENT
M.Phil – Biotechnology (CBCS)

Effective from the academic year 2016-2017

Eligibility: A pass with 50 % mark in Master Degree in any biological subjects

Course Structure

Sl.No.	Semester	Subject	Credits	Hours/ week	Maximum Marks			Passing Minimum	
					Int.	Ext.	Tot	Ext.	Tot.
1	I	Core-1(Theory): Bio Instrumentation and Research Methodology	8	8	25	75	100	38	50
2	I	Core-1(Theory): Applied Biotechnology	8	8	25	75	100	38	50
3	I	Elective-1(Theory): 1.Microbial Biotechnology 2.Bioactive Natural Products 3.Stem Cell and Tissue Engineering 4.Applied Plant Biotechnology	8	8	25	75	100	38	50
4	II	Project and Viva-voce	16	-	25	75	100	38	50
Total			40	-	-	-	400	-	-

Bio Instrumentation and Research Methodology

Unit 1

Microscopy- Fluorescence, Electron microscopy, Affinity chromatography, HPLC, UV-Visible spectrophotometer, NMR, GC-MS and Microarray technique.

Unit 2

SDS-PAGE, Agarose gel electrophoresis, 2D-Electrophoresis and Gel Documentation. Histochemical and Immunotechniques: Antibody generation, detection of molecules using ELISA, Western blot and Immunoprecipitation. Principles and techniques of Southern and Northern hybridization. Principles and applications of PCR, RT-PCR, and qPCR. DNA fingerprinting- RFLP, RAPD and AFLP. Automated DNA sequencing,

Unit 3

Recombinant DNA and biosafety guidelines: biosafety practices, radiation hazards, hazardous chemical and Decontamination procedures. Health and medical surveillance. Disposal of Biohazardous materials, Management of GMO, Bio-ethics.

Unit 4

Research: Meaning – Purpose- Types of research- Steps in Research: Identification, selection and formulation of research problem. Research proposal: Purpose and scope, Sponsor identification, format, Proposal development, structure of research proposal-style of write up. Research Report: Types of reports, Technical report, Popular report, Scientific papers, Short communication, Research articles, Review articles, book reviews; Synopsis, Thesis writing. Presentations: Oral and Poster, publications of scientific works in journals, proceedings and chapters in book, Plagiarism.

Unit 5

Brief description and tabulation of data and its graphical representation, Measures of central tendency and dispersion: mean, median, mode, range, standard deviation, variance. Idea of two types of errors and level of significance, tests of significance (F & t test); chi-square tests. Simple linear regression and correlation, Computer - Oriented Statistical Techniques and various statistical software and its applications- SPSS, SAS. Frequency table of single discrete variable, Bubble sort, Computation of mean, variance and standard deviation; t-test, correlation coefficient

References

1. A practical guide to clinical Biochemistry Keith Wilson
2. Instrumental methods of analysis, 6th edition Williard; Merrit, Dean Settle
3. Introduction to practical Molecular Biology – Phillipa. D. Darbee
4. Recombination DNA technology J:A. Brown Instrumental analysis – B. K. Shrma.
5. Laboratory Instrumentation – M. Prakash, L. K. Arora, Anmol publications PVT LTD, New Delhi

Applied Biotechnology

Unit 1

Animal model: Mouse, Zebra fish, Drosophila, earthworm, *C. elegans*, *E. Coli*, Arabidopsis, Knock out, knock-in, Knockdown (RNAi). Next Generation Sequencing, Transcriptome.

Unit 2

Vaccines and therapeutic agents- subunit vaccines – Live and recombinant Vaccines - Attenuated vaccines – Anti-idiotypic vaccines – genetically engineered Immuno therapeutic Agents – international standard of vaccines.

Unit 3

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

Unit 4

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

Unit 5

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.

References

1. *Kuby Immunology*, 4th edition R. A. Goldsby, Thomas. J. Kindt, Barbara, A. Osbarne. (Freeman)
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.
7. R. J. Henry: *Practical application of plant molecular biology*. Chapman and Hall. 1997.
8. P. K. Gupta: *Elements of biotechnology*. Rastogi and /Co. Meerut. 1996.

1. Microbial Biotechnology

Unit 1

History and scope of Microbial Biotechnology. Screening of strains- Isolation- Preservation. Classification and characterization of microbes: Media, physical and chemical parameters. Registration of microbes.

Unit 2

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.

Unit 3

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, Azola. Biocontrol: *Bacillus thuringiensis*, trichoderma and NPVs. Importance of biocontrol agents. Archaeobacteria- Extremozyme: role of Halobacteria in salt production- halophilic microalgae- products from halophilic bacteria.

Unit 4

Microbial genetic improvement: Conventional methods, recombinant technology based methods. Protoplast fusion, recombination, alternation in metabolic pathways, immobilization techniques of cells, enzymes.

Unit 5

Biodegradation and bioremediation: Biodegradation of xenobiotics- microbes in mining, ore leaching, oil recovery, microbes in waste water treatment, biodegradation of non cellulosic waste for environmental conservation. Bioconservation of cellulose waste into ethanol.

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 and Whittaker, Pergamon press.
4. *Microbial process development*, H. W. Woelle, World scientific.
5. *Product recovery in bioprocess technology*, J. Krijgsman, BIOTOL Buller worth Heinsmann.
6. *Aquaculture- principles and practices* by TVR Pillay, 1990, Fishing newsbook publications.

2. Bioactive Natural Products

UNIT 1

Biomedical potential of marine and terrestrial natural products – Isolation, structural elucidation and mode of action. Application in various field of biology of Secondary Metabolites isolated from both marine and terrestrial natural products

UNIT 2:

Important products isolated from marine organism and their uses – Agarose, Agar, Alginates, Carrageenans, chitin, chitosans and glucosanins, marine flavourants, Lectins, heparin and carotene. Single cell Protein

UNIT 3:

Biological fuel generation: Sources of biomass- Ethanol from biomass, Methane from biomass, Hydrogen from biomass.

UNIT 4:

Herbal products: carbohydrates and derived products - drugs containing glycosides, tannins, lipids (fixed oils, fats and waxes), volatile oils and terpenoids, enzymes and proteins, alkaloids. Biological testing of herbal drugs - Preliminary phytochemical screening for plant products - Qualitative chemical tests - Chromatography (TLC and HPLC).

UNIT 5:

Pharmaceutically important products from marine and terrestrial organisms pharmaceutical surfactants, antimicrobial compounds, hormone like materials, vitamins, immunomodulators, anticancer and cytotoxic compounds

REFERENCES:

1. Marine natural products: chemical and biological perspectives Paul J. Scheuer Academic Press, 392 pages
2. Bioactive Marine Natural Products Bhakuni, Dewan S., Rawat, D.S. 2005, XV, 400 p.
3. Marine natural products Hiromasa Kiyota, K. Fujiwara, T. Nagata, 2010 - 301 pages
4. Drugs from the Sea, Nobuhiro Fusetani, 2000 - 158 pages
5. Herbal plants and Drugs, Agnes Arber, 1999. Mangal Deep Publications.
6. Contribution to Indian Ethnobotany by Editor S.K.Jain, 1991 Scientific Publishers.
7. New Natural products and Plants drugs with Pharmacological, Biological (or)
8. Therapeutical activity, H.Wagner and P.Wolff, 1979. Springer, New Delhi.
9. Ayurvedic drugs and their plant source, V.V.Sivarajan and Balachandran Indra, 1994. Oxford IBH publishing Co.

3. Stem Cell and Tissue Engineering

Unit 1

Stem cell: Types of Stem Cells- Pluripotent stem cell, Progenitor or precursor cell, embryonic germ cell, embryonic stem cells, Adult stem cell, Differentiation. Plasticity. Hematopoietic 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).

Unit 2

Early embryonic development. Lymphoid cell differentiation and maturation, Pluripotency and Reprogramming. Epigenetic controls of stem cells.

Unit 3

Stem cell characterizations: isolation & characterizations, markers & their identification, FACS, fluorescent microscope, growth factor requirements and their maintenance in culture. Feeder and feeder free cultures. Cell cycle regulators in stem cells. Asymmetric cell division.

Unit 4

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 pluripotency and stem cell niche, migration of stem cell. Stem cell signaling pathways, Animal Models of Regeneration, Types of regeneration.

Unit 5:

Primordial Germ Cells and Germ Cell Development . Epigenetics and Reprogramming in Stem Cell Biology. Stem Cell Gene Therapy. Stem cell therapy for neurodegenerative diseases, cardiac regeneration, leukemia, Ethical issues.

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. Shlomchik, Immunology, 2001, Garland Science.

4. Applied Plant Biotechnology

Unit 1

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 metabolite production).

Unit 2

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.

Unit 3

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

Unit 4

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.

Unit 5

Plant microbe interaction: Plant pathogens, resistance, mechanism against bacteria, fungi, virus. Molecular farming: plantibodies, plant based vaccines by transgenic plants and/or plant viruses.

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.
3. H.S. Chawla: *Biotechnology in Crop Improvement*. International Book distributing Company.
4. R.J. Henry: *Practical Application of Plant Molecular Biology*. Chapman and Hall. 1997
5. P. K. Gupta: *Elements of Biotechnology*. Rastogi and Co. Meerut. 1996

