

**M.Phil Programme
In Biotechnology
SYLLABUS**

2015-2016



**NATIONAL COLLEGE
(Autonomous)
(College with Potential for Excellence)
(Nationally Re-accredited at 'A' Grade by NAAC)
(Affiliated to Bharathidasan University)
Tiruchirappalli - 620 001.**

M.Phil Programme in Biotechnology Programme Structure

Sem	Course	Title of the Paper	Credits	Hrs / Week	Internal Mark	External Mark	Max. Mark
I	Course I M16BT 1	Research methodology & Education Technology	4	6	40	60	100
	Course II M16BT 2	Advances in Biotechnology	4	6	40	60	100
	Course III M16BT 3	Environmental Biotechnology	4	6	40	60	100
	Course IV M16BT 4	Guide paper: Plant Tissue Culture(or) Bioinformatics (or) Animal Biotechnology (or) Bioremediation Techniques	4	6	40	60	100
M.Phil Dissertation			8	-	150	50	200
TOTAL							

COURSE I: RESEARCH METHODOLOGY & EDUCATIONAL TECHNOLOGY

Unit I

Introduction to research methodology: Basic and applied research, Essential steps in research, Defining the research problem, Research/Experimental design, Literature collection, Literature citation, Research report: components, Format of thesis and dissertation, Manuscript/research article, Review monographs, Bibliography and Reference, Significance of research.

Unit II

Microscopic techniques: Light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, Histochemical and Immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, FISH and GISH techniques.

Unit III

Computational methods: Nucleic acid and protein sequence database; data mining methods for sequence analysis, web-based tools for sequence searches motif analysis and presentation. Statistical Methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); sampling distribution; difference between parametric and non-parametric statistics.

EDUCATIONAL TECHNOLOGY

Unit IV

Origin, history, meaning and definitions of Educational Technology- Objectives, forms and approaches- Scope, Significance and use of educational technology- system concept-Types- Parameters- Steps involved in system approach –Education system- Instructional system.

Unit-V

Meaning of Information and Communication Technology (ICT)-Definition – features-Trends- Uses and limitations – Characterizes of e- learning advantages and limitations- ICT Integration of teaching and learning – ICT applications: using word processors, spread sheets, power point slides in the class room – ICT for research: On-line journals, E-Books, technical Reports, thesis and dissertations- computer mediated teaching: Multimedia, E-content.

Reference

1. C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age International (P) Ltd, Publishers, New Delhi.
2. Jenod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
3. Attwood. T.K and Parry-Smith D.J. (2002) Introduction to Bioinformatics, Pearson education Singapore.
4. 6. Khandpur R.S. Handbook of biomedical instrumentation ,Tata Mc GrawHill.
7. Brigal.L.Williams,A biologist guide to principle and techniques of practical biochemistry.

COURSE II- ADVANCES IN BIOTECHNOLOGY

Unit I

Plant Biotechnology - In-vitro regeneration protocols amenable for gene transfer, Vectors used in gene transfer in plants. Ti plasmids, Biolistic gun. Antisense and RNAi strategies for metabolic engineering. Transgenic crops for herbicide, pest and abiotic stress resistance. Terminator gene technology. Biosafety issues, IPR and Bioethics.

Unit – II

Animal Biotechnology- Different cell culture techniques ; Development of cell lines; Characterization and maintenance of cell lines; cryopreservation, Cell cloning and selection; transfection and transformation of cells; Application of animal cell culture for in vitro testing of drugs; Applications of cell culture technology in production of human and animal viral vaccines. Transgenic animal models: gene knock-outs; Cre-lox systems-applications.

Unit – III

Medical Biotechnology - Human health care, genetic disorder, gene therapy, Infectious diseases, DNA-based disease diagnosis, Stem cell biology: stem cell types haematopoietic and embryonic- chord blood cells- regenerative medicines. Production of Bioactive Compounds, Drug delivery, Development of recombinant vaccines, Herbal medicine.

Unit – IV

Industrial Biotechnology - Production of enzymes & organic acids, Downstream processing, Solid state fermentation, Bioprocess monitoring, modeling and control, Biocatalysis & Biotransformation, Bioconversion of biomass, Biosensors, Biofuel- bioethanol and biohydrogen, Biopolymers. Principles and applications of Nanobiotechnology.

Unit – V

Microbial Biotechnology - Global environmental issues and biotechnological solutions. Treatment of industrial effluents- solid waste management- Management of nuclear waste. Bioremediation- in situ and ex situ bioremediation. Biodegradation of xenobiotics. Biomonitoring. Biodiversity & conservation.

REFERENCES:

1. Slater, A. Scot, N. and Fowler, M. (2007) Plant Biotechnology-the genetic manipulation of plants. Oxford press,
2. Watson, J.D; Gilman, M; Witkowschi, J and M.Zoller, 1992. Recombinant DNA, 2nd edition. Scientific American Books, W.H. Freeman and Co; New york, USA
3. Glick, B.R and J.J. Pasternak. 2005. Molecular Biotechnology Principles and application of recombinant DNA, 3rd edition. ASM press. Washington, USA
4. Environmental Biotechnology, principles and applications, Bruce Rittman, Perry Mccarty, McGraw- Hill, 2nd edition, 2000.
5. Therapeutic Immunology, K. Frank Austen, Steven J. Burakoff, Fred.S.Rosen, Terry.B.Storm (2nd edition) 2001.

COURSE III- ENVIRONMENTAL BIOTECHNOLOGY

Unit-I

Status and Scope of Biotechnology in Environmental protection. Nonconventional energy sources. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics. UN declaration. Environmental protection and conservation. Environmental Impact Assessment, Ecoplanning and Sustainable Technology. Microbial Plastics.

Unit-II

Physicochemical and bacteriological analysis of soil and water, Problems associated with soil and solid waste, Determination of biodegradable organic material. Insecticides fungicides, pesticides as pollutants in soil. Use of genetically modified Microorganisms. Ecotoxicology of soil pollutants, E-waste, Municipal solid waste treatment strategies.

Unit-III

Waste water constituents, Analysis and selection of flow rates and loadings, Process Selection, Physical unit operations, Chemical unit operations, Fundamentals of biological treatment, Role of biotechnology in water purification systems. Advanced waste water treatment, Biological Processes for Industrial and domestic effluent, Treatment, Aerobic , Anaerobic and Biological Treatment, Toxicity testing using biological material.

Unit-IV

Bioremediation- Biomaterials as substitutes for non-degradable materials, Metal microbe interactions: Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance. *In situ*, *Ex situ* bioremediation techniques.

Unit-V

Biotechnology for clean environment. Bioindicators and biosensors for detection of pollution. Biotechnology for Hazardous Waste Management, Persistent organic pollutants, Xenobiotics, Biological Detoxification of PAH, Biotechniques for Air Pollution Control. Biochemical pathway of biodegradation.

Reference:

1. Alan Scragg, 2010. Environmental Biotechnology II Ed. Oxford University Press, UK.
2. Bruce Rittman, Perry Mccarty, 2000, Environmental Biotechnology, Principles and applications. Mc Graw- Hill, 2nd Edition
3. Bernard R, Glick and Jack J. 2002, Molecular Biotechnology, Panima Publishing House –New Delhi
4. Bimal Bhattacharyya C, Rintu Banerjee 2010, Environmental Biotechnology, Oxford University Press. New Delhi.

COURSE –IV PLANT TISSUE CULTURE TECHNIQUES (Guide Paper)

Unit- I

Introduction- History, scope and Concepts of techniques in plant tissue culture. Laboratory requirements and organization. Sterilization techniques - Media preparation – Culture media (MS, Whites, Gamborg's and Nitsch).

Unit- II

Cell, tissue and organ culture- Tissue explants for culture – Paper, raft, nurse technique, Plating method, Micro chamber techniques, Cell suspension cultures- Synchronization of suspension culture, cellular totipotency, Cytological, Cytochemical and Morphogenesis of vascular differentiations- Concept of Totipotency.

Unit- III

Micropropagation

Techniques in Micropropagation. Organogenesis- formation of shoots and roots – Role of growth regulators and other factors, somaclonal and gametoclonal variations. Somatic embryogenesis –Process of somatic embryogenesis, factors affecting embryogenesis, synthetic seed production.

Unit- IV

Haploid plant production – Androgenesis, gynogenesis- techniques of anther and pollen culture – plantlets from haploids- diploidisation – factors influencing androgenesis and gynogenesis, haploid mutants, utilization of haploids in plant breeding.

Protoplast culture: Isolation of protoplast – mechanical and enzymatic sources, culture of protoplasts, viability. Protoplast fusion – spontaneous, mechanical, induced electrofusion, selection of somatic hybrids, cybrids importance.

Unit-V

In vitro production of secondary metabolites – classification of secondary metabolites, biosynthetic pathways, immobilized cell cultures and biotransformation, elicitors and hairy root culture.

Application of tissue culture in forestry, horticulture and pharmaceutical industry.

References

Bhojwani, S.S. and Razdan, M.K (1983). Plant tissue culture. Theory and practice. Elsevier Science Publishers, Netherlands.

Dodds, J.H and Roberts, I.W (1985). Experiments in Plant tissue culture. Cambridge University Press, UK.

Flower, M.W (1986). Industrial Application of Plant Cell Culture. In Yeoman, M.M (ed). Plant Cell Culture Technology. Blackwell, Oxford, London.

Hammond, J., McGarvey, P. and Yusibov, V. (2000). Plant Biotechnology, Springer Verlag, New Delhi.

Ramawat, K.G (2000). Plant Biotechnology. S.Chand & Co., New Delhi.

kalyan Kumar, De (1992). Introduction to Plant tissue culture . New Central Book Agency, Calcutta.

Razdan, M.K (2004). Introduction to Plant tissue culture. 2nd ed .Oxford & IBH Publishing Co.Pvt.Ltd .New Delhi.

COURSE –IV ANIMAL BIOTECHNOLOGY (Guide Paper)

Unit I

ANIMAL CELL CULTURE: Primary cell culture - transformed cell lines - cell culture media – components and their function. Serum and serum free media. Flask culture and passage of cells. CO₂ incubator. Organ culture. Preservation of animal cells. American type culture collection.

Unit II

MANIPULATION OF REPRODUCTION: Pharmacological control of oestrous and ovulation. In vitro embryo production and manipulation – production of multiple embryos in vitro. Asexual multiplication of embryos. Evaluation of embryo quality. Embryo sexing, Cryopreservation of embryos, microinjection of embryos.

Unit III

ART: ART- Methods, superovulation - Embryo transfer – ICSI. Development and use of transgenic animals – retroviral - embryonic stem cell - micro –injection. Generation of gene knockouts and insertional mutants in mice. Biotechnology of silkworms and aquaculture.

Unit IV

GENE TRANSFER TO A WHOLE ANIMAL: DNA insertion methods – microinjection, calcium phosphate transfection, lipofection and electroporation. Reporter gene systems – luciferase and green fluorescent protein. CAT assay.

Unit 5

ADVANCED CONCEPTS: Gene knock out technology – generation of knockout and insertional mutants in mice. Stem Cells – types and Gene therapy – somatic versus germline therapy, Targets for gene therapy- inborn errors of metabolism, cancer, hematopoietic system as a target for gene therapy. Cloning of animals - reproductive cloning.

References

1. A. J. Griffiths- J.H. Miller- D.T. Suzuki- R.C. Lewontin and W.M. Gelbart (2000), An introduction to Genetic analysis, W. H. Freeman and Company.
2. J.R.W. Masters (2000), Animal Cell culture, Oxford University Press.
3. M.M. Ranga (2003), Animal Biotechnology, Student Edition- Jodhpur.
4. Bernard R. Glick and Jack J. Pasternak (2002), Molecular Biotechnology, Panima Publishing House- New Delhi.
5. Biotol Series: Biotechnological innovations in Animal Productivity, (1992), Butterworth-Heinemann.
6. R. A. Goldsby- T.J. Kindt- B. A. Osborne and J. Kuby. (2003), Immunology, W.H. Freeman and company.
7. T. A. Springer (1985), Hybridoma Technology in Biosciences and Medicine by Plenum Press- New York.

8. C. Garrison Fathman- F. W. Fitch (1982), Isolation- Characterization and utilization of T – Lymphocyte clones by Academic Press