

**PG & RESEARCH DEPARTMENT OF BIOTECHNOLOGY**  
**NEHRU MEMORIAL COLLEGE (AUTONOMOUS)**  
**PUTHANAMPATTI - 621 007**  
**TIRUCHIRAPPALLI**



**SYLLABUS FOR**  
**MASTER OF PHILOSOPHY IN BIOTECHNOLOGY**

*(For the candidates admitted from the Academic year 2019 – 2020 onwards)*

**NEHRU MEMORIAL COLLEGE (AUTONOMOUS)**

**PUTHANAMPATTI – 621 007.**

**P.G. AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY**

**M.Phil., BIOTECHNOLOGY PROGRAMME – FT/PT**

**(For the candidates admitted from the academic year 2019 – 2020 onwards)**

<b>Semester I</b>	<b>Title of the course</b>	<b>Marks</b>			<b>Credits</b>
		<b>Int</b>	<b>Ext</b>	<b>Total</b>	
Course-I	Research Methodology	25	75	100	4
Course-II	Advances in Biotechnology	25	75	100	4
Course-III*	i) Agricultural Biotechnology	25	75	100	4
	ii) Pharmaceutical Biotechnology	25	75	100	4
Course-IV	Teaching and Learning Skills	25	75	100	4
<b>Semester II</b>	Dissertation and Viva-Voce	50	150	200	8

**\*Topic of Research – *Guide Paper***

## **M.Phil., BIOTECHNOLOGY**

### **Programme Outcomes (POs):**

1. Scholars are to be adopted with a new paradigm of self-learning in the form of review of earlier knowledge acquired.
2. Scholars are brought to light from the previous investigation completed to the newer thrusts of knowledge and implementation in research.
3. Scholars are trained to design, implement and evaluate secured information systems with assured quality and efficiency.
4. Scholars are to be oriented towards becoming globally competent.

### **Programme Specific Outcomes (PSOs):**

- 1.Scholars will produce as Biotechnology professionals with leadership quality in technology, creativity, innovation and entrepreneurship.
2. Scholars are provided with state of the art outcome-based teaching/ learning practices.
3. Scholars will be developed as a research-based education model in Biotechnology.
4. Scholars will have an ability to demonstrate an advanced technical knowledge of Biotechnology.
5. Scholars will have awareness of modern bio-analytical techniques and their limitations.
6. Scholars will be equipped to undertake a research project which requires an understanding of techniques and published literature, originality in the application of knowledge, and some degree of self-direction.

## SEMESTER-I

### COURSE I: RESEARCH METHODOLOGY

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Course Code:

Max Marks: 100

Hours per Week:

Internal Marks: 25

Credits: 4

External Marks: 75

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#### **Course Objectives:**

To enable the students to

- Give information about basic concept of research and how to write/publish a thesis and its basic steps.
- Critically analyze the separation and characterization techniques.
- Know the statistical problems in biological science, this is useful for the students for their research works.
- Train the scholars to collect, organize and analyze data.
- Learn to apply different statistical/ bioinformatics tools in presenting biological data.

#### **Unit - I**

Literature review – sources of information – technical papers – peer reviewed journals-e-journals – citation index – impact factor – reference collection from internet – index card and arrangement of reference collected, Thesis writing – components of a thesis, preparation of research documents (abstracts, papers etc). Planning of research: Research ethics, Research proposals, time scheduling of research, available sources and generation of funds and facilities.

#### **Unit - II**

Principles and applications of atomic force microscope, atomic tunneling microscope, cytophotometry and flow cytometry, X-ray diffraction, NMR, and ESR spectroscopy, Mass Spectrometry, GC Mass Spectra, ion exchange and affinity chromatography, thin layer and reverse phase chromatography, High Performance Liquid Chromatography, Gas Chromatography.

#### **Unit - III**

Principles and applications of SDS – PAGE, AGE, 2D- gel electrophoresis, gel documentation, Immunoelectrophoresis, Immunodiffusion, Immunoprecipitation – agglutination techniques, Radio Immuno Assay. Southern, Northern and Western blotting techniques and hybridization, PCR, RFLP, RAPD, AFLP, DNA finger printing and DNA sequencing, Micro array technique, gel filtration.

#### **Unit - IV**

Databases : DNA and Protein databases, Sequence Analysis, Global and local alignments – Similarity searching – principles and algorithms – Pair wise and Multiple alignments; Data base searching methods; Protein structure prediction: secondary and tertiary structure predictions; protein motifs;– RNA structure analysis – Genome comparisons, phylogeny analysis, pharmacogenomics.

## **Unit - V**

Principles and practice of statistical methods in biotechnological research; collection and tabulation of data; graphical and diagrammatic representation of data; basic statistics; Simple Correlation and regression analyses; significance tests: Chi-square test, student's t-test, ANOVA, Duncan's Multiple Range Test. Multivariate Analysis: Basic principles and applications of Multiple regression analysis, Cluster Analysis.

### **Course Outcomes:**

- Relate to the learning process of how to write thesis and how to publish papers in various journals.
- Produce transformants by employing the various transfer techniques in the applied research.
- Explain the scope and applications of Biostatistics
- Analyze the recent molecular techniques pertaining to the Biological research.
- Analyze and apply various statistical tools.

### **TEXT BOOKS:**

1. Gurumani, N. 2006. Research methodology for biological science, MJP Publishers, Chennai.
2. Sathyanarayana, U. 2006. Biotechnology. Books and Allied (P) Ltd. India.
3. Dubey, R.C. 2001. A text book of Biotechnology, Rajendra Printers, New Delhi.
4. Das, H.K. 2005. Text book of Biotechnology (2<sup>nd</sup> edition). Wiley Dream Tech India Pvt Ltd., New Delhi.

### **BOOKS FOR REFERENCE:**

1. Anderson, J; Durston, D; Poole, M. 1991. Thesis and assignment writing. New Age International Pvt.Ltd, New Delhi.
2. Conference of Biological Editors. 2000. Style manual for Biological Journals, American Institute of Biological Science, Washington, D.C.
3. Gurdeep R Chatwal, Sham K Anand. 2007. Instrumental methods of chemical analysis (2<sup>nd</sup> edition), Himalaya Publishing House.
4. David Freifelder. 1982. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (2<sup>nd</sup> edition), W.H. Freeman & Co Ltd..
5. Jerrold H. Zar, 2005. Biostatistical Analysis (4<sup>th</sup> edition) Prentice Hall publishers,

## SEMESTER-I

### COURSE II: ADVANCES IN BIOTECHNOLOGY

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Course Code:

Max Marks: 100

Hours per Week:

Internal Marks: 25

Credits: 4

External Marks: 75

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#### **Course Objectives**

To enable the students to

- Provide education that leads to comprehensive understanding of the principles and practices of biotechnology.
- Empower students with the ability to think and solve problems in the field of biotechnology.
- Ensure students are able to effectively communicate with biotech and other interdisciplinary professionals.
- Produce responsible biotechnologists that can work within the interdisciplinary framework of biotechnology and related fields.
- Ensure students to gain an insight into the concepts and techniques of Plant, Animal & Microbial biotechnology and its wide industrial & medicinal applications.

**Unit – I: Plant Biotechnology:** Introduction to plant tissue culture and culture media. Plant transformation technology, Vectors for gene transfer in Plants. Agrobacterium mediated gene transfer, Biolistic transformation. Antisense technology. Transgenic crops for herbicide, pest and abiotic stress resistance. Plantibodies. Terminator gene technology. Biosafety issues, IPR- Copyrights, Trade secrets, Trade Mark, GATT and TRIPS, biopiracy 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; Transgenic animal models; gene knock-outs.

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

**Unit – IV: Industrial Biotechnology:** Production of enzymes & organic acids, Downstream processing, Solid state fermentation, Bioprocess monitoring and control, Biocatalysis & Biotransformation, Bioconversion of biomass, Biosensors, Biofuel – bioethanol and biohydrogen, biopolymers. Treatment of industrial effluents – solid waste management – Management of nuclear waste.

**Unit – V: Ethical Issues in Biotechnology:** Biosafety – Biosafety for human health and environment. Social and ethical issues of biosafety. Use of genetically modified organisms (BT cotton and BT brinjal) and their release into the environment. Special procedures for rDNA based products. Intellectual property rights, patenting (Process and Product). Bioethics - Ethical issues of Synthetic biology and Nanobiotechnology.

**Course Outcomes:**

- Explain in detail the importance of IPR, antisense technology and plant tissue culture techniques.
- Analyze the animal cell culture methods and gene knock out methods.
- Ability to produce fermented useful products using bacteria.
- Emphasise the importance of bioremediation bacteria and its importance to clean the environment which hamper the society in various ways.
- Understand the knowledge about gene therapy, DNA fingerprinting and human genome project.

**TEXT BOOKS:**

1. Das, H.K. 2005. Text Book of Biotechnology. Wiley Dream Tech India Pvt. Ltd., New Delhi.
2. Crueger, W. and Crueger, A., 2003. A Text Book of Industrial Microbiology. 2<sup>nd</sup> edition, Panima Publishing Corporation, New Delhi.
3. Glick, B.R and J.J. Pasternak. 2005. Molecular Biotechnology – Principles and application of recombinant DNA, 3<sup>rd</sup> edition. ASM press. Washington, USA.

**BOOKS FOR REFERENCE:**

1. Slater, A. Scot, N. and Fowler, M. 2007. Plant Biotechnology – The genetic manipulation of plants. Oxford press.
2. Watson, J.D; Gilman, M; Witkowshi, J and M.Zollar, 1992. Recombinant DNA, (2<sup>nd</sup> edition), Scientific American Books, W.H. Freeman and Co; New York, USA.
3. Jogdand, S.N. 2004. Advances in Biotechnology. Himalaya publishing House, Mumbai.
4. Benjamin Lewin. 1999. Genes VII. Oxford University Press, New York.
5. Mathuriya, A.S. 2009. Industrial Biotechnology, 1<sup>st</sup> edition, Ane Books India Ltd., New Delhi, 2009.

## **COURSE IV: TEACHING AND LEARNING SKILLS**

Course Code:

Max Marks: 100

Hours per Week:

Internal Marks: 25

Credits: 4

External Marks: 75

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### **Course Objectives:**

To enable the students to

- Apply and integrate knowledge of teaching and learning skills among scholars.
- Get a fundamental knowledge about basic and advanced teaching methods.
- Understand the role of advanced teaching skills in various institutions.
- Enlighten the scholars with the new information related to teaching technology.
- Teach the scholars understanding development of advanced teaching skills.
- Prepare the scholars e-contents for future use by using various technology.

**Unit - I: Computer Applications Skills:** Computer system: Characteristics, parts and their functions – Different generations of computer – Operation of computer: switching on/off/restart. Mouse control, Use key board and some functions of key – Information and Communication Technology (ICT): Definition, Meaning, Features, Trends. Integration of ICT in teaching and learning – ICT applications: Using word processors, Spread sheets, Power point slides in the classroom.

**Unit - II: Communication Skills:** Definitions – Elements of communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication – Spoken and Written; Non-verbal Communication – Intrapersonal, Interpersonal, Group and Mass communication – Barriers to communication: Mechanical, Physical, Linguistic & Cultural – Skills of communication: Listening, Speaking, Reading and Writing – Methods of developing fluency in oral and written communication – Style, Diction and Vocabulary – Classroom communication and dynamics.

**Unit - III: Communication Technology:** Communication Technology: Bases, Trends and Developments – Skills of using Communication Technology – Computer Mediated Teaching: Multimedia, E-Content – Satellite-based communication: EDUSAT and ETV Channels. Communication through web: Audio and Video applications on the internet, Interpersonal communication through the web.

**Unit - IV: Pedagogy:** Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture – Narration I tune with the nature of different disciplines – Lecture with power point presentation – Versatility of Lecture technique –Demonstration: Characteristics, Principles, Planning, Implementation and Evaluation – Teaching-learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion – Modes of teaching: CAI, CMI and WBI.

**Unit - V: Teaching Skills:** Teaching skill: Definition, Meaning and Nature – Types of Teaching skills: Skill of Set induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing, Questions, Skill of Black Board Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills.



**Course Outcome:**

- Analyze the components of computers and its.
- Enumerate the applications of ICT enabled teaching.
- Explain the scope of teaching skills.
- Emphasise the importance of EDUSAT and ETV Channels and its importance to improve the teaching skills.
- Understand the knowledge on valuation of teaching skills.

**TEXT BOOKS:**

1. Bela Rani Sharma. 2007. Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi.
2. Don Skinner. 2005. Teacher Training, Edinburgh University Press Ltd., Edinburgh.
3. Kumar, K.L. 2008. Educational Technology, New Age International publishers, New Delhi.

**BOOKS FOR REFERENCE:**

1. Michael, D and William, K. 2000. Integrating Technology into Teaching and Learning: Concepts and Applications, prentice Hall, New York.
2. Pandey, S.K. 2005. Teaching Communication, Commonwealth Publishers, New Delhi.
3. Ram Babu, A and Dandapani, S. 2006. Microteaching (Vol.1&2), Neelkammal Publications, Hyderabad.
4. Singh, V.K and Sudarshan, K.N. 1996. Computer Education, Discovery Publishing Company, New York.
5. Sharme, R.A. 2006. Fundamentals of Educational Technology, Surya Publications, Meerut.
6. Vanaja, M and Rajasekar, S. 2006. Computer Education, Neelkamal Publications, Hyderabad.

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## **COURSE III: AGRICULTURAL BIOTECHNOLOGY**

(Topic of Research)

Course Code:

Max. Marks: 100

Hours per Week:

Internal Marks: 25

Credits: 4

External Marks: 75

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### **Course Objectives:**

To enable the students to

- Understand the importance of soil and molecular methods in soil Microbiology.
- Learn the technology of vermicomposting.
- Study the methods of collection of wastes.
- Acquire knowledge on decomposition of organic matter.
- Know the methods of solid waste management.
- Assess the role of microbes in biodegradation and recycling of matters.

**Unit – I: Soil:** Introduction- Physiochemical properties of Soil, Soil water, Structure. Soil Micro organisms: Bacteria, Actinomycetes, Fungi, Algae, Protozoa. Methods used for screening of Soil Microbiological Studies – Streak plate, Pour plate, Spread plate. Molecular methods in Soil microbiology.

**Unit – II: Organic Matter Decomposition:** Humus, Mineralization, Composting, Green manure, Vermicomposting: Preparatory methods of vermiculture. Economic and ecological importance of vermicompost and vermi wash. Organisms involved in organic matter formation – Rhizosphere, root exudates, plant growth promoting Rhizobacteria. Waste as a resource organic compost-process of composting. Significance of organic compost.

**Unit – III: Biofertilizers:** Bacteria (Rhizobium, Azospirillum and Azotobacter) Blue green algae (Nostoc and Anabaena) Fungi (VAM), Phosphate solubilizing micro organisms. Nitrogen fixation by free living bacteria, Mechanism of nitrogen fixation, Symbiotic bacteria, Actinorhizal plants, Isolation, Identification, Mass multiplication of Biofertilizers.

**Unit – IV: Biopesticides – *Bacillus thuringiensis*,** Genetic Engineering of Bt toxin, Baculovirus – Mode of Action, Resistance, Mass production. Interaction among Microbial population: Interaction within a single microbial population – positive and negative interaction, Interaction within a diverse microbial population – Commonsalism, Synergism, Mutualism, Competition, Amensalism, Parasitism and Predation.

**Unit – V: Biogeochemical Cycles** – Carbon, Nitrogen, Oxygen, Phosphorous and Sulphur. Microbial degradation of Polysaccharides, Lignin, Biodeterioration. Microbial Interactions with Xenobiotic Compounds, Mineral nutrition to the plants, Macro and micro nutrients.

**COURSE OUTCOMES:**

- Demonstrate the molecular methods in soil microbiology.
- Distinguish the microbes involved in organic matter degradation.
- Experiment with the existing applications of microbes and its applications with reference to soil fertility.
- Produce industrial value added products using microbial fermentation at a commercial level.
- Analyze the role of various biogeochemical cycles in the atmosphere.

**TEXT BOOKS:**

1. Dubey, R.C. 2009. A Text book of Microbiology, S.Chand & Co. Ltd, New Delhi.
2. Sharma, A.K. 2004. Biofertilizers for Sustainable Agriculture. Agrobios Publication, Jodhpur, India.
3. Subba Rao, N.S. 2004. Soil Microbiology by N.S.Subba rao, Oxford and TBH Publications, Delhi.

**BOOKS FOR REFERENCE:**

1. NIIR Board, 2004, The Complete Technology Book on Biofertilizers and Organic Farming, National Institute of Industrial Research.
2. Bhatnagar, R.K and Palta, R.K. 1996. Earthworm – Vermiculture and Vermicomposting. Kalyani Pyblishers, Ludhiana, India.
3. Gupta, P.K.2005. Vermicomposting for Sustainable Agriculture. Agrobios, Jodhpur, India.
4. Prescott L.M., Harley J.P., Klein D.A., 2006. Microbiology, 6<sup>th</sup> edition. McGraw – Hill, New York.
5. Glazer and Nikaido, 2007. Microbial Biotechnology, 2<sup>nd</sup> edition, Cambridge University Press.

**COURSE III: PHARMACEUTICAL BIOTECHNOLOGY**  
**(Topic of Research)**

Course Code:  
Hours per Week:  
Credits: 4

Max. Marks: 100  
Internal Marks: 25  
External Marks: 75

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**Course Objectives:**

To enable the students to

- gain the knowledge on importance of pharmaceutical biotechnology
- be familiar with the basics of pharmacodynamics
- be acquainted with drug dosage and drug delivery
- discern pharmaceutical analytical techniques
- acquire knowledge about biotransformation.

**Unit – I: Pharmaceuticals:** Pharmaceuticals: Pharmaceutical products – importance of pharmaceutical biotechnology. Microbes in pharmaceutical industry: Applications of microbes - products. Secondary metabolites: Types - pharmaceutical importance. Drug discovery: Target discovery - target validation - assay development – screening - clinical trials.

**Unit – II: Pharmacodynamics and Pharmacokinetics:** Pharmacodynamics: Principle - mechanism of drug action. Pharmacokinetics: ADME properties - Mechanism of drug absorption - active - passive diffusion. Distribution of drugs: Plasma protein binding - factors affecting drug distribution. Biotransformation of drug metabolism: Phase I and Phase II reactions. Excretion of drug: Renal excretion – factors affecting excretion.

**Unit – III: Drug delivery:** Pharmaceutical dosage: Materials – formulations - manufacture of tablets. Delivery of biopharmaceuticals: Oral delivery system – pulmonary delivery system. Drug delivery system: Controlled drug delivery system - transdermal system - protein as drug delivery system. Drug delivery and development: Liposomes – liposomal drug delivery system – advantages and disadvantages.

**Unit – IV: Analytical techniques:** Chromatography techniques: Principle - procedure - applications of gel filtration - ion exchange - HPLC – GC-MS. Spectrophotometry: Principle – procedure - applications of flame emission - atomic absorption – fluorimetry. Pharmacogenomics: Drug interaction - applications. Personalized medicine: Definition - case studies on gene related diseases.

**Unit - V: Biotransformation:** Biotransformation of therapeutic agents: Production of aspirin - tissue Plasminogen activator – flucanazole. Production and purification of antibiotics: Streptomycin - chloramphenicol – safety – efficacy – US-FDA regulations. Monoclonal antibody in therapy: Antibody screening – therapeutic applications of monoclonal antibodies. Gene therapy: Basic approach to gene therapy – gene therapy of HIV.

### **COURSE OUTCOMES:**

- Explain the importance of secondary metabolites and its applications in pharma industries.
- Understand the concepts of Pharmacodynamics and Pharmacokinetics.
- Analyze the Drug delivery systems and their development.
- Elucidate various analytical techniques in Pharmaceutical Biotechnology.
- Discuss the production and purification methods of antibiotics.

### **TEXT BOOKS:**

1. Kumar, M., 2010. Pharmaceutical Biotechnology, 1<sup>st</sup> edition, Anmol Publication Pvt. Ltd., New Delhi, 2010.
2. Jogdand, S.N., 2005. Medical Biotechnology, 1<sup>st</sup> edition, Himalaya Publishing House, Mumbai, 2005.

### **BOOKS FOR REFERENCE:**

1. Kulkarni, J.S., Pawar, A.P. and Shedbalkar, V.P., 2012. Biopharmaceutics and Pharmacokinetics, 1<sup>st</sup> edition, CBS Publishers and Distributors, New Delhi.
2. Nallari, P. and Rao, V.V., 2010. Medical Biotechnology, 1<sup>st</sup> edition, Oxford University Press, New York.
3. Walsh, G., 2011. Pharmaceutical Biotechnology, 1<sup>st</sup> edition, CBS Publishers and Distributors, New Delhi.
4. Wilson, K. and Walker, J., 2010. Principles and Techniques of Biochemistry and Molecular Biology, 6<sup>th</sup> edition, Cambridge University Press, London.

## II Semester

Project Work

Total Marks = 200

(Thesis = 150 marks; Viva - voce = 50 marks)

### BLUE PRINT OF THEORY QUESTION PAPER FOR BOTH FULL TIME AND PART TIME

#### Question Paper Pattern

#### I Semester:

#### External: Total 75 Marks

#### Theory Paper

Section A : 10 Questions x 2 Marks = 20 Marks (Two Questions from each unit will be asked) Answer all the questions. Define each question in four or six sentences.	20
Section B: 05 Questions x 5 Marks = 25 Marks (Internal choice (or) Either or type and one set of questions from each unit will be asked) Answer all the questions in 500 -700 words, draw diagram wherever necessary.	25
Section C: 03 Questions x 10 Marks = 30 Marks (5 questions will be asked and one question from each unit will be asked) (Answer any THREE questions only) Write the answer in 1500 words, draw diagram wherever necessary.	30
<b>Total</b>	<b>75</b>

#### Internal: Total 25 Marks

<b>CIA Components</b>	<b>Portions to be covered</b>	<b>Question Paper pattern to be followed</b>	<b>CIA Marks allotted</b>
CIA Test – I	First 2½ Units	Same as Autonomous Examination Question Paper	10
CIA Test – II	Remaining 2½ Units		
Attendance	---	---	05
Assignments (2)	Any topics from five Units	---	05
Seminar (1)		---	05
		<b>Total</b>	<b>25</b>