

**M.Phil. MICROBIOLOGY (FT/PT) PROGRAMME**

(For the candidates to be admitted from the academic year 2018-19 onwards)

**Eligibility :** M.Sc. Microbiology.

**PROGRAMME OBJECTIVES :**

Microbiology is an applied science, helping agriculture, health and medicine and maintenance of the environment, as well as the biotechnology industry. Microbiologists study microbes at the level of the community, at the level of the cell and at the level of proteins and genes. Microorganisms are extremely important in our everyday lives. Some are responsible for a significant proportion of the diseases affecting not only humans, but also plants and animals, while others are vitally important in the maintenance and modification of our environment. Still others play an essential role in industry, where their unique properties have been harnessed in the production of food, beverages and antibiotics. Scientists also have learned how to exploit microorganisms in the field of molecular biology, which makes an enormous impact both industrially and medically. Microbiology also encompasses immunology, the study of the body's ability to mount defenses against infectious microbes.

The purpose of this course is to provide an additional learning experience on different methods of research, recent advances in research, methods of project preparation, writing research articles, collection, processing and presentation of data and writing hypothesis etc.,. This programme is structured in such a way to impart knowledge in recent trends in microbiology especially pharmaceutical microbiology, food microbiology and microbial technology. Research projects in second semester enhance the opportunity of students. They will work in advanced research settings, gain additional experiences with a variety of instruments, listen to others viewpoints and generally establish a certain degree of confidence.

**PROGRAMME STRUCTURE**

Sem-ester	Course	Title of the Course	Exam. Hours	Credits	Marks			
					IA	UE	Total	
I	Course - I	Research Methodology	3	4	25	75	100	
	Course - II	Trends in Microbiology	3	4	25	75	100	
	Course - III	Teaching and Learning skills (Common Paper)	3	4	25	75	100	
	Course - IV	Paper on Topic of Research (The syllabus will be prepared by the Guide and the examination will be conducted by the COE)	3	4	25	75	100	
II	---	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks	--	8	--	--	200	
<b>Total</b>					<b>24</b>	--	--	<b>600</b>

## **PROGRAMME OUTCOMES :**

After the completion of M. Phil microbiology course,

- The students will understand how to prepare a research project.
- The students will be able to write research articles, review articles and book chapters.
- Students will be able to understand basic and advanced techniques of various instrumentation like pH meter, spectroscopy, colorimetric, microscopy, chromatography, molecular techniques.
- The students would acquire basic knowledge of research data collection, processing and presentation of data and application of bioinformatics, biostatistics tools.
- The student will be able to demonstrate ability to provide advanced concept of microbial technology pharmaceutical technology, food microbiology process.
- The students will be able to demonstrate understanding of basic and advanced knowledge in microbiology disciplines.
- The students will be able to communicate effectively and demonstrate professional and ethical responsibilities.
- The graduates will acquire first-hand experience in working on projects at individual level and exposure to industrial and research environment.

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## **COURSE I**

### **RESEARCH METHODOLOGY**

#### **Course Objectives :**

- To understand the concept of research, review of literature, research articles, books, citation index.
- To impart knowledge on microscopic techniques and spectroscopic techniques.
- To get familiarity on various techniques of centrifugation, chromatography and electrophoresis methods.
- To understand basic concept of rDNA techniques.
- To get familiar with basics of computer and analyse& publish data using biostatistics and other related techniques.

#### **Unit I : Research Methodology**

Research Methodology – Introduction, importance, identification of research areas, Hypotheses, Review of Literature- Review and synopsis presentation. Research process, Research design and experimentation - Preparation of research report. Scientific documents – research paper, review paper, book reviews, theses, conference, books, book chapters and project reports. Guidelines for preparing an article - ISSN, ISBN, impact factor, citation index, downloading index, h-index, i-index, Google scholar, Scopus, Thomson & Reuters, Web of Science and Science Citation Index (SCI) of Web of Science (WOS). Plagiarism and its softwares.

#### **Unit II : Microscopy and Analytical instrumentations**

Principle, structure and applications of Bright field, Dark field, Phase contrast, Fluorescent, Electron microscopy(TEM & SEM), Confocal microscope and Foldscope. Atomic force microscope (AFM). pH meter- determination of pH, Colorimetry, Spectroscopy techniques - UV-Visible, Fluorescence, FT-IR, Atomic absorption, NMR, Mass spectrometry, MALDI ToF, IR spectrum, X-ray crystallography.

#### **Unit III : Separation techniques**

Centrifugation - preparative and analytical, ultra centrifugation, density gradient centrifugation. Principles and applications of gel-filtration, Ion-exchange, affinity chromatography; Thin layer and gas chromatography; High pressure liquid (HPLC) chromatography, HPTLC, GC-MS, LC-MS. Electrophoresis – Principle, types and applications - PAGE (proteins), Agarose Gel Electrophoresis (Nucleic acids), Pulse field Gel Electrophoresis (PFGE), Two dimensional electrophoresis (IEF).

#### **Unit IV : rDNA techniques**

Restriction mapping – RAPD, RFLP, STRR and LTRR. Cloning strategies, DNA sequencing – manual and automated methods. Southern, Northern, Western, Dot blotting & hybridization. Polymerase Chain Reaction – principles, types and applications, Single locus and multi locus DNA finger printing, rRNA in taxonomy & phylogeny. DNA Bar Coding, Microarrays/Chips.

## Unit V : Biostatistics

Principles and practice of statistical methods in biological research – Data collection, presentation of Data - Measures of central tendency - Mean, Median, Mode, Correlation coefficient, Standard deviation, student 't' test, chi-square test. Analysis of variance (ANOVA) and its uses. Basics of computers –types, servers, operating systems – Windows, UNIX and Linux. Finding scientific articles - Pubmed. Outline of SPSS and Mathematica.

### References

1. Arora, P.N. & Malhon, P.K. 1996. Biostatistics. Himalaya Publishing House, Mumbai.
2. Baxevanis, A.D. & Ouellette, B.F.F. 2001. Bioinformatics: A practical guide to the analysis of genes and proteins – Wiley Inter science – New York.
3. Gurumani, N. 2007. Research Methodology. MJP Publishers, Chennai – 600 005.
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8. Krishnamurthy, K.V. 2007. Scientometrics. BDU Journal of Science & Technology Vol.I (2) 153 – 168.
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### Course Outcomes :

- Learners will understand research, research methods, preparation of research reports, research articles, books, book chapters, impact factors, citation index.
- Students would acquire knowledge on different types of microscopes, pH meter, spectroscopic and crystallography techniques.
- Student would understand how to concentrate and separate biomolecules through centrifugation, chromatography and electrophoresis techniques.
- M. Phil Scholars would become knowledgeable in DNA sequencing, restriction mapping, blotting & hybridization techniques.
- Students would understand concepts of biostatistics and computers, analysis and interpretation of data, writing of thesis, and preparation of manuscript for publication.

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## COURSE II

### TRENDS IN MICROBIOLOGY

#### Course Objectives :

- To understand the concept of microbial diversity and characterization of microbes.
- To get familiarity with products obtained from microorganisms.
- To understand methods of preservation of pharmaceutical products.
- To impart knowledge on detection of microbes in food, risk assessment in food and food safety.
- To know the basics of bioinformatics methods.

#### Unit I : Microbial Diversity

Prokaryotic and eukaryotic microbial diversity - Isolation, cultivation and preservation of microorganisms - Criteria for classification of bacteria, fungi, algae, protozoa, helminthes and viruses. Identification of microorganisms – morphological, physiological & biochemical. Numerical taxonomy. Molecular characterization of bacteria.

#### Unit II : Microbial Technology

Production of useful products through microbial & recombinant microbes – insulin, vaccines, antibiotics, SCP (*Spirulina* & Mushroom) and Biofertilizers (Cyanobacteria and Bacteria). Biodegradation of organic wastes and xenobiotic compounds – heavy metals, pesticides, insecticides, oils and petroleum products. Microbial leaching. Microbial Biofuels - hydrogen production. Microbial production of nanoparticles – Silver and Gold. Therapeutic application of nanoparticles. Siderophores and magnetosomes. IPR & Patenting biological materials. National & International patent laws. Biosafety regulations and Bioethics.

#### Unit III : Preservation of pharmaceutical Products

Chemical preservatives – raw materials equipment – role of preservatives. Finished product tests – microbial enumeration test, tests for specified microorganisms. Sterility testing – antimicrobial effectiveness testing. Sterility assurance – biological indicators, sterilization validation process. Microbial risk assessment through HACCP plan.

#### Unit IV : Food Technology

Rapid methods for detection of microorganisms in food – conventional and automated. Application of light pulse technology. Risk assessment in food industry – physical, chemical and biological hazards. Assessment of microbial quality of marine foods: Conventional and recent development methods – flow cytometry, ATP estimation, radiometric, reflective colorimetry, LAL test, immunoassay. Application of additives in food. Food safety and standard act for adulteration. Significance of barcode and its uses in food industry. Brief note on Food safety and Standard authority of India (FSSAI).

#### Unit V : Bioinformatic methods

Genome sequence comparison, alignment - FASTA, BLAST, Phylyp, Clustalw. Nucleic acid and Protein data base searching - GenBank, EMBL, DDBJ and SWISSPROT. Tools used for phylogenetic analyses. Protein structure prediction - PDB. Submission of DNA sequences – Bankit & Sequin guidelines. Molecular Docking – Hex and FRED.

## Reference

1. Alexander Hillisch and Rolf Hilgenfeld. Modern Methods of Drug Discovery, Birkhauser, Switzerland
2. Ashutosh, K.2008. Pharmaceutical Microbiology, New Age International Publishers, New Delhi.
3. Baxevanis AD and BFF Ouellette, Wiley O. (ed).2001. Bioinformatics – A practical guide to the analysis of genes and proteins. Interscience, New York,
4. Brendan Wren (Editor), Nick Dorrell.2002. Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK.
5. Brenden Wren and Nick Dorrell, Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press.
6. Carlberg, D.M. 2004. Second Edition, Cleanroom Microbiology for the Non-Microbiologist, CRC Press
7. Clontz, L. 2008. Second Edition, Microbial Limit and Bioburden Tests: Validation Approaches and Global Requirements, CRC Press
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9. Glazer AN, Nikaido H. 1994. Microbial Biotechnology – Fundamentals of Applied Microbiology WH Freeman and Company, New York.
10. Glick BR, Pasternak JJ. 1998. Molecular Biotechnology - Principles and Applications of Recombinant DNA, ASM Press, Washington DC
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12. Higgins D, Taylor W. 2000. Bioinformatics, sequence, structure and databanks A practical approach. Oxford University Press.

## Course Outcomes :

- Students would learn about biodiversity, classification of microorganisms and various methods of microbial characterization.
- Students would knowledgeable in microbial products, process of biodegradation, microbial fuels, ethics and biosafety regulations.
- Student would understand how to preserve pharmaceutical products and sterility checking.
- Students would acquire knowledge on food microbiology especially microbes in marine food, risk factor assessment in food industry and food safety guidelines.
- Scholars would understand genome comparison, molecular docking, phylogenetic analysis, protein structure prediction and molecular docking.

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## **COURSE III**

### **Teaching and Learning Skills**

#### **Course Objectives :**

- Acquaint different parts of computer system and their functions.
- Understand the operations and use of computers and common Accessories.
- Develop skills of ICT and apply them in teaching learning context and Research.
- Appreciate the role of ICT in teaching, learning and Research.
- Acquire the knowledge of communication skill with special reference to its elements, types, development and styles.
- Understand the terms communication Technology and Computer mediated teaching and develop multimedia /e- content in their respective subject.
- Understand the communication process through the web.
- Acquire the knowledge of Instructional Technology and its Applications.
- Develop different teaching skills for putting the content across to targeted audience.

#### **Unit I : Computer Application Skills**

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 – ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations-- **ICT for Professional Development**: Concept of professional development; institutional efforts for competency building; individual learning for professional development using professional networks, OERs, technology for action research, etc.

#### **Unit II : Communications Skills**

Communication: 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 : Pedagogy**

Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture – Narration in 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.

## **Unit IV : E- Learning, Technology Integration and Academic Resources in India**

Concept and types of e-learning (synchronous and asynchronous instructional delivery and means), m-learning (mobile apps); blended learning; flipped learning; E-learning tools (like LMS; software's for word processing, making presentations, online editing, etc.); subject specific tools for e-learning; awareness of e-learning standards- Concept of technology integration in teaching- learning processes; frameworks guiding technology integration (like TPACK; SAMR); Technology Integration Matrix- Academic Resources in India: MOOC, NMEICT; NPTEL; e-pathshala; SWAYAM, SWAYAM Prabha, National academic depository, National Digital Library; e-Sodh Sindhu; virtual labs; eYantra, Talk to a teacher, MOODLE, mobile apps, etc.

## **Unit V : Skills of Teaching and Technology based assessment**

Teaching skills: 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- **Technology for Assessment:** Concept of assessment and paradigm shift in assessment; role of technology in assessment 'for' learning; tools for self & peer assessment (recording devices; e-rubrics, etc.); online assessment (open source software's; e-portfolio; quiz makers; e- rubrics; survey tools); technology for assessment of collaborative learning like blogs, discussion forums; learning analytics.

## **References**

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13. Sharma,R.A., (2006) Fundamentals of Educational Technology, Surya Publications,Meerut
14. Vanaja,M and Rajasekar,S (2006), Computer Education, Neelkamal Publications, Hyderabad.

### **Course Outcomes**

After completing the course, the students will:

- Develop skills of ICT and apply them in Teaching Learning context and Research.
- Be able to use ICT for their professional development.
- Leverage OERs for their teaching and research.
- Appreciate the role of ICT in teaching, learning and Research.
- Develop communication skills with special reference to Listening, Speaking, Reading and Writing.
- Learn how to use instructional technology effectively in a classroom.
- Master the preparation and implementation of teaching techniques.
- Develop adequate skills and competencies to organize seminar / conference / workshop / symposium / panel discussion.
- Develop skills in e-learning and technology integration.
- Have the ability to utilize Academic resources in India for their teaching.
- Have the mastery over communication process through the web.
- Develop different teaching skills for putting the content across to targeted audience.
- Have the ability to use technology for assessment in a classroom.

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