Department of Microbiology
School of Biosciences
Periyar University
Salem - 636 011, Tamil Nadu

M.Phil. Microbiology
Syllabus [OBE]

(For the students admitted from 2018 - 2019 onwards)

M.Phil. MICROBIOLOGY SYLLABUS

(Candidates admitted from 2018-2019 onwards)

Full Time

1. Eligibility

Candidates who have qualified for post graduate degree (any biological science) of this university or any other University recognized by the syndicate as equivalent there to shall be eligible to register for the Degree of Master of Philosophy (M. Phil) their respective subject and undergo the prescribed course of study in an approved institution or department of this University.

Candidates who have qualified their postgraduate degree on or after 1st January, 1991 shall be required to have obtained a minimum of 55% of marks in their respective postgraduate degrees to BECOME eligible to undergo the prescribed course of study in an approved Institution or department of this University.

In the case of teachers (or) others registering for part time registration, the minimum percentage of marks for registration is 50%.

For the candidates belonging to SC/ST community and those who have qualified for the Master's degree before 01.01.1991 the minimum eligibility marks shall be 50% in their Master's Degree.

2. Duration

The duration of the M. Phil course shall extend over a period of one year from the commencement of the course.

3. Course of study

Course of study for the degree shall consist of (a) Part-I comprising three written papers according to the Syllabus prescribed from time to time: and (b) Part-II Dissertation.

Part -I shall consist of Paper -I Research Methodology and Paper -II an advanced paper in the main subject. There shall be a third paper which shall be the background paper relating to the proposed Dissertation conducted internally by the College/Departments.

4. General Graduate Attributes:

- **Communication skills:**

  The scholars gain the ability to communicate information on microbiology using written, visual and oral reporting formats.

- **Research related skills:**

  The scholars ability to apply the principles of scientific experimental design and methods to investigate microbiologically relevant problems. They may gain the ability to analyse critique scientific papers in microbiologically relevant research areas.

- **Team work:**

The scholars acquire the ability to work effectively as a member and leader within a team. They are capable to employ the scientific method effectively as part of a collaborative team.

- **Knowledge:**
  The scholars will gain integrated knowledge on scientific research and gain insights on Research Methodology.
- **Global Perspective:**
  The scholars may acquire the current and emerging worldwide microbiological technologies, issues, and perspectives during their course period.
- **Critical thinking:**
  The scholars develop the skill to apply the scientific process, including ability to acquire, assimilate, synthesize, analyze and critique microbiological information.
- **Analytical reasoning:**
  The scholars were enhanced in logical reasoning, critical data evaluation and formation of evidence-based opinions.
- **Scientific reasoning:**
  The scholars gain demonstrative understanding and evaluation of knowledge as the key to knowledge creation.
- **Reflective thinking:**
  The scholars potential in self-discipline, planning, organizational and time management skills and the ability to work independently will be enhanced.
- **Digital literacy:**
  The data analysis ability to apply specific skills in acquiring, organizing, analyzing, evaluating and presenting the scientific information.
- **Multicultural competence:**
  The scholars acquire an awareness of the social and cultural context of the implications of microbiology and microbiological knowledge and investigation.

5. Programme objectives and outcomes

PROGRAM EDUCATIONAL OBJECTIVES (PEOS):

PEO1 – To enable the scholars to develop knowledge and skills in identifying specific research gaps in the field of Microbiology.

PE02 – To ensure that scholars will recognize, design and develop sustainable technologies to address the needs of community and expand the career opportunities in academic institute's hospitals / clinical laboratories, food industry, effluent treatment plants, research laboratories and pharmaceutical industry through innovative techniques.

PEO3 – To empower the scholars to develop leadership skills, communicative skills problem solving skills and reasoning skills.

PROGRAMME OUTCOME (POs)

PO1: Gains integrated knowledge on research methodologies and the advancements in the field of Microbiology.

PO2: Gains the ability to accurately and effectively communicate information on microbiology using written, visual and oral reporting formats.

PO3: Gains the ability to apply the scientific process, including ability to acquire, assimilate, synthesize, analyze and critique microbiological information. Develops logical reasoning, critical data evaluation and formation of evidence-based opinions.

PO4: Gains the ability to evaluate and solve the problems with scientific evidences. Apply the gained knowledge as the key to knowledge creation. An intellectual integrity, rigour , reasoning, analysis and interpretation of scientific and technical data.

PO5: Demonstrate specific skills in analyzing, evaluating and presenting scientific information, in particular incorporating the increasing importance of digital-based activity.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1: The Graduates will be able to desing a research problem independently and sove the problem through scientific methods. They also gain the communivcative skills that will be helpful for presenting their research findings.

PSO2: Design experiments to prove scientific process and to synthesize product / services for the benefit of community.

PSO3: Microbiologist usually works in hospitals/ clinical laboratories, food industry, environment, research laboratories, pharmaceutical industry and will able to understand

industrial processes, clean rooms, and how to effectively evaluate microbial risks to products from people and processes.

6. Scheme of Examinations

Part I: Written Examination (Paper I, II & III)

The examination of papers I, II and III shall be held at the end of the year. The duration for each paper shall be 3 hours carrying a maximum of 100 marks.

Paper -III examination will be conducted by the College/ Departments and the marks obtained by the candidate along with the question paper and valued answer scripts shall be sent to the University at least 15 days before the commencement of the examinations of paper I and II.

Part II: Dissertation

The exact title of the Dissertation shall be intimated within one month after the completion of the written examination. Candidates shall submit the Dissertation to the University through the Supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the University from a panel of four names sent by the Supervisor through the Head of the Department/Principal at the time of submitting the Dissertation.

The examiners who value the Dissertation shall report on the merit of candidates as "Highly Commended" (75% and above) or "Commended" (50% and above & below 75%) or "Not Commended" (Below 50%).

If one examiner commends the Dissertation and the other examiner, does not commend, the Dissertation will be referred to the third valuation shall be final. Submission or resubmission of the Dissertation will be allowed twice a year.

The allotment of marks for (i) Theory (ii) Dissertation and Viva Voce are as follows:

(i) Theory Papers

Internal	: 25 Marks
External	: 75 Marks
Total	: 100 Marks

(ii) Project Dissertation

Internal	: 50 Marks
Dissertation	: 100 Marks
Viva Voce	: 50 Marks
Total	: 200 Marks

(iii) Internal assessment for course I, II and III

Test	: 10 Marks
Seminar	: 10 Marks
Attendance	: 05 Marks
Total	: 25 Marks

S. No	Paper	Title of Paper	Exam Hrs	Max. Mark
1	Paper I	Research Methodology and its Applications	3	100

2	Paper I	Advances in Microbiology	3	100
3	Paper I	Research background paper	3	100
4	Part II	Dissertation	-	200
Total				500

7. Passing Minimum

A candidate shall be declared to have passed Part-I of the examination if he/she secures not less than 50% of the marks in each paper including Paper-III for which examination is conducted internally.

A candidate shall be declared to have passed Part-II of the examination if his/her dissertation is at least commended. All other candidates shall be declared to have failed in the examination.

8. Restriction in number of chances

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of commencement of the course.

9. Conferment of Degree

No candidate shall be eligible for conferment of the M. Phil degree unless he/she is declared to have passed both the parts of the examination as per the regulations.

M.Phil. MICROBIOLOGY (Choice Based Credit System)

Course of Study

Part	Course	Course Code	Name of the course	Credits	Marks		
					IA	UE	Total
I	I	18DMPMB01	Research Methodology and its Applications	4	25	75	100
	II	18DMPMB02	Advances in Microbiology	4	25	75	100
	III	18DMPMBE	Research Background Paper	4	25	75	100
II	IV		Dissertation and Evaluation Viva-voce	8 + 4 (12)	50	100	150 50
			Total	24			500

Research Background Paper

The candidate has to select one paper from the tem research background papers listed below tithe the consent of the guide.

1. BIOTECHNOLOGY OF ACTINOBACTERIA
2. BIO-PROSPECTIVE OF MICROBIAL METABOLITES
3. MICROBIAL TECHNOLOGY
4. ENVIRONMENTAL MICROBIOLOGY AND BIODEGRADATION
5. BIOLOGY OF MICROBIAL ENDOPHYTES

6. ALGAL TECHNOLOGY
7. BIORESOURCE TECHNOLOGY
8. MEDICAL MICROBIOLOGY
9. MICROBIAL DIVERSITY
10. PHARMACEUTICAL AND INDUSTRIAL MICROBIOLOGY

PAPER – I: RESEARCH METHODOLOGY AND ITS APPLICATIONS

Course Objectives

The course contents are designed to gain knowledge about the research ideas, various aspects relating to research such as preparation of research paper, various citation index, use of statistics, principle and application of various instruments, and role of bioinformatics in research. The learner will get an understanding about the research related skills.

Course Outcome

At the end of the course, the learner will be able to

1. Know the basics aspects of research process, Data presentation and Research report writing.
2. Learn the principles of statistics and its tools, the basics of the various advanced instruments for analysis in research.
3. To provide an exposure to the students on the basic skills for becoming a researcher in microbiology.

UNIT - I

Research Methodology - Meaning and importance. Review of literature - Review and synopsis presentation. Types of Research and research tools, Research designs - Experimental and non-experimental. Preparation of research report. Guidelines for preparing an article - ISSN, ISBN, impact factor, citation index, h-index, I- index, Google scholar, Scopus, Thomson& Reuters, Web of Science. Plagarism and Antiplagarism software, Computational- RSM.

UNIT - II

Biostatistics - Introduction - Basic concepts, Sampling and data collection, Data presentation, Descriptive Statistics - Measures of central tendency and Measures of dispersion, Population parameters, sample estimates and confidence intervals. Basic concepts of probability. Probability distributions, Z-scores, Student's t- test, Chi square test, Correlation, regression, ANOVA, SPSS, RSM.

UNIT - III

Units of measurements (Mole, equivalents - Molarity-Molality and normality), Cleaning of laboratory glassware's. Laboratory Instruments Principles and applications of pH meter, Centrifuge, UV-Vis spectrophotometer. Molecular techniques - Electrophoresis, PCR, RAPD, RFLP, field Gel Electrophoresis (PFGE), Two dimensional electrophoresis (IEF), DGCE, TGGE and TRFLP. STRR and LTRR analysis cDNA library - screening by oligonucleotide probe, nick translation, site directed mutagenesis.

UNIT - IV

Bioinstrumentation- Chromatographic Technique- Principles, types and applications of Chromatography -Thin layer chromatography(TLC), Gas Liquid Chromatography (GLC) ,High pressure liquid chromatography (HPLC),Fast performance liquid chromatography (FPLC), Gas chromatography - Mass spectrometry (GC-MS). Compound Microscope- Transmission Electron Microscope (TEM) and Scanning Electron microscope (SEM)- Principles, Procedure and Specimen preparation, Fluorescent Microscope.

UNIT - V

Bioinformatics and IPR - An overview of bioinformatics. Biological databases- Database searching, Sequence analysis, Pair alignment, Visualizing protein structures, Predicting structure and function of protein using sequences, computer based drug designing. Submission of nucteotides in NCBI-FASTA, Construction of phylogenetic tree. Phylogenetic analysis Genomics, Proteomics. Drug design and commercial bioinformatics. Intellectual property rights, patents, trade secrets, copyrights and trade mark. Patenting transgenic organisms. Plant breeder's right. Ethics in animal biotechnology.

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15. David W.M. (2001) *Bioinformatics*, Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press.
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3. http://www.math.yorku.ca/scs/statResource.html# General
4. http://www.anest.ufl.edu/computer/index.html
5. http://www.jegsworks.com/Lessons/index.html
6. http://www.bettycjung.net/statsites.html
7. http://www.biostat.harvard.edu/links/
8. http://www.ped.mod.utah.edu/genpedscrr/Epibio.html.

Course Outcomes

On the Successful completion of the course students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know the basics aspects of research process, Data presentation and Research report writing.	K1 & K2
CO2	Learn the principles of statistics and its tools, the basics of the various advanced instruments for analysis in research	K4
CO3	To provide an exposure to the students on the basic skills for becoming a researcher in microbiology	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	M	M	S	S	S
CO3	M	M	S	S	S

S – Strong; M- Medium

PAPER – II: ADVANCES IN MICROBIOLOGY

Course Objectives

The course contents are designed to gain knowledge about the various advances that have been made in the field of microbiology with regard to the instrumentation used in research and advanced science knowledge with regard to microbial technology, secondary metabolites, clinical microbiology and microbial pharmaceuticals.

Course Outcome

At the ends of the course, learners will be able to

1. Gain knowledge to the advanced microbial techniques and effectively learn the applications of the instruments.
2. Acquire knowledge of the various secondary metabolites production and their biological applications.
3. Understanding the importance of various emerging diseases and its diagnostic methods.
4. The students will be able to know about the advanced developments in Microbiology.

UNIT - I

Introduction – Development of microbiology and the early discoveries - Isolation of different types of bacteria – fungi – actinobacteria – cyanobacteria. Microbial taxonomy: Definition, systematics, Nomenclature rules and identification, Microbial respiration and fermentative pathway - respiratory metabolism, Fermentation of carbohydrates - homo and hetero lactic fermentation. Bioenergetics, Cell division - endospore - structure and properties.

UNIT - II

Current trends: Exploration of bioactive compounds from extremophiles. Bioremediation, Biosensors, Biofuel, Biofilms. Remote sensing microbiology, Microbial communication - Quorum Sensing. Barcoding of microbes - application in clinical and industrial fields, Microbial techniques: Confocal microscopy, DNA Microarray for comparative and Evolutionary genomics: Flow cytometry, Atomic flame photometry, Plasma emission spectroscopy, Infra-red spectrophotometry. Tandem mass spectroscopy, Electron Spin Resonance spectroscopy, MOLDI-TOF mass spectrometry.

UNIT - III

Microbes and Health: GLP, laboratory and hospital acquired infection. Emergence of MDR and XDR microbes. Harmful microbes and biological weapons. Automated diagnostic method. Recombinant vaccines. Environmental aspects of emerging diseases. Microbial pharmaceutics and biotechniques: Drug discovery and design, British and Indian Pharmacopacea, Marine microbial antibiotics, Microbial therapeutic enzymes, Microbial pigments, Single cell proteins. Microbial Products and their bioprocesses.

UNIT - IV

Pharmacokinetics and pharmacodynamics - Routes of drug administration- volume of distribution - biotransformation - Phase I and Phase II reactions - bioavailability - excretion of drugs and their metabolites as defined by Hendersson Hassle Batch equation. Adverse drug reactions. Principles of toxicity, evaluation and determination of LD50, ED50 and therapeutic Index.

UNIT - V

Microbial Technology: Microbes in nanotechnology, Nanoscience in biomedical application: Nanosensors in diagnosis - Nanorobotics in surgery Nanotechnology in tissue regeneration - Nanotechnology durg targeted delivery. Applications in tissue engineering and therapeutics. Biopolymers, Biosurfactants, Biofertilizers, Biopesticides, Bioluminescence, Genetically modified organisms. Gene silencing - Gene knockouts and gene therapies, antisense technologies. Gene therapy, Stem cell therapy. Carbon sequestration by microbes.

References

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4. http://www.biosci.ohio-state.edu/-mgonzalez/micro521.html
5. http://bioweb.uwlax.edu/Genweb/Microbiology/General/general.html

6. http://www.medunich.edu/TAMC/LINKS.HTML
7. http://acs.ucalgary.ca/-browder/transgeni.html.

Course Outcomes

On the Successful completion of the course students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge to the advanced microbial techniques and effectively learn the applications of the instruments.	K1, K2 & K3
CO2	Acquire knowledge of the various secondary metabolites production and their biological applications.	K4
CO3	Understanding the importance of various emerging diseases and its diagnostic methods.	K4
CO4	The students will be able to know about the advanced developments in Microbiology.	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	M	S	S	S	S
CO3	M	S	S	S	S
CO4	S	M	S	S	S

S – Strong; M- Medium

RESERACH BACKGROUND PAPER

Course Objectives

The course contents are designed to gain knowledge about the importance of research and to gain in-depth knowledge in various fields of microbiology. The research background paper was designed in such a way that it provides the necessary inputs for pursuing their research. Ten papers are listed below and the candidate has to select one paper that is more relevant to his/her research.

Course Outcome

At the ends of the course, learners will be able to

- Gain knowledge in the recent advances in their area of research
- Understanding the importance of research and learning to define a research problem.
- Acquire the skills for developing a process for accomplishing the fixed targets
- Learn the principles of advanced techniques and the applications of the instruments.

1. BIOTECHNOLOGY OF ACTINOBACTERIA
2. BIO-PROSPECTIVE OF MICROBIAL METABOLITES
3. MICROBIAL TECHNOLOGY
4. ENVIRONMENTAL MICROBIOLOGY AND BIODEGRADATION
5. BIOLOGY OF MICROBIAL ENDOPHYTES
6. ALGAL TECHNOLOGY
7. BIORESOURCE TECHNOLOGY
8. MEDICAL MICROBIOLOGY
9. MICROBIAL DIVERSITY
10. PHARMACEUTICAL AND INDUSTRIAL MICROBIOLOGY

Course Outcomes

On the Successful completion of the course students will be able to

CO Number	**CO Statement**	**Knowledge Level**
CO1	Gain knowledge in the recent advances in their area of research.	K3
CO2	Understanding the importance of research and learning to define a research problem	K4
CO3	Acquire the skills for developing a process for accomplishing the fixed targets	K4
CO4	Learn the principles of advanced techniques and the applications of the	K5

	instruments.	

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	S	S	S	S
CO2	S	M	M	S	S
CO3	S	M	S	S	S
CO4	M	S	M	S	S

S – Strong; M- Medium

1. BIOTECHNOLOGY OF ACTINOBACTERIA

Unit I

Introduction, history and importance of Actinobacteria. Diversity of actinobacteria, habitats - Terrestrial, aquatic and other extreme ecosystems. Sample collection, isolation and preservation of actinobacteria. Characterization, identification and taxonomy of actinobacteria based on phenotypic, chemotaxonomic and molecular methods.

Unit II

Screening methods - Preliminary and secondary screening for metabolites. Production and optimization of bioactive metabolites from actinobacteria. Bioassay guided fractionation of active compound - extraction, purification, bioautography. Characterization of purified compounds – based on spectral analysis such as UV, IR, Mass, NMR analysis and XRD analysis. MIC and MBC studies for bioactive compounds.

Unit III

Nanotechnology - Introduction to nanotechnology - history, scope and opportunities. Biosynthesis of nanoparticles and its mechanism. Applications - Biomedical and Environmental application of nanoparticles, dye degradation in nanotechnology, waste water treatment. Nano-composites - synthesis and its application.

Unit IV

Plant nutrition - primary and secondary plant nutrients - plant micronutrients. Bio fertilizers - biology of nitrogen fixation, preparation of different types of inoculants: nitrogen fixers, phosphate solubilizers, zinc solubilizers plant growth promoting rhizobacteria(PGPR), composting. Phytohormone production, antibiosis, plant growth promotion and biological control. Biofertilizers, Bioinsecticides, Biofortification, Mass production and delivery systems.

Unit V

Biofuel- Renewable and non renewable energy sources, Classes, types and applications of biofuels, current status of biofuels, Economical importance and application of biofuels, Organic waste management. Biofuel production- Primary and secondary screening for biofuel production, Bio gas production, Bio ethanol production, Bio diesel production, Microbes for biofuel production, Organic substrates for biofuel production, Characterization of biofuels, Dark fermentation and photo fermentation.

References

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http://biofuel.org.uk/

https://www.greenfacts.org/en/biofuels/l-2/1-definition.htm

2. BIO-PROSPECTIVE OF MICROBIAL METABOLITES

Unit I

Microbial bioconversion of agro industrial waste: Physical, chemical and biological properties of soil. Novel approach for waste disposal and reuse. Principles and methods of waste management. Source and types of organic wastes. Microbes involved in the Bio-decomposition of organic waste. History and methods of composting. Factors influencing quality of composting. Microbial process in agro waste utilization and their applications.

Unit II

Microbial bio-prospecting for sustainable development: Microbial potential for generation of renewable energy – Bio-ethanol, hydrogen, methanol and microbial fuel cells. Microbe assisted biomass generation. Microbial enzymes for carbon di-oxide sequestration. Microbial enzymes for removing pollution load in effluent systems. Microbial metabolites as Bio-pesticides and Soil fertility enhancers.

Unit III

Microbial Pharmaceutics and cosmetics: System biology for the production of pharmaceutical and commercial products from microbes and plants. Production, recovery and purification of various secondary metabolites - Antibiotics, steroids, antioxidants, ellagitannins, anti histamines, antihelminthes. Vaccine preparation. Detection and assay of desired products. Strategies for media formulation for secondary metabolites production. Microbial nano-particles in drug delivery systems. Properties and applications of plant and microbial derivatives.

Unit IV

Value added food and feed preparation using microbes: Single cell proteins, Mushroom cultivation, Probiotics, Cheese, Win, Alcohol, Vinegar making, fermented foods. Bacteriophage-based sensors for the detection of food-borne pathogens. Microbial Silage preparation using food wastes. Degradation of food industry disposals for animal feed preparation.

Unit V

Bio-prospecting by microbial bio-engineering: Bio-prospecting strategies for identifying new bio-products using cultivable and non-cultivable microbes. Modification of microbes for increased product formation of commercial and industrial importance. *In-silico* bio-prospecting, Metagenomic library construction and applications.

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3. MICROBIAL TECHNOLOGY

Unit I

Microbial Biomass: Microbial Technology - Scope and Introduction. Production of microbial biofertilizers - Mass cultivation of *Spirullina, Azolla* and other N2 fixers. Microbial insecticides - bacterial insecticide *Pseudomonas* Sp*, Bacillus* Sp. *Bacillus thuringiensis.*

Unit II

Bioprospecting of Microbes: Biotechnological potentials of microbes - pharmaceutical compounds, carotenoids, cobalamine and polysaccharides. Microbial production of new novel enzymes, steroids, organic acids and antibiotics.

Unit III

Prospective metabolites: Biosynthesis of natural products, Biomimics, Botanical Pharmaceuticals, Adhesion technologies, growth hormone, tissue plasminogen activator and subunit vaccines.

Unit IV

Microbes in warfare: Biological weapon - such as bacteria, viruses, toxins, or other biological agents. BioShield Biomining, Biosensors, Microbes in abatement of heavy metal pollution, Bioremediation of radioactive waste.

Unit V

Genetically modified organisms: Gene therapies - Antisense technologies and Gene knockouts animals. Transgenic plants – for nutrient deficiency, water stress and salinity resistant plants, pest and disease resistant plants.

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4. ENVIRONMENTAL MICROBIOLOGY AND BIODEGRADATION

Unit I

Environmental Microbiology: liquid Waste treatment - Characterization of liquid wastes. Treatment of liquid wastes - Primary, secondary (anaerobic and aerobic) - trickling, activated sludge, oxidation pond, and oxidation ditch-tertiary - disinfection.

Unit II

Microbiology of air and water: Composition of air, Number and types of organisms in air, Distribution and sources of air borne organisms, Droplet and droplet nuclei, Assessment of air quality, Airborne diseases, Air sanitation, Microbes and climatic change, Microbial carbon sequestration.

Unit III

Introduction - organic wastes in the biosphere-their source and composition - Various process of microbial conversion-aerobic and anaerobic degradation-mechanism and factors influencing degradation. Biodegradation of agricultural wastes – Compost - anaerobic digestion-methanogens -fermentative reactions -hydrogen metabolism- acetogenic reactions -Biogas yield-Factors affecting anaerobic digestion.

Unit IV

Bioremediation - types and its application. Hydrocarbon degradation - Bioaccumulation of metals - methylation of heavy metals. Biodegradation of xenobiotic compounds: Hydrocarbon, pesticides, paper, leather, wood, textile and paints. Genetically modified organisms and their impact- Genetically modified organisms in pesticide degradation and oil spills.

Unit V

Microbial assessment of water - MPN, BOD and COD. Quality assurance, quality control methods, disposable methods of wastes. Water borne diseases and their control measures. Air borne diseases and their control measures.

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5. BIOLOGY OF MICROBIAL ENDOPHYTES

Unit I

Endophytes: Definition, Introduction & Discovery of Endophytes, Evolution of Endophytes, Types of Endophytes - Bacterial & Fungal, Host plant - Endophyte Interactions - Resistance to disease, Protection from Insect, Growth Promotion of host, Physiological and Ecological role of Endophytes.

Unit II

Fungal Endophyte Diversity: Endophytes of Woody plants, Seaweeds and Medicinal plants, Bioprospecting of endophytic fungi - Antimicrobial compounds, Anticancer, Antioxidant, Immunomodulatory and Immunosuppressive compounds from Endophytes- their importance and application, Analysis of Bioactive compounds.

Unit III

Isolation and Identification of Endophytic fungi: Method of Screening of Endophytes- Primary and Secondary, Cultivation of Endophytes- Media composition and Optimisation of media components, Molecular characterisation and Identification of Culturable and Non cultural Endophytic fungi.

Unit IV

Antibiotics: Definition, Classification based on Spectrum and mode of action. Tests for sensitivity to antimicrobial agents - Disc Diffusion, Agar Dilution and Broth Dilution Methods. Bacterial Resistance- Mechanism of Drug Resistance, Beta lactam resistance- Phenotypic and Genotypic Detection- Inhibitors of Betalactamase.

Unit V

Antibiotic resistance: Scope and Importance of the Problem, Impact on the society, Steps taken to reduce resistance - Role of Policy makers, HealthCare Professionals, Agricultural sector, Health care Industry and Individuals, WHO role in curtailing resistance- Global action plan and its impact on the Society.

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1. R Ananthanarayan and C.K JayaramPaniker (2009). Textbook of Microbiology 8th EditionOrient Longman, Hyderabad.
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2. www.lavoisier.fr/notice/gbDJOKXRLDO2XKKO.html
3. www.bookfayre.cz/books/item/9780443071645.html.cs

6. ALGAL TECHNOLOGY

Unit I

Taxonomy of Algae: Classification, structure and reproduction of algal; Distribution of algae, Characteristics of microalgae, Dinoflagellates, cyanobacteria and Seaweed; Morphological identification of microalgae and cyanobacteria; Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms.

Unit II

Isolation, identification and Cultivation of Algae: Algal production systems; Different types of microalgal isolation, screening and identification methods; Technique of mass culture of Algae; Cultivation methods; Laboratory cultivation of micro and macro algae; Indoor cultivation methods and scaling up; Outdoor cultivation methods; closed system cultivation methods; Measurement of algal growth; Large-scale cultivation of algae.

Unit III

Optimization, Extraction & Estimation studies: Estimation studies: lipid, protein, carbohydrates, chlorophyll, biomass and pigments; Optimization of physical and chemical parameters - pH, Temperature, Light sources, CO_2 supplements and nutrients; Types of bioreactors; Extraction methods- lipid, pigments, Carbohydrate; Explain the different optimization software tools- RSM, SPSS, MiniTab, One factor and Plackett-Burman analysis.

Unit IV

Instrumental analysis: Principles, instrumentation and applications of adsorption, partition, exclusion, ion exchange, affinity, column chromatography, chromatofocussing, TLC, HPLC, FPLC and GLC; Principles, instrumentation and applications of gel electrophoresis (AGE and PAGE), Pulse field gel electrophoresis (PFGE); SWISS-MODEL, MODELLER, DaliLite and SSAP, Bioedit. Principle, methodology and application of Viscosity, Density and Flash point analyzer; Methods of measuring properties; Atomic structure, particle size determination, surface structure, Microscopy (TEM, SEM and Field Ion), Spectroscopy (IR and Raman) and X- ray crystallography.

Unit V

Bioactive metabolites from algae: Biotechnological approaches for production of important algae, pigments, biofuels, hydrogen production, important bioactive molecule; TAG, phospholipids, sphinolipids, glycolipids; Biosynthesis of lipid; Fatty acid oxidation: importance and regulation; Fatty acid biosynthesis, importance and regulation; Aqua, cattle feed and bio-

fertilizer conversion methods; Biodiesel separation and conversion methods; Transesterfication methods.

References:

1. Robert A Andersen (2005) *Algal Culturing Techniques.* Academic Press
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5. https:// www.enlightened-designs.com/growing_algae.html
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10. https:// www.uni-bielefeld.de/biologie/Zellbiologie/publik/paper/2007tpj.pdf

7. BIORESOURCE TECHNOLOGY

Unit I

Bioresource and Renewable energy: Introduction to Bioresource technology - Biomass, Biological wastes from domestic, agriculture and industries. Biomass - Feed stocks (agricultural crops, bioenergy crops, agricultural waste residues, wood residues, waste stream Energy resources - Hydropower, geothermal power, solar power, wind power, Biofuel.

Unit II

Fuel technology and bioconversion: History - Definition of biofuel, applications of biofuel for transport, direct electricity generation, home use and energy content of biofuel. Biogas from solid and liquid wastes, varying types of biogases. Biogas plant, feed stock materials, biogas production, factors affecting methane formation. Role of methanogens - Biohydrogen production - Oxygen sensitivity - problems in hydrogenenases.

Unit III

Bio ethanol, butanol and biodiesel: Bioethanol from natural wastes - molasses, starch wastes and cellulosic wastes. Ethanol recovery, Advantages of ethanol. Biobutanol production, energy content and effects on fuel economy - Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization - Butanol fuel mixtures. Production of biodiesel, oil extraction from algae by chemical solvents, enzymatic, expeller press. Applications of biodiesel, environmental benefits and concerns.

Unit IV

Fermentation and its Processes: Definition of fermentation, History and origin of fermentation process. Types of fermentation, Fermentor structure and its functions. Upstream processes, Industrially important microbes, Formulation of industrial media and sterilization. Fermentor vessels and its method of sterilization. Downstream process. Fermentation economics.

Unit V

Microbial Products from Natural Resources: Definition of Microbial Products, Organic acids-Amino acids, Antibiotics, Enzymes, Vitamins, Alcoholic beverages - wine and beer, Fermented foods - bread, cheese and soy sauce. Recombinant Products - insulin, interferon and growth hormone, Microbial transformations - steroids and sterols. Non-steroid compounds –Antibiotics.

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10. Twidell., J & Weir., T. (2006). Renewable energy resources, Taylor & Francis 2nd Edition.

8. MEDICAL MICROBIOLOGY

Unit I

Introduction to medical microbiology - Infection disease process- diagnosis- process of sample collection, transport and examination of the specimens, discarding of clinical specimens, Anti-biogram.

Unit II

Bacteriology: Gram positive organisms: morphology, culture characteristics, pathogenicity and laboratory diagnosis of *Staphylococcus aureus, S. pyogenes, Pneumococcus* sp*., Corynebacterium diphteriae, Bacillus anthracis, Clostridium tetani, Mycobacterium tuberculosis, M. leprae,* Spirochaetes - *Treponema pallidum, Leptospira lacteroheamorrhagiae, Chlamydiae.*

Unit III

Bacteriology Gram negative organisms: morphology, culture characteristics, pathogenicity and laboratory diagnosis of *E. coli, Klebsiella sp, Salmonella sp, Shigella sp, Pseudomonas* sp*, Vibrio cholerae, Bordetella pertusis, Yersinia pestis,* and *Niesseria gonorrhoeae, N. meningitidis.*

Unit IV

Virology: Basic concept of Virology - general properties of human viruses, Pathogenicity, Life cycle, Laboratory diagnosis, treatment and control measures of viral infections- Hepatitis A, B, and C viruses, Polio virus, Rabies, Influenza virus, Measles, Mumps, Dengue virus, HIV, Ebola virus and newly emerging viral diseases.

Unit V

Mycology: general properties and approaches to laboratory diagnosis of Superficial mycosis - *Tinea*, *Pidia*, Subcutaneous mycosis and systemic infections - *Cryptococcosis*, *Madura mycosis*, *Histoplasmosis*, and *Candida albicans*.

Parasitology: pathogenicity and laboratory diagnosis of *Entamoeba histolytica, Taenia solium, Plasmodium falcipalum, Wucheraria bancroft,* and *Trichomonas vaginalis*.

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1. Chakraborty P (2003). A Text book of Microbiology. Second edition, Published by New Central Agency (P) Ltd., Kolkata.
2. Ananthanarayan R and JayaramPanikerCK (2005). Text Book of Microbiology. Seventh edition, Orient Longman Limited, Hyderabad.

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9. MICROBIAL DIVERSITY

Unit I

Microbial Diversity Analysis: Introduction and scope of Microbial diversity: Analysis of Microbial Diversity - Archaea, bacteria, algae and fungi in different ecosystems, Major characteristics used in bacterial taxonomy: morphological, physiological, taxonomy, biogeochemical processes.

Unit II

Computational tools for microbiome profiling: Cultivation-independent methods to study microbial diversity; strategies for finding novel enzymes and antibiotics. Computational tools for taxonomic microbiome profiling of shotgun metagenomes. Prospects of microbiome.

Unit III

Genome Databases of *E.coli*, Data resources - EST, STS etc. Sequence analysis; basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues, pairwise sequence alignment algorithms.

Unit IV

Molecular tools for communities analysis: Genome level adaptation in extremophiles; hyperthermophiles, halophiles, microbial genome evolution. Interactions within microbial communities and between microorganisms and plants and animals. Microbial community analysis- PLFA, FAME, DGGE, TRFLP, qPCR, ITSPCR and ARDRA.

Unit V

Screening for metabolites: Screening for various prospective metabolites from bacteria, fungi and algae. Metabolic fingerprinting. Metabolomics - types - primary and secondary metabolites and Applications, drug discovery.

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10. PHARMACEUTICAL AND INDUSTRIAL MICROBIOLOGY

Unit I

Introduction and Strategies of strain improvement, Selection and adaptation, Selection of induced mutants, Selection of recombinants , Strain improvement for modification of properties other than yield, Preservation of industrially important organisms: Principle, methods and quality control.

Unit II

Introduction to downstream processes: Problems and designing, Removal of microbial cells and suspended solids - Foam separation , Precipitation , Filtration and Centrifugation. Cell disruption methods - mechanical methods, Chemical methods. Product concentration and purification - Liquid-liquid extraction, Chromatography, Membrane separation, Drying and Crystallization.

Unit III

Quality Assurance and Safety Measurement, Quality assurance of products- Bioassay, Sterility test, Pyrogen test. Methods for standardization of antibiotics, vitamins and aminoacids. Assessment of a new antibiotic. Evaluation of bactericidal & bacteriostatic. Drug synergistic effects, Adverse Drug Reactions (ADR).

Unit IV

Designing of aseptic area, laminar flow equipments, clean area classification, study of different sources of contamination. Principles, methods used in microbiological assay. Manufacturing and environment safety-Containment, Clean room environment, Effluent treatment.

Unit V

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents. Evaluation of microbial stability of formulations.

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