

**M.Sc. Microbiology**  
**Third Semester Examination**  
**Paper3.1 MB-631– Soil & Agriculture Microbiology**

Contact Hours / Week : 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination : 3 Hours	Continuous/Internal/Assessment Semester Assessment	: 30 Marks : 70 Marks

*Note: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions(maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

**UNIT I**

**15-18L**

Soil: Soil profile, Soil Plant Microorganisms:Soil fertility, Rhizosphere environment, organic compounds released by plant. Rhizosphere and phyllosphere microflora

Plant associated microbiome for enhanced plant growth and yield of agricultural crops.

Exploration of soil microbial diversity wealth through metagenomics approach for novel microbial genes and products for agricultural and industrial applications. Reclamation of waste agricultural land by microorganisms.

**UNIT II**

**15-18L**

Biogeochemical cycles: Carbon cycle, nitrogen cycle, phosphorous cycle and sulphur cycle. Mechanism of biological nitrogen fixation: Biological dinitrogen fixation, free living dinitrogen fixation, legume rhizobia symbiosis: nodule formation, bacteroids, leghaemoglobin, mycorrhizal association. Amino acid synthesis, proteolysis, urea cycle. Lichens.

**UNIT III**

**15-18L**

Role of enzymes and toxins in pathogenesis. Host parasite relationship and control measures, symptomatology of various diseases.

Fungal diseases of plants: Rusts of wheat; late blight of potato; red rot of sugarcane. Bacterial diseases of plants: Citrus canker, blight of rice. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady's finger.

## UNIT IV

15-18L

Biological control: Introduction, mechanism. Bacterial control of insect pests: *Bacillus thuringiensis* as bacterial insecticide. Viral control of insect pests: Nuclear polyhedrosis viruses (NPV) and cytoplasmic polyhedrosis viruses (CPV). Fungal control of insect pests: Entomopathogenic fungi.

## UNIT V

15-18L

Biofertilizers: Definition, types- Nitrogen fixing, Phosphate solubilizing and cellulolytic microbes, mass production of bacterial inoculants (*Rhizobium*, *Azotobacter*, *Azospirillum*, *cyanobacteria*) mode of applications, advantages and limitations.

Biopesticides: Definition, types – bacterial, viral, fungal and protozoan, mode of action, factors influencing, genes involved, target pests, production technology and use of transgenic plants. Microbial herbicides. Mycorrhiza: Types and their application in agriculture and forestry.

### Recommended Books:

1. Microbiology for sustainable agriculture, soil health and environment protection by Deepak Kumar Verma (2019) Publisher: Taylor and Francis LTD.
2. Microbes : Concepts & Applications- P.S. Bisen, Mousumi Debnath, Godavarthi B.K.S. Prasad , John Wiley & Sons Publication 2012.
3. Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing CO. PVT., LTD., New Delhi
4. Alexander M. (1977) Introduction to soil microbiology. John Wiley & Sons, Inc., New York.
5. P.D.Sharma.2006. Plant pathology. Alpha Science International.19.
6. R.S Mehrotra. Plant Pathology
7. Modern Soil Microbiology, Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Marcel Dekker INC, New York.



**Reference Books:**

1. Ronald M. Atlas, 2011. Microbial Ecology: Fundamental and applications. Richard Bartha.
2. David L. Kirchman, 2009. Microbial ecology of Oceans.
3. Robert, S. Burlage Ronald Maltus, 1998. Techniques in Microbial Ecology. ASM Press.
4. Larry Barton, Diana E. Northup, 2011. Microbial Ecology. John Publisher, Academic Press.
5. Alexander, M. 1997. Introduction to Soil Microbiology. John Wiley and sons Inc., New York.
6. Journals of Microbial ecology
7. FEMS journal of microbial ecology

Helpstudentpoint.com



Solid waste treatment (Agricultural/urban): Saccharification, gasification, composting, vermicompost, mushroom compost, ensilage.

## **UNIT V**

**15-18L**

Utilization of solid wastes- food (SCP, mushroom, yeast), fuel, manure. Non biodegradable solid waste and its management: Landfill development, incineration and recycling.

Biological alternatives for xenobiotic and Chemical synthesis (biopesticides, biosurfactants, biocolours and Biofuel).

Genetically Engineered Microorganisms for bioremediation.

Nanotechnology: Concept, scope and their role in pollution abatement.

### **Recommended Books:**

1. Environmental microbiology: principles and applications by Patrick K. Jemba. Science publisher, 2004.
2. Environmental microbiology by P. D. Sharma, Alpha Sciences international, 2005.
3. Environmental microbiology, second edition, by Ralph, Ji Doug Gu, Wiley.
4. Atlas R M and Bartha, 1993. Microbial Ecology, Benjamin Cummings Publishing Co. Redwood City CA
5. Environmental microbiology by Ian Papper and Charles Gerba, Elsevier Press.
6. Environmental microbiology by Rose Environmental microbiology Vol III-IV, 1999
7. Practical microbiology, third edition, by Dubey, D K. Maheswari, S. Chand publishers, 2012
8. Advances in applied Bioremediation, Springer.
9. Alexander M 1971. Microbial Ecology. John Wiley & Sons Inc., New York.
10. Eldowney Ec S., Hardman DJ. and Waite S 1993. Pollution: Ecology and biotreatment. Longman Scientific Technical.
11. Baker KH and Herson DS 1994. Bioremediation. Mc Graw Hill Inc., New York.
12. Michel R. 1999. Introduction to environmental microbiology.
13. Atlas & Bartha. Microbial Ecology
14. Indu Shekhar. Environmental Biotechnology
15. Environmental engineering and management S. K. Dhameja, Publ: Kataria & Sons
16. Experimental ecology R.M. Atlas
17. Environment Microbiology for Engineers by Ivanov V, Taylor and Francis CBS Publishers

**M.Sc. Microbiology**  
**Third Semester Examination**  
**Paper3.4 MB-634– Biofuel and Bioenergy**

Contact Hours / Week : 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination : 3 Hours	Continuous/Internal/Assessment Semester Assessment	: 30 Marks : 70 Marks

*Note: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

**UNIT I**

**15-18L**

Current energy consumption, overview of biofuel/bioenergy and biorefinery concepts. Fundamental concepts in understanding biofuel/bioenergy production. Biomass preprocessing: drying, size reduction, and densification. Microbes as a source of bioenergy. Biomass for energy. Calorific value and its estimation. Co-generation of energy. Various biofuels/bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion.

**UNIT II**

**15-18L**

Biomass conversion to biofuel: thermochemical conversion, syngas fermentation. Environmental impacts of biofuel production. Alternatives as biofuels: Alkanes, Biobutanol, bioethanol, biomethanol, biodiesel, biogas, hydrogen, syngas/synfuels and other energy dense molecules and their comparisons. Biochemical conversion to ethanol: biomass pretreatment, Starch to sucrose conversion and Sucrose to ethanol fermentation. Different enzymes, enzyme hydrolysis, and their applications in ethanol production. Distillation and Quantification of ethanol.

**UNIT III**

**15-18L**

Lignocellulosics hydrolysis, Fermentation of pentoses and other issues in bioethanol production from lignocelluloses. Biobutanol production, Estimation of biobutanol. Microbes and biogas production: Biogas and methane estimation. Bio gas Bottling Plant Technology, Application of Bio gas slurry in agriculture. Design of Biogas for cold climates.

#### **UNIT IV**

**15-18L**

Global biodiesel scenario. Oil crops. Microbes and Biodiesel: Production and feed stock. Techniques of lipid extraction and conversion to biodiesel (lipid transesterification), Biodiesel quality and its assessment. Strategies of genetic engineering of organisms for biofuel production.

Wastewater remediation and biomass generation for biofuel purposes. Microbial Fuel Cells.

#### **UNIT V**

**15-18L**

Food vs Fuel debate. Carbon sequestration and its necessity. Carbon credits. Biorefinery, Thermochemical Conversion Processes (Gasification: Biofuels from Synthesis Gas and Pyrolysis) Biochemical Conversion Processes, Photobiological conversion: Biohydrogen production. Commercialized microalgae (*Spirulina*, *Dunaliella*, *Hematococcus*, *Chlorella* and others) and their production. Economics of microalgae production. Cultivation of seaweeds.

#### **Reference Books:**

1. Balachandran P. (2010); Engineering Fluid Mechanics, Prentice Hall India
2. Dessler A. (2011); Introduction to Modern Climate Change, Cambridge University Press
3. Bioenergy (Biomass to Biofuel) 1<sup>st</sup> Edition 2014 Academic Press Editor: Anju Dahiya
4. Biorenewable Resources: Engineering New Products from Agriculture. Robert C. Brown. Wiley-Blackwell Publishing (2003).
5. Anaerobic Biotechnology for Bioenergy Production: Principles and Applications. Samir K. Khanal. Wiley-Blackwell Publishing (2008).
6. Kothari D. P. and Nagrath I. (2009); Basic Electrical Engineering, Third Edition, McGraw Hill, India
7. Zemansky M. and Dittman R. (2011); Heat and Thermodynamics, McGraw Hill, India
8. Wadhwa C. L. (2012); Generation, Distribution and Utilization of Electrical Energy, Third Edition, New Age International .

**M.Sc. Microbiology**

**Third Semester Examination**  
**Paper 3.5 BT 635 Lab Course V**

**Practical Exercises**

1. Analysis of soil: Texture, pH, moisture content, water holding capacity, percolation and capillary action.
2. Isolation and study of microbes (bacteria and fungi) from Rhizosphere and Rhizoplane.
3. Isolation of *Rhizobium* from root modules of legumes (*Trigonella / Cicer / Soybean*)
4. Isolation of free nitrogen fixers (*Azotobactor, Azospirillum*) from soil.
5. Isolation of Phosphate solubilizing bacteria from soil.
6. To enumerate microorganisms from different natural habitats.
7. To study the bacterial ecology in fresh water environment
8. To study the microbial ecology of the rhizosphere and determination of rhizospheric effect.
9. To study the effect of various salt concentrations on bacterial fungal growth.
10. To study the effect of osmotic pressure on bacterial fungal growth.
11. To determine the microbial biomass from different natural habitats.
12. Nitrogen spot test
13. Determination of moisture holding capacity of soil.
14. Microbiome analysis of different agro-climatic soils

## **M.Sc. Microbiology**

### **Third Semester Examination Paper 3.6 BT 636 Lab Course VI**

#### **Practical Exercises**

1. To study the micro-flora of air (indoor and outdoor).
2. Isolation of phosphate solubilizing micro-organism from soil and water.
3. Demonstration of biological treatment.
4. Determination of dissolved oxygen of water.
5. Determination of BOD of water (raw/ treated).
6. Determination of COD of water (raw/ treated).
7. Determination of alkalinity
8. Determination of chlorine in water.
9. Demonstration of VAM.
10. Production of Biofertilizers: *Rhizobium* / *Azotobacter sp.*
11. Production of Single cell protein
12. Mushroom cultivation.
13. Bioremediation of polluted soils by plants/ microbes.
14. Laboratory demonstration of vermi-composting
15. Field visit to recycling industries.
16. Qualitative and Quantitative estimation of solid waste from different sites.
17. Liquid bio-fuel production and characterization.
18. Biogas production by anaerobic digestion and analysis.
19. Production of energy from microbes (microbial fuel cell)
20. Production of Biodiesel from nonedible oil.
21. Biogas production and application.
22. Bioethanol production.
23. Cultivation of seaweeds.

## **M.Sc. Microbiology**

### **Fourth Semester Examination**

The students have to select one of the following specializations that shall be taught in fourth semesters:  
Paper 4.1 MB-641– Industrial Microbiology or Paper 4.2 MB-642– Medical Microbiology.

#### **Paper 4.1 MB-641– Industrial Microbiology**

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

*Note: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions(maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

#### **UNIT- I**

**15-18L**

Novel microbes for future industry. Industrial microorganisms: Isolation, screening and strain improvement. Preservation and maintenance of industrially important microbes. Media for industrial fermentation. Industrial sterilization process for media, air and equipment. Fermentations technology: Principles of fermentation, Basic design and operation of a microbial fermentor. Types and their applications. Basic principles of scale –up.

#### **UNIT-II**

**15-18L**

Downstream processing: Biomass separation by centrifugation, filtration, flocculation and other recent developments. Cell disintegration methods. Extraction: Solvent, two phase, liquid extraction, supercritical fluid extraction, whole broth, aqueous multiphase extraction. Product Purification: precipitation, Crystallization, chromatographic methods, ultra-filtration, reverse osmosis. Drying devices.

### **UNIT-III**

**15-18L**

Industrial production of antibiotics: Streptomycin, Penicillin. Industrial production of: Vitamin B12, Riboflavin, Citric acid, Lactic acid, Vinegar; Glutamic acid, L-lysine; Acetone, glycerol, alcohol. Steroid biotransformation. Production of alcoholic beverages. Microbial Enzymes: Tannases, Proteases, Amylases, Production of biopharmaceuticals through GEMs: Insulin, Interferons, Tissue plasminogen activator, Streptokinase. Immobilization of enzymes and cells: Types & applications.

### **UNIT- IV**

**15-18L**

Microbiology of food: sources and types of microorganisms in food, food borne pathogens, microbiological examination of food, spoilage of food, food preservation. Starter cultures their biochemical activities, production and preservation of the following fermented foods: Soy sauce fermentation by Moulds, Fermented vegetables – Sauerkraut, Fermented Meat – Sausages. Production and application of Baker's Yeast. Role of microorganisms in beverages – tea and coffee fermentations. Genetically modified foods. Biosensors in food,

### **UNIT- V**

**15-18L**

Dairy microbiology: sources and types of microorganisms in milk, microbial examination of milk, pasteurization and phosphatase test, sterilization of milk, grades of milk, Microbiology of fermented milk products (acidophilus milk, yoghurt), butter & cheese. Applications of microbial enzymes in dairy industry (Protease, Lipases). Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI.

### **Reference Books:**

1. Microbiology an Introduction by Gerard J Tortora, Berdell R Funke and Christine L Case. Pearson Publisher (11<sup>th</sup> Edition) 2016.
2. Basic and Industrial Microbiology by S. M. Reddy.
3. Microbes : Concepts & Applications- P.S. Bisen, Mousumi Debnath, Godavarthi B.K.S. Prasad , John Wiley & Sons Publication 2012.
4. Industrial Microbiology by David B. Wilson, Hermann Sahm, Klaus-Peter Stahmann, Mattheos Koffas. Wiley Publisher 2019.
5. Reed G (2004). Industrial Microbiology. CBS Publishers (AVI Publishing Co.)
6. Stanbury PF, Whitekar A. and Hall (2006). Principles of Fermentation Technology. Pergaman. McNeul and Harvey.
7. Creuger and Creuger (2004). Biotechnology- A textbook of Industrial Microbiology, Sinaeur Associates.
8. Casida LE (2001). Industrial Microbiology, Wiley Eastern.
9. Manual of Industrial Microbiology and Biotechnology, Demain & Davies, 2nd ed.
10. Microbial Biotechnology A. N. Glazer and H. Nikaido
11. Biotechnology An Introduction Susan R. Barnum
12. Topics in Enzyme & Fermentation Biotechnology by Wisemen
13. S.N. Jogdand. Medical Biotechnology
14. S.N. Jogdand. Biopharmaceuticals

**M.Sc. Microbiology**  
**Fourth Semester Examination**  
**Paper 4.2 MB-642– Medical Microbiology**

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

*Note: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions(maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc*

**UNIT-I**

**15-18L**

Human microbiome & its significance. Probiotics: Gut microbiota, Gut brain interaction. Infection: types, sources, reservoirs and vehicles of infection, predisposing factors. Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence. Mode of spread of infection. Emerging epidemics, Re-emerging epidemics. Epidemics fundamentals: Types of epidemics, investigation, management and control. Biosafety: components, laboratory safety management. Management of biomedical waste. Biosafety levels. Introduction of center for Disease Control (CDC) and National center for disease control (NCDC).

**UNIT-II**

**15-18L**

Study of diseases caused by pathogenic bacteria: Pathogenicity, laboratory diagnosis, epidemiology and control measures– *Streptococcus, Staphylococcus, Neisseria, Salmonella, E.coli, Klebsiella, Proteus, Pseudomonas, Shigella, Corynebacterium, Vibrio, Corynebacterium, Bacillus, Clostridium, Vibrio, Mycobacterium, Spirochetes, Chlamydiae, Rickettsia, Mycoplasma.*

**UNIT-III**

**15-18L**

Morphology, pathogenesis, immune response, diagnosis and prevention of Pox viruses, Herpes, Picorna viruses (Enteroviruses and Polioviruses). Paramyxoviruses, Orthomyxoviruses, Hepatitis viruses, Rhabdo viruses (Rabies virus), Oncogenic viruses, HIV virus, Prion infection. Introduction to emerging diseases- Swine flu, chikungunya, Ebola, SARA-CoV-2. Important protozoal diseases: Route of entry, Life Cycles, Immunity, diagnosis & prophylaxis of *Plasmodium, Entamoeba, Leishmania, Giardia, Taenia.*

**UNIT-IV**

**15-18L**

Fungal diseases: Aetiology, clinical symptoms, laboratory diagnosis and treatment of Human mycotic infections caused by Dermatophytes, *Histoplasma, Cryptococcus, Candida*, opportunistic mycoses. Mycotoxins.

Classification of antimicrobial agents, Mechanism of drug action: Antibacterial, Antifungal and Antivirals. Methods of testing drug sensitivity. Preclinical development: Safety profile of drugs, Toxicological evaluation of drug, Mutagenicity and Carcinogenicity. Clinical studies.

#### **UNIT-V**

**15-18L**

Antimicrobial resistance: Drug resistance organisms, mechanisms and development of multidrug resistance. Recent advances in medical microbiology-antiretroviral therapy, Plasma therapy. Probiotics as therapeutic agents, Aptamers, nanotechnology in medicines, Interferons.  
Brief account of vaccines (conventional, recombinant and live vaccines).

#### **Reference Books:**

1. Emerging epidemics: Management and control P.S. Bisen and E. Raghuvanshi 2013. Wilay & Sons publication New Jersey
2. Molecular Diagnostics: Promises & Possibilities 2010. Mousuni Dabnath , G.B.K.S. Prasad P.S. Bisen. Principles of Therapeutics, Burn J. H., Blackwell Scientific Pub. O. Ltd. Oxford.
3. Medical Microbiology, McGraw Hill Publication 2019, by Stefan Riedel, Stephen A. Morse, Timothy A. Mietzner, Steve Miller
4. Role of Novel Drug Delivery Vehicles in Nanomedicine Edited by R.K. Tyagi , N. Garg, R. Shukla & P.S. Bisen 2020.
5. Ananthanarayan and Jayaram Paniker. Textbook of Microbiology, 4th ed. Orient Longman, 2000.
6. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
7. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13<sup>th</sup> edition, Mosby
8. Medical Microbiology-David Greenwood
9. Text book of Microbiology, Ananthanarayan & Jayaram Panicker
10. Jawetz-Medical Microbiology-Geo F. Brooks, Janet S Butel.
11. Microbiology: An introduction, G.J. Tortora, B.R. Funke and C.L. Funke.
12. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
13. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
14. Medical Bacteriology, Medical Mycology and AIDS; N.C.Dey, T.K. Dey and D. Sinha, New Central Book Agency (P) Ltd.



Information retrieval system (Entrez, SRS). Data mining tools: Modelling tools (Rasmol, SPDV, HyperChem), Data submission tools (Bankit, Sequin, Webin, Sukura, Spin, AutoDep).

#### **UNIT-IV**

**15-18L**

Algorithms: Classification of algorithms. Sequence Comparison algorithms. Submission metrics algorithms, Tools for sequence alignment. Gene Prediction: Methods, Gene mapping: DNA sequencing, Sequence alignment optimal algorithms. Tools for Genome analysis. Phylogenetic analysis: Phylogenetic trees. Methods of phylogenetic evaluation. Prediction tools Proteomics: Proteome analysis, Tools for Protein sequence analysis and proteomics, structure analysis. Molecular descriptors in QSAR studies, Small molecule force field parameters (charges), potentials, Active site identification, ligand docking, Drug stability, synthesizability and drug delivery. Steps and software of drug designing.

#### **UNIT-V**

**15-18L**

Research Methodology: Introduction-Basic research, applied research, need based research. Identification of the problem, defining the problem. Research Project planning. Literature search-information sources, library resources-books, abstracts hand books, procedure manuals, encyclopedias, annual report, data banks, CDROMS, online literature search- internet access, websites, directories of information resources. Progress of research- evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communication, impact factor of journals, plagiarism. Software packages for statistical analysis.

#### **Reference Book:**

1. Principles of Technical Writing by Robert Hays. Addison-Wesley, 1965.
2. Rastogi. S. C, Mendiratta. N and Rastogi. P. Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt. Ltd.3rd edition.
3. Zhumur Ghosh & Bibekanand Mallick, Bioinformatics: Principles and Applications, Oxford University Press, Second Edition
4. Teresa K. Attwood and David J. Parry – Smith. 2005. Introduction to Bioinformatics. Pearson education, Singapore.
5. A.R. Leach, Molecular Modeling- Principles and Applications, Second Edition, Pearson.
6. David W. Mount. 2003. Bioinformatics: Sequence & Genome Analysis.CBS Publishers and Distributors. New Delhi.
7. Westhead. D. R, Parish. J. H and Twyman. R. M, 2003. Bioinformatics. Viva Books Private Limited, New Delhi.
8. C.R., Kothari, Research methodology.
9. Jin Xiong, 2006 Cambridge University Press, Essential of bioinformatics
10. Guide to Research Methodology and Biostatistics. Edited by KMK Masthan 2017 CBS Publisher.

**M.Sc. Microbiology**  
**Fourth Semester Examination**  
**Paper 4.3 MB-643–Dissertation**

A dissertation shall be initiated at the end of the Semester III and continued during Semester IV. A dissertation may be undertaken in any research laboratories/industries/university department. Project work will involve experimental work and the student will have to complete this in stipulated time i.e 3 months. The final evaluation of the project work will be through a Panel involving internal and external examiners. The students shall compulsorily submit the certificate of completion and report to the Department during the practical examination.

This process includes: Conceptualization of the independent research, Collection, analysis, and interpretation of data, Thesis writing, Oral presentation of findings and Viva-Voce.

The marks will be awarded by the external examiner on the day of the practical examination on the basis of the experimental, presentation and viva-voce. The distribution of marks for project work will be:

**Project work : 200 Marks**

1. Experimental Work & Thesis : 100
2. Research work presentation :50
3. viva-voce :50

## **M.Sc. Microbiology**

### **Fourth Semester Examination Paper 4.4 BM 644 Lab Course VII**

#### **Practical Exercises based on Paper 4.1 MB-641– Industrial Microbiology**

1. Components and Operation of a Bioreactor
2. Batch fermentation in conical flask
3. Solid state fermentation
4. Screening of industrially important microbes: Antibiotics producers, enzymes producers and organic acid producers.
5. Optimization of conditions for optimal production of enzyme: - Media composition, Incubation temperature, Aeration, Incubation time.
6. Purification of antimicrobial metabolites from a microbe.
7. Production of amylase and cellulase by SmF and SSF.
8. Production of antibiotics by SmF technology
9. Immobilization of cells and enzymes.
10. Instrumentation of fermentor. Design of various types of fermentors & bioreactors
11. Production of ethanol & wine from grapes.
12. DSP for microbial enzymes/antibiotics/organic acids.
13. Determination of TDT of microbes.
14. Determination of TDP of microbes.
15. Production and estimation of lactic acid by *Lactobacillus* Sp. or *Streptococcus* Sp.
16. Sauerkraut fermentation
17. Isolation of food poisoning bacteria from contaminated foods,
18. Production of Dairy products :yoghurt,cheese.
19. Extraction and detection of aflatoxin for infected foods.
20. Preservation of potato/onion by UV radiation
21. Production of fermented milk by *Lactobacillus acidophilus*.
22. Rapid analytical techniques in food quality control using microbial Biosensors.

#### **Practical Exercises based on Paper 4.2 MB-642– Medical Microbiology**

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.
2. To perform various biochemical tests (IMVC, oxidase, catalase, urea utilization test, sugar utilization and H<sub>2</sub>S production on TSI agar slant) used for identification.
3. To perform sugar fermentation tests used for identification of medically important bacteria.
4. Preparation of transport media for different clinical samples.
5. Demonstration normal microbial flora of skin, mouth and throat

6. Isolation and identification of *Staphylococcal* species using suitable media, staining techniques and biochemical tests.
7. Identification of bacterial species belonging to Enterobacteriaceae family using suitable biochemical tests (*E.coli*, *Proteus*, *Pseudomonas*, *Klebsiella*)
8. Isolation and identification of enteric fever causing bacteria (*Salmonella typhi*) using suitable media and biochemical tests.
9. Isolation and identification of *Bacillus* species using suitable media, staining techniques and biochemical tests.
10. Microbiological analysis of urine specimens.
11. Microbiological analysis of sputum specimens
12. Isolation dermatophytes and their identification based on colony morphology and microscopic characteristics.
13. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method
14. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
15. Identification of human blood groups.
16. Estimation of blood haemoglobin.
17. Perform Total Leukocyte Count of the given blood sample.
18. Perform Differential Leukocyte Count of the given blood sample
19. Separate serum from the blood sample.

**Practical Exercises** based on Paper 4.2 MB-642– Biostatistics, Bioinformatics & Research Methodology

1. To access scientific data from Literature data bases (PUBMED, LITDB, Medline)
2. To access nucleic acid databases for retrieval of gene sequence.
3. To access protein databases for retrieval of amino acid sequence of target protein.
4. To perform pair wise sequence alignment using Dot matrix.
5. To perform multiple sequence alignment using BLAST.
6. To perform multiple sequence alignment using CLUSTAL-W and to find conserved sequences using JAL view.
7. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W
8. 3D protein structure prediction and structure refinement using Swiss-PDB viewer
9. Representation of statistical data by
  - a. Histogram
  2. O give curves
  3. Pie diagrams
10. Collection of data using different sampling methods
11. Determination of Averages or Central tendencies (Mean, Mode, Median)
12. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation)
13. Application of Tests of significance (Chi-Square test, student t-test, Standard error)
14. Applications of computers in biology using MS-office (MS-Word, Excel, Power point)

**M.Sc. Microbiology**

**Fourth Semester Examination**

**Paper 4.4 MB 644 Comprehensive Viva Voce**

A grand viva-voce of all the papers of all the semesters will be conducted at the end of semester by a board of examiners.

Helpstudentpoint.com