

**A.VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE
(AUTONOMOUS),
POONDI, THANJAVUR DIST.**

**Question Pattern for UG and PG Programmes for students to
be admitted during 2014 – 2015 and afterwards**

Total Marks: 75

QUESTIONS PATTERN

**SECTION – A
(Question 1 to 10)**

10 x 2 = 20 Marks

1. Short Answer Questions
2. Two Questions from each units (All are answerable)

**SECTION – B
(Question 11 to 15)**

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

**SECTION – C
(Question 16 to 20)**

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1MBC1	Core I – General Microbiology	6	4

Objectives:

- ❖ To enable the students to know the general principles of microbiology.
- ❖ To enable the students to know the general characters and classification of microbes.
- ❖ To enable the students to know the important features of cyanobacteria and fungi.
- ❖ To enable the students to know the life cycle of virus.
- ❖ To know about the extremophiles

Unit I

Hrs 18

History and scope of microbiology–Principles and application of bright field, dark field, phase contrast, fluorescence and electron microscope - General features of prokaryotic and eukaryotic microorganisms – bacteria, microalgae, fungi, actinomycetes, mycoplasma, protozoa, rickettsiae and chlamydiae.

Unit II

Hrs 18

Classification and salient features of bacteria (Bergey's Manual of Determinative Bacteriology, 1994). A brief account on microbes growing in extreme environments – acidophilic, alkalophilic, thermophilic, barophilic and halophilic – general characters of the following family–Spirochaetaceae, Enterobacteriaceae, Streptococcaceae, Staphylococcaceae and Vibrionaceae.

Unit III

Hrs 18

Virology – History – General characters, classification. LHT system, multiplication – bacteriophage – structure and its cycles of phage lambda, T4 phage, X 174 phage.

Unit IV

Hrs 24

Structure and life cycles of the following – Animal virus and DNA virus– Hepatitis– B, Herpes simplex virus–Adeno virus–Pox viruses – RNA virus, Retrovirus, Rhabdo virus, HIV, Influenza–Chikungunya Dengu–Oncogenic viruses – Antiviral therapy - plant virus – TMV, CaMV – Transmission and control.

Unit V

Hrs 21

Preservation of microbes-culture collection centre–fossil microorganisms. Identification of microbes–physiological characteristics, microbial identification system (MIS) – fatty acid, 16srRNA sequence homology.

Books for Reference

1. Dubey, R.C. & Maheswari, D.K., (2003). A text book by Microbiology. S.Chand and Company Ltd., New Delhi.
2. Stanier *et al.*, (1994). General Microbiology, MacMillan Education Ltd., London.
3. Prescott, L.M., Harley, J.P. and Klein, B.V., (2007). Microbiology, VI Ed., W.M.C. Brown Publishers IOWA, U.S.A.
4. Powar and Daginawala, (1992). General Microbiology, Vol. I. Himalaya Publishing House, New Delhi.
5. Powar and Daginawala, (1922). General Microbiology, Vol. II. Himalaya Publishing House, New Delhi.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
I	14P1MBC2	Core II – BIOLOGICAL MACROMOLECULES	6	4

Objectives:

- ❖ To enable the students to know the various types of macromolecules in biological organisms.
- ❖ To understand the role of different biological macromolecules in the physiology of microbes.
- ❖ To know the biosynthetic pathways of various macromolecules.

Unit I

Hrs 18

Introduction, Definition, Scope and Biochemistry, Types and their properties – monosaccharides, oligosaccharides and polysaccharides – occurrence, chemistry and properties of sucrose, lactose, cellobiose, storage polysaccharides - e.g. Starch, glycogen, inulin – structural polysaccharides – e.g. Cellulose, pectin, chitin.

Unit II

Hrs 18

Enzymes: History of Enzymes – Function – Nomenclature, structure – classification – Mechanism of enzyme action – Enzyme kinetics – Michaelis – Menton Kinetics, Determination of Km and Vmax value – Factors influencing Enzyme reaction, Allosteric enzymes, Isoenzymes.

Unit III

Hrs 18

Nucleic acid – Types and functions of nucleic acid. Purines and Pyrimidines – Biosynthesis of Purines – Biosynthesis of Pyrimidines – Interconversion of Nucleotides, Nucleosides and Free bases.

Unit IV

Hrs 24

Proteins: Classification of proteins based on shape, composition and solubility – Chemical bonds involved in Protein structure – Peptide bond – N and C terminyl, Primary bond, Secondary bonds – Protein Configuration – Primary, Secondary, Tertiary and Quaternary – Biological Role of Proteins.

Unit V

Hrs 21

Lipids – General Structure – Physical and Chemical properties of Lipids – Types – saturated and Unsaturated fatty acids – Simple Lipids (Fat, Oil), Compound Lipids (Phospholipid, Glycolipid), Derived Lipids - Steroids.

Books for Reference

1. An Introduction to Biomolecules and Enzymes – Renuka Harikrishnan, Indrajit Pathipagam, 1996.
2. Mott, A.G. and Foster, J.W., (1988). Microbial Physiology, John Wiley Sons.
3. Jain, J.L., 1979. Fundamentals of Biochemistry, Published by S.Chand and Company Ltd., Ram Nagar, New Delhi.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1MBC3	Core III – Food and Agricultural Microbiology	6	4

Objectives:

To enable the students

- ❖ To know the various types of microorganisms found in the food.
- ❖ To know the principles and methods of preservation of foods.
- ❖ To know the ways of contamination of food and the prevention methods.
- ❖ To understand the principles of food spoilage and food borne diseases.
- ❖ To know the role of beneficial and harmful microbes in agriculture.
- ❖ To learn the microbial activity in soil.
- ❖ To understand the role of biofertilizers and biopesticides in agriculture.

Unit I

Hrs 18

Food microbiology – food as a substrate for microbes, sources of contamination. Food spoilage – General principles and causes – factors (intrinsic and extrinsic) affecting growth, chemical changes caused by microbes. Spoilage of cereal and cereal products, vegetables, fruits, meat, fishes and eggs.

Unit II

Hrs 18

Food preservation, physical and chemical methods – use of high and low temperature – use of chemical preservatives, drying and irradiation – food borne infections and intoxications, sources, symptoms and prevention – food hygiene and quality control.

Unit III

Hrs 18

Microflora of milk – sources of contamination, method and minimizing contamination. Milk borne infections – milk preservation methods - pasteurization, sterilization. Fermented dairy products butter milk, cream, yoghurt, kafil, cheese and its types.

Unit IV

Hrs 24

Agricultural Microbiology - Microbial interaction in soil – bacterial and fungal, fungi and plants. Organic amendments in soils. Biological and chemical control. Manipulation of physico-chemical and biological parameters in soil, integrated pest management systems (IPM) – soil fertility and management.

Unit V

Hrs 21

Diseases in crop plants - Bacterial: Leaf blight and Citrus canker. Fungal - Brown spot of paddy, Tikka disease of groundnut, Viral: Tungro virus and TMV, Biopesticides.

Books for Reference

1. Frazair, W.C. and Westheff, D.C., (1989). Food Microbiology, 8th Ed., Tata McGraw Hill Pub. Co., Ltd., New Delhi.
2. Jay, J.M., (1987). Modern Food Microbiology, CBS Publishers and distributors, New Delhi.
3. Subba Rao, N.S., (1995). Soil Microorganisms and plant growth. Third Edition Oxford and IBH Pub. Co. Pvt., Ltd., New Delhi.
4. Rangaswami, G., and Mahadevan, A., (2004). Diseases of crop plants in India. Fourth Edition. Prentice Hall of India Private Limited, New Delhi.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1MBEL1A	Major Elective I – BIOINOCULANT TECHNOLOGY	6	4

Objectives:

- ❖ To know the basic aspects of bioinoculant.
- ❖ To study the detail on various types of bioinoculant.
- ❖ To know about the production and mass multiplication of various bioinoculants.

Unit I

Hrs 18

General account - microbes used as biofertilizer. *Rhizobium* – taxonomy, physiology, host – *Rhizobium* interaction – isolation, identification, mass multiplication and carrier based inoculants. Frankia – Isolation and mass multiplication.

Unit II

Hrs 18

Azospirillum – taxonomy and physiology, isolation and mass multiplication, carrier based inoculants, rhizosphere competence and host plant specificity. *Azotobacter* – classification, characteristics, ecology, physiology – crop response to *Azotobacter* inoculums, maintenance and mass multiplication.

Unit III

Hrs 18

Cyanobacteria (BGA), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, BGA and *Azolla* in rice cultivation.

Unit IV

Hrs 24

Mycorrhizae – types of mycorrhizal association. VAM – taxonomy, occurrence, distribution. Influence of VAM on crops. PSM and phosphorus mobilization microbes – growth, yield, isolation, inoculum production.

Unit V

Hrs 21

Assessment of nitrogen fixing ability of different bioinoculants under controlled and field conditions. Culture production (fermentor). Storage, carriers, packing, quality control, ISI standards and marketing. Methods of applications.

Books for Reference

1. Subba Rao, N.S., (2004). Soil Microbiology – Fourth Edition, Oxford and IBIT Publishing Co., Pvt., Ltd. New Delhi.
2. Tilak, K.V.B.R., Algal Biofertilizers ICAR Publications, New Delhi.
3. Phosphate Solubilizing Microorganism – AC. Guru.
4. Whitton and Carr – Biology of cyanobacteria
5. Laxmi Lal, Nitrogenous Biofertilizers.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1MBEL1B	Major Elective II – SEED PATHOLOGY	6	4

Objectives:

- ❖ To know the seed borne microbes and diseases.
- ❖ To know the methods of seed health testing.
- ❖ To learn the process of seed borne disease development.
- ❖ To know the quarantine for seed and organization for plant protection at various levels.

Unit I

Hrs 18

History of Seed Pathology: Importance in agriculture – losses caused by seed borne diseases. Seed health testing for fungi, bacteria and viruses: Principles and methods.

Unit II

Hrs 18

Seed borne fungi, bacteria and viruses. Diseases caused by fungi – blast of paddy, red rot of sugarcane; bacteria – Blight of paddy, black arm of cotton; viruses – leaf roll of potato, Mosaic virus.

Unit III

Hrs 18

Seed infection and establishment – avenues, factors and its establishment – location in seed –Epiphytotics due to seed borne inoculum.

Unit IV

Hrs 24

Controls of seed-borne diseases – physical, chemical and biological treatment; post-entry control. Storage fungi and mode of seed deterioration. Mycotoxins, plant variety protection act, legal protection of crop varieties and seed legislation in developing countries.

Unit V

Hrs 21

Seed Quarantine, history and importance, principles and regulations of plant quarantine in India. Seed certification – history, scheme, eligibility procedure – (Organization, Economic Co-operation and Development) – Changing concepts, Applying quarantine provisions for seed.

Books for Reference

1. Agrios, George, N., 1998. Plant Pathology, Academic Press, San Diego, London.
2. Bilgrami, K.S. and Dube, H.C., 1980. A text book of modern Plant Pathology, Vikas Publishing House, New Delhi.
3. Mehrotra, R.S., 1980. Plant Pathology, Tata McGraw Hill Publishing Company Limited New Delhi.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1MBCP1	Core – PL – General Microbiology, Biological Macromolecules and Food & Agricultural Microbiology	6	5

Objectives:

- ❖ To know about the basic principles involved in Microbiology.
- ❖ To learn the methods of pure culture techniques of various microbes.
- ❖ To know the various techniques involved in bacterial growth.
- ❖ To isolate and enumerate microbes from various habitats.
- ❖ To isolate and culture the coliphages from sewage.

General Microbiology

Hrs 60

1. Preparation and use of glassware cleaning solutions.
2. Sterilization: Principles and methods.
3. Media preparation: Liquid media, solid media – Differential and selective media.
4. Pure culture techniques: Streak plate, pour plate, spread plate.
5. Micrometry – Measurement of microorganisms.
6. Isolation of aerobic bacteria, cyanobacteria, actinomycetes, fungi.
7. Enumeration of microorganisms – Fungi, bacteria and actinomycetes.
8. Staining methods for fungi – Lactophenol cotton blue.
9. Staining methods for bacteria – simple stain, gram stain, endospore and capsular stain.
10. Growth Curve.
11. Microscopic count using Haemocytometer.
12. Determination of dry weight.
13. Isolation of coliphages from sewage water

Biological Macromolecules

Hrs 60

1. Qualitative test for carbohydrates – Glucose, fructose, starch.
2. Quantification starch and protein
3. Isolation of DNA
4. Isolation of RNA

Food and Agricultural Microbiology

1. Microbiology of soft drinks, milk, meat and ice creams (Total plate count), fruits, vegetables and curd.
2. Methylene blue reduction test.
3. Isolation of phosphate solubilizers.
4. Isolation of nitrogen fixers-free living, associative and symbiotic.
5. Leghaemoglobin measurement.
6. Quantification and assessment of VAM fungi from rhizosphere soil.
7. Measurement of pH, salinity, nitrate and phosphate in soils.

Books for References

1. Kanika Sharma, (2005). Manual of Microbiology Tools & Techniques Ane Books. New Delhi.
2. Bharti Arora, D.R., Arora (2007). Practical Microbiology first ed. CBS Publishers and Distributors, New Delhi.
3. Cappuccino, J.G. and Sherman, N., (2006). First ed. Microbiology. A Laboratory Manula, Sixth ed. Pearson Education, New Delhi.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
II	14P2MBC4	Core I – Microbial Physiology	6	5

Objectives:

To enable the students

- ❖ To know about nutritional aspects of microbes.
- ❖ To know the basic aspects of chemical reactions and their processes.
- ❖ To know the various metabolic reactions of microbes.

Unit I

Hrs 18

Microbial nutrition – nutritional requirements– carbon, hydrogen, oxygen, phosphorus and sulphur. Growth factors: Uptake of nutrients – diffusion, active transport, group transport, ion uptake.

Unit II

Hrs 18

Free energy and reactions–law of thermodynamics, oxidation – reduction carriers, role of ATP in metabolism. pH measurement, Hydrogen ion concentration, Importance of pH, pH regulation. Buffer system – Mechanism of buffer system – Examples for buffer - Bicarbonate buffer system, phosphate buffer system.

Unit III

Hrs 18

Anabolism: Photosynthesis in prokaryotes – light reactions in cyanobacteria, green bacteria and purple bacteria, C₃ cycle, cholesterol, fatty acid and amino acid biosynthesis.

Unit IV

Hrs 24

Catabolism: Breakdown of glucose to pyruvic acid, Glycolytic pathway– PP and ED pathways–TCA cycle– electron transport and oxidative phosphorylation. Gluconeogenesis – Anaplerotic reactions, lipid catabolism; - β oxidation.

Unit V

Hrs 21

Methylotrophs–pathway of methanoxidation, methanogens – process of methanogenesis. Sulphur reducing bacteria and pathway of sulphate utilization.

Books for Reference

1. Mott, A.G. and Foster, J.W., (1988). Microbial Physiology, John wily sons.
2. Caldwell, D.R., (1995). Microbial Physiology and metabolism, Wm C. Brown Publishers.
3. Lim, D., Introduction to Microbiology, Rata McGraw, New Delhi.
4. Powar and Dagainawala, (1982). General Microbiology, Vol I. Tat McGraw, New Delhi.
5. Meenakumari, L., (2006). Microbial Physiology, MJP Publishers Co., Chennai.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2MBC5	Core II – ENVIRONMENTAL MICROBIOLOGY	6	4

Objectives:

To enable the students

- ❖ To know the microorganisms from environment.
- ❖ To know the different types of habitat and their microbial communities.
- ❖ To learn the role of microbes in biodegradation of industrial, municipal and other waste products.
- ❖ To understand the biological utilization of waste and food sources.
- ❖ To understand the uses of microorganisms and control of pollution.

Unit I

Hrs 18

Aeromicrobiology: Droplet nuclei, aerosols, air borne transmission of microbes and diseases assessment of microbes. Assessment of air quality and sanitation. Aquatic microbiology–aquatic habitats – freshwater lakes, ponds and streams. Marine habitats – estuarine, deep sea; hydrothermal vents, salt pans, coral reefs, mangroves and their microbial communities. Role of microorganisms in the aquatic ecosystems–food chain.

Unit II

Hrs 18

Liquid waste management. Composition, BOD, COD and DO. Physical, Chemical and Microbiological treatment. Water borne diseases.

Unit III

Hrs 18

Biodeterioration and biodegradation of natural and synthetic matters in soil. High molecular weight polymers–Cellulose, lignin, hemicelluloses, chitin, pectin, petroleum products, pesticides and plastics–mode of degradation, enzymes involved and their significance. Solid waste management–Anaerobic and anaerobic digestion–vermicomposting–landfills–leather degradation. Synthesis and significance of bioplastics.

Unit IV

Hrs 24

Role of Microbes in waste process technology – Bioremediation, Bioleaching, Degradation of xenobiotics. Utilization of waste as food (SCP, Yeast and Mushroom), as fuel (Ethanol and Methane) as fertilizer (Algae) and as feed (Algae and Yeast).

Unit V

Hrs 21

Pollution and its hazards–Sources–Mine drainage, radioactive leakage: chemicals and Industrial waste. Effect of microorganisms in various ecosystems–Air and water; control of pollution.

Books for Reference

1. Sharma, P.D., Ecology and Environment.
2. Dr.Sushmitha Baskar and R.Baskar–Environmental science for engineering under graduates.
3. Cyoel, P.K., Water Pollution (Causes, effects and control).
4. Rao, C.S., Environmental Pollution Control engineering.
5. Vasudevan, N., Essentials of Environmental Science.
6. Joseph, E., Daniel, Environmental aspects of Microbiology.
7. Sharma, P.D., Environmental Microbiology.
8. Vijaya Ramesh, K., Environmental Microbiology.
9. Sharma, P.D., Ecology and Environment.
10. Paulsamy, S., Introduction to Environmental Biology.
11. Sunakar Panda, Environmental and Ecology.
12. Arumugam, N., Environmental Biology.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2MBC6	Core III – MICROBIAL BIOTECHNOLOGY	6	5

Objectives:

To enable the students

- ❖ To know the modern concepts of microbial biotechnology.
- ❖ To learn genetic engineering, application, cloning strategies, gene libraries DNA cloning, database collection and bioinformatics.
- ❖ To understand the microbes and their applications in enzyme technology.

Unit I

Hrs 18

Scope and Importance of Biotechnology. Introduction, definition and concept – History and achievements and in the last century. Enzymes involved in genetic engineering – restriction endonucleases, lipases. Immobilization systems and its applications.

Unit II

Hrs 18

Vectors – Plasmids, cosmids, phagemids, phasmids, expression vectors, shuttle vectors and artificial chromosomes (BAC & YAC). Cloning strategies – Isolation of desired gene. Basis steps in gene cloning methods.

Unit III

Hrs 18

Blotting techniques – Southern, Northern and Western, Dot blotting, Colony and Plaque plating. PCR – Types and Applications. Chromosomes Walking. cDNA Libraries and genomic libraries. DNA finger printing – RAPD and RFLP.

Unit IV

Hrs 24

Transgenic animals, transgenic fish, transgenic plants, gene therapy. Gene silencing.

Unit V

Hrs 21

Genomics – definition. Whole genome analysis. Automated sequences – Physical methods of sequencing – Maxam and Gilbert and Sangers method. DNA micro arrays and microchips. Proteomics – definitions, multidimensional protein identification technology.

Books for Reference

1. Old, R.W. and Primose, S.B., (1987). Principles of Gene Manipulation, Blackwell Scientific Publications, Oxford, U.K.
2. Satyanarayana, U., (2005). Biotechnology, Books and Allied Private Limited, 1st Edition, Kolkata.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2MBEL2A	Major Elective 2 – MICROBIAL NANOTECHNOLOGY	6	4

Objectives:

- ❖ To understand the importance of nanotechnology.
- ❖ To know the role of various types of nanoparticles.
- ❖ To understand the applications of nanotechnology in medicine.
- ❖ To enable the student to acquire the knowledge on nanoparticles in environment.

Unit I

Hrs 18

Basic concepts in Nanotechnology: Classification of nanostructures, nanoparticles, nano-clusters, nanotubes, nanowires and nanodots, liposomes, cubosomes and hexosomes, lipid based nanoparticles-liquid nanodispersions- solid lipid nanoparticles (SLP), nanoscale dimensions affected properties.

Unit II

Hrs 18

Synthesis of Nanoparticles: Chemical- pyrolysis- inert gas condensation, solvothermal reaction, sol-gel fabrication, structured media- physical – Combustion method – soft chemical method ; Ball milling-and biological methods of nanoparticle synthesis- silver, zinc oxide, gold and titanium; intracellular synthesis and extracellular synthesis; role of microorganisms in nanoparticle biosynthesis, mechanism of synthesis of nanoparticles, properties; assembly. Inorganic, organic and hybrid nanomaterials.

Unit III

Hrs 18

Characterization Techniques Structural studies of Nanoparticles- XRD and FT- IR. Microscopic techniques- electron Microscopy- SEM, TEM, biological sample preparation for TEM- scanning probe microscopy- STEM- AFM- confocal Microscopy- Scanning Near Field Microscopy- Spectroscopic and Electrochemical techniques- UV-Vis Spectroscopy- Energy Dispersive X-ray spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Differential Scanning Calorimetry (DSC).

Unit IV

Hrs 24

Applications of Nanoparticles: Biomedical Applications Antimicrobial activity of nanoparticles- antibacterial, antifungal, antiviral, antiparasitic, antihelminthic, mosquito larvicidal, bacterial sporicidal, insecticidal activity, herbicidal activity. mechanism; mode of action of nanoparticles on microbial growth. Nano science in agriculture-fertilizers and pesticides. Nanoscience for water treatment and fermentation process. Cleaning the air with Nanotechnology. Nanoparticles as Photocatalyst (TiO₂ and ZnO)

Unit V

Hrs 21

Nanotoxicology - Nanotoxicity in humans and environment- *In vitro* toxicity assessment methods- proliferative assay, oxidative stress assay, inflammatory assay. *In vivo* toxicity assessment. Nanotoxicity evaluation in aquatic and terrestrial ecosystem.

Books for Reference:

1. Bandyopadhyay, A.K., (2008). Nanomaterials, New age International publisher. New Delhi.
2. Rosenthal, S.J. Wright, D.W., (2005). Nanobiotechnology protocols (Methods in Molecular Biology) Human Press Publisher, Totowa, New Jersey.
3. Poonam, T. and Sheefali, M.T., (2011). *In vitro* methods for nanotoxicity assessment: advantages and applications. *Arch. Appl. Sci. Res.*, **3(2)**:389-403.
4. Jain Taylor, K.K., (2006). Nanobiotechnology Molecular diagnostics: current techniques and applications (Horizon Bioscience) 1st edition, Basel, Switzerland
5. Johnston, H.J., Hutchison, G., Christensen, F.M., Peters, S., Hankin, S. and Stone, V., (2010). A review of the in vivo and in vitro toxicity of silver and gold particulates: Particle attributes and biological mechanisms responsible for the observed toxicity. *Cri. Rev. Toxicol.*, **40(4)**: 328–346.
6. Batley, G.E., Kirby, J.K., and McLaughlin, M.J., (2013). Fate and risks of nanomaterials in aquatic and terrestrial environments. *Accounts of Chem. Res.*, **46(3)**: 854–862.
7. Ravichandran, K., Swaminathan, K. and Sakthivel, B., (2013) Introduction to thin films, Research India Publications, New Delhi.

Web References :

1. <http://crnano.org/whatis.htm>
2. www.microbiologyprocedure.com/genetics/microbial-genetics/microbial-genetics.htm
3. www.nanobotblogspot.com
4. www.azonano.com

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2MBEL2B	Major Elective – 1 SOIL BIOLOGY	6	4

Objectives:

- ❖ To understand the biocontrol, IPM, soil fertility and also to learn the mineral transformation of different minerals in soil.

Unit I

Hrs 18

Soil – definition – subsoil – Soil factors for plant growth – origin of soil sedimentary – transported. Soil – minerals and rocks – Landforms and the classification of parent materials – Materials deposited from water, wind and ice.

Unit II

Hrs 18

Soil forming factors: Parental material, climate, Biota (Microbial biodiversity and organic residue, Topography (Slope and elevation) and time. Mechanical composition of soil – Physical properties of soil – texture, structure, air, colour temperature and other properties.

Unit III

Hrs 18

Soil colloids and chemical properties – clay, organic colloids (Humus), Soil reaction – importance of soil pH, soil water estimation of water content – Resistance blocks (Electrical Conductivity) – soil moisture – water flow through soils – soil taxonomy at order level.

Unit IV

Hrs 24

Biogeochemical cycles – nitrogen, carbon sulphur, phosphorus, zinc, iron.

Unit V

Hrs 21

Soil surveys – early and modern concepts – Factors that control the distribution of soil – Development of soil survey and the soil map of Tamil Nadu. Mineral transformation of N, P, K, S, Fe and other micro nutrients, C:N ratio.

Books for Reference

1. Raymond, W., Miler and Roy, L. and Donahue, (1992). Soils–An introduction to soils and plant growth, Prentice Hall of India P. Ltd., New Delhi.
2. Marlin Alexander (1961). Introduction to Soil Microbiology, Wiley International Ed.
3. Soil survey Division Staff (1955). United States Dept. of Agri., Soil Survey Manual Scientific Publishers, Jodhpur.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	11P2MBCP2	Core – PL – Microbial Physiology, Environmental Microbiology, Microbial Biotechnology	6	5

Objectives:

- ❖ To know about the production of enzymes by microbes.
- ❖ To estimate the various biochemical parameters in microbes.
- ❖ To isolate, plasmids, chromosomal DNA.
- ❖ To know the separation and quantification of nucleic acids.
- ❖ To isolate resistant mutants.
- ❖ To know about water and soil analysis

Microbial Physiology

Hrs 60

1. Indole production.
2. Methyl red and Voges-Proskauer test.
3. Citrate utilization test.
4. Casein hydrolysis.
5. Urease test.
6. Hydrogen sulphide production test.
7. Catalase test.
8. Triple sugar iron test
9. Oxidase test
10. Lipid hydrolysis
11. Effect of pH on growth
12. Effect of temperature on growth
13. Carbohydrate fermentation test
14. Coagulase test
15. Amylase Production test
16. Estimation of glycogen.
17. Estimation of protein (Lowry's method).
18. Estimation of sugar (Anthrone method).

Environmental microbiology

Hrs 60

1. Microorganisms in Air.
2. MPN technique
3. Water Analysis
 - a. Alkalinity of Water
 - b. Total Carbondioxide
 - c. Chloride
 - d. Dissolved Oxygen
 - e. Biological Oxygen demand
 - f. Chemical Oxygen demand
 - g. Total hardness
4. Soil Analysis
 - h. Moisture
 - i. pH
 - j. Estimation of Organic Carbon

Microbial Biotechnology

1. Protoplast and Spheroplast
2. Isolation of chromosomal DNA from bacteria and separation using agarose gel electrophoresis.
3. Isolation of protein using sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE).
4. Isolation plasmid & its separation
5. UV mutagenesis.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3MBC7	Core I MEDICAL MICROBIOLOGY	6	5

Objectives:

To enable the students

- ❖ To know the microbes of medical interest.
- ❖ To learn the bacterial diseases and its treatment.
- ❖ To learn the viral diseases and its treatment.
- ❖ To learn the fungal diseases and its treatment.

Unit I

Hrs 18

History of Medical Microbiology: History, Classification of medically important microbes. Normal microbial flora. Infection- Source, mode of transmission, Diagnosis – Process of sample collection, transport and examinations of the specimens.

Unit II

Hrs 18

Bacteriology: Gram positive organisms - Morphology, cultural characteristics, pathogenicity and laboratory diagnosis and prophylaxis of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pneumococcus*, *Bacillus anthracis*, *Corynebacterium diphtheriae*, *Clostridium welchii*, *Cl.tetani*, *Clostridium botulinum*. *Mycobacteria*, *Spirochaetes* – *Treponema pallidum*, and Elementary knowledge on Chlamydiae, Rickettsiae and Mycoplasma.

Unit III

Hrs 18

Bacteriology: Gram negative organisms:- Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of *E.coli*, *Klebsiella* sp, *Enterobacter* sp, *Salmonella* sp, *Shigella* sp, *Pseudomonas* sp, *Vibrio cholerae*, *Aeromonas hydrophila*, *Bordetella pertusis*, *Yersinia pestis*, *Bacteroides* and *Neisseria* spp.

Unit IV

Hrs 24

Virology: Basic concepts of virology - General properties of Human viruses, Approaches to viral diagnosis- Serological and Molecular techniques. Pathogenicity and Laboratory diagnosis and prophylaxis of viral infections - Hepatitis, Polio, Rabies, Influenza, Measles, Mumps, Rubella, Dengue virus, HIV and Ebola virus.

Unit V

Hrs 21

Mycology : General properties and approaches to laboratory diagnosis. Mycosis – Superficial, Subcutaneous and Systemic infections – Dermatophytosis, Cryptococcosis, Madura mycosis, Histoplasmosis, *Candida albicans*. Parasitology: Pathogenicity and laboratory diagnosis of *Entamoeba histolytica*, *Taenia solium*, *Plasmodium vivax*, *Wucheraria bancrofti* and *Enterobius vermicularis*. *Trichomonas vaginalis*.

Books for Reference

1. Ananthanarayanan and Jayaram Panicker. Textbook of Microbiology.
2. Lisa Anne Shimeld, Anne T. Rodgers . Essentials of Diagnostic Microbiology.
3. Lenette, E, Balows, H.A. Manual of Clinical Microbiology.
4. Subash. C. Parija. Textbook of Medical Parasitology.
5. Geo. F. Brooks. Medical Microbiology.
6. Jagadesh Chander. Medical Mycology.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3MBC8	Core II – IMMUNOLOGY	6	4

Objectives:

To enable the students

- ❖ To learn immunity and its types.
- ❖ To know the antigen antibody interactions
- ❖ To learn immunization with classical vaccines. Modern vaccination
- ❖ To learn tumor immunology.

Unit I

Hrs 18

Immunology: History, Introduction organs and cells of immune system – Antigen – Types and properties - Immunoglobulin – Structure, types and properties – monoclonal antibodies production. Innate immunity – acquired immunity.

Unit II

Hrs 18

B and T Cell Activation - B cell receptors complex, B cell maturation, Generation of antibody diversity, T Cell subpopulation, Organisation of T cell receptors. Humoral and cell mediated immunity.

Unit III

Hrs 18

Antigen – Antibody reaction – agglutination, precipitation, Complement fixation – pathway of complement activation. Hypersensitivity reaction – antibody mediated type I anaphylaxis – type II antibody dependent cell mediated cytotoxicity immunoresponse.

Unit IV

Hrs 24

Transplantation-Auto immune response.Tolerance lymphokines, cytokines. Types of vaccines – vaccines in current use and development. Tumor immunology.

Unit V

Hrs 21

Immunotechnology and its applications radiology in immunotechniques, Enzyme-Linked immunosorbent assay (ELISA), Western blotting, immunofluorescence, Flowcytometry and immunoelectron microscopy. Immunodeficiency diseases - immune system in AIDS.

Books for Reference

1. Roitt, IM., (1998). Essential of Immunology ELBS Blackwell Scientific Publication.
2. Kuby, J, (1994). Immunology, II Edition WH, IVEeman and Company, New York.
3. Klaus D. Elgent, (1996). Immunology understanding of immune system, Wiley Liss NY.
4. Stitcs, D.P. Terr, A.I., Parslow, T.G., (1993). Medical Immunology 9th Edition, Appleton and Iarnge, Stamford.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3MBC9	Core III – Microbial Genetics and Molecular Biology	6	5

Objectives:

To enable the students

- ❖ To know the types and forms of nucleic acids in the microbial world.
- ❖ To understand the internal mechanism of the genes and its techniques.
- ❖ To understand the isolation and purification of plasmids of microorganisms.
- ❖ To learn the gene transformation and transduction mechanism.

Unit I

Hrs 18

Types and forms of nucleic acid – their organization and functions – DNA replication – bidirectional, rolling circle replication and semiconservative DNA repair mechanism – excision repair, SOS repair and mismatch repair. Plasmids – types and replication.

Unit II

Hrs 18

Process of transcription – initiation, elongation – termination, RNA processing – capping and polyadenylation. Genetic code, Process of translation – initiation, elongation and termination – signal sequences and protein transport.

Unit III

Hrs 18

Concept of Gene – Operon concept - lac and trp operons. Regulation of gene expression in Prokaryotes and eukaryotes. Translational control – ribosome binding, codon usage, antisense RNA; Post translational regulations.

Unit IV

Hrs 24

Gene transfer mechanisms – Transformation – competence of cells, mechanisms of transformation – Transduction – general and specialized – conjugation – Hfr strains – mechanism of conjugation.

Unit V

Hrs 21

Transposable elements: IS elements, transposons, - mechanism of transposition and recombination. Introduction, characteristics, mechanism and regulation of transposition in Tn3 and Tn5. Transposable elements in fungi. Mutagenesis - biochemical basis of mutants, spontaneous and induced mutation. Isolation techniques of mutants. Reversion and suppression of mutation. Site directed mutagenesis.

Books for Reference

1. James, D., Watson, Tania A. Baker, Stephen, P. Bell and Alexander Gann, Molecular Biology of the Gene, Fifth Edition.
2. Malaunsk, G.M. and Freifelder, D., (1998). Essentials of Molecular Biology, 3rd Ed, Joh and Bartleh – Publishers.
3. Lewin, B., (2000). Genes VII Oxford University Press.
4. Stryer, L., (2002). Biochemistry 5th Ed, W.H. Freeman and Company.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	11P3MBCP3	Core – PL – Medical Microbiology, Immunology and Microbial Genetics & Molecular Biology	7	5

Objectives:

- ❖ To identify the normal flora of human body.
- ❖ To estimate various properties in urine, blood etc.,
- ❖ To perform various tests for disease confirmation.
- ❖ To learn about mutant and isolation
- ❖ To learn the bacterial transformation

Medical Microbiology and Immunology

Hrs 60

1. Isolation of bacteria from pus
2. Isolation of bacteria from urine
3. Identification of *E.coli* and *Staphylococcus aureus*
4. Estimation of urine – bile salt and albumin
5. Determination of total count of blood cells – WBC, RBC, Differential count.
6. Haemoglobin estimation
7. Estimation of glucose in serum (ortho toluidine method)
8. Widal test (Typhoid fever)
9. Determination of ABO blood group
10. Determination of Rh blood group
11. ELISA technique
12. Immuno diffusion - double
13. Antibiotic Sensitivity test and E test

Microbial Genetics and Molecular Biology

14. Bacterial conjugation
15. Bacterial transformation
16. Isolation of mutants by gradient plate techniques
17. Separation of protein by SDS-PAGE
18. Isolation of lactose (Lac) mutants of *E.coli*

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4MBC10	Core I – RESEARCH METHODOLOGY	6	4

Objectives:

- ❖ To learn the techniques used in research.
- ❖ To make the students understand the main principles in biostatistics.
- ❖ To make the students apply statistical principles to biological studies.
- ❖ To enable the students to understand computer hardware, software and various programming languages.
- ❖ To make the students know the scientific application of packages.
- ❖ To make the students understand the problems selection and project design.

Unit I

Hrs 18

Research design—choosing the problem, review of literature – primary, secondary and tertiary sources, bibliography, indexing and abstracting - Reporting the results of research in conferences—oral and poster presentation – report writing – components and preparation of thesis.

Unit II

Hrs 18

Filtration – methods, filter media, ultra filtration, Industrial filters— dead end filter, cross flow filter, Rotary vacuum filter, frame filter etc.

Centrifugation – principle, types, simple and differential, ultra centrifugation— Isopycnic and rate zonal centrifugation, preparative and analytical.

Unit III

Hrs 18

Principle and application of pH meter. Radio active isotopes, half life of isotopes and tracer technique – autoradiography— scintillation and GM counters.

Unit IV

Hrs 24

Principles and application of chromatography, adsorption, affinity, and ion exchange, Gel permeation, GCMS and HPLC. Colorimeter, UV-Vis-spectrophotometer, flame photometer, atomic absorption spectrophotometer, NMR, FTIR.

Unit V

Hrs 21

Biostatistics – scope – population and sampling (methods) – variables – Graphical and diagrammatic representation. Measures of central tendency – Mean, median and mode. Measures of dispersion – range, mean deviation. Standard deviation; coefficient of variants application of standard error

Test of significant 't' test, 'chi square test', one way ANOVA – simple correlation and linear regression, application of computers in biostatistics.

Books for Reference

1. Jayaraman, J., (1972). Techniques in Biology. Higginbothams Pvt., Ltd., Madras.
2. Jayaraman, J., (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.
3. Balagurusamy, E.,(1985). Programming in BASIC, 2nd Ed., Tata McGraw Hill Pub. Co., New Delhi.
4. Khan, I.A. and Khanum, A., (1994). Fundamentals of Biostatistics, Vikas Pub., Hyderabad.

Text Books

1. Gurumani, N., (2006). Research Methodology for Biological Sciences 1st Ed, MJP Publishers, Chennai.
2. Gurumani, N., (2005). An Introduction to Biostatistics, Second Revised Edition, MJP Publishers, Chennai.

M.Sc. Microbiology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4MBC11	Core II – INDUSTRIAL MICROBIOLOGY	6	4

Objectives:

- ❖ To know the principles of microbial fermentation and screening of industrially important strains.
- ❖ To know the fermentor – its types and their uses in the production of various enzymes and products.
- ❖ To learn about the fermentation products and the role of microbes involved.
- ❖ To understand the IPR and industrial management practices.

Unit I

Hrs 18

Principles of Microbial fermentation – Principles of Screening – culture collection and maintenance of important industrial strains – Immobilization system and its applications.

Unit II

Hrs 18

Fermentors – Types – Design and Operations – continuous parameters, sampling systems – Chemostat, Turbidostat. Containment – Mechanism of foam fermentations and foam breaking. Computerized control system - Biosensor.

Unit III

Hrs 18

Downstream processing – Precipitation, filtration, centrifugation, cell disruption, liquid - liquid extraction, chromatography, whole broth processing.

Unit IV

Hrs 24

Industrial production of penicillin, ethanol, vitamin B₁₂, citric acid, amylase, rabies vaccine, insulin, Interferon and SCP.

Unit V

Hrs 21

Patent laws and legal protection; Indian and International patent laws to patent microbes and their products. Intellectual Property Rights (IPR). Industrial Management and Management Practices.

Books for Reference

1. Agarwal, (2006). Industrial Microbiology: Fundamental and Application, M/S, IBD Publishers and Distributors, New Delhi.
2. Patel, A.H., (2003). Industrial Microbiology, Mac Millan.
3. Stanley, P.F.A., Whittaker and Hall, S.J., (1995). Principles of Fermentation Technology.
4. Alexander, N., Glazer and Hisorshi Nikaido, (1994). Microbial Biotechnology, Fundamentals and Applied Microbiology, W.H. Freeman and Co., New York.
5. Rajak, 2005. Microbial Biotechnology for Sustainable Development and Productivity, M/S. IBD Publishers and Distributors, New Delhi.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4MBEL3A	Major Elective –III BIODIVERSITY AND CONSERVATION MANAGEMENT	6	4

Aims and Objectives:

- ❖ The aim of the study of biodiversity conservation is to protect the existing flora and fauna for enhancing the beauty of our planet mother earth and to pass it on for our future generation with all the conserved resources for maintaining environment friendly sustainable development.

Unit I

Hrs 18

Biodiversity – Definition – Levels of Biodiversity, Types of Biodiversity – Public education and awareness, sustainable uses of component of Biological diversity, Biodiversity – conservation department in India.

Unit II

Hrs 18

Biodiversity assessment and inventory programmes – Morphological and molecular characterization of biodiversity – Methods for species Identification and Classification – UNEP – MAB Financial Resources.

Unit III

Hrs 18

Conservation of Biodiversity – *Ex-situ* and *In situ* conservation – protected areas – biosphere conserves – National park and wild life sanctuaries – Values of Biodiversity – Natural resources – Future strategy for conservation.

Unit IV

Hrs 24

IUCN categories – Endangered, Threatened, vulnerable and extinct species – Biodiversity registers - Red Book – Blue book – Green book - species richness in north east India, current status of Biodiversity Indicators.

Unit V

Hrs 21

Global Biodiversity Information System, Global back bones – Global species information system, Global Information system, Global Information Facility (GIF) – species 2000 – Tree of life – overview of the UNEP – Biodiversity Data Management Project (BDM) –CBD and Bioethics.

Books for Reference

1. Agarwal, SK. And Dubey, P.S. Biodiversity and Environment, APH Publishing Corporation, New Delhi.
2. Biodiversity Conservation in managed and forests protected areas, Kotwal and Banerjee, Agrobio, Jodhpur.
3. Kumar, U. and Asija Agrobios, M. Principles and Conservation, Jodhpur.
4. Introduction to Conservation Genetics Oxford Book Company–Rajendra Kanshik, Jaipur.
5. Biodiversity Conservation and Management, G.Senthilkumar and A.Panneerselvam, Sri Murugan Publications, Thanjavur.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4MBEL3B	Major Elective –III BIOINFORMATICS	6	4

Aims and Objectives:

- ❖ This subject was initiated with an aim to have basic knowledge in computer operating. Nowadays it is necessary to go to the websites and internet for future research work.

Unit I

Hrs 18

Narration of Computer: Input / Output and Storage Devices – keyboard, Mouse, Scanner, touch screen, Barcode, Microphone, Monitor, Speaker, Printer, RAM, ROM.

Hard disk, CD, DVD, Floppy Disk etc. ; Operating System – DOS, Windows, UNIX, LINUX; Internet Perception – Internet Service Providers, WWW, Search Engines, Search Techniques; Finding Scientific articles – Pubmed, Highwire, Press, Plos.

Unit II

Hrs 18

Biological databases and its types – Sequence, Mapping, Information retrieval from biological databases and Genomic databases. Inferring Data relationships – BLAST services – blastp, blastx, PSI, PHI - FASTA.

Unit III

Hrs 18

Sequence alignments pairwise and multiple alignment – local, Global, dot plot, dynamic. Matrix – BLOSUM, PAM, GONNET, multiple alignment – Clustal W.

Unit IV

Hrs 24

Analysis of nucleotides – restriction mapping, primer synthesis, ORF prediction. Phylogenetic analysis – Neighbour-Joining, Maximum parsimony, minimum likelihood, rooted and unrooted.

Unit V

Hrs 21

Analysis at protein level – signature, profiles and motifs, Secondary structure prediction, SWISS Model, Visualization of protein structure: RASMOL, SWISS PDB.

Books for Reference

1. Cynthia Gibas and Per Jambeck, (2001). Developing Bioinformatics Computer Skills: Shroff Publishers and Distributors Pvt. Ltd (O'Reilly), Mumbai.
2. Rashidi, H.H. and Buehier, L.K., (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
3. Des Higgins and Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press.
4. Baxeavains, A.D. and Ouellette, B.E.F., (2001). Bioinformatics: A practical guide to the analysis of genes and protiens, Wiley Interscience – New York.
5. Arora, P.N. and Malhon, P.K., (1996). Biostatistics Himalaya Publishing House, Mumbai.
6. Sokal and Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
7. Stanton, A., and Clantz, Primer of Biostatistics - The McGraw Hill Inc., New York.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	11P4MBCP4	Core – PL – Research Methodology and Industrial Microbiology	6	5

Research Methodology

Hrs 60

1. Preparation of Index cards
2. Citations of References in the text and reference section
3. Proof Correction
4. Preparation of Standard graph – Glucose and Protein

Industrial Microbiology

Hrs 60

1. Immobilization yeast cells by using sodium alginate
2. Isolation of amylase producer and amylase assay.
3. Production of Penicillin.
4. Production of citric acid
5. Cultivation of edible mushrooms – Preparation of spawn and mushroom bed.
6. Isolation of cellulase production and characterization
7. Production of bioethanol and its estimation
8. Wine production
9. Characterization of wild yeast and test its ethanol producing ability.