

### M.Sc., MICROBIOLOGY (2017 – 2018)

Sl. No.	SEM	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks of Pass			Hours Week	Credits
					CIA	E.E	Total	CIA	E.E	Total		
1	I	Core I	17P1MBC1	General Microbiology	25	75	100	10	30	50	6	4
2		Core II	17P1MBC2	Biological Macromolecules	25	75	100	10	30	50	6	4
3		Core III	17P1MBC3	Food and Agricultural Microbiology	25	75	100	10	30	50	6	4
4		Core PL	17P1MBCP1	Practical - I	40	60	100	16	24	50	6	5
5		Major Elective -I	17P1MBEL1A 17P1MBEL1B	Bioinoculant Technology Seed Pathology	25	75	100	10	30	50	6	4
6	II	Core I	17P2MBC4	Microbial Physiology	25	75	100	10	30	50	5	4
7		Core II	17P2MBC5	Environmental Microbiology	25	75	100	10	30	50	5	4
8		Core III	17P2MBC6	Recombinant DNA Technology	25	75	100	10	30	50	5	4
9		Core IV	17P2MBC7	Marine Microbiology	25	75	100	10	30	50	5	4
10		Core PL	17P2MBCP2	Practical - II	40	60	100	16	24	50	5	5
11	Major Elective -II	17P2MBEL2A 17P2MBEL2B	Microbial Nanotechnology Soil Biology	25	75	100	10	30	50	5	4	
12	III	Core I	17P3MBC8	Medical Microbiology	25	75	100	10	30	50	5	4
13		Core II	17P3MBC9	Immunology	25	75	100	10	30	50	5	4
14		Core III	17P3MBC10	Microbial Genetics and Molecular Biology	25	75	100	10	30	50	5	4
15		Core IV	17P3MBC11	Fundamental of Biological sciences	25	75	100	10	30	50	5	4
16		Core PL	17P3MBCP3	Practical - III	40	60	100	16	24	50	5	5
17		EDC	17P3MBEDC	Mushroom Technology	25	75	100	10	30	50	4	-
			Communicative Skill and Personality Development							1		
18	IV	Core I	17P4MBC12	Research Methodology	25	75	100	10	30	50	6	4
19		Core II	17P4MBC13	Microbial Biotechnology	25	75	100	10	30	50	6	4
20		Core PL	17P4MBCP4	Practical - IV	40	60	100	16	24	50	5	5
21		Major Elective-III	17P4MBEL3A 17P4MBEL3B	Biodiversity and Conservation Management Bioinformatics	25	75	100	10	30	50	6	4
22		Project	17P4MBPR	Project Work	40	60	100	16	24	50	1	4
23		CN	17P4MBCN	Comprehension	-	100	100	-	-	50	5	2
				Communicative Skill and Personality Development	-	-	-	-	-	-	1	
			<b>Total</b>			<b>2300</b>				<b>120</b>	<b>90</b>	

### M.Sc., MICROBIOLOGY (2017 – 2018)

<b>Paper Code</b>	<b>Total No. Of Papers</b>	<b>Total Marks</b>	<b>Total Credits</b>	<b>Classification</b>
Core	17	1700	72	✓
Elective	3	300	12	✓
E.D.C	1	100	---	✓
Project	1	100	4	x
Comprehension	1	100	2	✓
Soft skill using Language lab	--	--	---	X
<b>Total</b>	<b>23</b>	<b>2300</b>	<b>90</b>	

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

**Question Pattern for UG and PG Programmes for students to  
be admitted during 2017 – 2018 and afterwards**

**Total Marks: 75**

**QUESTION 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	17P1MBC1	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**

History and scope of microbiology – Principles and applications of bright field, dark field, phase contrast, fluorescence, TEM and SEM electron microscope - General features of prokaryotic and eukaryotic microorganisms – bacteria, microalgae, fungi, actinomycetes, protozoa, mycoplasma, Rickettsiae, chlamydiae, prions

**Unit II**

Bergey's Manual of Determinative Bacteriology, 1994 - 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**

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

**Unit IV**

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**

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

**Books for Reference**

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

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	17P1MBC2	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**

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

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**Unit II**

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

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**Unit III**

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

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**Unit IV**

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.

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**Unit V**

Carbohydrates: 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, insulin – structural polysaccharides – e.g. Cellulose, pectin, chitin

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**Books for Reference**

- An Introduction to Biomolecules and Enzymes – Renuka Harikrishnan, Indrajit Pathipagam, 1996.
- Mott, A.G. and Foster, J.W., (1988). Microbial Physiology, John Wiley Sons.
- 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	17P1MBC3	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.
- ❖ Agri University – Visit – within the state -2 -3 days.

**Unit I**

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**

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 III**

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 IV**

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**

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

**Books for Reference**

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

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	17P1MBCP1	<b>Core – PL – General Microbiology, Biological Macromolecules and Food &amp; Agricultural Microbiology</b>	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 the enumerate microbes from various habitats.
- ❖ To isolate and culture the coliphages from sewage.

**General Microbiology**

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

**Biological Macromolecules**

- Qualitative test for carbohydrates – Glucose, fructose, starch.
- Quantification starch and protein
- Isolation of DNA
- Isolation of RNA

**Food and Agricultural Microbiology**

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

**Books for References**

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

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
<b>I</b>	<b>17P1MBEL1A</b>	<b>Major Elective I Bioinoculant Technology</b>	<b>6</b>	<b>4</b>

**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**

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.

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**Unit II**

*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.

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**Unit III**

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

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**Unit IV**

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

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**Unit V**

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.

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**Books for Reference**

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



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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	17P1MBEL1B	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**

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**

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, bean, Mosaic virus.

**Unit III**

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

**Unit IV**

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**

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**

- Agrios, Gerge, N., 1998. Plant Pathology, Academic Press, San Diego, London.
- Bilgrami, K.S. and Dube, H.C., 1980. A text book of modern Plant Pathology, Vikas Publishing House, New Delhi.
- 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
II	17P2MBC4	Microbial Physiology	5	4

**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**

Free energy and reactions – law of thermodynamics, oxidation–reduction carriers, role of ATP in metabolism. pH - 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 II**

Anabolism: Photosynthesis in prokaryotes – light reactions in cyanobacteria, green bacteria and purple bacteria, C3 cycle, C4 cycle, cholesterol, fatty acid and amino acid biosynthesis.

**Unit III**

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, -  $\beta$  oxidation.

**Unit IV**

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

**Unit V**

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

**Books for Reference**

- Mott, A.G. and Foster, J.W., (1988). Microbial Physiology, John Wiley & Sons.
- Caldwell, D.R., (1995). Microbial Physiology and metabolism, Wm C. Brown Publishers.
- Lim, D.(2001) Introduction to Microbiology, Tata McGraw, New Delhi.
- Powar and Dagainwala, (1982). General Microbiology, Vol I. Tata McGraw, New Delhi.
- Meenakumari, L., (2006). Microbial Physiology, MJP Publishers Co., Chennai.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	17P2MBC5	Environmental Microbiology	5	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**

Aeromicrobiology: Droplet nuclei, aerosols, air borne transmission of microbes and diseases assessment of microbes. Assessment of air quality and sanitation. Marine habitats- estuarine, deep sea; hydrothermal vents, salt pans, coral reefs, mangroves and their microbial communities.

**Unit II**

Biodeterioration - biodegradation – Cellulose, lignin, hemicelluloses, chitin, pectin, petroleum products, pesticides and Bioplastics – mode of degradation, enzymes involved and their significance.-vermicomposting– landfills – leather degradation.

**Unit III**

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

**Unit IV**

Liquid waste management- Composition, BOD, COD and DO. Sewage treatment – physical, chemical and microbiological treatment -pollution and its hazards –sources –Mine drainage, radioactive leakage –Air pollution

**Unit V**

Aquatic microbiology –aquatic habitats fresh water, lakes, ponds and streams –Role of microorganisms in the aquatic ecosystems-food chain –water borne diseases – solid waste management –Aerobic and anaerobic digestion.

**Books for Reference**

- Sharma, P.D.,(2005) Ecology and Environment.
- Dr.Sushmitha Baskar and R.Baskar (1970)– Environmental science for engineering under graduates.
- Cyoel, P.K., (2005) Water Pollution (Causes, effects and control).
- Rao, C.S., (1991) Environmental Pollution Control engineering.
- Vasudevan, N., (2006) Essentials of Environmental Science.
- Joseph, E., Daniel, (1996) Environmental aspects of Microbiology.
- Sharma, P.D.,(2005) Environmental Microbiology.
- Vijaya Ramesh, K., (2005) Environmental Microbiology.
- Sharma, P.D., (2005)Ecology and Environment.
- Paulsamy, S., (2001) Introduction to Environmental Biology.
- Sunakar Panda, (2005) Environmental and Ecology.

*M.Sc. Microbiology*

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	17P2MBC6	r DNA technology	5	4

**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**

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 II**

Blotting techniques – Southern, Northern and Western, Dot blotting, Colony and Plaque plating. PCR – Types and Applications. Chromosomes Walking. and jumping. cDNA Libraries and genomic libraries. DNA finger printing. Enzymes involved in genetic engineering properties of enzymes, methods of enzyme production and application. Transgenic animals, transgenic fish, transgenic plants, gene therapy, Gene silencing

**Unit III**

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.

**Unit IV**

Protein engineering – enhancement of enzymes activity modifying specificity methods of addition of disulphide bonds – amino acid substitutions – substitutions reducing free sulphhydryl residues – site directed, evolutionary mutagenesis and DNA shuffling – uses of engineering proteins advantage of protein engineering .

**Unit V**

Biosafety – Introduction – Containment – physical and Biological, Recognition of facility competent authority – Large scale Experiments and manufacture Biological Produced by r DNA technology. Release to environments & field. Genetic engineering approval committee (GEAC) Good Laboratory Practices (GLPs)

**Books for Reference**

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

## *M.Sc. Microbiology*

Semester	Subject Code	Title of the Paper	Hours of Teaching /Weeks	No. of Credits
<b>II</b>	<b>17P2MBC7</b>	<b>Marine Microbiology</b>	<b>5</b>	<b>4</b>

### **Objectives:**

- ❖ To know the various microbes of marine
- ❖ To learn the novel bioactive compounds
- ❖ To know the various metabolic activity of marine microbes.

### **Unit I**

Marine Microbial diversity Marine environment – see benthic & littoral zone, salt pan, mangroves and estuarine microbes loop – marine microbial community – planktons, bacteria, fungi, protozoa.

### **Unit II**

Marine Microbial Disease Marine food borne pathogens – Aeromonas, Vibrio, Salmonella, Pseudomonas, Corynebacter.

### **Unit III**

Marine Microbial biotechnology production and application of marine microbial products – pigments –Astaxanthin B carotene –enzyme – antibiotics – polysaccharide- sea food preservation methods

### **Unit IV**

Seafood microbiology – normal general associated with fish food spoilage, fish and human pathogens :Indicator of pollution – faecal coliforme , prevention and control.

### **Unit V**

Methods of studying the marine microorganism, methods of collection enumeration (total and viral count Microbial nutrition – influence of environment factors on microbial growth, activity and distribution preservation of marine microbes.

### **Books for Reference**

- Prescott,L.M Harley J.P Klein (1999) Microbiology WCB,Mc Grow Hill Publication Rain M.Maier Ian
- L.Pepper, Charles P.Gerba (2006) Environmental Micrology, Academic Pree.
- James W. Nybakker(2001).Marine Biology Benjamin Cummings Shimshon Belkin and Rita
- 4.R.Colwell(2005) Ocean and health : Pathogens in the marine environment. Springer.
- Scheper,T. (2005) Advances in Biochemical Engineering / Biotechnology – Merine Biotechnology
- I.Springer Bhaakuni,D.S. and Rawat D.S. (2005).Bioactive marine natural products.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
II	17P2MBCP2	Core – PL – Microbial Physiology, Environmental Microbiology, Recombinant DNA Technology and Marine Biotechnology	5	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**

Indole production.  
Methyl red and Voges-Proskauer test.  
Citrate utilization test.  
Casein hydrolysis.  
Urease test.  
Hydrogen sulphide production test.  
Catalase test.  
Triple sugar iron test  
Oxidase test  
Lipid hydrolysis  
Effect of pH on growth  
Effect of temperature on growth  
Carbohydrate fermentation test  
Coagulase test  
Amylase Production test  
Estimation of glycogen.  
Estimation of protein (Lowry's method).  
Estimation of sugar (Anthrone method).

**Environmental microbiology**

Microorganisms in Air.  
MPN technique  
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

**Recombinant DNA Technology**

Plasimd DNA isolation from E.coli.  
Agarose gel electrophoresis technique  
Visualization of protein by SDS PAGE.

**Marine Microbiology**

Isolation and enumeration of microorganisms from marine soils.  
Isolation and microorganisms from salt pan  
Isolation of planktons  
Isolation of microorganisms from polluted environment.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	17P2MBEL2A	Major Elective - II Microbial Nanotechnology	5	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**

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**

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**

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**

Applications of Nanoparticles: Biomedical Applications Antimicrobial activity of nanoparticles- antibacterial, antifungal, antiviral, antiparasitic, antihelmenthic, 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 (TiO<sub>2</sub> and ZnO)

**Unit V**

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:**

- Bandyopadhyay, A.K., (2008). Nanomaterials, New age International publisher. New Delhi.
- Rosenthal, S.J. Wright, D.W., (2005). Nanobiotechnology protocols (Methods in Molecular Biology) Human Press Publisher, Totowa, New Jersey.
- Poonam, T. and Sheefali, M.T., (2011). *In vitro* methods for nanotoxicity assessment: advantages and applications. *Arch. Appl. Sci. Res.*, **3(2)**:389-403.
- Jain Taylor, K.K., (2006). Nanobiotechnology Molecular diagnostics: current techniques and applications (Horizon Bioscience) 1<sup>st</sup> edition, Basel, Switzerland
- 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.
- 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.
- Ravichandran, K., Swaminathan, K. and Sakthivel, B., (2013) Introduction to thin films, Research India Publications, New Delhi.

**Web References :**

- <http://crnano.org/whatis.htm>
- [www.microbiologyprocedure.com/genetics/microbial-genetics/microbial-genetics.htm](http://www.microbiologyprocedure.com/genetics/microbial-genetics/microbial-genetics.htm)
- [www.nanobotblogspot.com](http://www.nanobotblogspot.com)
- [www.azonano.com](http://www.azonano.com)



<b>Semester</b>	<b>Subject Code</b>	<b>Title of the Paper</b>	<b>Hours of Teaching / Week</b>	<b>No. of Credits</b>
<b>II</b>	<b>17P2MBEL2B</b>	<b>Major Elective - II Soil Biology</b>	<b>5</b>	<b>4</b>

**Objectives:**

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

**Unit I**

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

**Unit II**

Soil colloids and chemical properties – clay, organic colloids (Humus), inorganic colloids – importance of soil colloids - soil erosion and effects of erosion .

**Unit III**

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

**Unit IV**

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.

**Unit V**

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.

**Books for Reference**

- 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.
- Marlin Alexander (1961). Introduction to Soil Microbiology, Wiley International Ed.
- Soil survey Division Staff (1955). United States Dept. of Agri., Soil Survey Manual Scientific Publishers, Jodhpur.
- V.Kumarsan (-) Plant ecology and phytogeography, saras publication
- Sharma .P.D. (2003) Ecology and environment Rastogi publications

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
III	17P3MBC8	Medical Microbiology	5	4

**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.
- ❖ Medical research Institute –lab visit compulsory neighbouring place within the state -2-3 days.

**Unit I**

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 II**

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 III**

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 IV**

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* *Enterobius vermicularis*.and *Trichomonas vaginalis*.

**Unit V**

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.

**Books for Reference**

- Ananthanarayanan and Jayaram Panicker.(2005) Textbook of Microbiology.
- Lisa Anne Shimeld, Anne T. Rodgers. (1999) Essentials of Diagnostic Microbiology.
- Lenette, E, Balows, H.A. (1985)Manual of Clinical Microbiology.
- Subash. C. Parija.(2013) Textbook of Medical Parasitology.
- Geo. F. Brooks. (2010)Medical Microbiology.
- Jagadesh Chander.(1992) Medical Mycology.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	17P3MBC9	Immunology	5	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**

Organs and cells of immune system – Immunoglobulin – Structure, types and properties – monoclonal antibodies production. Innate immunity – acquired immunity. Hypersensitivity reaction – antibody mediated type I anaphylaxis – type II antibody dependent cell mediated cytotoxicity immunoresponse.

**Unit II**

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**

Antigen – Antibody reaction – agglutination, precipitation, Complement fixation – pathway of complement activation. Transplantation-Auto immuneresponse. Tolerance lymphokines, cytokines. Types of vaccines – vaccines in current use and development. Tumour immunology.

**Unit IV**

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.

**Unit V**

Immunology: History, Introduction – Antigen – Types and properties. Antigen – Antibody reaction – agglutination, precipitation, Complement fixation

**Books for Reference**

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

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	17P3MBC10	Microbial Genetics and Molecular Biology	5	4

**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**

DNA replication – bidirectional, rolling circle replication and semiconservative DNA repair mechanism – excision repair, SOS repair and mismatch repair. Process of transcription – initiation, elongation – termination, RNA processing – capping and polyadenylation., Process of translation – initiation, elongation and termination – signal sequences and protein transport.

**Unit II**

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 III**

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

**Unit IV**

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.

**Unit V**

Types and forms of nucleic acid – their organization and functions Plasmids – types – F plasmid, Resistance plasmid, Col plasmid, fertility plasmid, Degradative plasmid, Virulence plasmid, and replication.

Genetic code

**Books for Reference**

- James, D., Watson, Tania A. Baker, Stephen, P. Bell and Alexander Gann, 2013 Molecular Biology of the Gene, Fifth Edition.
- Malaunsk, G.M. and Freifelder, D., (1998). Essentials of Molecular Biology, 3<sup>rd</sup> Ed, Joh and Bartleh – Publishers.
- Lewin, B., (2000). Genes VII Oxford University Press.
- Stryer, L., (2002). Biochemistry 5<sup>th</sup> Ed, W.H. Freeman and Company.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Weeks	No. of Credits
III	17P3MBC11	Fundamental of Biological Sciences	5	4

**Objectives:**

- ❖ To enable the students to understand the basic knowledge in Biological Sciences
- ❖ To understand different life cycle patterns of plants and animals
- ❖ To know the structure and reproductive behaviour of organisms

**Unit I**

Algae and Fungi Thallophytes: Algae-General characteristics- Economic importance- Types of life cycle- Outline of various classifications. Fungi: General characteristics Classifications and Economic importance

**Unit II**

Plant reproduction General characteristics- Economic importance and outline of reproduction methods in Bryophytes, Pteridophytes and Gymnosperms

**Unit III**

Plants Basics of plant cell – Monocot and dicot - Classification of plant diversity – Classes of plant kingdom- Morphology: Inflorescence types -Racemose, cymose, and Mixed –Special types, Cyathium, Hypanthodium, Verticillaster and Thyrsus. Technical description of flower and floral diagram- Microsporangium and structure of Polygonum type embryo sac- Taxonomy: Systems of classification, (Artificial, Phylogenetic and Natural). Outline of Bentham and Hooker’s classification.

**Unit IV**

Invertebrates General characteristics and outline classification upto classes in Protozoa, Porifera, coelenterata, Platyhelminthes and Ashelminthes; Economic importance of invertebrates. Classification of Chordata – Characteristic features - protochordata class – Pisces and Amphibia up to orders - General characters - a brief study on Star fish.

**Unit V**

Vertebrates and pests control Salient features of Reptilia, Aves and Mammalia- Economic importance of Vertebrates. Bioluminescence. Insect pests of rice, sugarcane, coconut, cotton, vegetables, fruits and stored products (with an example of each). Principles of insect control: physical, mechanical, chemical, biological and integrated methods of pest control.

**Books for Reference**

- Arumugam N. Invertebrate Zoology, Saras publication, Nagercoil.2002.
- Ekambaranatha Iyar M and Ananthkrishnan TN. Manual of Zoology. Vol. I. part I and II, S. Visvanathan publication, Chennai.1994.
- Ayyar EK and Ananthkrishnan. A Manual of Zoology, Vol. II (Chordata).1992.
- Ekambaranatha Iyar M and Ananthkrishnan TN. Manual of Zoology Vol.II. S. Visvanathan publication, Chennai.1994.
- Ranganathan TN.Chordata Zoology, Rainbow printers, Palayamkottai.1996.
- Ekambaranatha Ayyar. Outlines of Zoology. Vols. I and II S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.1993.
- Kotpal RL. Invertebrata, Rastogi Publication, Meerut.2000.
- Jordan EL and Verma PS. Invertebrate Zoology, 12th Edition, S. Chand and Co.1995.
- Mani MS. General Entomology, Oxford and IBH publishing Co., New Delhi. 1982.
- Nayar KK, Ananthkrishnan TN and David M. General and applied Entomology, Tata McGraw Hill Pub. Co., Ltd., New York. 1995.
- David BV. Pest Management and pesticides Indian Scenario, Namrutha Publications.1992.
- Krishnan NT. Economic Entomology, J.J. Publications, Madurai. 1993.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
III	17P3MBCP3	Core – PL – Medical Microbiology, Immunology and Microbial Genetics & Molecular Biology	5	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**

- Isolation of bacteria from skin
- Isolation of bacteria from urine
- Identification of *E.coli*
- Estimation of urine – bile salt and albumin
- Determination of total count of blood cells – WBC, RBC, Differential count.
- Haemoglobin estimation
- Estimation of glucose in serum (ortho toluidine method)
- Widal test (Typhoid fever)
- Determination of ABO blood group
- Determination of Rh blood group
- ELISA technique
- Immuno diffusion - double
- Antibiotic Sensitivity test

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**Microbial Genetics and Molecular Biology**

- Bacterial conjugation
- Bacterial transformation
- Isolation of mutants by gradient plate techniques
- Separation of protein by SDS-PAGE
- Isolation of lactose (Lac) mutants of *E.coli*
- Separation of Isozymes by native gel electrophoresis.

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Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
<b>IV</b>	<b>17P4MBC12</b>	<b>Research Methodology</b>	<b>6</b>	<b>4</b>

### **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**

Filtration – methods, filter media, filter aid, ultra filtration, Industrial filters – dead end filter, cross flow filter, Rotary vacuum filter, frame filter etc. Radioactive isotopes, half life of isotopes and tracer technique–autoradiography–scintillation and GM counters.

### **Unit II**

Principle and application of chromatography, adsorption affinity and ion exchange, Gel permeation GCMS and HPLC. Colorimeter, Flame photometer, atomic absorption spectrophotometer, NMR, FTIR.

### **Unit III**

Centrifugation- Principles types, simple and differential, Ultra centrifugation, Isopycnic and rate zonal centrifugation –preparative and analytical –principles and application of pH meter - UV-Vis- Spectrophotometer Biostatistics-Scope –population and sampling (Methods)

### **Unit IV**

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.

### **Unit V**

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

### **Books for Reference**

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

### **Text Books**

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



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Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
IV	17P4MBC13	Microbial Biotechnology	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.
- ❖ Industrial visit is compulsory Regional /National / International level for a period of 5 days.

**Unit I**

Principles of Microbial fermentation – Principles and types of Screening. Types of Immobilization and its application. Industrial Management and management practices .

**Unit II**

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

**Unit III**

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

**Unit IV**

Biotechnology products from rDNA technology - Primary and secondary - penicillin, ethanol, vitamin B<sub>12</sub>, citric acid, amylase, rabies vaccine, insulin, Interferon and SCP, Biofuels, Detergents, Enzymes – protease, lipase.

**Unit V**

Patent laws and legal protection; Indian and International patent laws - patent microbes and their products. Intellectual Property Rights (IPR). culture collection and maintenance of important industrial strains.

**Books for Reference**

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

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<b>Semester</b>	<b>Subject Code</b>	<b>Title of the Paper</b>	<b>Hours of Teaching / Week</b>	<b>No. of Credits</b>
<b>IV</b>	<b>17P4MBCP4</b>	<b>Core – PL – Research Methodology and Microbial Biotechnology</b>	<b>5</b>	<b>5</b>

**Research Methodology**

- Preparation of Index cards
  - Citations of References in the text and reference section
  - Proof Correction
  - Preparation of Standard graph – Glucose and Protein
- 

**Microbial Biotechnology**

- Immobilization of yeast cells by using sodium alginate
- Isolation of amylase producer and amylase assay.
- Production of citric acid
- Cultivation of edible mushrooms – Preparation of spawn and mushroom bed.
- Isolation of cellulose, production and characterization
- Production of bioethanol and its estimation
- Wine production
- Characterization of wild yeast and test its ethanol producing ability.
- Production and quantification of enzymes – Amylase, cellulase, protease and lipase.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
IV	17P4MBEL3A	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.
- ❖ Field visit –Marine Biodiversity, Algal industries

**Unit I**

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**

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

**Unit III**

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**

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**

Global Biodiversity Information System, Global back bones – Global species 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**

- Agarwal, SK. And Dubey, P.S. (1996) Biodiversity and Environment, APH Publishing Corporation, NewDelhi.
- Kotwal and Banerjee,( ) Biodiversity Conservation in managed and forests protected areas Agrobio, Jodhpur.
- Kumar, U. and Asija Agrobios, M.(2008) Principles and Conservation, Jodhpur.
- Rajendra Kanshik, (2008)Jaipur. Introduction to Conservation Genetics Oxford Book Company
- G.Senthilkumar and A.Panneerselvam, (-) Biodiversity Conservation and Management, Sri Murugan Publications, Thanjavur.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
IV	17P4MBEL3B	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**

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**

Biological databases and its types – Sequence, Mapping, Information retrieval from biological databases and Genomic data bases. Data bank, Information analysis centers ,Referral centers, Translation centers.

**Unit III**

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

**Unit IV**

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

**Unit V**

Analysis of protein level – signature, profiles and motifs, Secondary structure prediction, SWISS Model, Visualization of protein structure: RASMOL, SWISS PDB. Inferring Data relationships – BLAST services – blastp, blastx, PSI, PHI - FASTA.

**Books for Reference**

- Cynthia Gibas and Per Jambeck, (2001). Developing Bioinformatics Computer Skills: Shroff Publishers and Distributors Pvt. Ltd (O’Reilly), Mumbai.
- Rashidi, H.H. and Buehier, L.K., (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
- Des Higgins and Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press.
- Baxeavains, A.D. and Ouellette, B.E.F., (2001). Bioinformatics: A practical guide to the analysis of genes and protiens, Wiley Interscience – New York.
- Arora, P.N. and Malhon, P.K., (1996). Biostatistics Himalaya Publishing House, Mumbai.
- Sokal and Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
- Stanton, A. and Glantz (2012), Primer of Biostatistics - The McGraw Hill Inc., New York.

**CORE OPTIONAL PAPERS**

<b>Semester</b>	<b>Subject Code</b>	<b>Title of the Paper</b>	<b>Hours of Teaching / Week</b>	<b>No. of Credits</b>
<b>I</b>		<b>Core Optional – Bio Energy</b>	-	-

**Objectives:**

- ❖ The emphasis of course is learning the energy and sources, types of biogas plants, feedstock materials for biogas plant, utilization of biomass for energy production and as biofuels.

**Unit I**

Biodiesel - Energy –Renewable and non – renewable energy – Energy plantations – Latex producing plants - *Jatropha* – nuclear energy – Energy management and use.

**Unit II**

Biogas plant – Types – Construction details – Loading of biogas plants – Biogas requirement for various use – Biogas applications – dual fuel engine. Conversion of biogas into electricity.

**Unit III**

Effective use of Agricultural , Horticultural, Forest and fishery wastes and byproducts as an alternative feed stock for biogas plants – Bio digested slurry – Manural value – Enrichment – Pelletization.

**Unit IV**

Bio mass residues for agriculture , Horticulture , forest and fishery energetic – fast growing biomass species as energy source – solid, liquid, gaseous energy production from biomass and its use.

**Unit V**

Biomass briquetting – coir pith groundnut shell etc., - Alcohol from sweet sorghum, tapioca , sweet potato – producer gas – Aqua gas , pyrolytic gas from biomass such as maize cob, groundnut husk, cotton stalk, briquettes.

**Books for Reference**

- Chawla, O.P.1986, Advances in Biogas Technology. ICAR Publication , New Delhi.
- Khandelwall, K.C. and S.S. Mahdi 1989. Biogas technology. Tata Mcgraw. Hill Publishing company Ltd., New Delhi.
- Kuppuswamy , G. and A.Jeyabal . 1996 . Biogas from Alternative feed stocks.
- MNES project publication.
- Mathur, A.N & N.S. Rathore. 1992. Bio gas Production Management and utilization. Himanashu publications Udaipur. Rajasthan.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
<b>II</b>		<b>Core Optional - Veterinary Microbiology</b>	-	-

**Objectives:**

To enable the students

- ❖ To learn about the different diseases caused in animals by bacteria, fungi, viruses, their treatment and control and also emphasizes the study of different parasites on animal and control.

**Unit I**

Microbes Associated with Animal Diseases – Symptoms, diagnosis, treatment and control of Actinobacillosis – Anthrax – Tuberculosis – Bovine mastitis – Haemorrhagic septicemia.

**Unit II**

Mycotic Diseases and Control. Pathogenic fungi – Characteristics Epidemiology of fungal diseases symptoms, diagnosis, treatment and control of mycotic diseases of animals.

**Unit III**

Parasites and control. Definition – Parasites , host, vector, parasitism , Effect of parasitism on the host – Protozoan parasites – Trypanosomes, Leishmania, Plasmodium, Coccidia – Diagnosis, treatment and control. Miscellaneous Protozoan parasites – Amoebae, Ciliates Sarcocysts.

**Unit IV**

Types of Important viral diseases on Animals. Picorna virus group – Foot mouth disease virus – Enteroviruses of animals – Reovirus group – African horse sickness virus – Blue tongue virus – Roto viruses – Infectious bursal diseases virus. Togo virus group – Swinefever viruses, Mucosal disease virus – Paramyxovirus group, pseudovirus group, Bovine Rhinotracheitis virus.

**Unit V**

Methods of diagnosis of animal diseases – types of vaccines.

**Books for Reference**

- Batzing , B.L.2002, Microbiology , An Introduction. Thamsan Brooks cole Publication, London.
- Inglis T.J.J. 1996. Microbiology and infection. Long Man Singapore pub.Ltd.
- Ingraham, J.L and C.A Ingarham 2002. Introduction to microbiology, 2nd Edn. Thamsan Brooks Cole publication, London.
- Johnson,A.G. 1996, Microbiology and Immunology 3rd Edn, Williams and Wilkins Pub. U.K
- Prescott, M.L., J.P.Harley and D.A Klein. 2002. Microbiology 5th Edn. McGraw Hills, USA.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
III		<b>Core Optional - Food Preservation and Processing</b>	-	-

**Objectives**

- ❖ To learn about food preservation
- ❖ To know about food processing
- ❖ To learn about food contamination
- ❖ To learn about food sterilization

**Unit I**

Food Preservation: Principles and methods - Perishable, semi-perishable and nonperishable foods - Methods of preservation - Temporary preservation - Asepsis, low temperature, antiseptics, pasteurization, electromagnetic radiation - Permanent preservation - Sterilization processing by heat, effect of acidification and antiseptics.

**Unit II**

Preservation by salting, Preservation by sugar syrup - Preservation by concentration - Preparation of Jam Jelly - Role of pectin in Jam - Preservation by chemicals: Benzoic acid, parabenzene, sulphur-di-oxide, sulphites, nitrites diethylpyrocarbonates (DEPC), hydrogen peroxide, chlorine and CO<sub>2</sub>

**Unit III**

Processing - Methods - Wet heating method by cookers. Microwave heating method - Processing of fruits and fruit products - Canning of fruits - Preparation of fruit juices - Squashes - Cordials - Preservation by antibiotics and irradiation.

**Unit IV**

Vegetable and vegetable products-Canning of vegetables and pickles. Baked products: Classification of wheat-hard wheat, soft wheat, durum wheat, flour preparation, baking formulation, processing. Milk and milk products: butter, ghee, lassi, unfermented milk products, condensed milk, cheese, ice-cream and milk powder.

**Unit V**

Food additives: Definitions, preservatives, antioxidants- colouring agents, emulsifier, stabilizers and thickening, bleaching and maturing agents, clarifying agents, anti-foaming agents, function of additives. Food adulteration - Adulterants and simple detection techniques - Food grades - Standards, laws and regulations.

**Books for Reference**

- Adams, M. R. and Moss, M. O. (1996). Food Microbiology. New Age International Pvt. Ltd. Publishers, New Delhi.
- Frazier, W. C. and Westhoff, D. C. (1988). Food Microbiology. 3rd ed. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Giridharilal, Siddappa, G. S. and Tandon, G. L. (1990). Preservation of Fruits and Vegetables, CFTRI, Mysore.
- Lal, B., Siddappa, G. B. and Tandon, G. N. (1967). Preservation of Fruits and Vegetables. ICAR Publication, New Delhi.
- Manorajan Kalia and Sangita Sood. (1992). Food Preservation and Processing. Department of Food Science and Nutrition, College of Home Science. Himachal Pradesh Agricultural University,
- Palampur. Ranganna, S. (1986). Handbook of Analysis and Quantity Control for Fruit, Vegetable Products. CFTRI, Mysore.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
IV		<b>Core Optional - Water and Textile Microbiology</b>	-	-

**Objectives:**

- ❖ The study Emphasises the different types of water habitats, estuaries, microbial ecosystems, microbial analysis of water, sources of water pollution and purification, biological sludge digestion, spoilage of aquatic products and its utilization, microbial degradation of fibers viz., jute, hemp, coir, flax, cotton, wood and leather and also prevention of damages of fibers.

**Unit I**

Microbiology of Water – Types of water – Fresh water – Ponds, Lakes, Streams – Marine habitats – Estuaries – Mangroves – Deepsea – Hydrothermal vents – Salt pans – Coral reefs – Microbial ecosystems – Potability of water – Microbial assessment of water quality – Water purification – Brief account of water borne diseases.

**Unit II**

Microbial analysis of water – Sanitary tests for coliforms – The MPN of coliforms (the membrane filter technique, advantages, disadvantages, defined substrate test, tMViC ftest) – Purification of water : Sedimentation filtration, disinfection.

**Unit III**

Sources of water pollution – water recycling – BOD – COD – Methods of sewage treatment – (Biological – Sludge digestion, activated sludge, aeration filters, oxidation ponds) imhoff tanks – Spoilage of aquatic products – corrosion and leaching.

**Unit IV**

Liquid waste treatment – Treatment methods primary, Secondary (anaerobic-methanogenesis : aerobic trickling filter and activated sludge process – Oxidation ponds) tertiary treatment – Utilization of liquid wastes.

**Unit V**

Microbiology of fibers – Retting of plant fibers– jute, hemp, coir, flax ect. – Microbial digeradation of cotton, jute coir, wood and leather – prevention of damage of fibers.

**Books for Reference:**

- Nybakken W., (1982). Marine biology–An Ecological Approach, Ames harper and Row publications. New York.
- Reheinheimer G., (1980). Aquatic Microbiology.
- Mitchell R., (1974). Introduction to environmental Microbiology.
- Dubey, R.C and Maheswari, D.K., (1999). A Text Book of Microbiology. S.Chand and company Ltd., New Delhi.
- Rajak, (2005). Microbial Biotechnology for Sustainable Development and Productivity, M/S. IBD Publishers and Distributors, New Delhi.