VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of studies in Microbiology

Programme: Master of Science (M.Sc.) in Microbiology

Duration: 2 Years (4 semesters)

Programme Overview:

Master of Science (M.Sc.) in Microbiology programme is designed for students who are willing to excel their career in teaching, research and development and industry. The course aims in providing basic understanding of the concepts of microbiology in various areas such as agriculture, industrial, environment, health care sectors by providing expertise in developing novel technologies and also nurturing young minds for the betterment of society.

Programme Educational Objectives (PEOs):

After 3-4 years of completion of the programme the graduates will be able to:

1. Execute their knowledge of Microbiology in handling academics, develop productivity and reproducibility in Research and Industrial sector by analysing data assessment and validation by handling equipments, instruments such as SEM, TEM, AFM,XRD.
2. Become entrepreneurs by developing low cost technologies using microorganisms
3. Develop their technical skills in microbiology in turn give societial development by developing antibiotics, vaccines, biologicals, and synbiotics in health care sector.
4. Improve their soft skills such as communication, leadership abilities, Mindfulness and multitasking and management abilities
5. They can save environment by removing residual toxins, waste management by knowledge in Microbiology.

Programme Specific Outcomes (PSOs):

At the end of the programme the students will be able to:

1. Apply the knowledge of basic concepts of Microbiology in Recombinant DNA technology, Molecular diagnostics, Bioinformatics, Biophysics, and Biochemistry.

2. Demonstrate the ability to design & execute experiments in agriculture by developing biocontrol agents, Biofertilizers, in food and dairy by developing fermented foods, probiotics ,prebiotics and assessing food borne infections and maintaining food standards, in industries development of organic acids ,alcohols, enzymes, vaccines, antibiotics, in medical sector by analysing and treating the infections caused by bacteria,virus and fungi.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Distribution of Courses/Papers in Postgraduate Programme as per Choice Based Credit System (CBCS) in

Microbiology

M.Sc. I - SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
FIRST	DSC1	21MBL1C1L	Virology and Bacteriology	30	70	100	4	-	-	4	3
	DSC2	21MBL1C2L	Mycology and Phycology	30	70	100	4	-	-	4	3
	DSC3	21MBL1C3L	Microbial Biochemistry and Physiology	30	70	100	4	-	-	4	3
	DSC4	21MBL1C4L	Instrumentation and techniques in Biology	30	70	100	4	-	-	4	3
	SEC1	21MBL1S1LP	Bioinformatics for microbiology	20	30	50	1	-	2	2	2
	DSC1P1	21MBL1C1P	Virology and Bacteriology Lab	20	30	50	-	-	4	2	4
	DSC2P2	21MBL1C2P	Mycology and Phycology Lab	20	30	50	-	-	4	2	4
	DSC3P3	21MBL1C3P	Microbial Biochemistry and Physiology Lab	20	30	50	-	-	4	2	4
Total Marks for I Semester						**600**				**24**	

M.Sc. II-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
SECOND	DSC5	21MBL2C5L	Microbial genetics and Molecular cell biology	30	70	100	4	-	-	4	3
	DSC6	21MBL2C6L	Food and Dairy Microbiology	30	70	100	4	-	-	4	3
	DSC7	21MBL2C7L	Environmental Microbiology	30	70	100	4	-	-	4	3
	DSC8	21MBL2C8L	Immunology and Immuno diagnostics	30	70	100	4	-	-	4	3
	SEC2	21MBL2S2 LP	Food Analysis, Safety and Standards	20	30	50	1	-	2	2	2
	DSC5P4	21MBL2C5P	Microbial genetics and Molecular cell biology Lab	20	30	50	-	-	4	2	4
	DSC6P5	21MBL2C6P	Food and Dairy Microbiology Lab	20	30	50	-	-	4	2	4
	DSC7P6	21MBL2C7P	Environmental Microbiology Lab	20	30	50	-	-	4	2	4
Total Marks for II Semester						**600**				**24**	

M.Sc. III-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
THIRD	DSC9	21MBL3C9L	Bioprocess engineering and Industrial Microbiology	30	70	100	4	-	-	4	3
	DSC10	21MBL3C10L	Medical Microbiology	30	70	100	4	-	-	4	3
	DSE1	21MBL3E1AL	A. Microbial Nanotechnology	30	70	100	4	-	-	4	3
		21MBL3E1BL	B. Chemical Microbiology								
		21MBL3E1CL	C. Enzyme technology								
	DSE2	21MBL3E2AL	A. Mushroom production and marketing	30	70	100	4	-	-	4	3
		21MBL3E2BL	B. Veternary Microbiology								
		21MBL3E2CL	C. Marine and extreme Microbiology								
	GEC1	21MBL3G1AL	A. Pharmaceutical Microbiology	20	30	50	2	-	-	2	2
		21MBL3G1BL	B. Baking and Brewing								
		21MBL3G1CL	C. Virology and Covidology								
	SEC3	21MBL3S3LP	Research Methodology	20	30	50	1	-	2	2	2
	DSC9P7	21MBL3C9P	Bioprocess engineering and Industrial Microbiology Lab	20	30	50	-	-	4	2	4
	DSC10P8	21MBL3C10P	Medical Microbiology Lab	20	30	50	-	-	4	2	4
Total Marks for III Semester						**600**				**24**	

IV-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
FOURTH	DSC11	21MBL4C11L	Agriculture Microbiology	30	70	100	4	-	-	4	3
	DSC12	21MBL4C12L	Recombinant DNATechnology	30	70	100	4	-	-	4	3
	DSE3	21MBL4E3AL	A. Diagnostic Microbiology	30	70	100	4	-	-	4	3
		21MBL4E3BL	B. Molecular diagnostics								
		21MBL4E3CL	C. Insect Microbiology								
	DSE4	21MBL4E4AL	A. Basics in clinical research	30	70	100	4	-	-	4	3
		21MBL4E4BL	B. Bioethics, Biosafety and IPR								
		21MBL4E4CL	C. Neutraceuticals, Biologicals and Synbiotics								
	GEC2	21MBL4G2AL	A. Microbes as immune boosters for better health	20	30	50	2	-	-	2	2
		21MBL4G2BL	B. Social immunity and Vaccination								
		21MBL4G2CL	C. Anaerobic Solid and waste water management								
	DSC11P9	21MBL4C11P	Agriculture Microbiology Lab	20	30	50	-	-	4	2	4
	Project	21MBL4C1R	Research Project	30	70	100		-	8	4	4
Total Marks for IV Semester						**600**				**24**	

(I-IV semester)- Total Marks: 2400 and Total credits: 96

DSC – Department Specific Core, DSE – Discipline Specific Elective, SEC – Skill Enhancement Course, GEC – Generic Elective Course, IA – Internal Assessment, SEE – Semester End Examination, L – Lecture, T – Tutorial, P – Practical.

M.Sc. Microbiology First Semester

Course: Virology and Bacteriology	**Course Code:** 21MBL1C1L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. To study the scope, history, economic importance, cell structure, growth, cultivation and control of bacteria.
2. Working principles of microscopy and staining.
3. Knowledge on history, general characters of viruses and viral classification. Knowledge on some common plant and animal diseases caused by different viruses, viral transmission and control.

Unit 1: 12 Hours

Introduction and Classification: Introduction to microbes and prokaryotes. Natural system of classification, binomial nomenclature, international code of nomenclature of prokaryotes.Taxon, species, strain. Criteria used for classification. Three domain classification, classification according to Bergey's manual of systematic bacteriology.

Recent trends in Microbial Taxonomy: a) Chemotaxonomy: cell wall components, lipid composition, isoprenoid-quinones, cytochrome composition. b) Molecular method: DNA homology, DNA-RNA homology, G + C ratio, rRNA sequencing c) Numerical taxonomy d) Genetic methods in taxonomy e) Serological methods f) Taxonomy based on ecology. Bacterial phylogeny, Phylogenetic trees- evolutionary models, homology, methods for tree building, maximum likelihood, organizing data on a tree, evaluating phylogenies. Dichotomous key

Unit 2 Morphology and Ultrastructure of Bacteria 12Hours

Different cell morphology, flagella, pili, capsule, cell wall, cell membrane, cytoplasm. Intracytoplasmic inclusions: nucleoid, plasmids, transposons, gas vacuoles, cellulosomes, carboxysomes, magnetosomes, phycobilisomes, parasporal crystals, reserved food materials (metachromatic granules, polysaccharide granules, polyhydroxybutyrate granules, glycogen, oil droplets, cyanophycean granules and sulphur globules), endospores and exospores, sporulation and cell differentiation in *Bacillus subtilis,* bacterial virulence factors.

Cyanobacteria: Ultrastructure, reproduction and significance of *Microcystis, Gleocapsa, Spirulina, Nostoc, Anabaena*and*Scytonema.* **Bacteria:** Spirochetes, Rickettsia, Chlamydiae**,** Mycoplasma, appendaged, sheathed, gliding and fruiting bacteria, Archaeobacteria, Actinomycetes and Bioluminiscent Bacteria.

Unit 3: Nutrition and Cultivation 10 Hours

Micro and macro nutrients, growth factors. Nutritional types of bacteria. Culture media**:** classification of media (Simple, complex and special media with example). Growth: Nutritional uptake, Growth kinetics, generation time, growth curve, factors affecting growth. Aerobic, anaerobic, batch, continuous and synchronous cultures. Mechanism of cell cycle and binary fission.

Unit 4: Acellular entities- viruses, viriods and prions 10 Hours

Brief outline on discovery of viruses, origin of viruses, Nomenclature and classification of viruses- ICTVand Baltimore system of classification, distinctive properties of viruses. Morphology and ultrastructure of viruses - capsids and their arrangements; types of envelopes and their composition- viral genome (RNA, DNA), Evolutionary importance of viruses. **Working with viruses**: Visualization and enumeration of virus particles, Biological activity of viruses. Isolation and purification of viruses, Detection of viruses.

Unit 5 Sub-Viral Particles; Viruses and the Future 10 Hours

Sub-viral particles: Discovery, Structure, Classification, replication and diseases caused bySatellite, Satellites virus, Virusoids, Viroids and Prions. **Microbial viruses**: Diversity, classification, characteristics and applications ofbacteriophages, and general account on algal, fungal and protozoan viruses.

Viruses and the future: Promises and problems.

Covid-19: Coronavirus, epidemiology, etiology, pathogenesis, Mutations, treatment and its impact on society and economy

Reference Books:

11. Mathematical Physics by Satya Prakash, S Chand and Sons, New Delhi, 2019.
12. Advanced Engineering Mathematics by H.K. Dass, S Chand and Company Ltd., 2013.
13. Mathematical Physics by B. D. Gupta, 3rd Ed, Vikas Publishing House Pvt. Ltd. 2004.
14. Mathematical Methods for Physicist, George Arfken and Hans J Academic press San Diego, 1995.
15. Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, 2011.
16. Linear Algebra – Seymour Lipschutz, Schaum Outlines Series, 4th Edition, 2009.

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
1	To know bacterial classification, nutrition, cultivation, preservation of microbial culture. To describe the morphological features, cell arrangement and structural components bacterial cell.
2	To enlist the characteristics of archaea,cyanobacteria To use different microscopes for studying bacterial morphology.
3	To work in medical laboratories, pharmacological, food and fermentation industries. To develop the skills in cultivation of Bacteria
4	To study the nature of viruses, Techniques employed for culturing and detection of plant and animal viruses, To gain knowledge about newer emerging viral diseases To unravel the mechanisms by which viruses infect cells and cause disease and Viruses used as cloning vectors for gene transfer, therapeutic agents

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M.Sc. Microbiology First Semester

Course: Mycology and Phycology	**Course Code:** 21MBL1C2L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. To understand the structure and classification of fungi and algae
2. To exploit the algae and fungi based on its commercial economical value.

Unit -1 Introduction to Fungi 12hrs

Occurrence and distribution, thallus structure, characteristics, nutrition, classification and reproduction. Introduction of fungi: Occurrence and distribution, somatic structure, hyphal growth, nutrition, heterothallism, sex hormones in fungi, physiological specialization in fungi, fungi and ecosystem; saprophytic parasitic, mutualistic and symbiotic relationship with plants and animals. Classification of fungi. Reproduction in fungi: asexual, sexual and parasexual.

Unit-2 Study Of Different Classes Of Fungi 10hrs

Salient features of division and sub division of Chytridiomycota, Zygomycota, Basidiomycota,Ascomycota, Deuteromycota, Oomycota, Hypochytriomycota, Labyrinthulomycota, Plasmodiophoromycota and Myxomycota. Structure and reproduction of: Dictyostelium, Allomyces, Pilobolus, Claviceps and Fusarium.

Unit-3 Sailent Features Of Algae 112hrs

General characters and comparative study of important systems of classification of algae –
Fritsch and Parker systems of classifications. Criteria used in the primary classification of algae: a). Pigments b). Reserve food materials c).flagella d). Cell wall e). Gross cell structure.
Algae of diverse habitats – a).Terrestrial. b). Freshwater algae and c). Marine algae, Reproduction of algae – a). Vegetative b). Asexual – Different types of spores. Sexual – Zygotic, Sporic and Gametic with suitable examples.

Unit 4 Study Of Different Classes Of Algae 10hrs

Distribution, morphology and classification of algae.Isolation from soil and water, algal ecology, media and methods used for cultivating algae.Measurement of algal growth, strain selection and large scale cultivation. Symbiotic algae: Lichens, coral reef and sea sponges. Structure and reproduction of important algae.

Unit -5 Economic Importance Of Algae And Fungi 10hrs

Economic importance of algae as primary producers and commercial products. Uses of algae in heavy metal removal, algal blooms and toxins. Economic importance of Mycorrhiza: ecto-, endo and ect-endo VAM, Fungi as insect symbionts, fungi as biocontrol agents, attack of fungi on other microorganisms, potential application in Agriculture, environment, industry, food. Role of fungi in bio deterioration of wood, paper, textile .Mycotoxins, quorum sensing in fungi.

References:

1. Tulasi Satyanarayana, Sunil Kumar Deshmukh, Mukund V. Deshpande, 2019, Advancing Frontiers in Mycology & Mycotechnology: Basic and Applied Aspects of Fungi, Springer Nature.
2. Robert Edward Lee, 2019, Phycology, 5th Revised edition, Cambridge University Press.
3. S. Sreekumar, 2016, Microbiology, Phycology, Mycology, Lichenology & Plant Pathology, Publisher: Medtech.
4. Alexopoulos, C.J. and C.W. Mims 1979. Introduction to Mycology (3rd Ed.)Wiley Eastern Ltd., New Delhi
5. Charlile M. & Watkinson S.C. The Fungi, Publisher: Academic Press.
6. E.Moore –Landeekeer: Fundamentals of the fungi, Publisher: Prentice Hall.
7. L. Barsanti, Paolo Gualtieri: Algae: anatomy, biochemistry, and biotechnology
8. Ayhan Demirbas, M. Fatih Demirbas: Algae Energy: Algae as a New Source of Biodiesel(2010)
9. Linda E. Graham, James Graham, James M. Graham: Algae(2009)
10. Burnett J.H., Publisher: Edward, Arnold Crane Russak: Fundamentals of Mycology.

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
1	To understand the general characteristics and reproduction in fungi and lichens.

2	To understand the economic and pathological importance of fungi.
3	To identify common fungal plant diseases and device control measures and work as plant doctor

M.Sc. Microbiology First Semester

Course: Microbial Biochemistry and Physiology	**Course Code:** 21MBL1C3L
Teaching Hours/Week (L-T-P): 4 - 0 – 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1.To understand the aqueous nature of solutions and clinical biochemistry
2.To understand the role of microorganisms in the metabolism of biomolecules.

Unit-1 Aqueous solutions and acid base chemistry 12hrs

Structure and properties of water molecule. units of expressing and inter-converting concentration of solutions: molarity, moles, normality, osmolarity, molality, mole fraction, Bronsted Concept of conjugate acid –conjugate base pairs, ionization of solutions, pH, itration curves. Buffers: preparation, action and their use in Biology, Henderson-Hasselbalch equation, buffer capacity, polyproteic acids, amphoteric salts, ionicstrengths.

Biomolecules:

Structure and function of protein and peptide bond, classification, Ramachandran plot, factors determining secondary, tertiary structures: amino acid sequence, thermodynamics of folding, role of disulfide bonds, dynamics of globular protein folding, chaperonins, motifs and domains, protein families, protein stability, , protein-protein interactions. Structure and function of Amino acids: Classification and stereochemistry, biochemical information of amino acid sequence, derivative, ionization. StrStructure and function of Carbohydrates; classification, stability of glycosidic bond, glycoconjugates, proteoglycans, glycoprtoeins, glycolipids, homopolysaccharide folding, functions of oligosaccharides. Structure and function of Lipid classification, structure of lipids in membranes, glycerolipids, ether lipids, galactolipids, sulfolipids, lipids in archaebacteria, sphingolipids, terpenes, isoprenoids, Functions of lipids, signals, cofactors, pigments. Structure and function of Nucleic acids.

Unit -2 Carbohydrates and Lipid Metabolism 11hrs

Glycolysis, regulation. Glycogenesis, glycogenolysis, gluconeogenesis, regulations; TCA cycle, regulations. Amphibolic nature of TCA cycle. HMP shunt. Fatty acid oxidation (β-oxidation), energetics of palmitic acid oxidation. Ketone bodies, ketogenesis, Ketonemia, ketonuria, ketosis, extra mitochondrial biosyntheses of long fatty acids (palmitate) and regulation. Synthesis of triacylglycerols, metabolism of phospholipids and glycolipids. Biosynthesis and degradation of cholesterol.

Unit-3 Metabolism of Amino And Nucleotide Metabolism 11hrs

Transamination, deamination, decarboxylation; Urea cycle - regulation. Metabolism of ammonia; Synthesis and degradation of Glycine, phenylanine and Tyrosine, Synthesis and degradation of Sulfur containing amino acids. Nucleotide metabolism of IMP, AMP and GMP, Salvage pathway for purines, degradation of purine nucleotides. Biosynthesis and degradation of pyrimidine nucleotides.

Unit-4 Classification of Microbes And Microbial Photosynthesis 11hrs

Classification of microbes based on their physical adaptation. Classification of organisms based on nutritional sources such as Carbon source, energy source and electron source, macro and micronutrients.Microbial Photosynthesis: Light Energy, Photolysis of Water, Photosynthetic Pigments, Cyclic and Non-Cyclic Photophosphorylation, Calvin's Cycle. Fermentation Reaction:Homo and Heterofermentation pathways; Alcohol and Lactic acid fermentation pathways. Biological Oxidation: Electron Transport System, Oxidative Phosphorylation, Inhibitors and mechanism of oxidative phosphorylation.

Unit-5 Signalling And Stress in Bacteria 11hrs

Introduction to two component signaling systems: i. Response by facultative anaerobes to anaerobiosis, nitrate and nitrite, nitrogen supply, inorganic phosphate supply. ii. Effect of oxygen and light on the expression of photosynthetic genes in purple photosynthetic bacteria, response to osmotic pressure and temperature, response to potassium ion and external osmolarity, response to carbon sources.

Bacterial response to environmental stress, heat shock response. Repairing damaged DNA, the SOS response, oxidative stress, Synthesis of virulence factors and quorum sensors, chemo taxis, photo responses, aero taxis. Quorum sensing: Myxobacteria, Caulobacter, bioluminescence systems similar to LuxR/LuxI in non luminescent bacteria, biofilms.

References:

1. Anderson,Sweeney&Williams,(2002):StatisticsforBusiness&Economics,11th Edn.,Thomson South-Western,CengageLearning,India.
2. AgarwalB.L (2013):BasicStatistics,NewAgeInternational Publication,NewDelhi.
3. GuptaSP(2012) StatisticalMethods,S.Chandand Company, NewDelhi.
4. GuptaS.C.(2017):FundamentalsofStatistics,HimalayaPublishingHouse,Bombay
5. GoonA.M.,GuptaM.K.andDasguptaB.(2013):FundamentalsofStatistics,Vol.I&II,8th Edn,The WorldPress,Kolkata.
6. JainTR,and VKOhri(2020):StatisticsforEconomics,VKGlobalPubliserPvt.Ltd.
7. JohnsonR.andG.Bhattacharya(2000):Statistics:PrinciplesandMethods,JohnWileyandSons.
8. NagarA.L.andR.K.Das (1997): Basic statistics, Oxford University Press, NewDelhi.
9. SachdevaS.(2017):QuantitativeTechniques,LakshmiNarainAgarwalPublications,Agra.
10. VeerachamiR.(2019):QuantitativeMethodsforEconomists,NewAgeInternational Publication,NewDelhi.

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
1	Perform calculations and unit of expressions of solutions; prepare the buffers used in biology. Understand the structure and function of biomolecules. Such as proteins amino acids, carbohydrates, lipids and nucleic acids.
2	Understand the concept of respiration and fatty acid oxidation.
3	Know the synthesis and degradation of Amino acid and nucleotide mechanism
4	To understand the physiology and metabolism of microorganisms and also how they respond to stress conditions.

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M.Sc. Microbiology First Semester

Course: Instrumentation and techniques in Biology	**Course Code:** 21MBL1C4L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. To develop skills in handling instruments and techniques used in laboratories inorder to culture microorganisms and analyse the biomolecules

Unit-1 **Electron microscopy and 3D image processing for Life sciences** **12hrs**

Principle and types of electron microscopy. Localization of macromolecules using electron microscopy. Principles of image formation, Fourier analysis, Contrast Transfer Function and point spread function. Advanced sample preparation, imaging, data collection techniques of bio-molecules by negative staining and cryo-electron microscopy. Theoretical, computational and practical aspects of various advanced 3D image processing techniques.

Unit-2 **Spectroscopy Techniques and centrifugation** **12hrs**

UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism; Fluorescence; MS, NMR, PMR, ESR and Plasma Emission spectroscopy– Principles of IR spectroscopy, vibrational spectra of biopolymers, Fourier transform of Infra Red spectroscopy, Instrumentation.

Basic principles; Types of centrifuges - Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications; Analytical centrifugation, Ultra centrifugation.

Unit -3 **Radioactivity and Radioactive Isotopes** **10hrs**

Units and measurement of radioactivity, Geiger-Muller counter; Solid & Liquid scintillation counters; Autoradiography; Measurement of stable isotopes; Radiotracer techniques; Distribution studies; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay.

Unit-4 Techniques in Molecular Biology 10hrs

Polymerase chain reaction, RT-PCR, Principles and techniques of nucleic acid hybridization and Cot curves, Theory and application of agarose gel electrophoresis; Capillary electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis. Southern and Northern blotting techniques.

Unit-5 Techniques in Protein Purification 12hrs

Chromatography Techniques - TLC and Paper chromatography; Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity. Theory and application of Poly acryl amide gel electrophoresis. SDS PAGE, NATIVE PAGE with tricine, tris acetate, and tris glycine gels, Blue native PAGE, iso electro focusing, Western blotting technique and MADI-TOFF.

References:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L.(2006) Biochemistry. Freeman, New York.
2. Nölting, B. (2006) Methods in modern biophysics. Second Edition. Springer, Germany.
3. Wilson Keith and Walker John (2005) Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed. Cambridge University Press, New York.
4. Horst Friebolin, Basic One-and Two-Dimensional NMR Spectroscopy (Fourth Edition), Wiley-VCH.Claridge, T.D., W, High Resolution NMR Techniques in Organic Chemistry, Volume27, Second Edition.
5. John J. Bozzola and Lonnie D. Russell (1992). Electron Microscopy (Jones & Bartlett Publishers).
6. Ray F. Egerton (2005). Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM (Springer).

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
1	Handle electron microscope and 3D image processing.
2	Handle UV Visible Raman spectroscope, understand the principle of fluorescence, NMR, IR.
3	Handle the separation of biomolecules using centrifuges.
4	Understand the concept of radioactive isotopes and Autoradiography.
5	Develop skills in molecular biology techniques such as PCR, Gel electrophoresis, in purification of proteins using chromatography techniques gel electrophoresis and blotting techniques.

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M.Sc. Microbiology First Semester

Course: Bioinformatics in Microbiology	**Course Code:** 21MBL1S1LP
Teaching Hours/Week (L-T-P): 1 - 1 - 0	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. To understand the biological databases used in microbiology
2. To find out novel microorganisms by using Bioinformatic analysis,Proteome analysis,Genome analysis of Microorganisms using sequence of microbial genomes

Unit-1 Introduction To Bioinformatics 10hrs

Overview, Internet and bioinformatics, Applications, Databases: Databases in bioinformatics, various biological databases, Protein and Nucleotide sequence Data bases. Protein sequence, structure and Classification databases.

Sequence Analysis - Global and Local Alignments, database similarity searching, FASTA, BLAST, Low-Complexity Regions, Repetitive Elements. Detection of functional sites of DNA sequences (Promoter Scan and Gen Scan), gene structure prediction (e.g. CENSOR and Repeat Masker)

P**hylogenetics**- Introduction, tree definitions, Stand alone packages: Phylip, ClustalW. Definition of protein families, sequence Vs family comparison,
Structural databases, Protein Data Bank, Molecular Modeling and docking. Molecular visualization software. Major web resources for bioinformatics. Protparam, Translate, Bioedit, findmod, Coils, TMHMM, Rasmol, Deepview.

Unit-2 Genomics and transcriptomics 9hrs

Gene prediction: Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions, Evaluation of Gene Prediction methods. Microarray techniques, gene expression analysis

Transcriptomics: Complete transcript cataloguing and gene discovery- sequencing based approach, Microarray based technologies and computation based technologies. RNA secondary structure prediction.

Unit-3 Proteomics and Microbiome 9hrs

Types of proteomics, tools for proteomics- separation and isolation of proteins, acquisition of protein structure information, databases and applications. Structural classification of proteins, Protein structure analysis, structure alignment and comparison, Secondary and tertiary structure prediction and evaluation, prediction of specialized structures, Active site prediction, Protein folding, Protein modeling and drug design. Predictive Methods for Proteins – structure prediction methods. prediction of trans-membrane regions. Metabolic pathways resources: KEGG, Biocarta, Nutrigenomics and metabolic health. Microbiome analysis.

References:

1. Bioinformatics: A Beginners Guide, Clavarie and Notredame
2. Bioinformatics: Rastogi
3. Introduction to Bioinformatics:Arthur M. Lesk
4. Bioinformatics: Principles and applications, Ghosh and Mallick
5. Bioinformatics: Genes, Proteins and Computer, C A Orengo
6. Protein Structure Prediction: Methods and Protocols, Webster, David (Southern Cross Molecular Ltd., Bath, UK. Tandy Warnow , 2019, Bioinformatics and Phylogenetics: Seminal Contributions of Bernard Moret, Springer,
7. Bioinformatics: Sequence and Genome Analysis. David W. Mount
8. Bioinformtics: Methods and protocols. Stephen A. Krawetz, Humana Press
9. Fundamental Concepts of Bioinformatics. Krane&Raymer, Pearson Ed.
10. Introduction to Protein Structure. C.I. Branden and J. Tooze, Garland Pub.
11. Introduction to Bioinformatics. Attwood &Parrysmith, Pearson Ed.
12. Applying Genomic, Microarray Technology and Proteomic array in Drug Discovery, by Robert S .Matson Second Edition, 2018, CRC Press

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
1	Understand introduction to Bio informatics.
2	Understand the concept of Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods, Evaluation of Gene Prediction methods.
3	Learn the concept of Transcriptomics, tools in Bioinformatics, Understand Genomics, Proteomics, Phylogenetic analysis and microbiome

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M.Sc. Microbiology First Semester

Course: Bacteriology and virology	**Course Code:** 21MBL1C1P
Teaching Hours/Week (L-T-P): 0 - 0 – 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. To learn the basic skills of isolation and cultivation of bacteria inorder to classify the based on biochemical and microscopic characterization
2. To learn the isolation and cultivation of virus

List of Experiments

1. **Isolation of microorganism:** Serial dilution, pure culturetechniques
2. **Culturing and cultural characteristics of microorganisms**:
3. **Autotrophic** - Benecks broth, Chu‟smedium
4. **Heterotrophic**- Nutrient agar, glucose peptonemedia
5. **Selective** - MRS, actinomycetesagar
6. **Enriched** - Dorsetts egg growth medium, chocolateagar
7. **Differential** - Maconkey, Blood agar, EMB,DCA
8. **Staining techniques:** Simple, Differential: acid-fast, endospore, capsule, cell wall, cytoplasmic inclusion vital stains: flagella, spore and nuclearstaining.
9. Biochemical tests for identification of Bacteria: Catalase, oxidase, IMViC, motility, gelatinace test, urease, levan formed from glucose, H_2S in TSIA and lead acetate paper, coagulase, optochin sensitivity, lecithinase, nitrate reduction, acid and gas from Carbohydrates (glucose, arabinose, inosital, lactose, maltose, mannitol, rhamnose, salicin, trehalose, sucrose, xylose, fructose), ONPG acid, hippurate hydrolysis, chitin, starch, casein, Tween 80 hydrolysis, pectin, arginine hydrolysis, lysine decarboxylase, ornithine, esculin hydrolysis. Identification of bacteria by APIsystem.
10. Bacterial growth measurement (cell count, turbidometry, platecount)
11. Isolation of bacteriophages from sewage
12. Isolation of plant viruses from sap.

Course Outcome: After completion of this course student should able to

CO	Statement
1	To perform the isolation, identification and microscopic, biochemical characterization of bacteria and virus

M.Sc. Microbiology First Semester

Course: Mycology and Phycology	**Course Code:** 21MBL1C2P
Teaching Hours/Week (L-T-P): 0 - 0 – 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. To learn the basic skills of isolation and cultivation of algae and fungi inorder to classify them and used in exploitation in industries

List of Experiments

1. Isolation of slime molds, fungi from water, soil, air, cereals and cereal based products.
2. Isolation of fungi from plant material:Epiphytic fungi, washing method, implant method, impression method, maceration method; endophyticfungi.
3. Growth measurement of fungi- linear andbiomass.
4. Effect of environmental (pH, temperature) and nutritional factors (carbon, nitrogen sources) on growth offungi.
5. Screening for antibiotic producing microbes (antibacterial,antifungal)
6. Measurement of concentration of fungal conidia by Haemocytometer.
7. Measurement of fungal cells by Micrometer.
8. Study of the following representative genera: *Aspergillus, Penicillium, Fusarium,Neurospora, Saccharomyces, Erysiphae, Polyporus, Agaricus, Puccinia, Ustilago, Alternaria, Drechslera, Saprolegnia, Rhizopus, Trichoderma*and symbiotic fungi-Lichens.
9. Study of phototaxis in*Dictyostelium.*
10. Identification of the genera mentioned in Cyanophyceae and Chlorophyceae.
11. Collection and identification of algae occurring in and around university college/campus.
12. Cell count using haemocytometer
13. Preparations of temporary mount and study the different stages of Mitosis (Onion root tip).
14. Depicting nature of cellular membranes: Osmosis, Hypertonicity, Hypotonicity, Isotonicity
15. Isolation of lipolytic microbes from soil-plate method and estimation of totallipid
16. Fractionation of total lipid (glycolipid, neutral lipid and phospholipid) by column chromatography
17. Extraction and estimation (by TLC) of ergosterol from fungi

Course Outcomes:

CO	Statement
1	Perform culturing and cultural characteristics of micro organisms.
2	Know about growth measurement of Algae, fungi/ Acitomycetes.

M.Sc. Microbiology First Semester

Course: Microbial biochemistry and physiology	**Course Code:** 21MBL1C3P
Teaching Hours/Week (L-T-P): 0 - 0 – 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. To learn the preparations of solutions and find out the analysis of estimation of carbohydrates, proteins, nucleic acids, fatty acids in foods, pharmaceutical products.

List of Experiments

1. Preperations of buffers
2. Qualitative analysis of Carbohydrates.Proteins.Amino acids.
3. Estimation of sugars by DNS method.
4. Estimations of proteins by Biuret method.
5. Estimations of DNA
6. Estimations of RNA
7. Estimation of ascorbic acid.
8. Determination of Iodine value of oils.
9. Estimation of cholesterol.

References:

1. Hawk's physiological chemistry Ed. by Oser (McGraw Hill).
2. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
3. An introduction to practical biochemistry by D.T.Plummer (McGraw Hill).
4. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).
5. Biochemistry - a laboratory courses by J.M.Beckar (Academic Press)

Course Outcomes:

CO	Statement
1	To isolate and characterize the themophiles,basophiles and acidophiles
2	Perform qualitative and quantitative analysis of Carbohydrates, Proteins, Amino acids, Nucleic acids.
3	Perform estimation of Sugars, Proteins, Ascorbic acid.cholestrol.
4	Determine the iodine values of oil.