VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

MICROBIOLOGY

SYLLABUS

Master of Science
(1st Semester)

With effect from
2024-25

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI - 583105

Department of studies in Microbiology

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

Duration: 2 Years (4semesters)

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 are as such as agriculture, industrial, environment, health care sectors by providing expertise in developing novel technology sandal sonurturing 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 analyzing 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. D**e**velop their technical skills in microbiology in turn give societial development by developing anti biotics, 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 saveen vironment by removing residual toxins, waste management by knowledge in Microbiology.

Programme Specific Out comes (PSOs):

Attend 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 borneinfections 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.

VIJAYANAGARASRIKRISHNADEVARAYAUNIVERSITY

DistributionofCourses/PapersinPostgraduateProgrammeasperChoiceBasedCreditSystem(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	24MBL1C1L	Virology and Bacteriology	30	70	100	4	-	-	4	3
	DSC2	24MBL1C2L	Mycology and Phycology	30	70	100	4	-	-	4	3
	DSC3	24MBL1C3L	Microbial Biochemistry And Physiology	30	70	100	4	-	-	4	3
	DSC4	24MBL1C4L	Microbial techniques and instrumentation	30	70	100	4	-	-	4	3
	SEC1	24MBL1S1LP	Bio in formatics for Microbiology	20	30	50	1	-	2	2	2
	DSC1P1	24MBL1C1P	Virology and Bacteriology Lab	20	30	50	-	-	4	2	4
	DSC2P2	24MBL1C2P	Mycology and Phycology Lab	20	30	50	-	-	4	2	4
	DSC3P3	24MBL1C3P	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	Molecular cellbiology and Microbial genetics	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 Immunodiagnostics	30	70	100	4	-	-	4	3
	SEC2	21MBL2S2LP	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 Nano technology	30	70	100	4	-	-	4	3
		21MBL3E1BL	B. Chemical Microbiology								
		21MBL3E1CL	C. Enzymetechnology								
	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	Titleof 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 DNA Technology	30	70	100	4	-	-	4	3
	DSE3	21MBL4E3AL	A. Diagnostic Microbiology	30	70	100	4	-	-	4	3
		21MBL4E3BL	D. Molecular diagnostics								
		21MBL4E3CL	E. 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:**24MBL1C1L
Teaching Hours/Week (L-T-P) :4-0-0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives

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

Unit1: Introduction to Microbiology 12Hours

History of Microbiology: Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. golden era of microbiology. Microbial taxonomy and systematics: Introduction to microbes and prokaryotes. Natural system of classification, binomial nomenclature, international code of nomenclature of prokaryotes. Three domain classification, Bacterial phylogeny and Phylogenetic trees. classification according to Bergey's manual of systematic bacteriology. Brief outline on discovery of viruses, Nomenclature and classification of viruses- ICTV and Baltimore system of classification

Unit2: Bacteriology 12 Hours

Bacteria and Archaeo bacteria : Different cell morphology, flagella, pili, capsule, cell wall, cell membrane, cytoplasm. Intracytoplasmic inclusions, nucleoid, plasmids, transposons, reserved food materials, endospores and exospores, sporulation and cell differentiation in Bacillus subtilis, bacterial virulence factors. Cyanobacteria, Spirochetes, Rickettsia, Chlamydiae, Mycoplasma, Bioluminescent Bacteria and Actinomycetes.

Unit 3: Bacterial Nutrition and cultivation 10 Hours

Micro and macro nutrients, growth factors. Nutritional types of bacteria. 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: Virology **10 Hours**

Origin of viruses, properties of virus, pioneers in virology, Morphology and ultrastructure of viruses - capsids and their arrangements; types of envelopes and their composition- viral genome.Sub-viral particles: Discovery, Structure, Classification, replication and diseases caused by Satellite, Satellites virus, Virusoids, Viroids and Prions.

Unit 5: 10 Hours

Microbial viruses: Diversity, classification, characteristics and applications of bacteriophages, 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 Evolutionary importance of viruses, Visualization and enumeration of virus particles, biological activity of viruses. Isolation and purification and detection of viruses.

ReferenceBooks:

11. Mathematical Physics by Satya Prakash, SC handand Sons, New Delhi,2019.
12. Advanced Engineering Mathematics by H.K.Dass, SC handand 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–Seym our Lipschutz, Schaum Outlines Series, 4th Edition,2009.

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

CO	Statement
CO1	To know bacterial classification, nutrition, cultivation, preservation of microbial culture. To describe the morphological features, cell arrangement and structural components bacterial cell.
CO2	To enlist the characteristics of archaea, cyano bacteria To use different microscopes for studying bacterialmorphology.
CO3	To work in medical laboratories, pharmacological, food and fermentation industries. To develop the skills in cultivation of Bacteria
CO4	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, the rapeuticagents

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M.Sc. Microbiology First Semester

Course: Mycology and Phycology	**Course Code:**24MBL1C2L
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, thallusstructure, 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: a sexual, sexual and parasexual.

Unit-2 Study Of Different Classes Of Fungi **10hrs**

Salient features of division and subdivision 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 **12hrs**

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 diversehabitats– a).Terrestrial. b).Fresh water algae and c).Marine algae, Reproduction of algae– a). Vegetative b). Asexual – Different types of spores. Sexual–Zygotic, Sporic and Gametic with suitable examples.

Unit4 Study Of Different Classes Of Algae **10hrs**

Distribution, morphology and classification of algae. Isolation from soil and water, algalecology, media and methods used for cultivating algae. Measurement of alge growth, strain selection and large scale cultivation. Symbiotic algae: Lichens, coralreef 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 micro organisms, potential application in Agriculture, environment, industry, food. Role of fungi in biodeterioration of wood, paper, textile. Mycotoxins, quorumsensing in fungi.

References:

1. Tulasi Satyanarayana, Sunil Kumar Deshmukh, Mukund V.Deshpande, 2019, Advancing Frontiersin Mycology & Mycotechnology: Basic and Applied Aspects of Fungi, Springer Nature.
2. Robert EdwardLee, 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 Demirb as: Algae Energy:Algaeasa New Source of Biodiesel (2010)
9. LindaE.Graham, A James Graham, James M.Graham: Algae (2009)
10. Burnett J.H.,Publisher: Edward, Arnold Crane Russak: Fundamentals of sMycology.

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

CO	Statement
CO1	To understand the general characteristics and reproduction in fungi and lichens.
CO2	To understand the economic and pathological importance of fungi.
CO3	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:**24MBL1C3L
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 micro organisms 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, mosmolarity, molality, molefraction, Bronsted Concept of conjugate acid–conjugate base pairs ,ionization of solutions, pH, itration curves. Buffers: preparation, action and their use in Biology, Henderson-Hassel balch 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 disulfidebonds, dynamics of globul arprotein folding, chaperonins, motifs and domains, protein families, proteinstability, protein-protein interactions. Structure and function of Aminoacids: Classification and stereochemistry, biochemical information of amino acid sequence, derivative, ionization. Structure and function of Carbohydrates; classification, stability of glycosidicbond, glycoconjugates, proteoglycans, glycoprtoeins, glycolipids, homopoly saccharide folding, functions of oligosaccharides. Structure and function of Lipid classification, structure of lipidsinmembranes, glycerolipids, etherlipids, galactolipids, sulfolipids, lipidsinarchaebacteria, sphingolipids, terpenes, isoprenoids, Functionsoflipids, signals, cofactors, pigments. Structure and function of Nucleic acids.

Unit-2 Carbo hydrates and Lipid Metabolism **11hrs**

Glycolysis, regulation. Glycogenesis, glycogenolysis, gluconeogenesis, regulations; TC Acycle, regulations. Amphibolic nature of T C Acycle. H M Pshunt. Fatty acidoxidation (β-oxidation), energetic 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. Biosyn thes is and degradation of pyramid in enucleotides.

Unit-4 Classification of Microbes And Microbial Photosynthesis **11hrs**

Classification of microbes based on theirphysical 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: Homoand Heter of ermentation 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 anaerobesto 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 externalosmolarity, response to carbon sources. Bacterial response to environmental stress, heat shock response. RepairingdamagedDNA, the SOS response, oxidative stress, Synthesis of virulence factors and quorumsensors, chemotaxis, photoresponses, aerotaxis. Quorumsensing: Myxo bacteria, Caulobacter, bioluminescence systems similar to LuxR / LuxI in non luminescent bacteria, biofilms.

References:

- Anderson, Sweeney & Williams, (2002): Statistics for Business & Economics, 11thEdn., Thomso Western, Cengage Learning, India.

1. AgarwalB.L (2013): Basic Statistics, New Age International Publication, New Delhi.
2. Gupta S P (2012) Statistical Methods, S. Chandand Company, New Delhi.
3. GuptaS.C.(2017): Fundamentals of Statistics, Himalaya Publishing House, Bombay
4. JainTR, and VKOhri (2020): Statistics for Economics, VKGlobal Publiser Pvt. Ltd.
5. JohnsonR. And G.Bhattacharya (2000): Statistics: Principles and Methods, John Wiley and Sons.
6. NagarA.L. and R.K.Das (1997): Basicstatistics, Oxford University Press, New Delhi.
7. Sachdeva S. (2017): Quantitative Techniques, Lakshmi Narain Agarwal Publications, Agra.
8. VeerachamiR. (2019): Quantitative Methods for Economists, New Age International Publication, New Delhi.

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 proteinsaminoacids, carbohydrates, lipids and nucleicacids.
2	Understand the concept of respiration and fattyacidoxidation.
3	Know the synthesis and degradation of Aminoacid and nucleotide mechanism
4	To under tand the physiology and metabolism of microorganisms and also how they respond to stress conditions.

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M.Sc. Microbiology First Semester

Course: Microbial techniques and Instrumentation	**Course Code:**24MBL1C4L
Teaching Hours/Week (L-T-P):4-0-0	**No. of Credits:** 04
Internal Assessment: 30Marks	**Semester End Examination:**70 Marks

Course Objectives:

1. To develop skills in handling instruments and techniques used in laboratories in order to culture micro organisms and analyse the biomolecules

Unit – I **12hrs**

Sterilization and disinfection techniques: Principles, Types and techniques of sterilization and disinfection. Physical sterilization, chemical sterilization, filtration and radiation sterilization, pasteurization, Disinfection and fumigation. Culture media: Components of culture media, Preparations and types of culture media. Pure culture techniques: Different methods of isolation-pour plate, spread plate and serial dilution techniques. Isolation of Metagenome, Maintenance and Preservation of microbial cultures. Type culture collection centres.

Unit-2 **12hrs**

Staining techniques: Nature and types of Stains. Principles, mechanism, method and types of staining Simple, Differential, Gram staining, Acid fast staining, Vital staining, negative staining. Staining for capsule, cell wall, endospore, inclusion bodies and flagella. Molecular biology techniques: Polymerase chain reaction, agarose gel electrophoresis; Pulsed field gel electrophoresis. Techniques in Protein Purification: Chromatography Techniques, SDS PAGE, NATIVE PAGE. Isoelectro focusing, Blotting techniques.

Unit -3 **10Hrs**

Instrumentation in Microbiology 1: Microscope and its modifications – Light, phase contrast and interference, Fluorescence, Confocal, Electron (TEM and SEM), Electron tunneling and AFM. 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

Unit-4 **14hrs**

Instrumentation in Microbiology II: Autoclave, Laminar air flow system, Incubator, Hot air oven, Orbital shaker, pH meter. Centrifugation - Types of centrifuges, Micro centrifuge, High speed & Ultracentrifuges; centrifugation, Types and Applications. Spectroscopy: 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.

Unit-5 **8 hrs**

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.

References:

1. Berg,J.M., Tymoczko,J.L. and Stryer,L.(2006) Biochemistry.Freeman,NewYork.
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 NMRS pectroscopy (FourthEdition), Wiley VCH.Claridge, T.D.,W,High Resolution NMR Techniques in Organic Chemistry, Volume27, Second Edition.
5. JohnJ.Bozzola and Lonnie D.Russell (1992). Electron Microscopy (Jones & Bartlett Publishers).
6. RayF.Egerton (2005). Physical Principles of Electron Microscopy: AnIntroduction 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 3Dimage processing.
2	Handle UV Visible Ramanspectroscope, understand the principle of fluorescence, NMR, IR.
3	Handle the separation of biomolecules using centrifuges.
4	Understand the concept of radio active isotopes and Autoradiography.
5	Develop skills in molecular biology techniques such as PCR, Gel electrophoresis, inpurification 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:** 24MBL1S1LP
Teaching Hours/Week(L-T-P):1-1-0	**No. of Credits:** 02
Internal Assessment: 20Marks	**Semester End Examination:** 30Marks

Course Objectives:

1. To understand the biological databases used in microbiology
2. To findout novel micro organisms by using Bioinformatic analysis, Proteomeanalysis,Genomeanalysis of Micro organisms using sequence of microbial genomes

Unit-1 Introduction to Bioinformatics 10hrs

Overview, Internet and bioinformatics, Applications, Databases: Databases in bioinformatics, various biological 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, treedefinitions, Standal one packages: Phylip, ClustalW. 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, Geneprediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions, Evaluation of Gene Prediction methods. Microarray techniques, gene expression analysis Transcriptomics:Complete transcript cataloguing and genediscovery – sequencing based approach, Microarray based technologies and computation based technologies. RNAsecondary structure prediction.

Unit-3 Proteomics and Microbiome 9hrs

Types of proteomics, tools for proteomics- separation and isolation of proteins, acquisition of protein structure information. 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 Protein Data Bank, Molecular Modeling and docking and drug design. Molecular visualization software. Predictive Methods for Proteins. Metabolic pathways resources: KEGG, Biocarta, Nutrigenomics and metabolic health. Microbiome analysis.

References:

1. Bioinformatics:A B eginners 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 MolecularLtd., 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 Proteomicarray in Drug Discovery, by Robert S .Matson Second Edition, 2018, C R C Press

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

CO	Statement
1	Understand introduction to Bioinformatics.
2	Understand the concept of Genestructure in Prokaryotes and Eukaryotes, Geneprediction 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 :24MBL1C1P
Teaching Hours/Week (L-T-P) :0-0–4	No. of Credits:02
Internal Assessment: 20Marks	Semester End Examination: 30 Marks

Course Objectives:

1.To learn the basic skills of isolation and cultivation of bacteria in order 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: Serialdilution, pureculture techniques
2. Culturing and cultural characteristics of microorganisms: Autotrophic-Benecksbroth, Chu‟s medium.
3. Heterotrophic- Nutrient agar, glucose peptone media.
4. Selective-MRS, actinomycetes agar
5. Enriched-Dorsetts egg growth medium, chocolate agar
6. Differential-Maconkey, Bloodagar, EMB, DCA.
7. Stainin gtechniques: Simple, Differential: acid- fast, endospore, capsule, cellwall, cytoplasmic inclusion vitalstains: flagella, spore and nuclear staining. Bioche mical 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, hippuratehydrolysis, chitin, starch, casein, Tween 80 hydrolysis, pectin, argininehydrolysis, lysinedecarboxylase, ornithine, esculinhydrolysis. Identification of bacteria by API system.
8. Bacterial Growth measurement (cellcount, turbidometry, platecount)
9. Isolation of bacteriophages from sewage
10. Isolation of plant viruses from sap.

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

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

M.Sc. Microbiology First Semester

Course: Mycology and Phycology	**Course Code:** 24MBL1C2P
Teaching Hours/Week (L-T-P) :0-0–4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:**30 Marks

CourseObjectives:

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

List of Experiments

1. Isolation of slimemolds, fungi from water, soil, air, cereals and cereal based products.
2. Isolation of fungi from plan tmaterial: Epiphytic fungi, washing method, implant method, impression method, maceration method; endophytic fungi.
3. Growth measurement of fungi-linear and biomass.
4. Effect of environmental (pH,temperature) and nutritional factors (carbon, nitrogen sources) on growth of fungi.
5. Screening for antibiotic producing microbes (antibacterial, antifungal)
6. Measurement of concentration of fungal conidia by Haemocy to meter.
7. Measurement of fungal cells by Micro meter.
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 mention edin Cyanophyceae and Chlorophyceae.
11. Collection and identification of algae occurring in and around university college/campus.
12. Cell count using haemocy to meter
13. Preparations of temporary mount and study the different stages of Mitosis (Onionroottip).
14. Depicting nature of cellular membranes: Osmosis, Hypertonicity, Hypotonicity, Isotonicity
15. Isolation of lipolytic microbes from soil-plate method and estimation of total lipid
16. Fractioation of total lipid (glycol lipid, neutral lipid and phosphor lipid) by columnchrom atography
16. Extraction and estimation (by TLC) ofergosterol from fungi

Course Outcomes:

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

M.Sc. Microbiology First Semester

Course: Microbial biochemistry and physiology	**Course Code:** 24MBL1C3P
Teaching Hours/Week(L-T-P):0-0–4	**No. of Credits:**02
Internal Assessment: 20Marks	**Semester End Examination:**3 0Marks

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. Aminoacids.
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 (Mc Graw Hill).
2. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
3. An introduction to practical biochemistry by D.T.Plummer (Mc Graw Hill).
4. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Easternlimited).
5. Biochemistry-alaboratorycoursesbyJ.M.Beckar(AcademicPress)

CourseOutcomes:

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, As corbicacid. cholestrol.
4	Determine the iodine values of oil.