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 excelltheir 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	24MBL2C5L	Molecular cellbiology and Microbial genetics	30	70	100	4	-	-	4	3
	DSC6	24MBL2C6L	Food and Dairy Microbiology	30	70	100	4	-	-	4	3
	DSC7	24MBL2C7L	Environmental Microbiology	30	70	100	4	-	-	4	3
	DSC8	24MBL2C8L	Immunology and Immunodiagnostics	30	70	100	4	-	-	4	3
	SEC2	24MBL2S2LP	Food Analysis, Safety and Standards	20	30	50	1	-	2	2	2
	DSC5P4	24MBL2C5P	Microbial genetics And Molecular cell biology Lab	20	30	50	-	-	4	2	4
	DSC6P5	24MBL2C6P	Food and Dairy Microbiology Lab	20	30	50	-	-	4	2	4
	DSC7P6	24MBL2C7P	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	24MBL3C9L	Bioprocess engineering and Industrial Microbiology	30	70	100	4	-	-	4	3
	DSC10	24MBL3C10L	Medical Microbiology	30	70	100	4	-	-	4	3
	DSE1	24MBL3E1AL	A. Microbial Nano technology	30	70	100	4	-	-	4	3
		24MBL3E1BL	B. Chemical Microbiology								
		24MBL3E1CL	C. Enzymetechnology								
	DSE2	24MBL3E2AL	A. Mushroom production and marketing	30	70	100	4	-	-	4	3
		24MBL3E2BL	B. Veternary Microbiology								
		24MBL3E2CL	C. Marine and extreme Microbiology								
	GEC1	24MBL3G1AL	A. Pharmaceutical Microbiology	20	30	50	2	-	-	2	2
		24MBL3G1BL	B. Baking and Brewing								
		24MBL3G1CL	C. Virology and Covidology								
	SEC3	24MBL3S3LP	Research Methodology	20	30	50	1	-	2	2	2
	DSC9P7	24MBL3C9P	Bioprocess engineering and Industrial Microbiology Lab	20	30	50	-	-	4	2	4
	DSC10P8	24MBL3C10P	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	24MBL4C11L	Agriculture Microbiology	30	70	100	4	-	-	4	3
	DSC12	24MBL4C12L	Recombinant DNA Technology	30	70	100	4	-	-	4	3
	DSE3	24MBL4E3AL	A. Diagnostic Microbiology	30	70	100	4	-	-	4	3
		24MBL4E3BL	D. Molecular diagnostics								
		24MBL4E3CL	E. Insect Microbiology								
	DSE4	24MBL4E4AL	A. Basics in clinical research	30	70	100	4	-	-	4	3
		24MBL4E4BL	B. Bioethics, Biosafety and IPR								
		24MBL4E4CL	C. Neutraceuticals, Biologicals and Synbiotics								
	GEC2	24MBL4G2AL	A. Microbes as immune boosters for better health	20	30	50	2	-	-	2	2
		24MBL4G2BL	B. Social immunity and Vaccination								
		24MBL4G2CL	C. Anaerobic Solid and waste water management								
	DSC11P9	24MBL4C11P	Agriculture Microbiology Lab	20	30	50	-	-	4	2	4
	Project	24MBL4C1R	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, 11th Edn., 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, H2S 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.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

MICROBIOLOGY

SYLLABUS

Master of Science
(II Semester)

With effect from
2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Microbiology

Jnana Sagara, Ballari - 583105

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

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	24MBL2C5L	Microbial genetics and Molecular cell biology	30	70	100	4	-	-	4	3
	DSC6	24MBL2C6L	Food and Dairy Microbiology	30	70	100	4	-	-	4	3
	DSC7	24MBL2C7L	Environmental Microbiology	30	70	100	4	-	-	4	3
	DSC8	24MBL2C8L	Immunology and Immuno diagnostics	30	70	100	4	-	-	4	3
	SEC2	24MBL2S2 LP	Food Analysis, Safety and Standards	20	30	50	1	-	2	2	1
	DSC5P4	24MBL2C5P	Microbial genetics and Molecular cell biology Lab	20	30	50	-	-	4	2	4
	DSC6P5	24MBL2C6P	Food and Dairy Microbiology Lab	20	30	50	-	-	4	2	4
	DSC5	24MBL2C7P	Microbial genetics and Molecular cell biology	20	30	50	-	-	4	2	4
Total Marks for II Semester						**600**				**24**	

M.Sc. Microbiology second Semester

Course: Microbial Genetics And Molecular Cell Biology	**Course Code:** 24MBL2C5L
Teaching Hours/Week (L-T-P): 4 - 0 – 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:

1. **To understand genetics of microorganisms and biology of cells and various mechanisms involved in regulation of cells.**

UNIT 1

Cell Biology **10 hrs**

Structure and functions of cell wall, cell membrane, nucleus, lysosome, ER, ribosome, plastids, mitochondria, Golgi bodies. Cytoskeletons and cell movements-Microtubules, microfilaments and intermediate elements, motor proteins. Cell cycle- Regulation of CDK-cyclin activities, molecular basis of cellular check points. Cell to cell signaling and communication.

Genomic structure and organization in bacteria and eukaryotes.Euchromatin and heterochromatin, repetitive and non- repetitive DNA, C-value paradox. Nucleosome model, telomere, centromere and kinetochore, Interrupted genes, gene clusters.

Gene, genetic code, Elucidation and salient features of genetic code, wobble concept.

UNIT 2

Central dogma, Replication of DNA, transcription and translation **14hrs**

Central dogma.Replication of DNA, evidence of semi-conservative replication.Mechanism and enzymology of DNA replication.Regulation of DNA replication.Replication of RNA. Transcription and Post transcriptional modifications: Biosynthesis of RNA in prokaryotes and eukaryotes, DNA dependent RNA polymerase, initiation, elongation and termination of transcription. Removal of intron transcripts, addition of 5' cap and 3 poly A tail, processing of mRNA, rRNA and tRNA. Reverse transcription. Translation and post translation modifications: Involvement of ribosome in translation, ribosome structure, initiation, elongation and termination of polypeptide chain synthesis in prokaryotes and eukaryotes, extra ribosomal factors, ribosome cycle, post translation modifications of

proteins.

UNIT 3

Gene Regulation And Expression 14hrs

Operon concept, Repression of the lac operon, Regulation of tryptophan biosynthesis operon by attenuation, catabolite repression instability of bacterial RNA, positive and negative regulation, inducers and co-repressors.

Negative regulation - *E. coli* lac operon; Regulation of the heat-shock regulon by an alternate sigma factor, two component regulatory systems.

Systems that safeguard DNA: DNA repair mechanisms – photo reactivation, mismatch repair, recombination repair, SOS repair, DNA restriction and modification.

UNIT 4

Microbial Genetics 14hrs

Definition and scope of Genetics.Microbes as genetic tools for genetic studies.**Viral Genetics**: General characteristics of viral genome, T4 virulent Phage- Structure- life cycle. Lambda temperate phage- Structure - Lytic and lysogenic cycle, Lysogenic repression.Genetic mapping of viruses.**Bacterial Genetics**: Gene transfer mechanisms, Natural transformation systems- *Streptococcus pneumonia* and *Haemophilusinfluenzae*. Transfection and forced competence. Bacterial Conjugation.Transduction- Generalized and specialized transduction, Drug resistance in bacteria.

Fungal Genetics: Features and consequences of heterothallism, homothallism, mating types, Vegetative incompatibility, Polyploidy and aneuploidy. Neurospora- Tetrad analysis and linkage detection - 2 point and 3 point crosses – Induction of Mutations - Mitotic recombination in Neurospora. Yeast plasmids, Mating type, genetics of yeast.

UNIT 5

Mutations and Transposable elements 10hrs

Types of mutations, null, leaky, and conditional mutations, mutations as random or adaptive events; Mutagenic agents – physical, chemical and biological; molecular basis of mutations; Reversion and suppression, Ames Test. Transposable elements, Insertion sequences, transposons, and integrons. Replicative transposition, Nonreplicative transposition, Excision and transposase-mediated rearrangements, Regulation of transposition, Use of transposons.Gene silencing.

References:

1. De Robertis E. D. P. and De Robertis E. M. F. (1987), Cellular and Molecular Biology Lea and Febiger, Philadelphia.
2. Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth edition, W. H. Freeman & Co. New York.
3. Molecular Biology of Gene. 5thEdn.The Benjamin / Cummings Pub. Co. Inc, 2003.
4. Watson JD et al, 2004; Molecular biology of the Gene, Pearson Education India.
5. Larry Snyder and Wendy Champness.Molecular Genetics of Bacteria. 3rd edition, ASM Press, Washington, D.C. 2007
6. Baumberg. S. Prokaryotic gene expression. Oxford University Press. 2002.
7. Daniel L. Hartl. Essential Genetics.A genomics perspective, 5th edition, 2009.
8. Jeremy W. Dale and Simon F. Park. Molecular Genetics of Bacteria. 2010.
9. Nancy Trun and Janine Trempy.Fundamental Bacterial Genetics. Wiley-Blackwell
10. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R.
11. Molecular Biology of Gene. 5thEdn.The Benjamin / Cummings Pub. Co. Inc, 2003.
12. William Hays, 1980; The genetics of bacteria and their viruses, CBS Publ. New Delhi
13. Jenkins JB, 1995; Genetics, Houghton Mifflin Co., Boston.
14. Strickberger MW, 1990; Genetics MacMillan Publ. Co. Inc. New York.
15. Stent GS & Calendar R, 1978; Molecular Genetics, Freeman & Co., San Francisco.
16. Benjamin Lewin, 2005, Genes - VIII, John Wiley & Sons, New York
17. Watson JD et al, 2004; Molecular biology of the Gene, Pearson Education India
18. Hartwell LH et al, 2000; Genetics – from Genes to Genomes, McGraw Hill Publ.,

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

CO	Statement
C O1	Will gain knowledge in the pre mendalian genetic concepts, theories of genetics.

CO2	Will gain understand the principle of genetic recombination in viruses.
CO3	Will gain understand the principle of genetic recombination in bacteria by conjugation, transduction and o transduction.
CO4	Will gain understand the principle of genetic recombination in fungi and importance is plasmids and genetics of yeast.
CO5	Understand the mechanism of regulation of Lac and tryptophan operon
CO6	Understand the different types of mutations, molecular basis of mutation.
CO7	Know the cell structure and functions of cell and its organelles.
CO8	Understand the concept of general genomic organization of prokaryotes and eukaryotes and its replication.
CO9	Understand the concept of mechanism of transcription process and post transcriptional modification of mRNA.
CO10	Understand the concept of translation, post translational modification.
CO11	Understand the concept of DNA repair mechanism.
CO12	Understand the concept of transposition and gene silencing.

M.Sc. Microbiology second Semester

Course: Food And Dairy Microbiology	**Course Code:** 24MBL2C6L

Teaching Hours/Week (L-T-P): 4 - 0 – 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:

1. To understand the principles of microorganisms during various food-processing and preservation steps.
2. To comprehend the interactions between microorganisms and the food environment, and factors influencing their growth and survival.

UNIT 1

Introduction to food and food contamination **10hrs**

Origin, Concept, Scope and historical developments. Food as substrate for microorganisms: Hydrogen ion concentration (pH), Moisture requirement, Water activity, Oxidation-Reduction potential, Nutrient content, Inhibitory substances and Biological structure.

Food contamination: Contamination of foods from green plants, animals, sewage, soil, water, air and handling

UNIT 2

Food spoilage **14hrs**

Food spoilage: General principles of food spoilage, Causes of food spoilage, Factors affecting kind and number of microorganism. Chemical changes caused by microorganisms. Spoilage of Meat and Meat products, Egg and Egg products, Fish and Marine products, Cereal and Cereal products, Fruits and Vegetables.

UNIT 3

Food Preservation and Food infection **14hrs**

General principles, Physical methods of food preservation (High temperature, Low temperature and Drying), Chemical methods of food preservation (Food additives) and Biological methods of food preservation. Food borne diseases and their control: Food Infection and Intoxication. Detection of food borne pathogens and their toxins by various methods.Fermented foods (Bread, Sauerkraut and temphe), Probiotics and Prebiotics.Concept and importance of Nutraceuticals and Nutraceutical products.

UNIT 4

Milk and Milk Composition **10hrs**

Definition, Composition, Nutritive value and Properties.Microbiology of milk.Testing of milk quality.Contamination, spoilage and preservation of milk and milk products. Fermented milk products: Production, Quality control and Significance of Cheese, Yogurt, Shrikhand and Acidophilus milk.

UNIT 5

Food Sanitaion and Food Safety **10hrs**

Food sanitation and food safety: Concept, Importance and Safety laws, GMP and LP. Quality control and food standards: Bureau of Indian Standard (BIS). PFAA, FPO, MPO, CSO, Agmark Standards, International standards – HACCP, ISO 9000 Series.Food testing laboratories.

References:

1. Doyte MP, Loory RB & Thomas JM; Food Microbiology, ASM Pres, Washington DC.
2. Jay JM, Modern; Food Microbiology, Chapman & Hall, New York.
3. Joshi VK &Pandey Ashok; Biotechnology of Food Fermentation, Asia tech Publ. Delhi, India.
4. Frazier WC &Westhof DC; Food Microbiology, 3rd Ed., Tata McGraw Hill.
5. Doyle PM et al; Food Microbiology – Fundamentals & Frontiers, 2nd Ed., ASM Press.
6. Danwart GJ; Basic Food Microbiology, CBS Publ. Delhi.
7. Pitt J & Hocking. (1985); Fungi & Food spoilage, Academic Press.
8. SandeepSareeen; Food Preservation, Sarops&Soni, New Delhi.
9. Ananthakrishnan CP. Et al. (1994); Dairy Microbiology, Sreelakshmi Publ. Chennai.

Rabinson RK. (1990); Dairy Microbiology, Elsevier Applied Science, London

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

CO	Statement
C O1	Gain knowledge on the properties of food and as a as a substrate for microorganisms.
CO2	Understand the principle of food contamination and spoilage of meat egg fish cereals fruits and vegetables.
CO3	Understand the general principles of food preservation.
CO4	Imbibe the knowledge of food borne disease and its treatment and also the preparation of formatted foods probiotics and nutraceuticals.
CO5	know the concept of dairy microbiology and the preservation of milk and milk products production of production of cheese milk
CO6	Understand the food sanitation and safety and also the standards that follow in food industries.

M.Sc. Microbiology second Semester

Course: Environmental Microbiology	**Course Code:** 24MBL2C7L
Teaching Hours/Week (L-T-P): 4 - 0 – 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:

1. To know the concept of environmental microbiology and also the structure and function of microbial communities in extreme environments.

UNIT 1

Ecology of Microorganisms **10hrs**

Introduction: Origin, Concept and Development of Environmental Microbiology. Microbial Community: Ecosystem, habitat and niche. Concept and dynamics of microbial population and community.Structure and functions of microbial communities.Ecological succession Diversity of microorganisms in different environments.Conventional and molecular methods of studying microbial diversity.Microbes in extreme environments. Extremophiles - Psychrophilic, thermophilic, acidophilic, alkalophilic, halophilic and barophilic. Mechanism of adaptation in extremophilic microorganism.

UNIT 2

Water pollution and Waste Water Management **14hrs**

Environment pollution and Microbiological indicators: Concept and significance. Microbiological indicators of water and air pollution

Water Pollution: Sources, Characteristics of water pollutants, health hazards due to water pollution.Standard water quality criteria, Water quality testing (MPN technique). Eutrophication - causes, consequences and prevention.

Waste water treatment: Primary-physical processes; Secondary-biological treatment by fixed biofilm systems (trickling filters, RBC, fluidized bed reactors), suspended systems (activated sludge process, oxidation lagoons, anaerobic digesters, septic tank); Tertiary- Filtration (sand beds & membrane filters) chlorination, ozonization, radiation and reverse osmosis.

UNIT 3

Air pollution and Radiation hazards **10hrs**

Air pollution and Radiation hazards: Sources and characteristics of air pollutants; Health hazards due to

air pollution; Green house gases and green house effect.Ozone hole and acid rain. Radiation hazards and safety measures – sources, effect of radiations and safety measures

UNIT 4

Soil Pollution And Solid Waste Management **14hrs**

Soil pollution: Sources and characteristics of soil pollutants. Effects of soil pollution on human health and crop productivity. Solid waste management: **Handling and treatment of solid wastes.** Sludge handling and disposal- sludge processing, screening, dewatering, thickening, conditioning; stabilization-aerobic and anaerobic digestion (biomethanogenesis). Handling of biohazard and hospital wastes

UNIT 5

Biodegradation of Xenobiotics **14hrs**

Microbial degradation of pesticides, polycyclic aromatic hydrocarbons, natural and synthetic polymers (cellulose, pectin, lignin, detergents, plastics). Microbial remediation: Concept and scope of bioremediation. Methods and types of bioremediation of contaminated soil and water using microorganisms.

Microbial leaching: Origin and concept. Mechanism and role of microorganisms in recovery of important minerals - Iron, Copper and Gold.

References:

1. Brock T.D. Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.
2. Martin Alexander. Microbial Ecology. John Willey & Sons. New York.
3. Atlas & Bertha. 1998. Microbial Ecology. 3rd Ed.
4. Gabriel Britton, 1994, Wastewater Microbiology, John Willey & Sons, New York.
5. Ralph Mitchell, 1995, Environmental Microbiology, Wiley Liss, New York.
6. Criston J. Hurst, Manual of Environmental Microbiology, ASM Publ., New York.
7. Feltcher, M. & Grey TRG, 1987, Ecology of Microbial Communities, Cambridge Univ. Press.
8. Rose R.D. Air Pollution & Industry. Reinhold Co., New York.
9. Metcalf and Eddy. 1991. Waste Water Engineering. McGraw Hill Int. Publ.
10. APHA, 1994, Standard Methods, 17th Ed., American Public Health Association

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

CO	Statement

C O1	Know the concept of environmental microbiology and also the structure and function of microbial communities.
CO2	Diversity of microorganisms in extreme environments.
CO3	Gain skills in maintaining water quality by wastewater treatment.
CO4	Understand air pollution and radiation pollution and the effects of air pollution.
CO5	Understand soil pollution and also solid waste management which provides eco friendly environment.
CO6	Gain knowledge in biology bioremediation bioleaching and degradation of pesticides polycyclic aromatic hydrocarbons and synthetic polymers.

M.Sc. Microbiology second Semester

Course: Immunology and Immunodiagnostics	**Course Code:** 24MBL2C8L
Teaching Hours/Week (L-T-P): 4 - 0 – 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:

1. To gain knowledge of immune system, cells involved along with complement system and autoimmunity
2. Skill development in diagnostic immunology by understanding the antigen and antibody reactions and assays

UNIT 1

Immunity and Immune Response **10hrs**

Introduction: Origin, concept and historical development of immunology. Immunity: Definition, Types of immunity-Innate and Acquired immunity. Cells and organs of immune system: Circulatory and lymphatic systems. Hematopoiesis.Cells of immune system.**Immune response:** Immune response-Primary and secondary. Effector mechanism of HMI and CMI. Complement system-Components and pathways of component activation Cell mediated cytotoxicity, ADCC and Inflammation.

UNIT 2

Biology of T cell and B cells **12hrs**

Biology of T cell and B cells: Biology of immune cells: B cells-Origin, development, maturation and surface molecules. T cells- Origin, development, maturation and surface molecules; Subsets of T cells. Structure and function of T Cell receptors. MHC molecules-Types, structure, genetics and functions.Antigen processing and presentation; Activation of T and B cells; Differentiation and formation of functional T cells; Differentiation of B cells and formation of plasma and memory cells.Cytokines-Types, functions and applications.

UNIT 3

Biology of Antigen and Antibodies **10hrs**

Antigens and Antibodies: Antigens - Physical and chemical properties of antigens, Epitopes, Antigenicity and Immunogenicity; Types of antigens. Antibodies- Physical and chemical structures of antibodies, Types and biological functions of immunoglobulins.Monoclonal and Polyclonal antibodies- Production and applications.

UNIT 4

Hypersensitivity and Transplantation Immunology **12hrs**

Hypersensitivity: Mechanism and types of hypersensitivity. Autoimmunity and Immuno deficiency syndrome: Autoimmunity and autoimmune disorders. Immuno deficiency syndrome: AIDS due to deficient T and B cells, phagocytes, complement. Severe combined immunodeficiency syndrome.

Tumour and Transplantation immunology: Tumor antigens and immunology to tumor cells. Transplantation immunology-Blood transfusion, Tissue transplantation and HLA typing.Immuno tolerance and Immuno modulators.

UNIT 5

Immunodiagnostics **14hrs**

Antigen-Antibody reactions: Mechanism and principles of antigen antibody reactions. Types and determination of antigen antibody reactions – Radio immune assay, Ouctherlony double diffusion technique, Precipitin test, OuchterlonyImmuno diffusion test, Immunoelectrophoresis, Complement fixation test, Enzyme linked immunosorbent assay and Immuno blotting. Serological Diagnosis of Infectious diseases- WIDAL Test, VDRL Test (RPR), HBs Ag Test, HCG test (Agglutination inhibition test), Detection of RAfactor. CRPtest.ASO Test (Anti streptolysin 'O'Test),Blood group detection. Pregnancy detection, significance of Diagnostic kits, types, Methods in development of diagnostic kits

References:

1. Bradley and Mecharty. Clinical Immunology. Oxford University Press, New York.
2. Abbas AK, Lichtman and Pobes. Cellular and Molecular Immunology. W.B. Saunders Co.,
3. Coleman. Fundamental Immunology. Brown Publishers. BubuoneZowa.
4. Catty. Maintenance of Laboratory Animals and Production of antibodies.
5. Janis Kubey. Immunology. Freeman & Co., New York.
6. Janeway and Travers et al. Immunology. Churchill Publishers.
7. Stities, Tesss and Parslow. Medical Immunology. 9th Ed. Appleton & Lange, Connecticut.
8. Benjamin E, Coice R and Sunshine G. Immunology – A Short course. 4th Ed. Willey-Liss
9. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward Arnold
10. Roitt I.M., 1994, Essential of Immunology, Raven Press, New York.

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

CO	Statement
C O1	Understand the basics of immunology, types of immunity, the cells and organs of the immune system.
CO2	Learn the structure and function of immune cells (B and T cells) its origin development maturation and surface receptors such as MHC molecules.
CO3	Learn the structure and function of antigens and antibodies .Skill development in diagnostic immunology by understanding the antigen and antibody reactions and assays.
CO4	Learn the types of immune response and mechanism of humoral and cell mediated immunity.
CO5	Understands the types and mechanisms of hypersensitivity reactions, autoimmunity disorders.
CO6	Understands the tumours and transplantation immunology.

M.Sc. Microbiology second Semester

Course: Food Analysis Food Safety and Standards	**Course Code:** 24MBL2S2LP
Teaching Hours/Week (L-T-P): 4 - 0 – 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:

1. Evaluate microbial analysis by Screening and Enumeration of spoilage from microorganisms and detection of food borne pathogens.
2. Asses the Bio -Chemical analysis of food, food adultration, sanitation.
3. Maintain standards and safety of food by understanding food laws and regulations.

UNIT 1

Food analysis **10hrs**

Microbioal analysis: Screening and Enumeration of spoilage from microorganisms. Detection of pathogens in food, Rapid detection technique for microorganisms – Total ATP measurement, PCR based, Biosensor based, Immunological, Bacteriophage based markers etc.

Bio -Chemical analysis: Proximal Analysis, Moisture Analysis, Carbohydrates Analysis, Protein Analysis, Lipid Analysis, Enzyme Analysis. Modern Food Analysis, Sampling and Data Analysis, Buffers and Titratable Acidity. Role of Ultraviolet and Visible Spectroscopy,chromatograophictechniquin Food Analysis with demonstration using selected food samples.Pesticide Residue Analysis using GC ECD/GC-MS.

Role of sensory science in defining the food quality.

UNIT 2

Food Safety and Assessment **10hrs**

Food Sanitation and safety. Food adulteration,Food Safety and Quality Assurance: quality control of raw materials, Food Safety Assessment, The importance of food safety, Food safety management.

UNIT 3

Food Laws and Standards **10hrs**

Food regulations and Food laws in india. Food quality systems and Good Manufacturing Practices (Code

of GMP), Fair Packaging and Labeling Act (1966), Federal Meat Inspection Act (1906), International Food, Standards and Codex Alimentarius, HACCP and ISO 9000 series. Hazard Analysis Critical Control Point planning and Implementation 3 (3-0-0)

References:

1. Food Analysis: Third Edition, S. Suzanne Nielsen. (2003). Official Methods of Analysis. Association of Official Analytical Chemists, 15th ed. (1990). Food Analysis: Theory and Practice. Pomeranz and Meloan, 3rd. ed., (1994).
2. Fennema's Food Chemistry, Fourth Edition; SrinivasanDamodaran, Kirk L. Parkin and Owen R. Fennema (Editors). (2007).
3. Kirk, R.S and Sawyer, R. (2005) Pearson's Composition and Analysis of Foods, Longman Scientific and Technical. 9th Edition, England.
4. Early, R. (2006) Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
5. Gould, W.A and Gould, R.W. (2005) Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
6. Pomeraz, Y. and MeLoari, C.E. (2008) Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.
7. Bryan, F.L. (2007) Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva.
8. Mortimre, S., and Wallace, C., (2005) HACCP: A practical approach, 2nd Ed, Aspen Publication. The training manual for Food Safety Regulators. Vol.II- Food Safety regulations and food safety management. (2011) Food safety and Standards Authority of India. New Delhi .

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

CO	**Statement**
C O1	To evaluate the microorganisms by screening and enumeration from the spoiled foods.
CO2	To detect the food born pathogens by using various microbiological

	methods.
CO3	To perform Bio -Chemical analysis of food, food adultration, sanitation
CO4	To understand the national and international standards of food products
CO5	Maintain standards and safety of food by understanding food laws and regulations

M.Sc. Microbiology second Semester

Course: Microbial Genetics And Molecular Cell Biology	**Course Code:** 24MBL2C5P
Teaching Hours/Week (L-T-P): 2 - 0 – 0	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objective:

- Isolation of nucleic acids and extra chromosomal materials and understanding of various stages of cell division through cell cycle

1. Study of mitosis and meiosis.
2. Isolation and Extraction of genomic DNA.
3. Isolation of plasmid DNA.
4. Problems related to DNA and RNA characteristics, Transcription and Translation.
5. Qualitative and quantitative estimation of nucleic acids by UV spectrophotometry.
6. Amplification of DNA
7. Digestion of plasmid DNA with restriction endonucleases.
8. Ligation of DNA fragments.
9. Separation of DNA fragments by Agarose gel electrophoresis.
10. Elution of DNA from agarose gels.
11. Preparation of competent cells and genetic transformation of DNA
12. Blue white screening
13. conjugation in *E.coli*
14. Induction of mutation in *Neurospora* or *Aspergillus* or yeast
15. Study of yeast plasmids

16. Colorimetric estimation of DNA by Diphenyl amine method.
17. Colorimetric estimation of RNA by Orcinol method

References:

1. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology. S. Chand & Co. Ltd., New Delhi.
2. Plummer, D.T. (1988). An Introduction to Practical Biochemistry. 3rd Edition, Tata McGrawHill, New Delhi.
3. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
4. Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
5. SashidharaRao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
6. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology,Himalaya Publishing House, Mumbai.
7. Molecular Cloning: A laboratory manual Vols. 1-3, Sambrook, J

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

CO	**Statement**
C O1	Prepare of competent cells, and genetic transformation of DNA.
CO2	Know about isolation of plasmids.
CO3	Perform colorimetric estimation of DNA by Diphenyl amine method RNA by Orcinol method.
CO4	Know about cell cycle, to understand stages of cell cycle, mitosis and meiosis.
CO5	Know about problems related DNA and RNA characteristics.
CO6	Know about separation and elution of DNA from Agarose gel electrophoresis.

M.Sc. Microbiology second Semester

Course: Food and Dairy Microbiology	**Course Code:** 24MBL2C6P
Teaching Hours/Week (L-T-P): 2 - 0 – 0	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objective:

- Determination and detection of pathogenic microorganisms from food
- Production of Microbial Food Products

1. Enumeration of microorganisms from healthy and spoiled fruits and vegetables.
2. Enumeration of microorganisms from cereals and dry products.
3. Enumeration of microorganisms from jam, sauce and pickles.
4. Enumeration study of spoilage of egg, meat and fish.
5. Detection of food borne pathogens from street and restaurant food.
6. Study of microbiology of milk and milk products.
7. Production of yoghurt, acidophilus milk and tempeh.
8. Rapid platform test for milk
9. Fat estimation in milk and milk products
10. Methylene blue reduction test
11. Estimation of lactic acid in milk and curd .
12. Production of microbial lipids
13. Production of Sauerkraut
14. Estimation of proteins from Spirulina
15. Estimation of Aflatoxin from food samples.

References:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.

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

CO	Statement
C O1	Perform the determination of microorganisms from healthy fruits, vegetables, egg, jam sauce, pickle and spoiled fruits, vegetables, egg, jam sauce, pickle.
CO2	Detection of food borne pathogens from food.
CO3	Production of yogurt, acidophilus milk and temph, microbial lipids.
CO4	Estimation of lactic acid, proteins, aflatoxin from food samples.

M.Sc. Microbiology second Semester

Course: Environmental Microbiology	**Course Code:** 24MBL2C7P
Teaching Hours/Week (L-T-P): 2 - 0 – 0	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objective:

- Determination of dissolved O_2, CO2, BOD, COD and Total dissolved solids of different water samples
- Isolation of microorganisms used in biodegradation.

1. Study of microbial ecology by winogradsky column.
2. Isolation of microorganisms in polluted air ,soil and water.
3. Detection of coli forms for determination of purity of potable water samples.
4. Determination of dissolved O_2, CO_2, BOD, COD and Total dissolved solid of water sample.
5. Isolation and determination of Iron and Manganese reducing bacteria
6. Test for degradation of aromatic hydrocarbons by bacteria
7. Survey of degradation plasmids in microbes growing in polluted environment
8. Effect of SO_2 on crop plants
9. Demonstration of heavy metals in water/soil by atomic absorption spectrophotometer.
10. Estimation of Phosphate, sulphates, Nitrates and major cations (Na, K, Mg, and Ca) in water samples
11. Isolation of Cellulose, Hemicellulose, Starch, Lignin, Pectin degrading microorganisms.

References:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad

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

CO	Statement
C O1	Determination of dissolved O_2, CO2, BOD, COD and Total dissolved solids of different water samples.
CO2	Perform isolation of microorganisms in polluted and un polluted soil, water and to isolate and determination of Iron and Manganese reducing bacteria.
CO3	Understand the degradation of cellulose, Hemicellusoe, Starch, Lignin, Pectin by microorganisms.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

MICROBIOLOGY

SYLLABUS

Master of Science

(III Semester)

With effect from

2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Microbiology

Jnana Sagara, Ballari - 583105

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

III – SEMESTER

With Practical

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC9	24MBL3C9L	Bioprocess engineering and Industrial Microbiology	30	70	100	4	-	-	4	3
	DSC10	24MBL3C10L	Medical Microbiology	30	70	100	4	-	-	4	3
	DSE1	24MBL3E1AL	A. Microbial Nanotechnology	30	70	100	4	-	-	4	3
		24MBL3E1B	B. Chemical Microbiology								
		24MBL3E1CL	C. Enzyme technology								
	DSE2	24MBL3E2AL	A. Mushroom production and marketing	30	70	100	4	-	-	4	3
		24MBL3E2B	B. Veternary Microbiology								
		24MBL3E2CL	C. Marine and extreme Microbiology								
	GEC1	24MBL3G1AL	A. Pharmaceutical Microbiology	20	30	50	2	-	-	2	1
		24MBL3G1BL	B. Baking and Brewing								
		24MBL3G1CL	C. Virology and Covidology								
	SEC3	24MBL3S3LP	Research Methodology	20	30	50	1	-	2	2	1
	DSC9P7	24MBL3C9P	Bioprocess engineering and Industrial Microbiology Lab	20	30	50	-	-	4	2	4
	DSC10P8	24MBL3C10P	Medical Microbiology Lab	20	30	50	-	-	4	2	4
			Total Marks for III Semester			**600**				**24**	

Dept Name: Microbiology

Semester-III
DSC9: Bioprocess engineering and Industrial Microbiology

Course Title: Bioprocess engineering and Industrial Microbiology	Course code: 24MBL3C9L
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:
Course Outcomes (CO): After completion of this course student should able to

1. Understand the origin concept of fermentation, and strain development. Understand the construction and design of fermentor and the types of fermentors.
2. Get acquainted with preparation of culture media formulations for the production of metabolites and growth kinetics.
3. Production of purification of microbial products such as enzyme, organic acids, amino acids, antibiotics, alcoholic beverages.
4. Understand the concept of Bioprocess engineering.
5. Learn the basic component of bioprocess engineering includes Upstream and Downstream bioprocess.

DSC9: Bioprocess engineering and Industrial Microbiology

Unit	Description	Hours
1	Introduction to fermentation technology. Construction and Design of a typical fermenter. Manual and automatic control systems.Design of sterilization process for batch and continuous fermentation. Types of fermenters- Tower, Jet, Loop, Airlift, Bubble, Column, Packed bed,	**(10 Hrs)**

	Fluidized bed. Types of Fermentations- Surface, Submerged, Solid State, Batch, Continuous, Dual and Fed batch fermentations.	
2	Media for industrial fermentations: Criteria, Media formulation, Media ingredients. Buffers, Precursors and Growth factors. Oxygen requirement, Chelaters andAntifoaming agents. Industrially important Microorganisms, Screening of metabolites. Phases of cell growth in batch culture. Monod model. Growth of filamentous organisms. Growth associated (primary) and non - growth associated (secondary) product formation Kinetics.Strain development- Mutation, Recombination and Protoplast fusion technique. Inoculum development for industrial fermentation.	**(12Hrs)**
3	Production and purification of few important microbial products: Enzymes(Amylase, Proteases), Organic acids (Citric acid and Vinegar), Amino acids (L-lysine and L-glutamic acid), Antibiotics (Penicillin and Streptomycin), Solvents-(Ethyl alcohol, Acetone) Alcoholic beverages-(Beer, Wine). Vitamins (Vitamin B_{12}).	**(8 Hrs)**
4	Bioprocess Engineering:Concept and Principles of Bioprocess Engineering. Upstream bioprocess: Major process variables. Optimization of process variables. Strategies for the enhanced production: Immobilization and Response surface methodology.	**(10 Hrs)**
5	Downstream bioprocess: Filtration-Micro, Cross-flow and Ultra, Centrifugation-High speed, Continuous and Ultra. Cell disruption. Precipitation, Coagulation and Flocculation. Solvent /Aqueous 2-phase extractions, Dialysis and Electrodialysis. Reverse osmosis. SDS-PAGE, Ion Exchange chromatography,HPLC and Gel Filtration, Drying and Crystallization.	**(12 Hrs)**

References:

1. Ali Cinar, SJ. Parulekar, et al., (2003) Batch Fermentation: Modelling, Monitoring, and Control. Marcel Dekker

2. Arnold D & J E. Davies, Atlas. RM 1999 Manual of Industrial Microbiology & Biotechnology 2nd Ed.Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.

3. Crueger & Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition

4. Casida, Industrial Microbiology

5. Demain, A.L Biology of Industrial Microorganisms 6. Diliello Methods in Food and Dairy Microbiology

7. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc

8. Vogel A & L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2nd Standard Publishers Distribution New Delhi

9. Harvey,W., Blanch, S.Clark. 2007 Biochemical Engineering, Marcel Dekker

10. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2002. Industrial Microbiology: AnIntroduction. Blackwell Science.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSC10: Medical Microbiology

Course Title: **:** Medical Microbiology	Course code: 24MBL3C10L
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the mechanism of microbial pathogenicity and pathogenesis of Microorganisms.
2. Learn the Systemic bacteriology which includes epidemiology, symptoms, diagnosis and treatment of diseases.
3. Learn the viral disease which includes epidemiology, symptoms, diagnosis and treatment of diseases.
4. Learn the fungal infections and human parasites which include epidemiology symptoms diagnosis and treatment of diseases.

DSC10: Medical Microbiology

Unit	Description	Hours
1	Microbial pathogenicity and pathogenesis: Attributes of pathogenicity and pathogenesis. Mechanism of disease process and prognosis. Host and microbial factors influencing susceptibility.Concept and types of microbial infections; Modes of transmission of pathogens, Portal of entry and exit; Types of infections.	**(8 Hrs)**
2	Systematic study of important pathogenic bacteria with reference to Epidemiology, aetiology, pathogenesis, symptoms, diagnosis, treatment; Enterobacteriaceae (*Salmonella,Vibrio cholerae E.coli*); *Mycobacterium*	**(12 Hrs)**

	tuberculosis, Streptococci,Clostridium tetani and *Treponema palladium, Chlamydia, Mycoplasma and Rickketsia*.	
3	Systematic study of important pathogenic bacteria with reference to Epidemiology, aetiology, pathogenesis, symptoms, diagnosis, treatment of viral diseases caused by important viruses - Pox, Herpes, Adeno, Papovo, Picorna, retro, arbo, hepatitis, Rabies, Chikungunya, Ebola.	**(12 Hrs)**
4	Systematic study of important pathogenic bacteria with reference to Epidemiology, aetiology, pathogenesis, symptoms, diagnosis, treatment offungal diseases - *Mycoses, Candidiasis, Mycetoma, Chromomycosis, Sprorotrichosis, Cryptococcosis, Blastomycosis, Coccidiomycosis and Histoplasmosis.*	**(10 Hrs)**
5	Parasitology: Morphology, life cycle and pathogenesis of the human parasites. Intestinal protozoa, Urogenital protozoa, *Leishmania donovani*, *P. vivax*, *Toxoplasma gondii*, Helminths, Nematodes *Wuchereria*, Cestodes– Taenia, Hymenolepis, neurocysticercosis and hydatid disease. Trematodes blood flukes.	**(10 Hrs)**

References:

1. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward
2. David Greenwood, Richard C and Slack B. Medical Microbiology. ELBS Churchill
3. Rajesh Bhatia R. Essentials of Medical Microbiology. Jayjee Brothers.
4. Kenneth jR. Medical Microbiology – Introduction to Infectious Disease. Prentice Hall
5. joanstokes, Ridewaywren and Sir ashleymiles. Clinica Microbiology. Edward Arnold.
6. Dougias J and Slekh. Medical Bacteriology. Churchill Livingstone.
7. Bailey and Scotts. Diagnositc Microbiology. C.V. Mosry Company
8. Hoghl and Moffet. Clinical Microbiology. JB Lippincott Company

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE1: Microbial nanotechnology

Course Title: Microbial Nanotechnology	Course code: 24MBL3E1AL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's): At the end of the course, students will be able to:

1. Understand the basics of nanotechnology.
2. They will know the different types of nanotechnology.
3. Understand green synthesis of nanoparticles by bacteria and plants.
4. Handle the instruments used in nanoparticles detection using x-ray diffract technology SEM, TEM, AFM spectroscopic technology.
5. Gain knowledge in applications of nanoparticles in agriculture smart environmental wastewater treatment and uses of nanoparticles in medicines.

DSE1.A:Microbial nanotechnology

Unit	Description	Hours
1	Introduction to Nanotechnology: Definition of nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age, new form of carbon (CNT to Graphene), Types of nanostructure and properties of nano materials, Quantum Dots shell structures, metal oxides, semiconductors, composites.	**(8 Hrs)**
2	Applications of nanoparticles: nano biofertilizers and pesticides, nano-agriculture and microcapsule designs, DNA nano capsule. Assessing nanotechnology for enhanced food security in India. Nanoparticles based smart delivery systems. Applications of nanotechnology in seed science and detoxification of herbicide residues, in environmental remediation and water treatment, Nanoporous polymers and their applications in water purification, nanotoxicology. Use of nanoparticles in medicine.	**(12 Hrs)**
3	Synthesis of nanoparticles; approaches to synthesis, mechanisms involved in biogenic nanoparticle synthesis. Green synthesis of nanoparticles bacterial biosynthesis, fungal and yeast synthesis, plant and plant extracts for biosynthesis, waste mediated synthesis of nanoparticles.	**(12 Hrs)**

4	Instruments used in nanoparticle detection: Characterization Techniques, X-ray diffraction, powder diffraction, lattice parameters, structure analyses, strain analyses, phase identification, particle size analyses using - Scherer`s formula - X-ray photoelectron spectroscopy (XPS) - Auger electron spectroscopy (AES).	**(10 Hrs)**
5	Instruments used in nanoparticle detection: Surface Imaging: Scanning Electron Microscope (SEM), Field Emission Scanning Electron Microscope (FESEM)-Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Transmission Electron Microscopy (TEM). Spectroscopic techniques: Infra-red spectroscopy (IR) Rotational & Vibrational UV-visible - Raman Spectroscopy- Photoluminescence (PL) – Cathodeluminescence (CL).	**(10 Hrs)**

References:

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
4. Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge, UK 2005

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE1 B: Chemical Microbiology

Course Title: **: Chemical Microbiology**	Course code: 24MBL3E1BL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's): At the end of the course, students will be able to:

1. To understand the physiological process involved in microorganisms
2. To study the classification of microorganisms based on physical and nutritional adaptations. To study in detail about the growth phases of microorganisms.
3. To study the role of microorganisms in biogeochemical cycles.
4. To study the various applications of microorgnisms in environment as well as industry by chemicals synthesised by microorganisms.

DSE1 B: Chemical Microbiology

Unit	Description	Hours
1	Microbial Physiology: Classification of Microorganisms based on physical and nutritional adaptations. Microbial growth and its phases.	**(8 Hrs)**
2	Microbial energy metabolism: Microbial photosynthesis, Biological Oxidation, Fermentation pathways.	**(12 Hrs)**
3	Biogeochemical cycles: Nitrogen cycle, Carbon cycle, Sulphur cycle, Phosphorus cycle and hydrological cycles.	**(10 Hrs)**
4	Concept of Biodegradation and Bioleaching and its Scope. Biodegradation of pesticides, Insecticides, plastic, detergents. Bioleaching of Iron, Copper, Manganese, Magnesium, Silver and Gold .	**(10 Hrs)**
5	Chemicals synthesized by microorganisms – Antibiotics, other Secondary metabolites, Amino acids, Organic Acids, Vitamins, Preservatives, PGPRs, Peptides, Enzymes and Solvents, Single cell protein, Single cell oil, microbial pigments.	**(12 Hrs)**

References:

1. Voet & Voet, 1995; Biochemistry, John Wiley & Sons, New York.
2. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.
3. Freifelder D, 1982; Physical Biochemistry, Freeman & Co. New York.
4. Harper, 1999; Biochemistry, McGraw Hill, New York.
5. Brock T.D. Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.
6. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IBH

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 1 C: Enzyme Technology

Course Title: **Enzyme Technology**	Course code: 24MBL3E1CL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's): At the end of the course, students will be able to:

1. To understand the physiological process involved in microorganisms
2. To study the classification of microorganisms based on physical and nutritional adaptations. To study in detail about the growth phases of microorganisms.
3. To study the role of microorganisms in biogeochemical cycles.
4. To study the various applications of microorgnisms in environment as well as industry by chemicals synthesised by microorganisms.

DSE 1 C: Enzyme Technology

Unit	Description	Hours
1	Microbial Physiology: Classification of Microorganisms based on physical and nutritional adaptations. Microbial growth and its phases.	**(8 Hrs)**
2	Microbial energy metabolism: Microbial photosynthesis, Biological Oxidation, Fermentation pathways.	**(12 Hrs)**
3	Biogeochemical cycles: Nitrogen cycle, Carbon cycle, Sulphur cycle, Phosphorus cycle and hydrological cycles.	**(10 Hrs)**
4	Concept of Biodegradation and Bioleaching and its Scope. Biodegradation of pesticides, Insecticides, plastic, detergents. Bioleaching of Iron, Copper, Manganese, Magnesium, Silver and Gold.	**(10 Hrs)**
5	Chemicals synthesized by microorganisms – Antibiotics, other Secondary metabolites, Amino acids, Organic Acids, Vitamins, Preservatives, PGPRs,	**(12 Hrs)**

	Peptides, Enzymes and Solvents, Single cell protein, Single cell oil, microbial pigments.	

References:

1. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.
2. Freifelder D, 1982; Physical Biochemistry, Freeman & Co. New York.
3. Harper, 1999; Biochemistry, McGraw Hill, New York.
4. Brock T.D. Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.
5. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IBH

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 2 A: Mushroom Production and Marketing

Course Title: **:** Mushroom Production and Marketing	Course code: 24MBL3E2AL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Identify edible types of mushroom
2. Gain the knowledge of cultivation of different types of edible mushrooms and spawn production
3. Gain knowledge about nutritive value, medical and therapeutic importance of mushrooms
4. Manage the diseases and pests of mushrooms
5. Learn a means of self-employment and income generation. Awareness about the marketing trends of Mushrooms.

DSE 2 A: Mushroom Production and Marketing

Unit	Description	Hours
1	**Introduction to mushrooms** Mushrooms Taxonomical rank, History and Scope of mushroom cultivation. Edible, medicinal and Poisonous Mushrooms, Vegetative characters. Identification of poisonous mushrooms.	**(8 Hrs)**
2	**Common edible and medicinal mushrooms** Distribution of mushroom; life cycle of mushroom of Button mushroom (*Agaricus bisporus*), Milky mushroom (*Calocybe indica*), Oyster mushroom (*Pleurotus sajorcaju*) and paddy straw mushroom (*Volvariella volvcea), Cordycepes mushrooms* .	**(12 Hrs)**

3	**Principles of mushroom cultivation** Structure and construction of mushroom house. Sterilization of substrates. Spawn production, culture media preparation, production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation, Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom.Problems in cultivation, diseases, pests and nematodes, weed moulds and their management strategies.	**(10 Hrs)**
4	**Health benefits of mushrooms and Post harvest technology** Nutrient values of mushroom, protein, carbohydrate, fat, fibre, vitamins and amino acids contents, short and long term storage of mushroom, preparation of various dishes from mushroom. Medicinal value of mushroom, cultivation, extraction, isolation and identification of active principle from mushroom. Pharmacological and economic values of mushroom.Therapeutic aspects of mushrooms. Value added products of mushrooms. **Preservation of mushrooms -** freezing, dry freezing, drying, canning, quality assurance and entrepreneurship.	**(10 Hrs)**
5	**Mushroom Marketing** Status of mushroom cultivation in India. Genetic improvements in mushrooms, harvesting, packing and storage, problems in cultivation, diseases, pests and nematodes, weed moulds and their management strategies. Strategies of marketing, Mushroom marketing from door to door, farmer to big stores, hotels, Farmer to local market, distributer to farmer.	**12 Hrs)**

References:

. Marimuthu, T. et al. (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.

2. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

3. Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.

4. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.

5.Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.

6. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.

7. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi (2000)

8. Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.

9. Tewan and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.

10. Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.

11. Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II.

12. Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 2 B: Veterinary Microbiology

Course Title: **:** Veterinary Microbiology	Course code: **:**24MBL3E2BL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the mechanism of pathogenesis of Microorganisms.
2. Learn the Systemic bacteriology and virology which includes epidemiology symptoms diagnosis and treatment of diseases.
3. Learn the fungal disease which includes epidemiology symptoms diagnosis and treatment of diseases
4. Learn the human parasites which include epidemiology symptoms diagnosis and treatment of diseases.
5. To study the immunology i.e., antigen antibody reactions and detection tests and serology of pathogens.

DSE 2 B: Veterinary Microbiology

Unit	Description	Hours
1	Veterinary microbiology Highlights of developmental history of Veterinary Microbiology. Scope of Veterinary Microbiology, Definitions: Infection, infectious disease, contagious disease, non-contagious disease etc. Types of infection– primary, secondary, cross, nosocomial, iatrogenic infection, localized infection, generalized infection, Bacteraemia, septicaemia, toxaemia etc. Sources of infection-animal, human, insects, inanimate. Transmission of	**(8 Hrs)**

	infection– Modes of transmission, direct & indirect contact etc. Pathogenicity and Virulence Factors determining the ability of organism to produce disease, pathogenicity, virulence, invasiveness, toxigenicity: endotoxin and exotoxin. Resistance and susceptibility of Host factors- breed, species, individual factors- age, physiological & nutritional status, use of antibiotics or corticosteroids etc. Vector borne and zoonotic diseases	
2	Veterinary Bacteriology and Virology: Important Systemic bacterial diseases of animals: Epidemology, aetiology, symptoms,pathogenesis, diagnosis and treatment of Anthrax, Brucellosis, Bordetella, Mastitis. Veterinary virology Important Systemic Viral diseases of animals: Epidemiology, aetiology, symptoms, pathogenesis, diagnosis and treatment of Foot and mouth disease, Blue tongue, Cow pox, Egg Drop Syndrome Virus, capri pox virus, goat and sheep pox, Lumpy Skin Virus Disease, Bovine Herpes Disease, Duck viral hepatitis, Rabies	**(12 Hrs)**
3	Important Systemic fungal diseases of animals: Epidemiology, aetiology, symptoms,pathogenesis, diagnosis and treatment of Aspergillosis, Coccidioides, Blastomyces, Histoplasma, Rhinosporidium, Mucor, Cryptococcus, Mycetoma, Sporothrix.	**(10 Hrs)**
4	Important Systemic parasitic diseases of animals: Epidemiology, aetiology, symptoms, pathogenesis, diagnosis and treatment of Giardia duodenalis, Anaplasmosis, Theileriosis, Schistosoma nasalis, Fasciolopsis, Leishmanosis, Ehrlichia, Acanthocephala.	**(10 Hrs)**

5	Immunology and serology Concepts in Veterinary and Medical Immunology. organs and cells of immune system. Types of immunity and immune response. Antigens,Antibodies, mechanism and theories of antibody production. Major histocompatibility complex, Complement system: Cytokines: Major types and functions. Antigen and antibody reactions, Agglutination, precipitation, haemagglutination, Complement fixation, neutralization, toxin and antitoxin reaction, immunofluorescence, ELISA. Hypersensitivity reactions, Autoimmunity and immunotolerance. Immunisation of animals. Biological: Role of conventional and modern vaccines in immunoprophylaxis, Adjuvants.	**(12 Hrs)**

References:

1. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward
2. David Greenwood, Richard C and Slack B. Medical Microbiology. ELBS Churchill
3. Rajesh Bhatia R. Essentials of Medical Microbiology. Jaypee Brothers.
4. Kenneth jR. Medical Microbiology – Introduction to Infectious Disease. Prentice Hall
5. joanstokes, Ridewaywren and Sir ashleymiles. Clinica Microbiology. Edward Arnold.
6. Dougias J and Slekh. Medical Bacteriology. Churchill Livingstone.
7. Bailey and Scotts. Diagnositc Microbiology. C.V. Mosry Company
8. Hoghl and Moffet. Clinical Microbiology. JB Lippincott Company

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 2 C: Marine and Extreme Microbiology

Course Title: **:** Marine and Extreme Microbiology	Course code: 24MBL3E2CL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To study the diversity of marine microorganisms and their evolution and interaction with other microbial community.
2. To study different ocean processes and its metabolism and the role of microorganisms in it.
3. To study the aspects of marine microbes in biofueling and pollution control
4. To study about extreme environment and microorganisms living in that environment.
5. To understand the physical and molecular adaptations of extremophiles and their applications.

DSE 2 C: Marine and Extreme Microbiology

Unit	Description	Hours
1	**Marine microorganisms and its interactions** Marine microbial Diversity and evolution of bacteria, archaea, fungi, protists, and viruses and their importance in marine processes. Impacts of rising CO_2 levels on microbial community structure and ocean processes. Methods in Marine Microbiology. Metabolic Diversity and Ecophysiology. Microbial Symbioses of Marine Animals. Microbial Diseases of Marine Organisms. Marine Microbes as Agents of Human Disease.	**(8 Hrs)**
2	Role of Microbes in Ocean Processes, Carbon Cycling, Nitrogen,	**(12 Hrs)**

	Sulfur, Iron, Phosphorus and Silicon Cycling	
3	Microbial Aspects of Marine Biofouling, Biodeterioration, and Pollution Marine Microbial Biotechnology.	**(10 Hrs)**
4	Extreme environments and extremophiles: Extreme environments, Extremophiles and its characteristics, Microorganisms in extreme environment (Temperature, pH, Pressure, Salinity, Sugar Concentration, Humidity, Rocks, Extreme Radiation, Heavy metals).	**(10 Hrs)**
5	Extremophiles Adaptations and applications: Physiological adaptations and Molecular adaptations of various extremophiles. Applications of extremophiles in food industry, fermentation industry, pharmaceuticals, Biomining, Bioremediation, Polymer industry.	**12 Hrs)**

References:

1. *Colin B. Munn*Marine Microbiology Ecology & Applications 3rd Edition. ISBN 9780367183561 Published December 23, 2019 by CRC Press 436 Pages 153 Color & 15 B/W Illustrations
2. **A Textbook on Marine Microbiology by Dr. P. F. Steffi (Author), Mrs. R. Rajeswari Anburaj (Author)**
3. **Microbes in Extreme Environments (Special Publications of the Society for General Microbiology) December 1997 by R.A. Herbert (Editor), Geoffrey Codd (Editor)**

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
GEC 1 A: Pharmaceutical Microbiology

Course Title: **:** Pharmaceutical Microbiology	Course code24MBL3G1AL
Total Contact Hours: 30 hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (CO's):At the end of the course, students will be able to:

1. Know the significance and production of pharmaceuticals, biological in production of therapeutic enzymes, cytokines.
2. Know the significance and production of antibiotics and vaccines.
3. Know the quality assurance and validation and know the designing layout for microbiology laboratory. Learn the concept related to patents novelty, utility, anticipation, patent application, PCT and implications, Role of a country patent office.

GEC 1 A: Pharmaceutical Microbiology

Unit	Description	Hours
1	Biopharmaceuticals. Concepts of pharmaceuticals, biologics and biopharmaceuticals, sources of biopharmaceuticals, biopharmaceuticals in production and research, monoclonal antibodies cytokines, haemopoietic growth factors, hormones, blood products, therapeutic enzymes (Asparaginase, Streptokinase, beta lactamases).	**(10 Hrs)**
2	Chemotherapy, Antibiotics and antibiogram, antibiotic policy NCCLS and WHO guidelines, vaccines, new vaccine production methods (DNA vaccines, synthetic, peptide vaccines, multivalent subunit vaccines, edible vaccines and their trials), Case studies.	**(10 Hrs)**
3	Quality Assurance and Validation. Regulatory aspects of QC, QA, and QM. GMP, GLP and CMP in Pharma Industry. ISO, WHO, USFDA certification. Microbial Limit test of Pharma products. Sterility testing, pyrogen testing and LAL test of Sterile Pharma products. Sterilization- heat, D- value, Z-value and survival curve, radioactive, gaseous and filtration. Chemical and	**(10 Hrs)**

	biological indicators. Designing layout for microbiology laboratory.	

References:

. Pharmaceutical Microbiology- Edited by W. B. Hugo & A.R. Russel Sixth Edition. Blackwell Scientific Publications.

2. Lippincott's illustrative Reviews: Pharmacology Edition: 02 Maryjnycck by Lippincott's review Publisher Pheladelphia 1997.

3. Principles of medicinal chemistry Vol. 1 by Kadam S.S., Mahadik K.R., Bothra K.G. Edition: 18, Nirali Publication.

4. Pharmacognosy by Gokhle S.D., KoKate C.K.. Edition: 18, Nirali Publication.

5. Biotechnology – Expanding Horizon by B.D. Singh., First Edition, Kalyani Publication, Delhi.

6. Analytical Microbiology- Edited by Fredrick Kavanagh volume I &II. Academic Press New York.

7. Pharmaceutical Biotechnology by S. P. Vyas & V.K. Dixit. CBS publishers & distributors, NewDelhi

8. Quniolinone antimicrobial agents- Edited by David C. Hooper, John S. Wolfson. ASM Washington DC. 9. Quality control in the Pharmaceutical industry - Edited by Murray S. Cooper Vol. 2, Academic Press New York.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
GEC 1 B: Baking and Brewing

Course Title: **:** Baking and Brewing	Course code24MBL3G1BL
Total Contact Hours: 30 hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (CO's): At the end of the course, students will be able to:

1. To understand the concept and importance of baking and brewing in fermentation process.
2. Gain knowledge on microorganisms involved in baking and brewing processes.
3. To learn the production of baking products, their ingriedients and importance

GEC 1 B: Baking and Brewing

Unit	Description	Hours
1	Fermentation, Milestones in fermentation, baking and brewing, reaction mechanisms of baking and brewing. Microorganisms involved in baking and brewing. Bakers yeast, its biology and production. Brewers yeast -top yeast, bottom yeast and its production.	**(10 Hrs)**
2	Baking and baked products: Intro to Yeast Breads, Advanced Yeast Breads, Naturally Leavened Breads (Sourdough), Ingredients and preparation of baked products.Bread, Buns hamburgers, hot dog buns sweet rolls English muffins, bagels, pret gels, croissants, Danish pastries, raised doughnut, crackers, cakes, pies, cookies.	**(10 Hrs)**
3	Brewing: Ingredients for brewing, role of cereals in fermentation, steps involved in brewing process, malting, milling, mashing, lautering, boiling, fermenting, conditioning, filtering and packaging. Cereal based Beverages: Beer, types of Beers, Production of Beer, Brewed coffee, Vinegar, Whiskey,	**(10 Hrs)**

	Bourbon whiskey, Sake, Gin, Vodka, Kishik, Tarhana, Raabdi.	

References:

1. Carmen Schott, Brewing and Baking With Wild Yeasts: Adventures in Traditional Fermentation, 30 September 2014.
2. Edward Ralph MoritzA Text-Book of the Science of Brewing , 10 October 2018
3. Temitayo Ogunmora, Brewing Book for beginners https://www.academia.edu/7122879/Brewing_Book_for_beginners.
4. Maratha sweetwarts Baking Handbook
5. Osslen, Professional Baking.
6. LABENSKY/LABENSKY_A_TEXTBOOK_OF_BAKING_AND_PASTRY_FUNDAMENTALS 4TH EDITION.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology

Semester-III

GEC 1 C: Virology and Covidology

Course Title: **:** Virology and Covidology	Course code24MBL3G1CL
Total Contact Hours: 30 hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (CO's): At the end of the course, students will be able to:

1. Understand the classification of virus and their arrangements.
2. Knowledge on properties of virus, sub viral particles, replication of virus.
3. Learn the virus cultivation using chick embryo, plaque assay.

GEC 1 C: Virology and Covidology

Unit	Description	Hours
1	Virology, Classification of viruses- ICTV and Baltimore system of classification, properties of viruses. ultrastructure of viruses - capsids and their arrangements. Sub-viral particles**,** bacteriophages. Replication of viruses	**(10 Hrs)**
2	Virology techniques: Cultivation of viruses using cell lines, chick embryo, plaque assay method. Detection of viruses by PCR, RTPCR, Neutralisation assay, ELISA, Haemagglutination inhibition assay, Complement fixation, indirect fluorescent antibody assay.	**(10 Hrs)**
3	Covidology: General structure of Coronavirus, classification of coronavirus, COVID-19, epidemiology, pathogenesis, symptoms, Diagnosis, treatment. Mutations in Corona virus and its impact on society and economy.	**(10 Hrs)**

References:

1. Pinciples of virology by Jane Plint, Vincont R. pub. 2020
2. Medical microbiology by Patric R. Murry pub. 2020
3. DNA Tumor viruses – Virology, Pathogenesis and Vaccines By Sally Roberks
4. Covid, 6th edition by Bernd Sebastian Kamps, Christian Hofmann Pub 2021
5. Covidians and Covidology by yasser negm kindle edition published: 2020

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
SEC 3 : Research Methodology

Course Title: **:** Research Methodology	Course code: 24MBL3S3LP
Total Contact Hours: 30 hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To understand the basic concepts and fundamentals of research.
2. To gain knowledge on different search engines to collect information
3. To understand the concept of bioethics in research

SEC 3: Research Methodology

Unit	Description	Hours
1	Introduction to Research: Aims, Objectives and principles; Fundaments research Vs Applied research with examples: Qualitative vs Quantitative research: theoretical research vs experimental research with examples: Selection of a research problem and sources of literature – journals. Conferences, books. Types of sources: literature survey engines – scopus, web of science, google scholar, PubMed, NCBI, Scihub, etc. Science citation index. Citations, h-index, i 10 index, impact factor. Bioethics : Introduction to bioethics ,principles of bioethics,biotechnology and social responsibility, public acceptance issues in microbiology and biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.	**(10Hrs)**
2	Methods of Data Collection: Data collection methods- Framing a hypothesis, designing controlled experiments, choosing the sample size, sampling bias,	**(10Hrs)**

	importance of independent replicates, conducting an experiment, maintaining a lab- note book to record observations: identifying experimental errors. Case-studies on well designed experiments vs. poorly designed experiments. Correlations vs. causation. Good laboratory practices. Safety practices in laboratories; introduction to chemdraw, chemsketch and other basic softwares.	
3	Data presentation and writing: Technical presentation, technical writing, formatting citations; MS Excel for plotting the data (pie chart, plots, bar charts). Analysis using software tools: Decriptive Statistics: mean, standard deviation, varience, plotting data and understanding error-bars, curve fitting: correlation and regression. Distributions: normal distribution, Gaussian distribution, Skewed distributions. Inferential statistics: hypothesis testing and understanding p-value. Parametric tests: students t-test, ANOVA. Tests to analyse categorical data: chi-square test.	**(10Hrs)**

References:

1. C.R. Kothari, Research Methodology: Methods and Techniques, II Ed. New Age International Publishers, (20009)
2. Shanthibhushan Mishra, Shashi Alok, Handbook of Research Methodology, I Ed, 2017, Educreation Publishers.
3. Basic statistical Tools in research and Data Analysis
4. Introduction to statistical methods with MATLAB.

Date Course Coordinator Subject Committee Chairperson

DSC 9P7 : Bioprocess engineering and industrial microbiology Lab

Course Title: Bioprocess engineering and industrial microbiology Lab	Course code:24MBL3C9P
Total Contact Hours:30 Hours	Course Credits: 02
Internal Assessment Marks: 20 Marks	Duration of ESA/Exam: 4 Hours
Semester End Examination Marks: 30 Marks	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Study the fermentation antibiotic pencilin, citric acid production.
2. To learn the isolation and screening of various industrially important microorganisms and production indrustrially important microbial products.
3. Understand the production of vitamins and alpha amylase.
4. Do Preparation of wine, and immobilized cells.

DSC 9P7 : Bioprocess engineering and industrial microbiology Lab

List of Experiments

1. Study of Fermentor and On-line measurement of a fermentation process.
2. Isolation of industrially important microorganisms for microbial processes.
3. Batch fermentation of Citric acid production, recovery and estimation of citric acid.
4. Antibiotic fermentation and estimation of penicillin.
5. Preparation of wine and estimation of alcohol by specific gravity method.
6. Alcoholic fermentation and determination of total acidity and non-reducing sugars
7. Production of Pectinase from Aspergillus niger by using Wheat bran, Coffee pulp using small scale fermentor and its assay.
8. Production of α- Amylase using A. oryzae, Bacillus licheniformis using Wheat bran in small scale solid state fermentation and its assay
9. Preparation of banana juice using Pectinase.
10. Immobilization of yeast cells by calcium alginate gel entrapment and assay for enzymes Invertase.
11. Preparation of immobilized cells of B. licheniformis for the use in the production of alpha amylase.

References:

1. Demain, A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology and Biotechnology IInd Edition. ASM Press, Washington.

2. Maheshwari, D.K., Dubey, R.C. and Saravanamtu, R. 2010. Industrial Exploitation of

3. Microorganisms. I.K. International Publishing House. New Delhi.

4. Nduka Okafor 2010. Modern Industrial Microbiology and Biotechnology ASM Publisher

5. Nupur Mathur Anuradha 2007. Industrial Microbiology A Laboratory Manual.

6. Peppler, H.J. and Perlman, D. 2005. Microbial Technology: Fermentation Technology Second Edition Volume 1. Elsevier India Private Limited.

7. Peppler, H.J. and Perlman, D. 2005. Microbial Technology: Fermentation Technology Second Edition Volume 2. Elsevier India Private Limited.

8. Richard H Baltz, Julian E Davies and Arnold L Demain 2010. Manual of Industrial Microbiology and Biotechnology 3e ASM Publisher

Date Course Coordinator Subject Committee Chairperson

DSC 10P8 : Medical Microbiology Lab

Course Title: Medical Microbiology Lab	Course code:24MBL3C10P
Total Contact Hours:30 Hours	Course Credits: 02
Internal Assessment Marks: 20 Marks	Duration of ESA/Exam: 4 Hours
Semester End Examination Marks: 30 Marks	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Study the antibiotic sensitivity test, and study of cancer cells.
2. Perform preparation of culture media and to perform presumptive identification of pathogens using colony morphology on selective/differential/ selective differential enrichment media.
3. Determination of Drug susceptibility testing by various methods.
4. Study the Bacteriological examinations of urine, blood, Pus samples from Hospitals.

DSC 10P8 : Medical Microbiology Lab

List of Experiments

Study of commensal flora of mouth and human body.

2. Bacteriological examination of Urine, Blood, Pus Samples from Hospitals.

3. Detection of thyphoid by widal test

4. Detection of malarial parasite from human blood sample.

5. Study antibiotic sensitivity test by using paper disc as well as agar cup plate method.

6. Study of cancer cells and visit to cancer research institute.

7. Anaerobic culture method for anaerobes of clinical importance.

8. Presumptive identification of pathogens using colony morphology on selective/differential/ selective-differential/ Enrichment media. Isolation and characterization of clinical significant species of Staphylococcus, Streptococcus, enterobacteriaceae,

9. Determinations of MIC for selected antibiotics (Kirby-Bauer method, T test, Checker board method).

10. Conventional and rapid methods for isolation and identification of pathogenic bacteria, fungi.

References:

1. Mohamed A Daw. Medical microbiology laboratory manual second edition 2009. ISBN: 978-9959-53-052-3.

2. R Panjarathinam. Practical Medical Microbiology, Published by Jaypee Brothers Medical Publishers

Date Course Coordinator Subject Committee Chairperson

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

MICROBIOLOGY

SYLLABUS

Master of Science
(IV Semester)

With effect from
2022-23

IV-SEMESTER

SemesterNo.	Category	Subjectcode	TitleofthePaper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
FOURTH	DSC11	24MBL4C11	AgricultureMicrobiology	30	70	100	4	-	-	4	3
	DSC12	24MBL4C12	RecombinantDNATechnology	30	70	100	4	-	-	4	3
	DSE3	24MBL4E3A	A.DiagnosticMicrobiology	30	70	100	4	-	-	4	3
		24MBL4E3B	B.Moleculardiagnostics								
		24MBL4E3CL	C.InsectMicrobiology								
	DSE4	24MBL4E4A	A.Basicsinclinicalresearch	30	70	100	4	-	-	4	3
		24MBL4E4BL	B.Bioethics,BiosafetyandIPR								
		24MBL4E4CL	C.Neutraceuticals, Biologicals andSynbiotics								
	GEC2	24MBL4G2AL	A.Microbesasimmuneboosters for better health	20	30	50	2	-	-	2	1
		24MBL4G2BL	B.Social immunity andVaccination								
		24MBL4G2CL	C.AnaerobicSolid andwaste water management								
	DSC11P9	24MBL4C11P	AgricultureMicrobiologyLab	20	30	50	-	-	4	2	4
	Project	24MBL4C1R	ResearchProject	30	70	100		-	8	4	4
TotalMarksforIVSemester						**600**				**24**	

(I-IVsemester)- TotalMarks:2400 and Totalcredits:96

DSC–DepartmentSpecificCore,DSE–DisciplineSpecificElective,SEC–SkillEnhancementCourse,GEC–GenericElectiveCourse,IA – InternalAssessment,SEE–SemesterEndExamination,L–Lecture, T–Tutorial,P–Practical.

Dept Name: Microbiology
Semester-IV
DSC11: Agriculture Microbiology

Course Title: Agriculture Microbiology	Course code: 24MBL4C11L
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the concept of agriculture microbiology and the role of microorganisms in soil formation and fertility.Understand the plant microbe interactions.
2. Understand the mechanism of biological nitrogen fixation and phosphate solubilization, Develop the formulations of microbial biofertilizer's
3. Develop the formulations of biopesticides using bacteria fungi and viruses.
4. By gaining knowledge on plant diseases crops by bacteria fungi and viruses.
5. To understand Genetically modified organisms.

DSC11: Agriculture Microbiology

Unit	Description	Hours
1	Introduction to Agriculture Microbiology,Role of microorganisms in soil formation and soil fertility. Factors affecting soil microorganisms. Plant - Microbe Interactions: Mutualism, Commensalism, parasitism, amensalism and synergism. Concepts of Rhizosphere, Phyllosphere and Spermosphere. Rhizosphere effect and R/S ratio. Factors influencing rhizosphere microorganisms. Plant growth promoting rhizobacteria.	**(10 Hrs)**
2	Nitrogen cycle,biological nitrogen fixation,Mechanism and genetics of biological nitrogen fixation. Nitrogen fixation by diazotrophs-*Rhizobium, Azotobacter,Frankia and Blue Green Algae.*Nitrogen Biofertilizers and its types. Screening and selection of potential strains for biofertilizer. Production	**(12 Hrs)**

	and quality control of Bacterial (Rhizobium,), Algal (BGA) biofertilizers Phosphorus cycle. Phosphate solubilizing microorganisms, Mechanism. Mycorrhizae and its significance.Production and quality control of phosphorous biofertilizers. Other fertilizers such asGreen manure, Organic matter, Compost.	
3	Biopesticides,types of biopesticides, Isolation, screening, cultivation and mode of action of microbial biocontrol agents. Merits and demerits of biological control. mass production and applications of microbial biopesticides. Bacterial (*Bacillus thuringiensis)*, Fungal (*Trichoderma viridae*), Viral (NPV and CPV).Integrated pest and plant diseases management.	**(10 Hrs)**
4	**Plant Pathology:** Etiology, pathogenesis, Symptoms and control measures of plant diseases. Bacterial diseases –Bacterial Wilt of Potatoes, Tomatoes, Citrus canker; Fungal diseases – Verticillium Wilt, Downy mildew, Rust of sugarcane and Wheat and Smuts of wheat and sugarcane; Viral diseases - Tobacco mosaic and Bunchy top of Banana; Mycoplasmal diseases - Grassy shoot of sugar cane and Coconut yellowing disease	**(10 Hrs)**
5	Genetically modified crops: Role and significance of microbial genes. Construction, evaluation and field application of BT cotton and BT brinjal. Advantages and disadvantages of GM crop plants.	**(10 Hrs)**

References:

1. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IBH

2. Subba Rao. Biofertilizers in Agriculture. Oxford & IBH

3. Subba Rao. Recent Advances in Biological Nitrogen Fixation. Oxford & IBH.

4. Rangaswamy and Bagyraj. Agricultural Microbiology.

5. Swaminathan M.S. Biotechnology in Agriculture. McMillan.

6. Steinhaus. 1963. Insect Pathology. Vol I & II. Academic Press, New York.

7. Burges H D. 1970-1980. Microbial Control of Pests and Plant Diseases.

8. Plant pathology. By George Agrios; Academic Press, New York.

9. Microbial Ecology: Fundamentals and Applications by Rinald Atlas and Richard Bartha;

10. Benjamin/Cummings Science Publis., 2725 Sand Hill Road, Menlo Park, California

11. Plant pathology. By George Agrios; Academic Press, New York.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSC12:Recombinant DNA Technology

Course Title: Recombinant DNA Technology	Course code: 24MBL4C12L
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand Introduction to RDNA technology.
2. Skills in the amplification of DNA and its types.
3. The students develop skills in understanding the concept of cloning and various kinds of vectors and enzymes.
4. Develop skills on the construction of recombinant DNA, cDNA and genomic DNA libraries.
5. Understand the expression of recombinant proteins in bacteria yeast insect in mammalian cells, genome sequencing

DSC12:Recombinant DNA Technology

Unit	Description	Hours
1	Introduction to Recombinant DNA technology and its applications, steps involved in R-DNA technology, Cloning vectors, enzymes, Hosts for Recombinant DNA technology, methods of insertion, methods of screening and expression.	**(10 Hrs)**
2	**Vectors and enzymes used for cloning:**Plasmids, (pSC 101, RI, pBR 322, pUC 18, Ti-plasmid), phages Lambda and M13, phagemids, cosmids, P1 phage, PACs, BACs and YACs. Restriction endonucleases – Type, I, II &III,Nucleotide Kinase, reverse transcriptase, T4 DNA ligase, Taq DNA	**(12 Hrs)**

	polymerase, and klenow polymerase. Various thermophilic enzymes used in PCR.	
3	DNA template and Host used for cloning:Amplification of DNA, PCR and its types. Designing primers. Rolling Circle Amplification Technology. Hosts for Recombinant DNA technology, Competency, prokaryotic hosts, unicellular eukaryotic hosts, multicellular eukaryotic hosts, Acellular hosts.	**(10 Hrs)**
4	Construction of R-DNA and types of cloning:Cloning and its types, Sticky end, Blunt end cloning. Methods of cloning - using linker, adapters, homopolymer tailing, ligation with RES. Insertion of R-DNA, Host Selection, Transformation, Transfection, Electroporation, Lipofection. Construction of R-DNA, Synthesis of of cDNA, Construction of cDNA and genomic libraries. Screening of libraries by colony hybridization and PCR	**(10 Hrs)**
5	**Expression of recombinant clones and sequencing of recombinant DNA:**Over expression of recombinant proteins: Over expression and tagging of recombinant Proteins in *E.coli,* lac, T7 and Tet-regulatable promoters. Overexpression systems in yeast (*S.cerevisiae*), Baculovirus overexpression System. Mammalian cell overexpression system. Gene and Genome sequencing, DNA sequencing by Sanger's method – traditional and cycle Sequencing. Whole genome shotgun sequencing. Clone-by-clone shotgun sequencing of Genome.	**(10 Hrs)**

References:

1. Brown TA. Ed. Homes BD & Richwood D, 1998; Molecular Biology – LABFAX, Academic Press.
2. Gerard Karp, 1999; Cell and Molecular Biology, John Wiley & Sons Inc., New York.
3. Miller G et al, 1996; An introduction to Genetic analysis, Freeman & Co., New York.
4. Watson JD et al, 1992; Recombinant DNA, Scientific American Books.
5. Desmond ST & Nicoll, 1994; An introduction to Genetic Engineering, Cambridge Uni. Press.
6. Nicholl DST, 1994, An introduction to Genetic Engineering, Cambridge Univ. Press.

7. Trapp BE &Freifelder D, 2007; Molecular Biology – Genes to proteins, Jones &Bartlet Publ. Inc. Learning.
8. David P Clark, 2005; Molecular Biology, Academic Press
9. Harvey F Lodish, 2008; Molecular Cell Biology, W.H. Freeman
10. Cornell Mechardt, 2007; Molecular Biology & Genomics, Academic press

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSE3:Diagnostic Microbiology

Course Title: Diagnostic Microbiology	Course code: 24MBL4E3AL
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To learn the Role of microbiologist in diagnostic microbiology.
2. To understand the conventional technique in diagnostic microbiology.
3. Knowledge on blood grouping hematology and serology.
4. To learn the detection and measure of genetic material and protein underlying diseases.
5. Knowledge on recent diagnostic tools and techniques.

DSE3:Diagnostic Microbiology

Unit	Description	Hours
1	**Introduction to Clinical Microbiology:** Role of Microbiologist in Diagnostic laboratory, General concepts for specimen collection, handling, transportation, processing, specimen workup, Laboratory safety and infection control. Scientific and Laboratory basis for Clinical/Diagnostic.	**(10 Hrs)**
2	**Conventional techniques of Diagnostic microbiology:**Identification of pathogenic Microorganisms by cultivating on selective medias.Microscopic examination of infectious diseases, Growth and biochemical characteristics, Rapid methods of identification, antibiogram,	**(12 Hrs)**

3	Haematology: collection of Blood samples, Blood grouping and typing, Various Anticoagulants used in Haematology, Prothrombin Time, Activated Partial Thromboplastin time, Total count of RBCs, WBCs and Differential count of WBCs and their significance. Examination of bone marrow. Hb%. Serological Methods: Precipitation, ELISA and PCR. Laboratory diagnostic Test for Typhoid, Dengue, malaria, tuberculosis. Antigens and Antibody reactions *in vitro;* Agglutination, complement fixation, ELISA, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Immuno precipitation, Radioimmunoassay and serotyping.	**(10 Hrs)**
4	Molecular diagnostics: Detection and measure of genetic material and proteins of underlying disease. PCR, RTPCR, Development of diagnostic kits.	**(10 Hrs)**
5	Advanced diagnostic tools: Principle, working and application of a) Autoanalyzer b) Biosensor glucometer /labon chip/microfluidics c) Diagnostic kits- ELISA, Western Blot d) Enzymes in Disease diagnosis and therapy. Automation in Diagnosis.	**(10 Hrs)**

References:

1. Diagnostic microbiology Byconniemohan, Donald lehman published 2016.
2. Diagnostic molecular biology by mifflin, chang hui sen.
3. Diagnostic pathology and molecular genetics of thyroid by yuri. V. Nikiforov.
4. Diagnostic molecular pathology by william b. Coleman.
5. Molecular oncology by mohammed A. Vasef.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSE3:Molecular Diagnostics

Course Title: Molecular Diagnostics	Course code : 24MBL4E3BL
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To learn the molecular biology and molecular diagnostics.
2. To understand the biological markers in genome and proteome.
3. Knowledge on molecular diagnostics on clinical oncology.
4. To understand the molecular diagnostics in infectious diseases.
5. To learn the molecular diagnostics in inherited diseases.

DSE3:Molecular Diagnostics

Unit	Description	Hours
1	**Introduction to molecular biology and molecular diagnostics.** Central dogma. Replication of DNA. Mechanism and enzymology of DNA replication. Regulation of DNA replication. Replication of RNA. Transcription and Post transcriptional modifications. Introduction to Diagnostics, History of diagnostics of diseases, types of infectious diseases, philosophy and general approach to clinical specimens.	**(10 Hrs)**
2	**Biological markers in genome and proteome.**Introduction to biomarkers, FDA definition of biomarkers, role of biomarkers in disease diagnosis, types of biomarkers – Imaging, Molecular, histological, radiographic/physiological biomarkers, classification- diagnostic, predictive, prognostic, staging biomarkers.	**(12 Hrs)**

	Some important biomarkers in diagnostics – BI-RADS breast imaging reporting and data system, PI-RADS prostate imaging reporting and data system, LI-RADS Liver imaging reporting and data system, PIK 3CA, CA125, HER,CRP 2. Approaches and methods in the identification of disease markers, predictive value,diagnostic value, emerging blood markers for sepsis, tumor and cancer marker, markers in inflammation and diagnosis of cytoskeletal disorders.	
3	**Molecular diagnostics in clinical oncology**,Molecular pathology, cytology, imaging, endoscopy, laparoscopy, mitochondrial inheritance, mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing. Important biomarkers used in diagnosis of cancer.	**(10 Hrs)**
4	**Molecular diagnostics in infectious diseases,** Traditional disease diagnosis methods Diagnosis of infectious diseases caused by bacteria, fungi, viruses, protozoa and Helminthes. Culture independent analysis of bacteria; Molecular diagnosis of fungal pathogens.	**(10 Hrs)**
5	**Molecular diagnostics in inherited diseases**, Molecular Techniques for diagnosis Disease identification and Genetic tests of disorders; Population screening for genetic disorders; Treatment and management of genetic disorders.Applications of PCR-based microbial typing PCR based microbial typing	**(10 Hrs)**

References:

1. Molecular diagnostics fundamental methods and clinical applications by lela buckinghum.
2. Molecular pathology and diagnostic markers tumors by lynettesholl.
3. Clinical chemistry and molecular diagnostics by carl A burtis.
4. Clinical molecular diagnostics by shiyang pan.
5. Molecular diagnostics for the clinical Laboratarian by william b. Coleman.
6. Molecular microbiology diagnostic principles and practices by david h persing.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSE3: Insect Microbiology

Course Title: Insect Microbiology	Course code : 24MBL4E3CL
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To learn the entomology insect morphology, structure, types of insects.
2. To understand the insect physiology and nutrition.
3. To learn the entamopathogenic microorganisms, insect microbial interactions.
4. Knowledge on economic importance of insects.
5. To understand the insect expression system.

DSE3: Insect Microbiology

Unit	Description	Hours
1	**Introduction to Entomology:** Entomology, Phylum Arthropoda, classification of insects with examples, Insect morphology: Insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation. Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites. Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications. Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemoreceptors).	**(10 Hrs)**
2	**Insect microbial interactions** Diversity and significance of microbe interactions, Mutualistic associations between insects and microbes, Insect nutrition and the importance of microbes Gut symbionts, Dynamics of insect microbiome interaction Plant	**(12 Hrs)**

	pest parasitoid interaction, Plant pest pathogen interaction Gut microbiota of insects : Introduction to gut microflora. Role of gut microbes in maintaining health and diseases. Regulation of mind and behaviour changes by gut microbes. Examples of gut microbes Bacterioids, prevotella, fusobacterium, ,ruminococcus, peptococcus, Bifidobacterium, lactobacillus	
3	Entamopathogenic microorganisms Entamopathogenic microorganisms; bacteria – bacillus thuringenisisisraelensis, bacillus thuringenisiskurstaki. Fungi – metarhiziumanisopilae, lecanicilliumlecani. nematodes – heterorhabditisbacteriophora,steinernemacarpocapsae. Viruses – nucleopolyhedrovirus,granulovirus. Common pest in agriculture: Arthroptera,Hemiptera, Thysanoptera,coleopteran, life cycle of mosquito , parasitic insects. Insects act as food for wild life.	**(10 Hrs)**
4	**Economic importance of insects:** Pests nas substrates for synthesis or metabolites and value added products. Life cycle of silkworm, Luciferase producing insect gallaria, Phelomones in insects honeybee, Benificial insects-cockroach, termides, silk worms,Honeybees.	**(10 Hrs)**
5	**Insect expression systems:** Insect cell, Baculovirus system, Mosquito cell lines, Growth and maintenance of insect cell lines.	**(10 Hrs)**

References:

1. Chapman RF. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge.
2. David BV &Ananthkrishnan TN. 2004. General and Applied Entomology. ata-McGraw Hill, New Delhi.
3. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSE4: Basics in clinical research

Course Title: Basics in clinical research	Course code : 24MBL4E4AL
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the introduction to clinical research and historical guidelines in clinical research.
2. Introduction to drug discovery and drug development.
3. Learn the clinical trials phase 1, 2, 3, 4, trails in new drug discovery process.
4. Learn the concept of pre clinical toxicology.
5. Understand and imbibe the guidelines and regulations for good clinical practice, career in clinical research.

DSE4: Basics in clinical research

Unit	Description	Hours
1	**Introduction to Clinical Research:** Origin and History of Clinical Research, Differencebetween Clinical Research and Clinical Practice, Types of Clinical Research, Phases of Clinical research. Historical guidelines in Clinical Research, Nuremberg code, Declaration of Helsinki Belmont report.	**(10 Hrs)**
2	**Introduction to Drug Discovery and drug Development:** Basic pharmacology and Basic Conceptual knowledge about receptors, drugs, preclinical studies, pharmacodynamics, Pharmacokinetic (ADME), drug interactions, Introduction to pharmacoeconomics.	**(12 Hrs)**

3	**Clinical trials new drug discovery process:** Clinical Trials in India –The National Perspective, purpose, main steps involved in new drug discovery process, timelines of each Steps, advantages and purposes of each steps, thalidomide tragedy, Phase-I, II, III, IV trials.Various phases of clinical trials -Post Marketing surveillance – methods, Principles of Sampling, Inclusion and exclusion criteria -Methods of allocation and randomization –Informed consent process in brief -Monitoring treatment outcome -Termination of trial –Safety monitoring in clinical trials.	**(10 Hrs)**
4	**Pre clinical toxicology:** General principles, Systemic toxicology (Single dose and repeat Dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements.	**(10 Hrs)**
5	**Guidelines for Good Clinical Practice :** The Principles of ICH GCP, Institutional Review Board / Independent Ethics Committee Investigator Sponsor, Clinical Trial Protocol and Protocol Amendment(S) Investigator's, Brochure Essential Documents for the conduct of a Clinical Trial Introduction of Clinical Trial Regulation, European Medicine Agency, Food And Drug Administration (US FDA), Drug and cosmetic act, Schedule Y, ICMR Guideline, Clinical trial and data management, Career in Clinical Research.	**(10 Hrs)**

References:

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN.
3. Clinical pharmacokinetics, Pub. Springer Verlab, Dr. D.R Krishna, V. Klotz
4. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
5. Drug interaction, Kven Stockley. Hamsten
6. Drug interaction, Basic BussinessPubl, Bombay, J.K. Mehra

7. Clinical pharmacology and drug therapy Grahame smith and Aronson,
8. Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms,
9. Clinical Pharmacy and therapeutics Herfindal E T and Hirschman JL, Williams and Wilkins.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSE4: Bioethics, Biosafety and IPR

Course Title**:** Bioethics, Biosafety and IPR	Course code :24MBL4E4BL
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Basic concepts of biotics and ethical conflict in biotechnology.
2. Learn the regulations of biosafety.
3. Understand the biosafety guidelines.
4. Understand the intellectual property includes patents trademarks copyright and related rights trademarks.
5. The concept related to patents valets' commercialization and licensing.

DSE4: Bioethics, Biosafety and IPR

Unit	Description	Hours
1	**Bioethics**: Introduction to bioethics, principles of bioethics, biotechnology and social Responsibility, public acceptance issues in microbiology and biotechnology, issues of access, Ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental Sustainability, public vs private funding. Ethical conflicts in biotechnology- interference with Nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business Ethics.	**(10 Hrs)**
2	**Biosafety**: Definition of bio-safety, Biotechnology and bio-safety concerns at the level of Individuals, institutions, society, region, country and world with	**(12 Hrs)**

	special emphasis on Indian Concerns. Biosafety in laboratory institution: laboratory associated infection and other Hazards, assessment of biological hazards and level of biosafety.	
3	**Bio safety regulation:** handling of recombinant DNA products and process in industry and in Institutions (Indian context). Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.Infringement and Litigation with case Studies on patent, Commercialization and Licensing. Recent Amendments, Precautions before Patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office.	**(10 Hrs)**
4	**Biosafety guidelines –** Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and Agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk Management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.	**(10 Hrs)**
5	**Introduction to Intellectual Property:** Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP. Intellectual property Protection. WTO: agency controlling trade among nations, WTO with reference to Biotechnological affairs, TRIPs. WIPO, EPO. IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS. Concept related to patents novelty, non-obviousness, utility, anticipation, prior art etc. Type of patents. Indian patent act and foreign patents. Patentability, Patent application, Revocation of patent, Procedure for filing a PCT application.	**(10 Hrs)**

References:

. Fleming, D.A., Hunt, D.L.(2000).Biotechnology and Safety Assessment (3rd Ed) Academic press.

2. Thomas, J.A., Fuch, R.L.(1999).Biotechnology and safety assessment (3rd Ed).CRC press, Washington.

3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007)

4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,

5. Intellectual Property Right- Wattal- Oxford PublicatiopnHouse.(1997) ISBN:0195905024.

6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions. (2nd ed)

7.B.D. Singh. Biotechnology expanding horizons.

8. Sree Krishna, V., 2007. Bioethics and Biosafety in Biotechnology, 1st Ed. New Age International Publishers, New Delhi.

9. Trayror, P.C., Frederic.R. and Koch, M. 2002. Biosafety. Board of Trustees, Michigan State University, USA

Date Course Coordinator Subject Committee Chairperson

Dept Name: Microbiology
Semester-IV
DSE4 : Nutraceuticals, synbiotics and biologicals

Course Title: Nutraceuticals, synbiotics and biological	Course code :24MBL4E4CL
Total Contact Hours: 52 Hours	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To understand the microbial nutraceuticals, dietary supplements and functional foods.
2. To learn the properties structure and functional nutraceuticals and also vitamins and protiens.
3. To learn the synbiotics as nutraceuticals
4. Knowledge on production of biologicals
5. To understand the Clinical applications of nutraceuticals,Synbiotics and biological

DSE4 : Nutraceuticals, synbiotics and biologicals

Unit	Description	Hours
1	**Properties, structure and functions of various Nutraceuticals** Introduction to Nutraceuticals, History, classification of nutraceuticals, and functional foods, zoo nutraceuticals, Phyto nutraceuticals, microbial nutraceuticals, dietary supplements, fortified foods.	**(10 Hrs)**
2	Sources of neutraceuticals : Plant sources - Glucosamine, Octacosanol, Lycopene, Carnitine, Melatonin and Ornithine alpha ketoglutarate. Use of proanthocyanidins, grape products, flaxseed oil, Bee pollen, Caffeine, Green tea, as Nutraceuticals. Nutraceutical rich supplements from microbial sources e.g. edible and *medicinal Mushroom*, *Kelp, Spirulina, cerevisiae, bacillus*	**(12 Hrs)**

	subtillis,Lactococcuslactis,lactobacillusacidophillus. Vitamins as nutraceuticals- bioactive peptides, bioactive proteins, minerals, Microbial peptides, organic acids, bioactive vitamins, fiber, fatty acids, biopolymer, single cell oil, minerals, single cell protein. .	
3	**synbiotics as neutraceuticals:** Prebiotics, definition, sources, types, production of prebiotics, Mechanisms. Probiotics definition, foods contain probiotics, Classification and physiology of *Lactic acid bacteria (LAB),*Classification and physiology of *Bifidobacterium* and *Propionibacterium*, Interactions of probiotics with the host immune system, probiotics in human, animal, fishery and poultry health. Synbiotics definition, sources, types, production of synbiotics.	**(10 Hrs)**
4	Biologicals :Definition, types of biologics – Antitoxins and Antivenins, Hematopoietic stem cell mobilizer, in vivo diagnostic biologicals, miscellaneous erythropoiesis agents, recombinant human erythropoietins, production of biological.	**(10 Hrs)**
5	**Clinical applications of nutraceuticals,Synbiotics and biological:** Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Applications of biologicals – Vaccines, growth factors, immune modulators, monoclonal antibodies.	**(10 Hrs)**

References:

1.Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author), Blackwell Publishing, 2007

3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.

4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Wood head Publ., 2000

5. Hanson, James R. "Natural Products: The Secondary Metabolites", Royal Society of Chemistry, 2003.

Date Course Coordinator Subject Committee Chairperson

GEC 2: Microbes as immune boosters for better health

Course Title: **:** Microbes as immune boosters for better health	Course code: 24MBL4G2AL
Total Contact Hours: 30 Hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. To understand the microbial microorganisms as food and functional foods.
2. To learn the properties structure and functional nutraceuticals and probiotics.
3. To learn the Spirulina as immune boosters.

GEC 2:Microbes as immune boosters for better health

Unit	Description	Hours
1	**Microorganisms as source of food** Microorganisms as source of food: Mushrooms,edible mushrooms, Medicinal mushrooms,Mushrooms as immune boosters, Yeast as immune boosters.Probiotics,Types of probiotics,Applications of probiotics, Probiotics as immune boosters.	**(10 hrs)**
2	**Probiotics as neutraceuticals** Prebiotics, definition, sources, types, production of prebiotics, Mechanisms. Probiotics definition, foods contain probiotics, Classification and physiology of Lactic acid bacteria (LAB), Classification and physiology of Bifidobacterium and Propionibacterium, Interactions of probiotics with the host immune system, probiotics in human, animal, fishery and poultry health. Synbiotics definition, sources, types, production of synbiotics. Clinical applications of prebiotics, probiotics and synbiotics.	**(10 hrs)**

3	**Spirulina as immune boosters:** spirulina production, Types of spirulina, Uses of spirulina,Applications of spirulina, spirulina as a food. Spirulina in antioxidant. Health benefits of spirulina.	**(10 hrs)**

References (indicative)

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author),BlackwellPublishing,2007

3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.

4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Wood head Publ., 2000

5. Hanson, James R. "Natural Products: The Secondary Metabolites", Royal Society of Chemistry, 2003.

Date Course Coordinator Subject Committee Chairperson

GEC 2: Social immunity and vaccination

Course Title: **:** Social immunity and vaccination	Course code: 24MBL4G2BL
Total Contact Hours: 30 Hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (COs):At the end of the course, students will be able to:

1. To learn the social immunity, types mechanism and immunization schedule.
2. Knowledge on vaccination, types, mechanism and vaccination schedule.

GEC 2: Social immunity and vaccination

Unit	Description	Hours
1	**Social immunity:**Social immunity – History, Edward Jenner, Louis Pasteur, Definition, Types of Immunity- local immunity, Herd immunity. Herd immunity calculator, herd immunity and infectious diseases, evolution of social immunity, immunological challenges, variolation, immunization and vaccination, immunization schedule.	**(10 hrs)**
2	**Vaccination:**Definition, types of vaccines, preparation of vaccines, vaccination schedule, impact of vaccination on selected diseases, mechanism of vaccines, features of vaccine induce protection, immunodeficiency and vaccination, significance and wide variety of vaccination.	**(10 hrs)**
3	**Recombinant vaccines:** Recombinant vaccines, DNA and RNA vaccines, sub unit vaccines peptide vaccine, vaccine production, future vaccine development.	**(10 hrs)**

References (indicative)

1. Stities, Tesss and Parslow. Medical Immunology. 9th Ed. Appleton & Lange, Connecticut.
2. Benjamin E, Coice R and Sunshine G. Immunology – A Short course. 4th Ed. Willey-

Liss
3. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward Arnold
4. Roitt I.M., 1994, Essential of Immunology, Raven Press, New York.

Date Course Coordinator Subject Committee Chairperson

GEC 2: Anaerobic Solid and waste water management

Course Title: **:**Anaerobic Solid and waste water management	Course code: 24MBL4G2CL
Total Contact Hours: 30 Hours	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 Hour
Summative Assessment Marks: 30	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Classify waste, and able gain impact of waste in environment
2. Learn various methods to treat house hold, municipal solid waste
3. Learn treatment of sludge – handling and disposal

GEC 2: Anaerobic Solid and waste water management

Unit	Description	Hours
1	**Introduction to Waste Management:** Introduction to hazardous and non-hazardous waste, types of waste, Classification of wastes, Sources of solid waste and liquid waste, Microbiology of waste. Impact of solid waste on environment and liquid waste on environment. Methods of solid waste management – landfill, composting, pyrolysis, incineration. Waste water management.Handling of biohazard and hospital wastes.	**(10 hrs)**
2	**Anaerobic Solid waste management:** Handling and treatment of solid wastes. Sludge handling and disposal- sludge processing, screening, thickening, conditioning, stabilization of solid waste -aerobic and anaerobic digestion, mechanism of biomethanogenesis, dewatering. Anaerobic sewage sludge digestion process, types of anaerobic digesters, global significance of biomethanogenesis.	**(10 hrs)**
3	**Waste water treatment**: Primary-physical processes; Secondary-biological treatment by fixed biofilm systems (trickling filters, RBC, fluidized bed reactors), suspended systems (activated sludge process, oxidation lagoons,	**(10 hrs)**

	anaerobic digesters, septic tank); Tertiary- Filtration (sand beds & membrane filters) chlorination, ozonization, radiation and reverse osmosis.	

References (indicative)

1. Gabriel Britton, 1994, Wastewater Microbiology, John Willey & Sons, New York.
2. Ralph Mitchell, 1995, Environmental Microbiology, Wiley Liss, New York.
3. Metcalf and Eddy. 1991. Waste Water Engineering. McGraw Hill Int. Publ.
4. APHA, 1994, Standard Methods, 17th Ed., American Public Health Association
5. Atlas & Bertha. 1998. Microbial Ecology. 3rd Ed.

Date Course Coordinator Subject Committee Chairperson

DSC 11P9 : Agriculture Microbiology Lab

Course Title: Agriculture Microbiology Lab	Course code:24MBL4C11P
Total Contact Hours:30 Hours	Course Credits: 02
Internal Assessment Marks: 20 Marks	Duration of ESA/Exam:4 hrs
Semester End Examination Marks: 30 Marks	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Know about enumeration of Rhizophere and phyllosphere micro organisms and phosphate solubilising bacteria and fungi.
2. Know about isolation of bioinoculants and isolation of bacteria and fungi.
3. Know about plant diseases-Rust, Smuts, Powdery mildews, Tikka disease of ground nut, citrus canker, bhendi yellow vein mosaic, tomato leaf curl, little leaf of brinjal.
4. Perform Mass production of Fungal and B. thurigenesis in laboratory

DSC 11P9 : Agriculture Microbiology Lab

List of Experiments

1. Isolation, enumeration of Rhizosphere and Phyllosphere microorganisms.
2. Study of root nodules of leguminous plants. Isolation enumeration and Characterization of symbiotic and nonsymbiotic nitrogen fixing microorganisms.
3. Isolation enumeration and characterization of phosphate solubilising bacteria and Fungi-plate method.
4. Staining & observation of VAM fungi.
5. Laboratory scale production of bacterial biofertilizers.
6. Assay of bio fertilizers (seed treatment, seedling, inoculation and measurement of root And shoot length).
7. Isolation of bioinoculants: Bacillus thuringiensis, Bauveria bassiana, Trichoderma, Pseudomonas. Observation of spores and crystals of B.thuringenesis.
8. Mass production of B.thuringenesis in laboratory.
9. Mass production of fungal entomopathogens in laboratory.
10. Observation of wet mount of NPV.
11. Mushroom cultivation and evaluation of protein content

12. Plant diseases- Rust, Smuts, Powdery mildews, Tikka disease of ground nut, citrus Canker, bhendi yellow vein mosaic, tomato leaf curl, little leaf of brinjal.
13. Isolation of funal and bacterial plant pathogens sclerotium rolfsii, xantomonas, Rolstonia, fusarium, Alternaria alternata.
14. Extraction and estimation of phenolics from diseased plants

References:

1.Motsara, M.R. Bhattacharyya, P.and Srivastava, B. 1995 Biofertilizer- Technology, Marketing and Usage. Fertilizer Development & Consultant Organization , New Delhi.

2.Subba Rao, N.S., 1994. Biofertilizers in Agriculture and Agroforestry. Oxford & IBH, New Delhi.

3.Subba Rao, N.S. 1995. Soil Microorganisms and Plant growth. Oxford & IBH, New Delhi.

4.KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai.

Date Course Coordinator Subject Committee Chairperson

Project: Research Project

Course Title: Research Project	Course code:24MBL4C1R
Total Contact Hours:60 Hours	Course Credits: 04
Internal Assessment Marks: 30 Marks	Duration of ESA/Exam:4 hrs
Semester End Examination Marks: 70 Marks	

MAJOR PROJECT **(4 Credits)**

Preamble: Project work includes the major research problems associated with various fields Relevant to microbiology which will help the students to understand, plan experimental Designs and analyze the data of the experimental outcome. The outcome of the study will be Having scientific relevance and commercial value.The candidate should submit an independent project report by the end of final year course on A topic relevant Microbiology, based on the laboratory experiments/case studies/field studies Carried out in a Microbiology/related industry, it will be evaluated by external and internal Examiners. It will be carried out 4th semester, but will be started in the 3rd semester. Three Copies of the project report shall be submitted to the chairman, Department of Microbiology Before one week of the theory examination of fourth semester.

The assignment of marks for Project is as follows:

Project dissertation	**50 marks**
Viva-voce	**20 marks**
Internal assessment	**30 marks**
Total	**100 marks**

Date Course Coordinator Subject Committee Chairperson