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	21MBL4C11L	AgricultureMicrobiology	30	70	100	4	-	-	4	3
	DSC12	21MBL4C12L	RecombinantDNATechnology	30	70	100	4	-	-	4	3
	DSE3	21MBL4E3AL	A.DiagnosticMicrobiology	30	70	100	4	-	-	4	3
		21MBL4E3BL	B.Moleculardiagnostics								
		21MBL4E3CL	C.InsectMicrobiology								
	DSE4	21MBL4E4AL	A.Basicsinclinicalresearch	30	70	100	4	-	-	4	3
		21MBL4E4BL	B.Bioethics,BiosafetyandIPR								
		21MBL4E4CL	C.Neutraceuticals, Biologicals andSynbiotics								
	GEC2	21MBL4G2AL	A.Microbesasimmuneboosters for better health	20	30	50	2	-	-	2	1
		21MBL4G2BL	B.Social immunity andVaccination								
		21MBL4G2CL	C.AnaerobicSolid andwaste water management								
	DSC11P9	21MBL4C11P	AgricultureMicrobiologyLab	20	30	50	-	-	4	2	4
	Project	21MBL4C1R	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: 21MBL4C11L
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: 21MBL4C12L
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: 21MBL4E3AL
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 : 21MBL4E3BL
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 : 21MBL4E3CL
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 : 21MBL4E4AL
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 :21MBL4E4BL
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 :21MBL4E4CL
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: 21MBL4G2AL
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: 21MBL4G2BL
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: 21MBL4G2CL
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:21MBL4C11P
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:21MBL4C1R
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