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	21MBL2C5L	Microbial genetics and Molecular cell biology	30	70	100	4	-	-	4	3
	DSC6	21MBL2C6L	Food and Dairy Microbiology	30	70	100	4	-	-	4	3
	DSC7	21MBL2C7L	Environmental Microbiology	30	70	100	4	-	-	4	3
	DSC8	21MBL2C8L	Immunology and Immuno diagnostics	30	70	100	4	-	-	4	3
	SEC2	21MBL2S2 LP	Food Analysis, Safety and Standards	20	30	50	1	-	2	2	1
	DSC5P4	21MBL2C5P	Microbial genetics and Molecular cell biology Lab	20	30	50	-	-	4	2	4
	DSC6P5	21MBL2C6P	Food and Dairy Microbiology Lab	20	30	50	-	-	4	2	4
	DSC5	21MBL2C7P	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:** 21MBL2C5L
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:** 21MBL2C6L
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:** 21MBL2C7L
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:** 21MBL2C8L
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.