SEMESTER – II			
CORE VI MEDICAL MICROBIOLOGY			
Code : 17PMIC23	**Hrs/ Week: 6**	**Hrs/ Sem: 60**	**Credit: 5**

OBJECTIVES

To impart advanced level information in the subject of Medical Microbiology.

UNIT I

Basics in Medical microbiology - Infectious diseases overview. Medically important microbes. Microbial diseases - sources, ***route*** of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections. Immunity of microbial diseases.Bacteriology - *Staphylococci, Bacillus, Clostridium, Corynebacterium, Salmonella, Klebsiella, Vibrio, Pseudomonas, Mycobacteria.*

UNIT II

Virology - Structure, multiplication, classification and medical importance of DNA viruses - General properities of viruses host interaction- Pox virus(small pox,)- Herpes virus-(Chicken pox, Herpes loster,)—Adenovirus—Orthomyxovirus(Infleunzavirus,Swine Flu)- Paramycovirus,-Enterovirus(Poliovirus)- Arbovirus-(Chikungunga virus, Dengue)- Hepatitis virus- Rotavirus- Rubella virus – Ebolla virus –AIDS-SARS

UNIT:III

Mycology - Human mycotic infections caused by Dermatophytes, Histoplasma, Cryptococcus, Candida, opportunistic mycoses.

Parasitology - Medical importance of Entamoeba, Giardia, ,Taenia, Ascaris, . Laboratory techniques in parasitology.

UNIT:IV

Chemotherapy – Basics of chemotherapy, history and development chemotherapy, general properties of antimicrobial agents and attributes of an ideal antimicrobial agents – Principal groups of antibacterial agents and mechanism of action : Inhibitors of cell wall – Inhibitors of protein synthesis – Inhibitors of nucleic acid synthesis – Inhibitors of DNA replication and inhibitors of RNA polymerase – Inhibitors of cytoplasmic membrane function .

Unit – V

Antibacterial, antifungal and antiviral agents – Drug resistance (Origin, mechanisms and transmission) – Selection and testing Factors influencing the selection of drugs – Resistant Staphylococci and testing of antibiotics; (Checker board assay, Schlichter's Test and E-test). **References:**

1. Ananthanarayanan, R. and Panicker. J. (2000). Text Book of Microbiology. Orient Longmans.
2. Rajan. S. (2007). Medical Microbiology. MJP Publisher, Chennai. Bernard. D. Davis, Renato Dulbecco, Herman N. Eisen and Harold, S. Ginsberg. (1990). Microbiology (4th Edition) J.B. Lippincott Company, New York.
3. Prescott L.M. Harley J.P., and klein D.A (2008). Microbiology (7th Edition) McGraw Hill, New York.

4. Madigan M., T., Martinko. J.M., and Parker J., Brock TD. (1997). Biology of Microorganisms. (8th Edition). Prentice Hall International Inc, New York.
5. Nester, E.W. Roberts, C.V. and Nester, M.T. (1995). Microbiology, A Human perspective. IWOA, U.S.A.
6. Pelczar Jr. M.J. Chan E.C.S. and Kreig N.R (1993). Microbiology – Mc Graw Hill, Inc., New York.
7. Stainer R.Y., Ingra ham J.L., Wheelis M.L., and Painter P.R. (1986). General Microbiology, Macmillan Education Ltd., London.
8. Tortora, Funke, Case Addison 2001, Microbiology – An Introduction – 7th Edition, Wesley Longman Inc.
9. Dubey R.C. and Maheswari, S. 2003 A Text Book of Microbiology. S. Chand & Co., New Delhi.
10. John L. In graham and Catherine A Ingrahani. (2000) Introduction to Microbiology. Books / Cole Thomas Learning, New York.

SEMESTER- III			
CORE – VII AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY			
Code:17PMIC31	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES

1. To inculcate the knowledge on interaction between microbes and environment.
2. To impart advanced information in Agricultural Microbiology.

UNIT I :

Based on oxygen requirement, nutrition, temperature, habitat (soil, water & air). Physio-chemical properties of soil -Rhizosphere and rhizoplane organisms. Mineralization and Immobilization. Biogeochemical cycling: Carbon, Nitrogen, Phosphorus & Sulphur.

UNIT II :

Microbial analysis of drinking water: Tests for coliforms (presumptive, confirmed and completed tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. Aeromicrobiology – Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative humidity and temperature) – Air Pollution – aerosol, droplet nuclei and infectious dust. Examination of air microflora.

UNIT III :

Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment – primary, secondary and tertiary treatments (Trickling filters, Activated sludge process, Oxidation lagoons and Imhoff tank).

UNIT – IV

Biological Nitrogen fixation- The range of nitrogen fixing organisms- mechanism of nitrogen fixation (biochemistry of nitrogenase) - genetics of nitrogen-fixation - Rhizobium-Legume Association - N_2 fixation by non-leguminous plants.

UNIT – V

Microbial products and plant health: PGPR (plant growth promoting rhizobacteria) - significance of mycorrhizae - Role of biofertilizers and biopesticides- Biofertilizers- (*Rhizobium*, *Azospirillum*, *Azotobacter*, *Cyanobacteria*, *Phosphobacteria and Azolla*)- Inoculants, mass production and method of application and its Quality Control (BIS specification).

REFERENCE BOOKS:

1. Shiva Aithal, C. (2010). Mordern approaches in Soil,Agricultural and Environmental Microbiology. Himalaya Publishers, New Delhi.
2. Atlas,R.M., and Bartha.M. (2003). Microbial Ecology –Fundamentals and applications. Benjamin – Cummings, Mento Park, California.
3. Martin Alexander (1983).Introduction to Soil Microbiology, Wiley eastern Ltd., NewDelhi.
4. SubbaRao,N.S.(1997). Biofertilizers in Agriculture and Forestry III Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi.

5. SubbaRao,N.S.(1995). Soil Microorganisms and Plant growth. Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi
6. Wheeler, B.E. (1976). An introduction to Plant disease. ELBS and John Wiley and sons, Ltd.
7. Rangaswamy.g., and Bagyaraj.D.J. (1996). Agricultural Microbiology. Prentice-Hall of India Pvt Ltd., New Delhi.
8. Dirk, J. Elasas, V., Trevors,.T., and Wellington, E.M.H. (1997). Modern Soil Mirobiology. Marcel Dekker INC, New York, HongKong.
9. Dubey R.C. (2001).A Text Book of Biotechnology. S Chand & Co. New Delhi.
10. Gupta,S.K.(2014).Approaches and trends in plant disease management. Scientific publishers.Jodhpur,India.
11. Jammaluddin et al (2013). Microbes and sustainable plant productivity. Scientific Publishers Jodhpur,India,G.
12. Purohit, S.S.Kothari,P.R.andMathur (1993). Basic and Agricultural Biotechnology, Agrobotanical Publishers (India).Bikaner.

SEMESTER - III			
CORE –IX INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY			
Code: 17PMIC33	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES:

1. To inculcate the knowledge of Industrial and Pharmaceutical Microbiology
2. To impart the students with the knowledge of various processes involved in Pharmaceutical industry.

UNIT-I

Isolation, preservation and improvement of industrially important microorganisms; Raw materials and media design for fermentation processes; Sterilization; Development of inoculums for industrial fermentations; Types of fermentation: Batch, Continous, Dual or Multiple, Surface, Submerged, Aerobic and Anaerobic.

UNIT-II

Fermenter- Design and types, Instrumentation and control-aeration and agitation. Recovery and purification of fermentation products. Enzymes and cell immobilization, Production of recombinant proteins having therapeutic and diagnostic applications: Insulin, Interferon, Somatotropin, Single cell protein.

UNIT-III

Biology of industrial microorganisms.*Streptomyces*, Yeasts (*Saccharomyces, Hansenula)Spirulina* and *Penicillium*. Mushroom cultivation. Biosensors and Biochips. Biofuels from microbial sources.

UNIT-IV

Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Aminoacids (Glutamic acid and Lysine); Organic acids (Citric acid and acetic acid); Vaccines (Plant – *Agrobacterium tumefaciens*, Animal – Leptospirosis, Microbes - DPT).

UNIT-V

Antibiotics (Penicillin, Cephalosporin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Production of enzymes (Protease, Amylase and Lipase); Biopolymers (Xanthan gum and PHB); Biopreservatives (Nisin); Production of Hormones (Testosterone and Androstenedione).

REFERENCE BOOKS:

1. WulfCrueger (2000).A Text Book of IndustrialMicrobiologyII.Ed. Panima Publishing Corporation,NewDelhi.
2. Peter F.Stanbury., Whittaker, A. and Hali,S.J.(1997).Principles of Fermentation Technology,II Ed., Pergamon Press.
3. A.H.Patel, Industrial Microbiology (1996).Macmillan India Limited.
4. Reed.G.(Editor),Industrial Microbiology, CBS Publishers
5. Prescott &Dunn(1997). Industrial Microbiology.CBS publishers and Distributors.
6. Casida,L.E.(1986).Industrial Microbiology. Eastern Limited, NewYork.
7. Michael J.Waites, Neil L.Morgan, John S.Rockey and GrayHigton(2001). Industrial Microbiology An Introduction, Replika press Pvt.NewDelhi.
8. S. S. Purohit, H.N. Kakrani, A.K. Saluja, Pharmaceutical Biotechnology (2006). Student edition, Jodhpur.
9. U. Satyanarayana, Biotechnology (2013). Books and Allied (P) Ltd, Kolkata.

SEMESTER – I			
ELECTIVE – I COMPUTERS AND BIOSTATISTICS			
Code:17PMIE11	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credit: 5**

OBJECTIVES:

1. To inculcate knowledge on the basics of computers.
2. To furnish the students with the knowledge of biostatistics.

UNIT I

Introduction to Computers : Classification of computers – personal, mini, main frame and super computers, their characteristics and application, Computer generation,Compliers and Interpreters, BIT, BYTE, WORD, Computer memory and its types, Data representation and storage.

UNIT II

Hardware and software: Input, output, and secondary storage devices, central processing unit; types of software; meaning, functions and types of operating system; computer languages. Understanding computer networks: LAN, WAN and MAN -Types of topologies - transmission media.

UNIT III

Working with software packages: An introduction to PC-software packages; MS Word-working with text, tables, checking spelling and grammar, printing a document; MS Excel-working with worksheet, formulas and functions, inserting charts; MS Powerpoint presentation-working with different views and designing presentation.

UNIT IV

Introduction, population and samples – variables- collection of Data- Classification and tabulation of data- Diagrams and graphs-Measures of central tendency &Disperssion.

UNIT V

Hypothesis testing, Test of hypothesis involving one sample – Test of hypothesis involving two samples – The analysis of variance. Excel software- SPSS, STATA.

Reference Books:

1.How computers work, 2000 Ron White, Techmedia.
2.How the internet works 2000, Preston GrallaTechmedia.
3.Alexis leon& Mathews leon:Introduction to computers 2008, McGraw-Hill.
4.B.L. Juneja&A.Seth; Computer fundamentals &C Programming 2012 Cengage Learning India
5.Thomas Glover, Kevin Mitchell; An Introduction to Biostatistics
2002 bythe McGraw Hill.
6.Steve Selvin Biostatistics How it works 2004 by Pearson education.
7. Dr.N.Gurumani; An Introduction to biostatistics 2005 by MJP publisher
8. Arora P.N. Malhan P.K. Biostatistics, Delhi: Himalaya Publishing House, 1996.
Gupta C.B. An introduction to statistical methods New delhi; Vikas Publishers, 1992.
9. Palanichamy S. and ManoharanM.Statistical methods for biologists.

Casella G. and Berger R. L., Statistical Inference (The Wadsworth and Brooks / Cole Statistics / Probability Series), Brooks / Cole Pub Company.
10. Spiegel M. R., Schiller J.J., Srinivasan R. A. , A. SrinivasanSchaum's Outline of Probability and Statistics.McGraw-Hill Trade.
11.B.Thigarajan& PA Rajalakshmi;Computational biology 2009.

SEMESTER- I			
Core I - Fundamentals of Microbiology			
Course Code : 21PMIC11	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objectives:

To highlight the basic concepts and principles about the different aspects of microbiology and advanced level information in the subject of General Microbiology.

To enhance the students with the basic knowledge on various techniques involved in culturing microorganisms.

Course Outcome:

CO. No	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	get an idea about the historical events in microbiology.	1	Kn
CO-2	know the scope of microbiology	1,2	Kn
CO-3	know parts of microscope, type and its principle	1,2	Kn
CO-4	distinguish different methods of staining techniques	3	Un
CO-5	understand various physical and chemical means of sterilization.	1,5	Un
CO-6	know various culture media and its application	4	Kn
CO-7	analyse nutritional requirements of microbes.	5,6	Ev
CO-8	understand the techniques for isolation of pure culture of microorganisms.	1,5,6	Un

SEMESTER- I			
Core I - Fundamentals of Microbiology			
Course Code: 21PMIC11	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Unit I - Evolution of Microbiology

Contributions of Van Leeuwenhoek, Joseph Lister, Louis Pasteur, Robert Koch, Edward Jenner, Winogradsky and Beijerinck– Further developments in Microbiology **(Self Study)** – identification, characterization and classification of microorganisms – Distinguishing characteristics between prokaryotic and eukaryotic cells – Phenotypic characters – Taxonomic characters – Distinctive characters of major groups of microorganisms – Principles of classification .

Unit II - Microscopy

Microscopy – It's principles and applications in the field of microbiology including the following; Dark field, phase contrast, fluorescence microscopy, transmission and scanning electron microscopy, confocal microscopy – colorimeter, spectrophotometer and lyophilizers – Staining methods- Gram's, acid-fast, meta chromatic granules, nuclear, capsule, flagella, silver impregnation and Giemsa staining methods.

Unit III – Sterilization and Media

Methods of sterilization: Physical and chemical agents, radiation and filtration **(Self Study)** – Indicator microorganisms for sterilization methods- Cultivation of microorganisms – Microbiological media, enrichment media, enriched media, transport media, selective media and pure culture technique – Methods of preservation and maintenance of cultures – Role of disinfectants.

Unit IV - Bacterial anatomy and growth

Bacterial anatomy, structure, properties and biosynthesis of cellular components of bacteria – Sporulation and it's mechanism – Growth and nutrition – Nutritional requirements – Autotrophs – Heterotrophs – Enrichment cultures – Growth curve – Kinetics of growth – Batch culture – Synchronous growth – Measurement of growth and enumeration of cells – Techniques of pure culture.

Unit V – Microbe - Human interaction

Microbe-Human interaction: infection and disease- Resident flora- pathogenicity and virulence. Varied pattern of infection-epidemiology- infectious diseases-recognition of an infectious disease in a population- recognition of an epidemic- the infectious disease cycle-study of disease - virulence and the mode of transmission- the emergence of new disease-control of epidemics.

Books for Reference:

1. Madigan M., T., Martinko. J.M. and Parker J. Brock TD. *Biology of Microorganisms.* London: Hall International Inc. 8th Edition Prentice 1997.
2. Salle, A.J. *Fundamental Principles of Bacteriology*. New Delhi: Tata McGraw – Hill Publishing Company Ltd, 7th Edition. 1996.
3. Stainer R.Y. Ingra ham J.L. Wheelis M.L. and Painter P.R. London: *General Microbiology,* Mac Millan Education Ltd 1986.
4. Tortora, Funke, Case Addison, *Microbiology – An Introduction* –Wesley Longman Inc. 7th Edition 2001.
5. Dubey R.C. and Maheswari,S. *A Text Book of Microbiology.* New Delhi: S. Chand & Co, 2003
6. Talaro K.P. and Talaro.A. *Foundations in Microbiology*. New York: WCP McGraw – Hill, 1999
7. Dubey and Maheshwari.. *A text book of Biotechnology*. Chand publications, 2006
8. Jeffrey C. Pommerville., *Alcamo's Fundamentals of Microbiology* Jones & Bartlett learning 9th edition, 2010.
9. Prescott L.M. Harley J.P. and Klein D.A *Microbiology* New York: McGraw Hill, 7th Edition, 2008.
10. Pelzar Jr. M.J.Chan E.C.S. and Kreig N.R. *Microbiology* – New York: McGraw Hill, Inc 1993.

SEMESTER I			
Core – II Microbial Diversity and Classification			
Course Code : 21PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objectives:

To understand about the evolution of organisms on earth and variability among living organisms.

To study about the microbial population and its habitat and about microbial communities which are excellent models for understanding biological interactions and evolutionary history.

Course Outcome:

C O No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	understand the ubiquitous nature of microbes.	1	Un
CO -2	explain the basic concept of microbial diversity and classification.	3	Re
CO -3	discuss the knowledge about the various diversification in microorganism	4	Cr
CO -4	explain the knowledge of reproduction in microbes	5	Un
CO- 5	describe genetic characters of microbes.	5	Un
CO -6	understand the general classification of microbes	4	Un
CO -7	explain the characters of protozoa	4	Un
CO -8	understand the characters of arthropod vectors	3	Un

SEMESTER I			
Core – II Microbial Diversity and Classification			
Course Code : 21PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Unit I: Biodiversity and Classification

Classification of microorganisms – Introduction – Haeckel's three kingdom concept – Whittaker' five kingdom concept – Three domain concept of Carl Woese basis of microbial classification, Salient features of bacteria according to Bergey's manual of determinative bacteriology. Identification of Microorganisms –phenotypic classification, phylogenetic classification, genotypic classification, taxonomic ranks – Techniques for determining microbial taxonomy & phylogeny: Classical & molecular characteristics - Genetic relationship - DNA homology -16S r RNA sequencing.

Unit II: Bacteria

General characters, Classification, nomenclature and properties. Structure and characteristics: Gram positive cocci– *Staphylococci, Streptococci*. Gram negative cocci– *Gonococci*. Gram positive non spore forming bacilli: aerobic – *Corynebacteria* and anaerobic- *Actinomyces*. Gram positive spore forming bacilli: aerobic- *Bacillus anthracis* and anaerobic *Clostridia.*

Unit III: Fungi and Algae

General characters, Morphology, taxonomy and classification, structure and cell differentiation of *Aspergillus sp, Candida sp, Agaricus sp*. Mycorrhiza – Ectomycorrhizae, Endomycorrhizae, Vesicular Arbuscular Mycorrhizae. Algae: Distribution, general characters, thallus and its structure, classification, nutrition and reproduction – Characters of selected groups – Blue green algae, Euglenophyta, Chrysophyta, Phaeophyta and Rhodophyta – Economic importance of algal biotechnology.

Unit IV: Virus

Classification, nomenclature and properties. Structure and characteristics of Plant virus (CaMV ,TMV) Animal virus (Adeno virus, HIV, Rhabdo virus) Insect virus (NPV,CPV) Brief outline on virion and Prions.

Unit V: Protozoa

Distinguishing characters, classification, host-parasite relationship, pathogenic mechanism, transmission, life cycle, lab diagnosis, treatment for the following: *Entamoeba sp, Leishmania sp, Giardia sp and Trichomonas sp*. Helminthes: Classification, lifecycle, pathogenesis, transmission, lab diagnosis treatment for Cestodes (*Taenia solium*) – Nematodes (*Ascaris lumbricoides*) – Arthropod vectors: Tick and mosquitoes.

Books for Reference:

1. Prescott L.M., Harley J.P., and Klein D.A *Microbiology* New York: Mc Graw Hill, 7th Edition, 2008.
2. Madigan M.T. Martinko. J.M. Parker .J. and brock T.D. London: *Biology of Microorganisms*.. Prentice Hall International Inc, 8th Edition, 1997.
3. Alexopoulos, C.J., and Mims, C.W. New York. *IntroductoryMycology*,Wiley, 1979.
4. Stainer R.Y., In graham J.L., wheelis M.L., and Painter P.R. London: *General Microbiology*, Macmillan Education Lt., 1986.
5. Starr, M.P., Stolp, H., Truper, H.C.Balows, A., and Schlegel, H.C. *The Prokaryotes.A Hand Book of Habitats, Isolation and Identification of Bacteria.* Springer Verleg. 1991.
6. Tortora, Funke, and Case Addison *Microbiology - An Introduction* – Wesley Longman Inc 7th Edition, 2001.
7. JohnL.Ingraham and Catherine A. Ingrahani *Introduction to Microbiology*. , UK: Books/Cole Thompson Learning, 2000.
8. Talaro. K.P. and A.Talaro. *Foundations in Microbiology*. New York: WCP McGraw-Hill, 1999.
9. Jagadish Chandar. *A Text Book of Medical Mycology.* New Delhi: Inter Print. 1996
10. Powar C.B and Daginawala H.F *General Microbiology, Volume I & II,* Mumbai Himalaya Publishing House, 8th Edition, 2005.
11. Dubey. R.C. and Maheswari, S. *A Text Book of Microbiology* – New Delhi: Chand & Co, 2000.
12. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. *Microbiology* – New York: McGraw Hill, Inc., 1993.
13. Salle, A.J. *Fundamental Principles of Bacteriology*. New Delhi.. Tata McGraw- Hill Publishing Company Ltd., 7th edition. 1996.
14. Holt, J.S. Kreig, N.R., Sneath, P.H.A. and Williams, S.T.. *Bergey's Manual of Determinative Bacteriology.*– Balimore: Williams & Wilkins, 9th edition 1994.

SEMESTER I			
Core III- Biochemistry			
Course Code : 21PMIC13	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Objectives:

To be recognized as a centre for excellence in biochemistry that provide an atmosphere to acquire skills in identifying the link between biological and human resources and transform it to enhance the quality of life

To enhance the students with a broad-based knowledge in concepts and principles of biochemistry.

Course Outcome :

CO No	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	compare and contrast the structure, classification and function of the carbohydrates.	1,2	Un, Kn
CO-2	understand the structure, classification and function of lipids.	1,3	Un
CO-3	compare and contrast saturated, mono-saturated and poly-saturated fatty acids.	1	Kn
CO-4	know the structure and classification of proteins	5	Kn
CO-5	know the classification and properties of amino acids.	5	Kn
CO-6	recognize the importance of nucleic acids and its role.	6	Un
CO-7	know the dna, rna structure, function, types and importance	6	Kn
CO-8	understand the functions of enzymes, coenzymes and cofactors	5,6	Un

SEMESTER I			
Core III- Biochemistry			
Course Code : 21PMIC13	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I - Nucleic acid

Nucleic acid- structure of nitrogen bases and base pairing, structure of nucleosides, nucleotides, Ribose, Deoxyribose sugar. DNA, RNA structure, function, types and importance.

Unit II - Proteins

Proteins- classification, structure of primary, secondary, tertiary and quarternary protein, classification of amino acids, properties, peptide bond, formation and types

Unit III - Enzymes

Enzymes- concept, definition, nature, active site, properties, classification, physico-chemical properties. Factors affecting the enzyme synthesis and activity. Allosterism – Determination of Michaelis Menten constant – Factors affecting Km Value – Mode of Enzyme action (Lock and Key model and Induced fit model)- coenzymes – Cofactors – Isozymes and Inhibitors.

Unit IV - Carbohydrates

Carbohydrates- definition and classification- properties- optical and chemical structure of glucose, ring structure, Haworth and Fischer's projection, pyranose, furanose isomers, mutarotation, triose, pentose, hexose, heptose,- examples and structures, derived monosaccharide, glycosides, furanoacids, sugar, phosphates, uronic acids, sugar alcohol, disaccharides, glycosidic linkage, lactose, maltose, sucrose, oligosaccharide, trisaccharides, structure of raffinose- polysaccharide- homo polysaccharide, hetero polysaccharide structure, starch, cellulose, mucopolysaccharide,and biological significance.

Unit V - Lipids

Lipids- classification, chemistry of fatty acids- unsaturated, saturated fatty acids, triglycerides, saponification, sterols, cholesterol, prostaglandins, glycolipids and function of lipids.

Books for Reference :

1. Stryer,L.. *Biochemistry.* Newyork: Ed.W.H. Freeman and company, 1995.
2. J.L.Jain, *Fundamental of Biochemistry*- New Delhi: S.Chand & company Ltd,, 1999.
3. A.C.Deb *Concepts of Biochemistry.* Kolkata Books and Allied (P) Ltd. 7th Edition, 1999.
4. Hubert, Styer,. *Biochemistry*– Newyork: Freeman and Company, 1995.
5. Lehninger,. *Principle of Biochemistry.* by Nelson and Cox (Worth) 3rd edition, 2009
6. A.C.Deb. *Concepts of Biochemistry.* Kolkata: Books and Allied (P) Ltd., thEdition, 1999

SEMESTER – I			
Core – IV Microbial Physiology			
Course Code : 21PMIC14	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Objectives:

To give the students knowledge about the physiological processes of micro organisms.

To impart advanced level information in the subject of microbial physiology.

Course outcome:

CO No	Upon completion of this course students will be able to	PSO addressed	CL
CO -1	illustrate the basic knowledge about the microbial physiology fuctions and its various metabolism	3	Re
CO - 2	define various components of electron transport chain and their functions.	4,3	Re
CO -3	elaborate the bacterial growth curve and the measurement of their cell growth	4	Cr
CO - 4	explain the various bacterial transport mechanisms and their secretion system	2	Un
CO - 5	discuss about various electron transport takes place under aerobic and anaerobic condition.	1,3	Cr
CO- 6	interpret the list of fermentation mechanisms for atp regeneration.	7	Un
CO -7	prioritize various aerobic and anaerobic phototrophic bacteria with examples	1,2	E v
CO - 8	know about various pigments of the photosynthetic apparatus and learn about photosynthesis in *halobacteria* bioluminescence.	2,6	K n

SEMESTER – I			
Core – IV Microbial Physiology			
Course Code : 21PMIC14	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I – Respiration and its related pathways

Definition, terminology – types - specific functions and general pattern of metabolism - anabolism Vs catabolism - metabolic pathways - linear, irreversible and branched metabolic pathways. Aerobic respiration – glycolysis - TCA cycle, gluconeogenesis and Calvin-Benson cycle.

Unit II – Microbial growth and transport

Microbial growth- Growth curve of bacteria- Measurement of cell growth - factors affecting microbial growth: physical, chemical and biological

Bacterial Transport: Simple, passive, active transport: Symport and Antiport and Group translocation mechanisms – Role of siderophores.

Unit III- Electron transport chain

Electron transport chain: Functions and components ; NAD, NADP, FAD, FMN, Coenzyme Q, Cytochromes, Ferredoxin and Iron Sulphur protein – Mechanism of electron movement in aerobic and anaerobic organism - Chemiosmotic theory. Substrate level phosphorylation, Oxidative phosphorylation.

Electron transport under anaerobic conditions - nitrate respiration, sulphate respiration, sulphur respiration, carbonate respiration, fumarate respiration and iron respiration.

Unit IV- Fermentation

Outline mechanisms and ATP regeneration by fermentation- alcoholic fermentation by yeasts and bacteria- ethanol formation. Lactic acid fermentation- homo-fermentation, hetero-fermentation - propionic acid fermentation - formic acid fermentation – butyric acid- butanol fermentation - homo acetate fermentation- Bioluminescence.

Unit V- Photosynthesis

Aerobic and anaerobic phototropic bacteria-purple sulphur, non-sulphur purple bacteria, green sulphur bacteria and Cyanobacteria-pigments of the photosynthetic apparatus-bacterio-chlorophylls, carotenoids and bacterirhodopsin- localization of the pigments-regulation of pigments. Anoxygenic photosynthesis-Oxygenic photosynthesis-photosynthesis in halobacteria.

Books for Reference:

1. Santhyanarayana. U.. *Essentials of Biochemistry*. Kolkata Books and Allied (P) Ltd., 1st Edition, 2002.
2. A.C.Deb. *Concepts of Biochemistry.* Kolkata: 7th Edition, Books and Allied (P)Ltd.,. 1999.
3. Prescott, Lansing M, Harley, John P, Klein Donald A, ,*Microbiology*. McGraw-Hill, New York, 1999.
4. David L. Nelson. *Lehninger Principle of Biochemistry*. .7th edition. 2017.
5. Stryer,. *Biochemistry* 5th edn W.H. Freeman. 2001.
6. Dr.J.L.Jain, Dr.Sunjay Jain and Nitin Jain, *Fundamentals of Biochemistry.* S.Chand Publisher, VI Edition. 2005.

SEMESTER – II			
Core – V Immunology			
Course Code : 21PMIC21	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Objectives:

To impact advanced level information in the study of the immune system.

To study about the various immune responses of the human system towards the pathogens.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	interpret the basic system of immune response.	1	Un
CO - 2	recall about the classification of various immune cells and their functions in elevating immune response.	4	R e
CO - 3	improve knowledge about the nature , functions and characteristics of antigen and antibodies involved in immune response.	3,2	C r
CO - 4	assess the detailed information about the mhc and hla.	4	Ev
CO - 5	illustrate various complement fixation pathways and their basic mechanisms.	6	U n
CO - 6	interpret the knowledge about various antigen and antibody reactions with their principle.	1	Un
CO - 7	improve the knowledge about various hypersensitivity reactions and transplantation immunology.	3,4	Cr
CO - 8	prioritize various applications of monoclonal antibodies and types of vaccines.	1	E v

SEMESTER – II			
Core – V Immunology			
Course Code : 21PMIC21	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Unit: I– Basics of Immunology

History and development of immunology - Immunity: Innate & Acquired. An over view on the cells of immune system. Organs & tissues of immune system. Clonal selection theory. Immune response: HIR & CMI. Phagocytosis.

Unit: II–Immune response and its components

Antigens and antibody – structure, types and functions. Antibody diversity: isotypes, allotypes and idiotypes. Biology of T & B cell. Major Histo compatibility Complex (MHC). Human leucocyte antigen (HLA). Complement pathways: classical, alternative.

Unit: III – Applied Immunology

Agglutination. Precipitation. Complement fixation. Immunoblotting. Immuno-fluorescence. Immunodiffusion: SRID, ODD & Immnoelectrophoresis - RIEP. Flow cytometry. Radio Immuno Assay.

Unit: IV - Clinical Immunology

Hypersensitivity - immediate & delayed type. Autoimmunity. Transplantation immunology. Tumor immunology. Immuno deficiency diseases - AIDS

Unit: V -- Immunization

Monoclonal antibody: production & applications. Vaccination: types, principle & applications. Current basic immunization schedule.

Books for Reference:

1. Stefan, H. and Kaufmann, E*Immunology of infectious diseases.* USA : ASM Press,. .2002.
2. Abbas, A.K., Lichtman, A.H. and Pober, J.S.. *Cellular and Molecular Immunology.* (2nd edition). USA: WB Saunders,. 1994
3. Humphrey, J.H, and Wite, R.G. *Immunology for students of Medicine,* (5th edition) ELBS, London: 1995.
4. Weir, D.M. *Experimental Techniques in Immunology*. London : Blackwell Scientific Publishers,. 1995.
5. Donald M. Weir and John Sterward . *Immunology* (7theditoin). ELBS, London: 1993.
6. Hue Davis.. *Introductory Immunology* (1st edition). London : Chapman and Hall Publisher,. 1997.
7. Ivan M. Roit . *Essential Immunology* – London : Blackwell Scientific.Publishers,. 1998.
8. Paul .. *Fundamental Immunology,* (2nd edition). New York: Raver Press,. 1998.

9. Peter J. Delves and Ivan M. Roit (Eds). *Encyclopedia of immunology* -(2nd edition). Academic Press. 1998.
10. Ridklad, M. Aydl . *Immunology,* (2nd edition), Baltimore, Hong Kong, NMS Publication. 1995.
11. Roit, J.M., Brostaff, J.J and male, D.K. . *Immunology* (4th edition). C.V. Mosby Publisher, St. Loius. 1996.
12. Stewart Sell.. *Immunology, immunopathology and immunity.* (6th edition). USA: ASM Press,. 2001
13. Rajan, S.. *Medical microbiology*, Chennai : MJP Publishers,. 2007
14. Fathimunisa Begum.. *Monoclonal antibodies: The hopeful drugs.* Chennai: MJP Publishers,. 2008
15. Kannan, I. Immunology. Chennai: MJP Publishers, 2007.
16. Ananthanrayanan, R., and Panicker, J. *Text Book of Microbiology*. Orient longmans. 2000.

SEMESTER-II			
Core-VI Medical Microbiology			
Course Code: 21PMIC22	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits:4**

Objectives:

A centre of excellence for training and research in medical microbiology.

To train quality healthcare professionals carry out creative innovative and inventive research and provide reliable diagnostic services in the field of medical microbiology.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	recall the clinical microbiology concept to patient care	1	Re
CO -2	analyse the level information in the subject of medical microbiology	6	An
CO -3	illustrate the different classes of microbes	3	Un
CO -4	describe the applied microbiology aspects of clinical technique**.**	1	Un
CO- 5	describe the role of chemotherapic technique	4	Un
CO -6	explain the drug resistance capacity of microbes	4	Un
CO -7	outline the concepts of chemotherapy and its mode of action	4	Un
CO -8	explain the knowledge of mycology and parasitology	5	Un

SEMESTER-II			
Core-VI Medical Microbiology			
Course Code: 21PMIC22	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits:4**

Unit-I : Infection and transmission

Microbial diseases - sources, route of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections. Immunity of microbial diseases. Diagnosis of microbial diseases - Collection, transport, preliminary processing of clinical pathogens.

Unit- II: Bacterial diseases

Characteristics, classification, pathogenesis, pathology, diagnosis, treatment, prevention and control of diseases caused by *Staphylococci, Bacillus, Clostridium, Corynebacterium, Salmonella, Klebsiella, Vibrio, Pseudomonas, Mycobacteria.*

Unit- III: Viral diseases

Etiology, Clinical symptoms, laboratory diagnosis and treatment-Pox virus(small pox,)-Herpes virus-(HSVI&II), Orthomyxovirus (Infleunza virus, Swine Flu) - Paramyxovirus (Measles and Mumps), Enterovirus (Poliovirus), Arbovirus- (Chikungunga virus, Dengue, rubella), Hepatitis virus(HAV, HBV, HCV, HDV), HIV,SARS.

Unit-IV: Mycology and Parasitology

Human mycotic infections caused by Dermatophytes*, Histoplasma, Cryptococcus, Candida,* opportunistic mycoses. Medical importance of *Entamoeba, Giardia, Taenia, Ascaris*, Laboratory techniques in parasitology.

Unit-V: Antimicrobial agents

Classification of antimicrobial agents, Mechanism of drug action –antibacterial (Bacteriostatic and bactericidal) antifungal and antiprotozoans. Methods of testing drug sensitivity (*in vitro* and *in vivo*), antibiotic assay in body fluids. Mechanism of drug resistance and dissemination of multi drug resistance. Probiotics as therapeutic agents.

Books for Reference:

1. Chaechter M. Medoff G. and Eisenstein BC. *Mechanism of Microbial Diseases* 2nd edition. Baltimore: Williams and Wilkins,. 1993.
2. David Greenwood, Richard CD, Slack, John Forrest Peutherer. *Medical Microbiology*. 14th edition. ELBS with Churchill Livingstone. 1992.
3. Hugo WB and Russell AD. *Pharmaceutical Microbiology* 4th edition. Oxford : Blackwell Scientific Publication,. 1989.

4. Joan Stokes E, Ridgway GL and Wren MWD. *Clinical Microbiology*, 7th edition. Edward Arnold. A division of Hodder and Stoughton. 1993.
5. Ronald M. Atlas. *Microbiology. Fundamentals and Applications*. 2nd edition, Maxwell Macmillan international editions. 1989.
6. Topley and Wilsons's. *Principles of Bacteriology, Virology and Immunity,* London: 8th edition, Vol. III Bacterial Diseases, Edward Arnold,. 1990.
7. Connie R Mahon. *Textbook of Diagnostic Microbiology*. 3rd edition. Pearson. 2010.
8. Fritz H. Kayser. *Medical microbiology*. Thieme Verlag. 2005.
9. Credric, A. Mims. *Medical microbiology*. 3rd edition. Moshy Inc. 2004.
10. Frank, Steven A. *Immunology and Evolution of Infectious Disease*. Princeton University Press. 2002.

Web References:

1. http://dmoz.org/Science/Biology/Microbiology/
2. http://microbiology.mtsinai.on.ca/manual/default.asp
3. http://cal.vet.upenn.edu/parasite/links.html
4. http.www.suite101.com/links.cfm/microbiology
5. http://www.biosci.ohio-state.edu/-zoology/parasite/home.html

SEMESTER – II			
Core –VII Microbial Genetics and Molecular Biology			
Course Code: 21PMIC23	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Objectives:

To make the students knowledgeable in the field of Microbial Genetics and Molecular Biology.

To make the students aware of the concepts of Microbial Genetics and Molecular Biology.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	relate the genetics of microorganisms	1	Re
CO-2	recall the molecular mechanisms of microorganisms	1	Re
CO-3	explain all important topics to prepare for competitive exams	5	Un
CO-4	examine the history of molecular biology	2	An
CO-5	analyse about nucleic acids, their damage and repair mechanism	6	An
CO-6	compare all gene transfer methods	2	Ev
CO-7	interpret the central dogma of molecular biology	1	Un
CO-8	agree the concept of mutation	2	Ev

SEMESTER – II			
Core –VII Microbial Genetics and Molecular Biology			
Course Code: 21PMIC23	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Unit I: DNA-The Genetic Engineering

Historical aspects and current concepts of Molecular Biology - Experimental evidence for Nucleic acids as genetic information carriers - DNA features: Superhelicity, linking number, topological properties – Melting of DNA - DNA replication: General principles, Experimental proof for modes of replication, proof reading – Enzymology of DNA replication.

Unit II: DNA Damage and Repair

Relationships between replication and cell cycle- Inhibitors of DNA replication (Blocking precursor synthesis, nucleotide polymerization and altering DNA structure),- DNA damage and repair – Types of DNA damage (Dimeration, oxidative damage, alkylation pyrimidine dimers) – Repair pathways : Methyl directed very short patch repair, nucleotide excision repair, base excision repair, recombinational repair and SOS repair.

Unit III: Central Dogma of Molecular Biology

Transcription in Prokaryotes - General principles, basic apparatus, types of RNA polymerases, steps in initiation, elongation and termination, inhibitors of RNA synthesis – Polycistronic and monocistronic RNAs – Control of transcription by RNA polymerases, promoter regions, sigma factors – Controlled termination: Attenuation and anti – termination– Protein synthesis: Steps, details of initiation elongation and termination, role of various factors, inhibitors – Signal hypothesis.

Regulation of gene expression: Operation concept, catabolite repression, instability of bacterial RNA, negative regulation *(E.coli,* lac operon), Positive regulation (*E.coli* ara operon) – Regulation by attenuation (trp operon). Maturation and processing of RNA: Methylation, trimming of rRNA - Capping, Poly adenylation and splicing of mRNA – Cutting and modification of tRNA.

Unit IV: Gene as a Unit of Mutation and Recombination

Mutants and mutation, mutagens, revertants, spontaneous mutation, mutant isolation, mutagenesis and it's types, suppression – Plasmids: Types, detection, transfer, replication and properties. Transposable elements – Nomenclature, classes, IS elements, Transposons – Composite structure and complex transposon structure, mechanism of transposition.

Unit V: Gene Transfer Mechanisms

Transformation modes, transformation, natural and artificial competence, DNA uptake, molecular mechanisms of transformation in *Bacillus* sp and *E.coli* recombination and genetic mapping, Bacterial conjugation – F plasmid, structure and function, origin of conjugation (Hfr and F+) Interrupted and uninterrupted mating, time map and recombination map, conjugation in *E.coli*, colicins and col factors. Transduction – Generalized and Specialized – Lambda phage and P1 Mechanism of gene transfer through lambda and P1 Phages – HFT and LFT lysate – Co transduction – Transduction mapping.

Books for Reference:

1. David Freifelder, George M. Malacinski. *Molecular Biology*. Narosa Publishing House. 1993.
2. Avinash ., Kakoli Upadhyay MolBio - *Fundamentals of Molecular Biology* . Himalaya Publishing House. 2005.
3. Satyanarayana. U. .*Biotechnnology* – Books and Allied (P) Ltd. 2013
4. Mohan P. Arora., Gurdarshan.,Sandhu. S.*Genetics*.5th edition. Himalaya Publishing House.' 2004
5. Sambamurty.A.V.S.S . *Molecular Biology*. Narosa Publishing House. 2011.
6. Veer Bala Rastogi. *Fundamentals of Molecular Biology*. India : Ane Books. 2010
7. Jeyanthi,G.P . *Molecular Biology.* Chennai: MJP Publisher, 2009
8. Raja Pandian.K., Shanthi. S. *Molecular Biology and Microbial Genetics*. PBS Book Enterprises. 2011.

SEMESTER – II			
Core VIII -Marine Microbiology			
Course Code :21PMIC24	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits:4**

Objectives:

To provide the learners with the best learning experience in Marine Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.

To develop young students with active and creative minds in the field of microbiology. To motivate learners to contribute to sustainable development of nation through environmental protection and social responsibility

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	describe the basic knowledge on marine ecosystem.	1	Re
CO -2	acquire the knowledge about diversity of marine ecosystem	1,2	Kn
CO-3	can analyses the aware of bio fouling and prevention.	2,3,4	Ev
CO-4	interpret the knowledge on marine microorganisms.	1,2	Ap
CO-5	determines the microbial indicator organisms.	1	Kn
CO-6	explain the concept of marine pollution	2,3,4	Co
CO-7	grasp the knowledge about bioactive compounds.	2,3,4	An
CO-8	know the wealth of the sea	2	Kn

SEMESTER – II			
Core VIII -Marine Microbiology			
Course Code :21PMIC24	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I : Marine Environment – Zonation and Biota

Classification of marine environment. – Plankton– classification (size, life, habitat) and adaptations. Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. light, temperature, pressure. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit II: Marine Diversity

Ecology of coastal, shallow and deep sea microorganism - importance and their significance. Diversity of microorganism - Nutrient cycles- Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments including mangroves.

Unit III: Marine Ecosystems

Estuaries, salt marshes, mangroves. Coral reef -– ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves). Actinomycetes in the mangroves and coral environment.

Unit IV: Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Microbial indicators of pollution. Role of microbes in pollution abatement, Bio fouling. Microbial biodegradation - hydrocarbon. Bioremediation of heavy metal.

Unit V :Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Phycocolloids; agar-agar and algin. Microbial diseases diagnosis and control. Marine microorganisms as a source of biomedical resources - dinoflagellates as a source of bioactive molecules - chemistry and pharmacology of marine toxins - saxitoxin -tetradotoxin.

Books for Reference:

1. Gross, G.,.*Oceanography: A view of the Earth*. 6th edition. New Jersey: Prentice Hall Inc.,. 1993

2. McCormick, J.M. and Thiruvathaakal J.V., *Elements of Oceanography.* Philadelphia: W.B. Saunders Company,. 1976.

3. Nybakken, J.W.. *Marine Biology – An Ecological Approach*. California: Addison Weslay Longman, Inc., 477pp. 1997

4. Olivia J.Fernando. *Sea water-Properties and dynamics*, Thanjavur : Dhanesh Publications, Ponnagam,. 1999.

5. Russel. *Marine Ecology*, London and New York: Academic Press-. 1970.

6. Nelson and Smith, *Oil pollution and Marine Ecology*-Plenum press. 1973.

7. Daws, C.J.. *Marine Botany.* New York : John Wiley and Sons,. 1981.

8. Austin. B, and D.A Austin. *Bacterial Fish pathogens- Diseases of Farmed and Wild Fish.* Springer Publisher. 1999.

9. Munn and Munn. *Marine Microbiology: Ecology and Applications*. BIOS Scientific publisher. 1996.

10. Rheinheimer, G., *Aquatic Microbiology-an Ecological Approach*. Blackwell Scientific Publications. 1980.

SEMESTER-III			
Core-IX- Industrial and Pharmaceutical Microbiology			
Course Code:21PMIC31	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:4**

Objectives:

1. To impart the professional ability and skill by increasing the global knowledge, Understanding and application in Industrial and Pharmaceutical Microbiology.
2. To empower the learners to address current and future challenges faced by the humanity using Industrial and Pharmaceutical Microbiology.

Course outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	revise the idea about the usage of microorganisms in the field of industrial microbiology	3	An
CO -2	analyse the knowledge of various industrial and pharmaceutical products and its impacts on the society.	4	Un
CO -3	knowledgeable in industrial fermentation	3	Un
CO -4	have an insight on industrial microbiological techniques	2	Re
CO -5	understands in the field of pharmaceutical microbiology	1	Un
CO-6	Knowledge of basics and applied microbiological aspects of industries.	1	Un
CO-7	acquire the knowledge about production of various industrial and pharmaceutical products	4,5	Un
CO-8	know the detail knowledge about antibiotics and production of hormones	2,3,4	Un, Ap

SEMESTER-III			
Core-IX- Industrial and Pharmaceutical Microbiology			
Course Code: 21PMIC31	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:4**

Unit-I- Basics of Industrial Microbiology

Historical account of microbes in industrial Microbiology; Screening, isolation, preservation and improvement of industrially important microorganisms; Strain improvement; Fermenter - principles and design - types of Fermenter, Instrumentation and control- aeration and agitation. Raw materials and media formulation for fermentation processes; Industrial Sterilization; Microbial growth kinetics in Batch, Continuous and Fed batch fermentation. Downstream processing.

Unit-II- Microbial products

Microbial production of industrially important products: Solvents (Alcohol and Acetone); Aminoacids (Glutamic acid and Lysine); Organic acids (Citric acid and Acetic acid); Enzymes (Microbial rennet, Amylase, Protease); Biopolymers (Xanthan gum and PHB); Biopreservatives (Nisin); Antibiotics - (Penicillin, Cephalosporin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Production of Hormones (Auxins and Gibberellins). Production of protein in bacteria and yeast (Chymosin production) – Synthetic and recombinant vaccines.

Unit-III- Bio pesticides and Bio fertilizers

Bio pesticides – history of development, production of bio pesticides from bacteria (BT), fungi (*Trichoderma viride*), virus (NPV) and their applications against different types of pathogens. Bio fertilizer – mass production of bio fertilizer (*Rhizobium*, *Azotobacte*r), quality control and field applications.

Unit-IV- Basics of Pharmaceutical Microbiology

Properties of antimicrobial agents, types of chemotherapeutic agents – Synthetic, Semi synthetic, Natural therapeutic agents. Types of antibiotics and their mode of action: antibacterial, antifungal, antiviral, antiprotozoal. Pharmaceutical Formulation (Tablets, Capsule, Oinments, Syrup, Gel), stages of pharmaceutical product development.

Unit-V- Spoilage and preservation of Pharmaceutical products

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Objectives of preservation, the ideal preservative, preservative system. Antimicrobial preservatives and their properties. Preservative stability and efficacy.

Text books:

1) Dubey, R.C. *A Textbook of Biotechnol*ogy. New Delhi: S Chand and Company Limited. 4th Rev. Edition 2006.

2) Gupta, P.K. *Elements of Biotechnology.* Meerut: Rastogi Publications, 2005.

3) Jogdand, S. N. *Gene Biotechnology.* New Delhi: Himalaya publishing house. 4th Edition, 2016.

4) Reed, G Prescott and Dunn. *Industrial Microbiology.* US: Macmillan Publication. 1982.

Books for Reference:

1) Wulf Crueger. *A Text Book of Industrial Microbiology.* New Delhi: Panima Publishing Corporation. 1st edition 2000

2) Patel A.H. *Industrial Microbiology.* India: Macmillan Limited. 2017.

3) Casida L.E. *Industrial Microbiolog*y. NewYork: Eastern Limited. 1986.

SEMESTER-III			
Core-X- Genetic Engineering			
Course Code -21PMIC32	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:4**

Objectives:

1. To promote applicable genetics, bioengineering, and bio technological knowledge through education and state of the art technologies

2. Educate students for technical competence and knowledge management in different areas of Genetic engineering.

Course outcomes:

C O No	Upon completion of this course, students will be able to	PSO's Addressed	CL
CO- 1	Explain the knowledge about cloning	2	An,Un
CO -2	Perceive the applications of genetic engineering in various fields	4	Un, Re
CO- 3	Understands the hazardous and potential risk in releasing transgenic into environment	5	Un
CO -4	Create the techniques used in genetic engineering	2	An, Re
CO -5	Understands the concepts of blotting techniques and its applications	3	Un
CO -6	Discuss the cloning techniques and the production of transgenic materials	4	Un,An
CO -7	Understand the synthesis of genetically modified commercial products	4	Un
CO- 8	Make use of enzymology in genetic engineering	1	Cr

SEMESTER-III			
Core-X- Genetic Engineering			
Course Code -21PMIC32	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:4**

Unit – I: Gene cloning and vectors

Biology of vectors – Cosmids, phasmids, specialized vectors – Plant viral vectors, Animal viral vectors, Virus vectors and other plasmid vectors – Biology of host – *Escherichia coli* , *Saccharomyces cerevisiae*. Cloning strategies: Cloning of genomic DNA, cDNA cloning

Unit II: Enzymology of genetic engineering

Restriction enzymes – Types - Nomenclature – Recognition sequences – Cleavage patterns. Other enzymes used in Genetic engineering – DNA Ligase, Nuclease, Alkaline phosphatase, Kinase, Reverse transcriptase, Taq DNA polymerase, Thermal transferase, DPN1 enzyme.

Unit-III: Recombinant techniques

Blotting techniques – Southern, Northern and Western Blotting – Transformation of E.coli- PCR – types and variation- RFLP – AFLP – RAPD – SSCP and VNTR- Construction of cDNA library – Molecular mapping of genome – Genetic and physical maps.

Unit- IV: Synthesis of commercial products by Recombinant microorganisms

Antibiotics, Vitamins, Amino acids, Recombinant vaccines, Hormones, Monoclonal antibodies, Biopolymers. Genetic engineering of bio-degradative pathways – Manipulation by Transfer of plasmids and Gene alteration.

Unit – V: Cloning in plants and animals

Transgenic plant (Golden rice, Tearless onion, Colourful cauliflower, FlavrSavr Tomato) – Transgenic animal (Transgenic Fish, Transgenic Mouse, Transgenic Pig, Dolly) – GEM (Super bug) – Ethical aspects of Biotechnology

Books for Reference:

1. Burrel, M.M. *Enzymes of Molecular Biology*, Humana press. 1993.
2. Chirikjian, J.G. *Biotechnology- Theory and Techniques.*Vol.II, Jones and Burtlett Publishers. 1995.
3. Gerhardt, P., Murray, R.G., Wood, W.A., and Kreig, N.R. *Methods for General and Molecular Bacteriology*. Washington D.C: ASM Press, 1994.
4. Cafferty. Mc. J., Hoogenboom, H.R. and Chiswell, D.J. *Antibody Engineering- A Practical Approach,* Oxford University Press, 1996.
5. Lewin, B. *Genes VII*, Oxford: Oxford University Press,. 2000.
6. Murray Moo Young . *Plant Biotechnology*. Pergamon Press. 1992.
7. Radledge, C. and Kristiansen, B. *Basic Biotechnology*.2nd Edition.Cambridge University Press. 2001.
8. Das. H.K. *Text Book of Biotechnology*. New Delhi: Wiley Dreamtech India (P) Ltd., 2005.
9. Rigby. P.W.J.Ed. *Genetic Engineering*. London: 6thAcadamic press, 1987.
10. Wiseman.A. *Principles of Biotechnology*. New York: Chapman and Hall, 1983.
11. Desmond.S.T., Nicholl. *An Introduction to Genetic Engineering.* Cambridge Press. 1994.
12. Winnacker, E.L. *From Genes to Clones. Introduction to Gene technology*. New Delhi: Panima Publishing Corporation, 1st Edition. 1987.
13. Brown, T.A. *Gene Cloning – An Introduction*. Chapman and Hall, UK: 3rd Edition. 1995.
14. Glick, B.K. and Pasternik, J.J. *Molecular Biotechnology. Principles and applications of recombinant DNA.* ASM Press. 2nd Edition. 1998.
15. Mitra. *Genetic engineering*. Chennai: Published by Macmillan India Ltd., 2005.
16. Jogdand S.N . *Gene biotechnology*. Mumbai: Himalaya Publishing House, 2005.
17. Satyanarayan, *Biotechnology*. Kolkata: Books and Allied (P) Ltd., 1st edition, 2005.
18. Preeti Joshi, *Genetic engineering and its application*. Agrobios. India: 1st edition, 2002.
19. Bernad R Glick, *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. Washington, D.C: ASM Press, 3rd edition, 2003.
20. Ramawat K and Shaily Goyal, *Molecular Biology and Biotechnology*. New Delhi: S.Chand and company Ltd., 1st edition, 2010.

SEMESTER –III			
Core- XI - Food and Dairy Microbiology			
Course Code : 21PMIC33	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives:

To impart the advanced level knowledge in the subject of food microbiology

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	Recall the techniques in food microbiology.	1	An
CO- 2	Explain the about microorganisms important in food	2,5	Un
CO -3	Knowledge about the microbial contamination of food.	1,2,4	Un
CO- 4	knows about the techniques in food preservation and fermented foods	3,4,6	Re
CO -5	Knowledge about beneficial and harmful aspects of microbes in dairy products	2,4,5,6	Cr
CO -6	Communicate the recent techniques on good manufacturing.	2,4,5,6	Un
CO-7	Grasp the quality and safety assurance in food industry and the hazard analysis and critical control point	2,3	Re, Un
CO-8	Grasp microbial examinations in food	4,5	Un,Ap

SEMESTER –III			
Core- XI-Food and Dairy Microbiology			
Course Code : 21PMIC33	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit I : Introduction to Food Microbiology

Food as a substrate for microorganisms – Microorganisms important in food microbiology – Molds, yeasts and bacteria –General characteristics, classification and importance –Factors influencing microbial growth in food – Extrinsic and intrinsic factors (Nutrient content, pH, redox potential, relative humidity, temperature, gaseous atmosphere).

Unit II: Microbial contamination of foods

Microbial contamination of foods - spoilage of food by microbes in cereals and cereal products- fruits, vegetables and its dried products- Eggs and poultry – meat- fish – canned foods.

Unit III: Food Preservation

Principles of food preservation: Methods of food preservation – Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, Radiation - UV, Smoking chemicals – organic acids, nitrates, nitrites, sulphur di oxide and sulphites. Food fermentation: Bread, Tempeh, Fermented dairy products (Kefir, Koumiss, Acidophilus milk).

Unit IV: Dairy Microbiology

Dairy Introduction – Sources of microorganisms in milk – Classification of microbes – Biochemical types, characteristics and pathology. Milk borne diseases – bacterial (Mastitis, Anthrax, Brucellosis, Diphtheria, Tetanus) and viral diseases (Food and mouth disease, Rinderpest, Cowpox, and Virus diarrhoea) in cattle's – Control measures.

Unit V: Microbiological examination of foods

Microbiological examination of foods – Estimation and examination of specific microorganisms, Bacteriological examination of milk – microbial standard and milk grading- MBRT and Resazurin method. Good manufacturing practice, hazard analysis critical control point (HACCP) concept. BIS Laboratoryservice.

Textbook:

1. FrazierW.C., and Westhoff D.C., *Food Microbiology.* New Delhi: Tata McGraw Hill Publishing Co. Ltd,. 4th edition, 2008

Books for Reference:

1. Adams M.R., and Moss M.O., *Food Microbiology*. Cambridge: The Royal Society of chemistry, 1995.
2. Atlas. R.M., *Microbiology–Fundamentals and Applications*, MacmillianPublishing Company. 1989.
3. Banwart G.J., *Basic Food Microbiology*. NewYork: Chapman & Hall. 1989.
4. Board R.C., *A modern Introduction to food Microbiology.* Oxford: Blackwell Scientific Publication,. 1983.
5. Robinson .R.K., *Dairy Microbiology*. London: Elsevier Applied Sciences, 1990.
6. Jay J.M. *Modern Food Microbiology*. New Delhi: CBS Publishers and Distributors, 1987.

SEMESTER – IV			
Core – XIII- Environmental Microbiology			
Course Code :21PMIC41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Objectives:

1. To provide the learners with the best learning experience in Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.
2. Developing young students with active and creative minds in the field of microbiology enabling the students to become entrepreneur by applying the microbial technology.
3. Motivating learners to contribute to sustainable development of nation through environmental protection and social responsibility.

Course Outcome:

CO.No	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	recall the ecological groups of microbes	1	Re,
CO -2	have knowledge about the interaction between microbes and organisms at other tropic level.	1,2	Un, An
CO-3	interpret the microbiology of sewage and its treatment	2,3	Co
CO-4	explain about aero microbiology and microbial ecology	2	Un, An
CO-5	acquire basic knowledge about water purification	2	Ap
CO-6	gets knowledge about biogeochemical cycles	2,4	Co
CO-7	understanding about biodegradation.	2	Sy
CO-8	develop the application of biodegradation and bioremediation.	5	Ap, Cr

SEMESTER – IV			
Core – XIII- Environmental Microbiology			
Course Code :21PMIC41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Unit I: Microbial Ecology

Interaction between abiotic and biotic factors in an ecosystem, ecological niche, limiting factor, concept of community, fluctuation and succession. Basic concept of food chain, food web and energy flow. Microbial symbiosis: commensalism, mutualism, parasitism and predation with examples.

Unit II: Biogeochemical cycles

Types of biogeochemical cycles: Water cycle, gaseous cycle (Oxygen, Carbon & Nitrogen), and sedimentary cycles (Sulphur & Phosphorus). Biogeochemical cycles of micronutrients.

Unit III: Aerobiology

Air space in different layers of atmosphere, bioaerosol, assessment of air quality - sedimentation, impaction impingement, suction, and filtration. Brief account of transmission of airborne microbes (Bacteria, Virus & Fungi). Microbiology of indoor and outdoor. Allergy: causes and tests for detection of allergy.

Unit IV: Aquatic Microbiology

The aquatic ecosystem (Pond)– factors governing micro flora and their distribution in natural water. Water pollution and its sources. Role of organic pollutants in water, concepts of C-BOD, N-BOD & COD. Treatment of waste water by aerobic and anaerobic processes (like trickling filter, activated sludge, oxidative pond, anaerobic digestion and chemical disinfection).

Unit V: Advancement in Bioremediation

Concept, principle and mechanism of bioremediation, factors affecting bioremediation, types of bioremediation. Bioremediation of metals with examples. Biodegradation and biotransformation of xenbiotics including pesticides, chlorinated and nitrated aromatic compounds, phenolic compounds and polycyclic aromatic compounds.

Books for Reference:

1. Atlas,R.M and Bartha.M. *Microbial Ecology –Fundamentals and applications.* California: *Benjamin – Cummings*, Mento Park, 2003.
2. SubbaRao, N.S. *Soil Microorganisms and Plant growth*. NewDelhi Oxford and IBH Publishing Co, Pvt. Ltd, 3rdEdition, 1995.
3. Gupta,S.K. *Approaches and trends in plant disease management*. India: Scientificpublishers.Jodhpur, 5th Edition, 2014.
4. Jammaluddin et al. . *Microbes and sustainable plant productivity* India*:* Jodhpur: Scientific Publishers,. 3rdEdition, 2013.
5. G.Purohit, S.S.Kothari,P.R.andMathur. *Basic and Agricultural Biotechnology*, India: Agrobotanical Publishers Bikaner. 1993.
6. Prescott, L.M., Harley, J.P. and Helin, D.A.. *Microbiology*, , New York. McGraw Hill, 5th Edition, 2008.
7. Schlegal, H.G.. *General Microbiology*, Cambridge: Cambridge Univeristy. 7th edition, 1995.
8. Prabhakaran, G. *Introduction to Soil and Agricultural Microbiology, New Delhi:* Himalaya Publishing House. 2004.
9. George N. Agrios.. *Plant Pathology*. Academic Press. 5th Edition. 2005
10. Raina M. Maier, Ian A. Pepper and Charles Gerba. *Environmental Microbiology*. Academic Press. 2nd edition. 2009.
11. Dubey, R.C. and Maheswari, D.K.. *A text book of Microbiology*, NewDelhi: S. Chand and Company Ltd, 2013.
12. Shiva Aithal, C. *Mordern approaches in Soil,Agricultural and Environmental Microbiology*. NewDelhi: Himalaya Publishers. 2010.
13. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D.. *Biology Microorganisms*, NewDelhi: Prentice Hall, 12th Edition, 2000.
14. Pelczar, M.J., Schan, E.C. and Kreig, N.R. *Microbiology – An application based approach*, NewDelhi: Tata McGraw Hill Publishing Company Limited, 5th Edition, 2010.

SEMESTER – IV			
Core – XIV- Soil and Agricultural Microbiology			
Course Code :21PMIC42	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Objectives:

1) To provide the learners with the best learning experience in Soil and agricultural Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.

2) To develop young students with active and creative minds in the field of microbiology

3) To enabling the students to become entrepreneur by applying the microbial technology.

4) To motivate learners to contribute to sustainable development of nation through environmental protection and social responsibility

Course Outcome:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	recall the ecological groups of microbes and properties of soil	1	Re, Un
CO -2	have knowledge about the soil fertility	1,2	Un
CO-3	recall the previous basic knowledge about nitrogen fixing	1,2	Re, Co
CO-4	explain about plant microbe interaction.	2	Un
CO-5	acquire basic knowledge about important of plant microbe interaction for different layers (rhizosphere, phyllosphere)	2	Ap ,Un
CO-6	gets knowledge about recombinant microbes in agriculture.	2,4	Un, Co
CO-7	demonstrate an understanding of bio fertilizer	2	Sy
CO-8	develop the application of bio fertilizers in agricultural	5	Ap, Cr

SEMESTER – IV			
Core – XIV- Soil and Agricultural Microbiology			
Course Code :21PMIC42	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Unit I : Microbes and soil fertility

Introduction and concepts of agricultural microbiology- soil microorganisms – bacteria (Cyanobacteria and Actinobacteria), algae, fungi, protozoans, nematodes and viruses Soil formation - Soil properties – Physical and chemical - Role of microbes in soil fertility. Soil fertility evaluation and improvement.

Unit II: Biogeochemical cycling and microbes

Biogeochemical cycles – Carbon, Phosphorus, Sulphur, Iron, Nitrogen - Symbiotic nitrogen fixation (*Rhizobium, Frankia*), non- symbiotic nitrogen fixation (*Azotobacter, Azospirillum*); Nitrogenase enzyme, *nif*genes and molecular mechanism of nitrogen fixation. Role of nodulin genes in nodule development and symbiosis. Genetic engineering of BNF.

Unit III: Plant-microbial interaction

Interrelationships between plants and microorganisms and their interactions with plants. Microbial associations in Spermosphere, Phytosphere, Rhizosphere (Mycorrhiza types and importance to agriculture) –phyllosphere (Anabaena-Azolla) -decomposition of organic Matter by microorganisms - cellulose, hemicellulose, lignin. Humus formation.

Unit IV: Plant Pathology

Plant pathogens: Bacterial – *Xanthomonas, Agrobacterium,*Fungal – *Cercospora, Pyricularia,* Viral – TMV, Bunchy top virus) Mechanisms of plant pathogenicity, symptoms of plant diseases, transmission of plant diseases. signaling events in pathogenesis and resistance to pathogens. Molecular basis of Plant disease control along with cultural practices, chemical and biological control.

Unit V: Bio fertilizers & **Bio pesticides**

Principles of mass production, Quality Control and Field applications - Bacterial bio fertilizer: *Rhizobium, Azotobacter- Azopirillum,*–Phosphobacteria. Algal biofertilizer - Blue green algae, Azolla.Fungal biofertilizers - Mycorrhizae – ecto and endo mycorrhiza. Biopesticides – Viral (NPV, CPV & GV), bacterial (*Bacillus thuringiensis*, *B. papillae* & *Pseudomonas* sp.), Fungal (*Beaveria* sp., *Metarrhizium* sp. & *Verticillium* sp.), Protozoan (*Mattesia* sp., *Nosema* sp., & *Lambornella* sp.)

Text books:

1. Dubey R.C. and Maheswari D.K.*A text book of Microbiology*.New Delhi:S. Chand and Company Ltd. Reprint, 2006.

2. Rangaswamy G and BagyarajD.J. *Agricultural Microbiology*. NewDelhi: Prentice-Hall of India Pvt Ltd.2nd edition, 2004.

Books for Reference:

1. Atlas R.M, and BarthaM. *Microbial Ecology –Fundamentals and applications.* California: Benjamin & Cummings, 2003.

2. Subba RaoN.S. *Soil Microorganisms and Plant growth*. New Delhi: Oxford and IBH Publishing Co, Pvt. Ltd, 3rd edition, 1995.

3. SahaT.K. *Ecology and Environmental Biology*. Kolkata: Books and Allied Pvt. Ltd., 2010.

4. Shiva Aithal, C. *Modern approaches in Soil, Agricultural and Environmental Microbiology*. New Delhi: Himalaya Publishers,.1st edition, 2010.

SEMESTER –IV			
Core Practical VIII - Laboratory in Applied Microbiology			
Course Code: 21PMICR8	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits:3**

Objectives:

To provide the learners with the best learning experience in Applied Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.

Course Outcome:

CO. No	**Upon completion of this course, students will be able to**	**PSO addressed**	**C L**
CO-1	acquire basic knowledge on preparation of vermin bed	4	Un, Ap
CO -2	explain the maintenance of vermicomposting.	4	Un, Ap
CO-3	appreciate the production of biogas from cassava tubes.	4	Ap
CO-4	grasp the knowledge about medicinal values of mushroom.	4	Un
CO-5	acquire knowledge about *spirullina* mass production	2	Ap
CO-6	knowledge about the bio gas production from organic waste.	4,2,5	Un,Ap
CO-7	have knowledge on entrepreneurship skill	2,4	Ap
CO-8	acquire detailed knowledge about production techniques through the industrial visit.	4,5	Un,Ap

SEMESTER –IV			
Core Practical VIII -Laboratory in Applied Microbiology			
Course Code: 21PMICR8	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 3**

1. Preparation of Vermi bed
2. Tissue culture - mushroom.
3. Estimate protein from mushroom.
4. Estimate carbohydrate from mushroom.
5. Estimate lipid from mushroom.
6. Mass production of the Blue-Green Alga *Spirulina.*
7. Mass production of Azolla
8. Cultivation of *Spirulina platensis* in different selective media.
9. Biogas production from Cassava tubers.
10. Biogas production from organic waste.
11. Biodegradation of dye using *Pseudomonas*
12. Isolation of biodegrading bacteria from soil
13. Preparation of bio fertilizer (Demonstration)
14. Industrial visit.

Books for Reference:

1. Satchel, J.E. *Earth worm ecology*. London: Chapman Hall, 1983.
2. Bernard Glick, Jack J. Pasternak., *Molecular Biotechnology*. Washington: ASM press 2^{nd}Edn. 2001.
3. Brown, T.A. *Gene Cloning*. USA: Chapman and Hall Publications,. 3^{rd}Edition. 1999.
4. Rajan.S.,Selvi Christy. R.*Experimental procedure in Life sciences*. Book House. 2012.
5. Cappuccino. J.G., and Sherman. N. *Microbiology – A Laboratory Manual*. NewYork: Benjamin Cummins. 1996.
6. Kannan.N. *Laboratory Manual in General Microbiology*. Palani: Palani Paramount Publication, 1996.
7. Gunasekaran.P. *Laboratory Manual in Microbiology*. New Delhi: New Age International Ltd., Publishers, 1996.

SEMESTER- III	
Self Study Course (Optional) -Probiotics	
Course Code:21PMISS1	**Credit: +2**

Objectives:

1. To provide the learners with the best learning experience in Probiotics by self study education and enabling the students to become entrepreneurs and socially responsible and to develop young students with active and creative minds in the field of microbiology.
2. To motivate learners to contribute to sustainable development of nation through environmental protection and social responsibility

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	recall the basic knowledge on probiotics	3	Re
CO -2	be acquainted with characteristics of probiotics	1,2	Kn
CO-3	can analyses the aware the probiotics organisms.	2,3,4	Ev
CO-4	interpret the knowledge on the roles of probiotics.	1,2	Ap
CO-5	differentiate the probiotics and prebiotics	1,2	Co
CO-6	explain the concept of mechanisms of probiotics	2,3,4	Un, Ap
CO-7	grasp the knowledge about prebiotics.	2,3	An
CO-8	know the wealth of the probiotics and prebiotic	2	Kn

SEMESTER- III	
Self Study Course (Optional) - Probiotics	
Course Code:21PMISS1	**Credit: +2**

Unit: I Introduction to Probiotics

Introduction and history of Probiotics, Probiotic microorganisms.

Unit : II Characteristics of Probiotics

Tolerance to additives, stability during storage, stability maintenance of probiotic microorganisms.

Unit: III Role of probiotics

Role of probiotics in health and disease: prevention and treatment of gasterointestinal bacterial infection treatment of chronic urinary tract infection, antitumor and cholesterol level

Unit: IV Mechanism of probiotics

Production of antimicrobial substances, modulation of immune system, alteration of intestinal bacterial metabolite action

Unit: V Prebiotics

Concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora- Prebiotics and health benefits: mineral absorption,immune response, cancer prevention, elderly health and infant health, prebiotics infoods.

Books for Reference:

1. Salminen. S and Wright , A. V. *Lactic Acid Bacteria*, 1998.
2. Marcel Dekker Glenn R. G. Marcel R. *Handbook of Prebiotics* CRC press. 2008.
3. Lee Y K, Salminen S. *Handbook of Probiotics and Prebiotics*. A John Willey and Sons Inc.Publication. 2009.
4. SandholmT. M. Saarela M.. *Functional Dairy Products* CRC Woodhead Publishing. 2003.