SEMESTER- V			
CORE VII - AGRICULTURAL MICROBIOLOGY			
Code : 15UMIC51	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES:

1. To enhance knowledge of various microbial activities and its impact on the environment.
2. To study about various beneficial aspects of soil microbes.

UNIT-I

Soil- physical and chemical properties of soil- Microbial flora of soil (Bacteria, fungi, algae and nematodes) - Role of microbes in biogeochemical cycles- Carbon, Nitrogen and Phosphorous.

UNIT-II

Microbial interactions-Mutualism, commensalisms, competition, amensalism, parasitism and predation. Interactions between microbes and plants-rhizosphere, phyllosphere.

UNIT-III

Nitrogen fixation and its mechanism - Symbiotic *(Rhizobium* sp) - Asymbiotic (*Azotobacter* sp) – Associative (*Azospirillum* sp). Phosphate solubilising bacteria. Bacterial biofertilizers- Definition, isolation, mass production and commercial applications of *Rhizobium*, *Azotobacter*, *Azospirillum*, *Phosphobacteria*, *Cyanobacteria* (*Anabaena*, *Nostoc*)- Mycorrhizae – VAM.

UNIT-IV

Plant diseases - symptoms, etiology, life cycle and control measures - Bacterial (Soft rot of vegetables, Blight of paddy, Citrus canker), fungal (Red rot of sugarcane, Stem rust of wheat, Tikka leaf spot of groundnut, Late blight of potato) and viral (TMV, CMV, Banana bunchy top virus).

UNIT-V

Biopesticides - Bacterial (*Bacillus thuringiensis*)- Fungal (*Trichoderma viridae*)- Viral (NPV,CPV & GV)- mode of action and applications- Biopesticide developments.

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. Subba Rao,N.S.(1997). Biofertilizers in Agriculture and Forestry III Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi.
5. Subba Rao,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.

SEMESTER – IV			
SKILL BASED ELECTIVE – COMPUTERS & BIOSTATISTICS			
Sub code:15UMIS41	**HRS/WEEK- 2**	**HRS/SEM - 30**	**CREDITS:2**

OBJECTIVES

To impart advance level information in the subject of computer &biostastics

Unit I

Introduction to computer- computer generation- classification of computers – computer memory and its types.

Unit II

Introduction to computer software- operating system-Compiler&interpreter – Internet networking.

Unit III

Software, MS windows, MS excel, MS power point.

Unit IV

Introduction to biostatistics- Basic concepts of biostatistics population (data, sample, variable)- Collection of data-(Primary& Secondary)- Sampling-Processing of data.

Unit V

Diagrammatic presentation of data- Graphic presentation of data(Bar diagram, Pie diagram, Line graph, Pictogram, Histogram, Frequency polygon, Frequency curve, Ogive).

Reference Books:

1.Introduction to Information Technology, Pearson Eduction, New Delhi.
2. Norton, peter,Introduction to Computers,Tata McGraw Hill, New Delhi.
3. Douglas,Comer E., Computer Networks and Internet, Pearsons Education, New Delhi.
4. Rajaraman, V., Fundamentals of Computers, Prentice Hallof India, New Delhi.
5. Office 2000: No Experince Required, BPB Publications, New Delhi

6. Spiegel M. R., Schiller J.J., Srinivasan R. A. , A. Srinivasan Schaum's Outline of Probability

and Statistics. McGraw-Hill Trade.

7.Arora PN & Malhon PK (1996). Biostatistics Imalaya Publishing House, Mumbai.

8.Sokal & Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.

9.Stanton A & Clantz, Primer of Biostatistics (2005). The McGraw Hill Inc., New York.

SEMESTER- V			
Common Core VII	**Psychology and Microbiology for Health care**		
Code: 18UBCS51	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credit: 4**

Vision:

To familiarize the concepts of psychological aspects in health.

Mission:

To understand the complex interactions of biological, psychological, social factors of human health and disease.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	learn the nature of psychology and microbiology	1	Re
CO-2	understand the importance of human system	1	Re
CO-3	gain knowledge about the acute stressors.	2	Un
CO-4	analyze the various problems in menstrual cycle	5	An
CO-5	develop a proper lifestyle	3	Cr
CO-6	understand about sleep related disorders	6	Un
CO-7	create a depth knowledge about the warning and health risk	2	Un
CO-8	evaluate the concept of health care.	4	Ev

SEMESTER- V			
Common Core VII	**Psychology and Microbiology for Health care**		
Code: 18UBCS51	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credit: 4**

Unit – I:

Introduction to Microbiology - The History and Contributions of Microbiology (Antony Van Leeuwenhoek, Joseph Lister, Pasteur, Robert Koch) Classification of microorganisms (Bacteria, fungi, virus), Applied fields of Microbiology.

Psychology as a science - Schools of psychology, Various fields in psychology, Nature and scope of psychology .

Unit – II:

Introduction and historical overview of Immune system, Basic Immunology- Specific immune mechanisms and functions – Immuno mediators: [Immune-specific (e.g., cytokines); Non-immune-specific (e.g., aging, sleep)], Neuro immunology- Lymphocyte neuro hormonal receptors. Human stressor - Laboratory acute stressor effects on immunity.

Unit – III:

Personality disposition. CHD, Asthmatics, Allergy, Eczema, Hiding, Rheumatoid Arthritis, Peptic Ulcer, Diabetes and menstrual disorders.

Unit – IV:

Keeping the motor running -Neurobiological process that govern exercise, related psychological effects, Nutrition, Eating-related process, Overweight and obesity -making changes – Healthy foods-public health-Sleep, Sleep disorders, accidents at work and at home.

Unit – V:

Recognizing illness symptoms and what needs to be done-recognizing warning and health risks -illness perceptions and beliefs – Relation between patients and the health provider-obtaining health care.

Text books:

1. Cacioppo, J.T., Tassinary, L.G., & Berntson, G.G 2007. *Handbook of Psycho physiology*. 3rdedition. Cambridge, UK: Cambridge University Press.
2. Marks, D. F., Murray, M., Evans, B., & Estacio, E.V. 2006. *Health Psychology* India; Sage Publication.
3. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne. 2007. *Kuby Immunology*. 6th edition. W. H. Freeman and Company, New York.
4. Wiley, Sherwood, Woolverton. 2014. *Prescott's Microbiology*. Ninth Edition. McGraw Hill International Edition.

Books for Reference:

1. Sarafino, E.P. 1999. *Health Psychology*. John Wiley & Sons Inc.
2. Hymie Anisman ,2016. *Health Psychology*. Sage publication Ltd.
3. Taylor,S.E.2014. *Health psychology*. Mc Graw-Hill Education.
4. VamanRao. C. 2007. *Immunology*. 2nd Edition. Narosa Publishing House, New Delhi.

SEMESTER- VI			
Core X - Food Microbiology			
Code :18UMIC61	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Vision:

To highlight the basic concepts and principles about the techniques in food microbiology and advanced level information about food microbiology.

Mission:

To enhance the students with the basic knowledge on various techniques involved in food production and preservation.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	explain food microbiology	1	Un
CO-2	classify food.	1	Un
CO-3	explain food as a substrate for microorganisms.	3	Ev
CO-4	determines microbial contamination of food	3	Ev
CO-5	explain food preservation- physical and chemical methods.	1	Ev
CO-6	evaluate the causes of food spoilage-fruits, vegetables, dairy products, meat and fish.	3	An
CO-7	determine food borne disease and food spoilage.	4	Ev
CO-8	importance of food laws and regulations.	3, 4 ,5	Ev

SEMESTER- VI			
Core X - Food Microbiology			
Code :18UMIC61	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Unit - I

Food as a substrate for microorganisms- Microorganisms important in food microbiology- Bacteria, Molds and Yeasts- Brief account of each group – General characteristics and importance –Microbiological examination of food - Microscopic techniques. Direct microscopic examination, total colony counts and differential enumeration.

Unit- II

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

Unit- III

Methods of food preservation: Aseptic handling, removal of microorganisms, anaerobic conditions, heat processing, refrigeration and freezing, drying, osmotic pressure- Chemical preservatives - Radiation- UV light, irradiation - Canning- Food Hygiene and sanitation.

Unit- IV

Food poisoning- Food borne diseases- Food intoxication and Food infection- Bacterial toxins (*Staphylococcus*, *Clostridium*, *Escherichia* and *Salmonella*) – Fungal (Mycotoxins) – Viral (Hepatitis) – Protozoan (*Entamoeba*).

Unit-V

Quality and safety assurance in food industry- - Microbial standards in food –*fssai* – Hazard Analysis Critical Control point (HACCP) - Food laws and Regulations- FAO,FDA,WHO,AGMARK, ISI, ISO. - BIS Laboratory Services, BIS product certification and licensing quality systems.

Text Book:

1. Frazier, W.C. and Westhoff, D.C. 2008. *Food Microbiology*. 4th Edition. Tata McGraw Hill publishing Co Ltd., New Delhi.

Books for Reference:

1. Adams, M.R. and Moss, M.O. 1995. *Food Microbiology*. 4th edition McGraw Hill, New York.
2. Jay, J.M. 2006. *Modern Food Microbiology*. CBS Publishers and Distributors, New Delhi.
3. Hobbs, B.C. and Roberts, D. 1993. *Food Poisoining and Food Hygiene*, Edward Aarnold (A division of Hodder and Sloughton), London.

SEMESTER –VI			
Core Practical – VI - Laboratory in Food Microbiology, Industrial Microbiology and Microbial Biotechnology			
Code : 18UMICR6	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 2**

Vision:

To highlight the techniques involved in food and industrial microbiology

Mission:

To expose the students to different processes used in industries, food production and preservation and get information about the spoilage microorganisms.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	explain the importance of food and industrial microbiology	1	Un
CO-2	understand different food microbes and their role.	1	Un
CO-3	explain food as a substrate for microorganisms.	3	Ev
CO-4	exploit microbes in the production of food	3	Ev
CO-5	explain food preservation- physical and chemical methods.	1	Ev
CO-6	evaluate the causes of food spoilage-fruits, vegetables, dairy products, meat and fish.	3	An
CO-7	recall the techniques involved in industries.	1	Re
CO-8	explain the quality and safety assurance in food industry.	2, 4 ,5	Un

SEMESTER –VI			
Core Practical – VI - Laboratory in Food Microbiology, Industrial Microbiology and Microbial Biotechnology			
Code : 18UMICR6	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 2**

1. Evaluation of Milk quality- Methylene blue reduction test.
2. Milk testing by Resazurin method.
3. Microbiological analysis of food product- Curd.
4. Microbial Examination of fruits and vegetables - Surface washing and internal tissues- TVC.
5. Microbial examination of Meat- Surface washing and internal tissues- TVC.
6. Testing of soft drinks.
7. Immobilization of bacterial cells (*Escherichia coli* and *Bacillus*).
8. Preparation of Single cell Protein (*Spirulina*) - Demonstration
9. Mushroom cultivation.
10. Wine production using yeast .
11. Antibiotic production by Bacteria or Actinomycetes- (Demonstration).

Books for Reference:

1. Cappuccino J.G and Sherman N. 1996 *Microbiology – A lab manual* Benjamin Cummins, New York.
1. Kannan, N., *Laboratory Manual in General Microbiology*.Palani Paramount Publication, Palani.
2. David greenwood, Richard. B., Slack & John. F., Peutherer, 2002. *Medical microbiology* 16th edition.
3. Murray P.R; Baron E.J; Jorgerson J.H; Pfaller M.A. and Yolker R.H 2003. *Manual of Clinical microbiology*, 8th edition. Vol. 1 & 2 ASM Poem Washington D.C.
5. Gunasekaran, P.1996. *Laboratory Manual in Microbiology.* New Age International Ltd., Publishers, New Delhi.
6. Jayaraman, J.,1985. *Laboratory Manual in Biochemistry*. Wiley EasternLtd., New Delhi.
7. Plummer, D.T.,. *An Introduction to Practical Biochemistry*. Tata McGraw-Hill. New Delhi.
8. Dubey, R.C.and Maheswari,D.K. 2002. *Practical Microbiology*, 1st edition Chand and Company Ltd., India.

SEMESTER –V			
Core Integral - I – Microbial Nanotechnology			
Code: 18UMII51	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credit: 4**

Vision:

To create the ability to be multi-skilled in the field of nanotechnology with good technical and instrumentation knowledge on various concepts and providing standard education and enabling the students to become entrepreneurs and socially responsible.

Mission:

To aware the basic knowledge about the basic nanotechnology and developing young students with active and creative minds in the field of nanotechnology.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	acquire basic knowledge on nanotechnology	4	Un
CO -2	explain the basics of microbial applications of nanotechnology.	4	Un
CO -3	appreciate the structural and functional principles of nanomatreials.	4	An
CO- 4	grasp the fundamental knowledge about synthesis of nanomaterials.	4	Un
CO- 5	acquire basic knowledge about biosensors and types.	2	Ap
CO- 6	get knowledge about analysis of biomolecular nanostructures.	4,2	Un
CO -7	acquire knowledge on cancer diagnosis and treatment.	2,4	Ap
CO- 8	get knowledge about drug designing and delivery	2,4	Ap

SEMESTER –V			
Core Integral - I – Microbial Nanotechnology			
Code: 18UMII51	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credit: 4**

Unit I

Introduction to nanotechnology - Structural and functional principles of nanotechnology - Applications of nanotechnology. Bionanoparticles – Carbon nanotubes, Carbon nanocones.

Unit II

Nanotechnology : Nanoparticle synthesis by plants, bacteria and yeast. Methods of Nanobiotechnology - Analysis of bimolecular Nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microcopy and XRD.

Unit III

Biosensors – optical nanosensors, multi-functional biochip (MFB) and Detection of the *Mycobacterium by MFB.*

Unit IV

Application of Nanobiotechnology in medicine – Cancer diagnosis and treatment, Drug designing and delivery.

Unit V

Nanotechnology and Food safety – Food Packaging and Processing. Nanotechnology in Agriculture – crop improvement and Pest management. Bio security

Text Books:

1. David. S. Goodsell. Jhonwiley 2006.*Bionanotechnology*: Lessons from Nature.
2. R. K. Rathi, 2009, *Nanotechnology* 1st Edition. S. Chand & Company Ltd, New Dehli.

Books for Reference:

1. Bernd Rehm, 2006.*Microbial Bionanotechnology*: *Biological Self-assembly Systems and Biopolymer-based Nanostructures*, Horizon Scientific Press.
2. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E.Lemons. *Biomaterials Sciences: An Introduction to Materials in Medicine* 2nd Edition.
3. Christof M. Niemayer, Chad A. Mirkin, 2004. *Nanobiotechnology:* Concepts, Applications and perspectives, Wiley VCH publishers.
4. Fulekar M.H., 2010, *Nanotechnology: Importance and Applications*, I. K. International Pvt Ltd, New Delhi
5. JainK.K., Tailor L.,*Nanobiotechnology: Molecular Diagnosis*. Francis Group.

SEMESTER-VI			
Core Integral–III- Cosmetic Microbiology			
Code :18UMII61	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credit:4**

Vision:

To impart basic level information in the novel subject of Cosmetic microbiology.

Mission:

To enhance the knowledge on the applications of Cosmetic microbiology in various fields.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	recall the history of cosmetic microbiology.	1	Re
CO- 2	explain about sanitary manufacturing in cosmetic manufacturing	2,5	Un
CO -3	infer practical knowledge about the microbiological targets of preservation	1,2,4	Un
CO- 4	explain the recent techniques on good manufacturing techniques in cosmetic microbiology	3,4,6	Un
CO- 5	demonstrate the quality and safety assurance in cosmetic industry and the hazard analysis and critical control point.	2,4,5,6	Un
CO- 6	apply the techniques in preservation of cosmetics	2,4,5,6	Ap
CO-7	have knowledge on cosmetic production	2,4	Cr
CO-8	get knowledge about analysis of cosmetic production	2,4	Cr

SEMESTER-VI			
Core Integral–III- Cosmetic Microbiology			
Code :18UMII61	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credit:4**

Unit I

Introduction to cosmetic microbiology-History of cosmetic microbiology – Biology of microbes-Bacteria, growth, diversity, molds and yeast.

Unit II

Sanitary manufacturing in cosmetic manufacturing – Cleaning (Detergent ingredients & properties,Types of surfactants) – Sanitization(Physical &chemical sanitizers)-Cleaning & sanitizing equipments-Cleaning and sanitization procedures.

Unit III

Hazard Analysis and Critical Control Point (HACCP) protocols in cosmetic microbiology-Apply HACCP to cosmetics-Waste water removal and CIP system-Selecting Critical Control Points – Parameters of an effective HACCP program.

Unit IV

Cosmetic microbiology test methods preservative efficacy methods-CFTA methods-ASTM methods-Test for factors affecting preservative efficacy-Neutralizer evaluation-Rapid methods used in preservative testing-Microbial content testing.

Unit V

Validation methods – Model for validation-Validation of equipment cleaning & sanitization-Validation in microbiology laboratory- Preservation strategies-Scope and microbiological targets of preservation.

Textbook:

1. Daniel. K. Brannan. 1997. *Cosmetic Microbiology. A Practical Handbook.* CRC press.

Books for Reference :

1. Brannan , D.K.,DilleJ.C., and Kaufman, D.J.1987. Correlation of invitro challenge testing with consumer-use testing for cosmetic products, *Appl.Environ.Microbiol.,53.*
2. Halleck F.E.,1978. Thermal solution sterilization,*Pharm.Technol.*,June.
3. Pflug I.J.,and G.M.Smith. 1977. "the Use of Biological Indicators for Monitoring Wet-Heat Sterilization Processes.". In *Sterlization of Medical products.*(EDS. E.R.L. Gaughran and K.Kereluk), New Brunswick, N.J.,Johnson and Johnson.
4. Gardner J.F., and M.M.Peel.1991.*Introduction to Sterilization, Disinfection, and Infection Control.* Second Edition. Churchill Livingstone, Melbourne

SEMESTER-IV			
NME II - Clinical Microbiology			
Code:18UMIN41	**Hrs/Week: 2**	**Hrs/Sem:30**	**Credit: 2**

Vision:

Highlighting the students about diverse microbial pathogens and its effects on human health.

Mission:

To be aware of the diagnosis, treatment and prevention of pathogens and good medical practice.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	C L
CO- 1	provide knowledge on the importance of clinical microbiology	1,4	Un, An
CO -2	acquire knowledge on normal flora on human body.	1	Un
CO- 3	acquire knowledge on various types of diseases.	6	Co
CO- 4	provide information about the mechanisms of infectious disease transmission	1,6	Un
CO- 5	acquire knowledge on causative agent, treatment , prevention and control measures.	1,6	Un
CO- 6	provide interpretation of laboratory tests in the diagnosis of infectious diseases.	2	Co
CO- 7	understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.	6	Co
CO- 8	develop basic skills necessary to work in the microbiology laboratory.	1,2	Un

SEMESTER-IV			
NME II - Clinical Microbiology			
Code:18UMIN41	**Hrs/Week: 2**	**Hrs/Sem:30**	**Credit: 2**

Unit - I

Sources of infection - Routes of transmission - control measures - Testing by Koch's postulates - Antibiotic sensitivity testing

Unit - II

Bacterial pathogens - *Streptococcal, Staphylococci, E.coli, Vibrio, Salmonella, Shigella* and *Mycobacterium*

Unit – III

Fungal pathogens - *Candida, Aspergillus - Dermatophytes*

Unit - IV

Viral pathogens - Pox virus, Mumps virus, Rabies virus and HIV

Unit - V

Protozoan pathogens - Malarial, Amoebic , Giardiasis and Yellow fever

Text Books:

1. Ananthanaryanan R and Panikar J , 2000. *Text book of Microbiology*, Orient Longmans.
2. Rajan.S. 2007 . *Medical Microbiology*, MJP Publisher, Chennai

Books for Reference:

1. Kanika L Mukherjee, *Medical Laboratory Technology*, Mc Graw Hill Publishing Co., Ltd., New Delhi Vol I-III
2. Salle, A.J.,1996. *Fundamental Principles of Bacteriology*. (7^{th} edition), Tata McGraw-Hill Publishing Company Ltd., New Delhi.
3. Pelczar Jr.,M.J., Chan E.C.S. and Kreig, N.R. 1993. *Microbiology.* McGraw Hill Inc., New York.

SEMESTER –V	
Self Study – Sea Food Processing	
Code: 18UMISS3	**Credits:2**

Vision:

To understand the different food sources from the sea environment.

Mission:

To gain knowledge in the concept of sea food processing.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	build an idea about the sea environmental science.	3,4	Ap
CO -2	elaborate the nutritional benefits of marine resources	3	Cr
CO -3	importance of food processing.	3	Ev
CO- 4	explain the preservation methods- canning, smoking, drying, chilling and freezing.	1	Un
CO -5	demonstrate to handle and store the fish products	3	Un
CO -6	design the fish products	4	Cr
CO- 7	explain packaging and labelling techniques.	3	Un
CO -8	evaluate the methods to extend shelf life.	4	Ev

SEMESTER –V	
Self Study – Sea Food Processing	
Code: 18UMISS3	**Credits:2**

Unit– I

Sea environmental science: Marine eco system - Nutritional benefits of marine resources – fish, fish oil, seaweeds.

Unit- II

Scope and importance of food processing - principles and methods of food preservation - Sun drying, Smoking, Salt curing, Chilling, Pickling,

Unit- III

Preservation methods: Canning and Frying, irradiation process, value addition**.**

Unit– IV

Microbiology of fish products - storage and handling, preservation – freezing techniques and, preparation of fish products (Fermented fish, Fish products, Fish soups, Fish powder, Prawn powder and Cutlets)

Unit– V

Introduction to packaging and labelling - packaging principles and operation - packaging materials - deteriorative changes in foodstuff and packaging methods for prevention - shelf life of packaged foodstuffs - methods to extend shelf life, requisites of good packages.

Text book:

1. Bonnell A. D. 1993 - *Quality Assurance in Sea Food Processing:* A practical guide – Chapman and Hall, Inc.

Books for Reference:

1. Linda AnkenmanGranata, George J. Flick, Jr, Roy E. Martin.2012. *The sea food industry – Spices, products, processing and safety* – 2nd edition – Wiley Blackwell Publication.
2. Hall G. M. 1997 -*Fish Processing Technology* – 2nd Edition – Blackie academic and Professional publication.
3. Ioannis S. Boziaris. 2013. *Sea food processing – Technology, Quality and safety* – Wiley Blackwell publication.

SEMESTER – II			
Allied-II Biochemistry			
Course Code -21UMIA21	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Objectives:

To extend the fundamental knowledge of biochemistry and to provide the highest quality of translational biomedical research, education and service.

To enhance the students with knowledge on various biochemical aspects of the bio- molecules.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	develop fundamental knowledge about various bio-molecules.	2	Un
CO -2	learn the element present in biomolecules	2	Un
CO-3	differentiate between monomers and polymers	2	Un
CO-4	compare and contrast the structure and function of the carbohydrates, protein, and lipid.	2	Ap
CO-5	summarize the functions of carbohydrates, proteins, lipids, enzymes and vitamins	2	Sy
CO-6	compare and contrast saturated, mono-saturated and poly-saturated fatty acids.	2	Un
CO-7	recognize the importance of the three dimensional shape of a protein on its function and its role.	2	An
CO-8	know the working principle of spectrophotometer and able to handle.	2 ,3	Kn

SEMESTER – II			
Allied-II Biochemistry			
Course Code -21UMIA21	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Unit I Basis of Biomolecules

Structure of atom – chemical bonds – principles of bioenergetics - Laws of thermodynamics – Structure and functions of energy rich phosphate ATP, PEP and creatine phosphate – Role of pH and buffers in biological systems.

Unit II Carbohydrates

Monosaccharides, Disaccharides, oligosaccharides and Polysaccharides - Structure, classification
and functions.

Unit III Proteins

Amino Acids – Peptides – Types, Structure, classification and functions. Nucleic acids – structure and forms and types of DNA and RNA- Functions of nucleic acids.

Unit IV Lipids

Classification – Structure and functions. Enzymes: Classification – Functions of enzymes - Active site – 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 V Vitamins

Introduction – Fat soluble vitamins (A,D,E & K) – Water Soluble vitamins (B- complex and Vitamin C) – sources, functions ,deficiency and syndromes.

Text book:

1. Santhyanarayana. U. Essentials of Biochemistry. (1st Edition) Books and Allied Ltd., Kolkata , 2002.

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: (7st Education), Books and Allied (P) Ltd., 1999.
4. Hubert,Styer,. *Biochemistry*. Newyork: Freeman and Company,. 1995
5. Lehninger, *Principle of Biochemistry*. 3rd editions by Nelson and Cox (Worth**),** 2009.

SEMESTER–III			
Allied–III–Genetic Engineering			
Course Code:21UMIA31	**Hrs/Week:4**	**Hrs/Sem:60**	**Credit:3**

Objectives:

1. To understand the steps of gene cloning
2. To understand significance of GMOs
3. To know ethical values related to genetic modification
4. To screen out various techniques involved in molecular cloning

Course Outcome:

CONO	Upon completion of this course, students will be able to	PSO Addressed	CL
CO-1	Infer basic knowledge about cloning	2	Un
CO-2	Identify the applications of genetic engineering in Various fields	4	Ap
CO-3	Explain cloning vectors	2	Un
CO-4	Interpret the techniques used in genetic engineering	2	Un
CO-5	Compare different types of vectors	4	An
CO-6	Explain Genetically modified food	2	Un
CO-7	Demonstrate the hazardous and potential risk in Releasing transgenic into environment	6	Un
CO-8	Make use of DNA Libraries	4	Ap

SEMESTER–III			
Allied–III–Genetic Engineering			
Course code:21UMIA31	**Hrs/Week: 4**	**Hrs/Sem:60**	**Credit:3**

Unit–I: Methods of gene cloning

Genetic engineering–History–Tools of Genetic Engineering-Gene cloning-Steps in cloning- Gene transfer methods-Screening of chimeric DNA. Cloning using linkers and adapters

Unit–II: Gene cloning vectors

Cloning vectors for rDNA (Plasmids, Phages, Cosmids, Transposons)-Binary and Shuttle vectors. Strategies for selecting and designing cloning vectors

Unit–III: Gene libraries and blotting methods

Techniques in Genetic Engineering - Southern, Western, Northern blotting - PCR and its modification-DNA finger printing-DNA libraries .BAC library – YAC library

Unit–IV: Advantages of gene cloning

Applications of genetic engineering- Transgenic plants – Development of crops for disease resistance (Bt cotton) - herbicide tolerance- Medicine (Insulin) – Environment - role of superbug in bio degradation. Markers and Reporter genes and their applications

Unit-V: Role of Genetically modified organisms and regulations

Genetically modified organisms–Advantages and disadvantages-Ecological impact of transgenic plant–Release of GMO in to environment. Indian and international agencies involved in patenting, patenting biological materials

Textbooks:

1. Dr.Verma P.S and Dr.Agarwal.V.K. *Genetic Engineering*. NewDelhi: Chand and Company Ltd. 2009.
2. DubeyR.C. *A Text Book of Biotechnology*. NewDelhi: Fifth revised Edition. S Chand &Co. 2014.
3. Dr.Prakash.S Lohar. *Text Book of Biotechnology.* Chennai: MJP Publishers, 2005

Books for Reference:

1. Glick.B.R.and Pasternak,J.J. *Molecular Biotechnology–Principles and Applications of Recombinant DNA.* Washington D.C: ASM Press, 2017.
2. Brown,T.A. *Gene Cloning.* USA: Third Edition. -Chapman and Hall Publications, 2016.
3. Satyanarayana.U. *Biotechnology*. Kolkata: Books and Allied(P) Ltd. 2013.
4. Rastogi S.C. *Biotechnology Principles and applications.* New Delhi: Narosa Publishing HousePvt.Ltd . 2007.
5. Mohan P. Arora.*Biotechnology.* Mumbai :Himalaya Publishing House Pvt Ltd, 2005
6. Jogdh and.S.N.*Gene Biotechnology* Mumbai: Himalaya Publishing House Pvt. Ltd. 2009

SEMESTER-III			
Allied practical III–Laboratory in Genetic Engineering			
Course Code:21UMIAR3	**Hrs/Week:2**	**Hrs/Sem:30**	**Credit:1**

Objectives:

1. To illustrate creative use of modern tolls and techniques in genetic engineering
2. To familiarize with molecular research-based enzymes
3. To develop different ends of restricted fragmented used in gene cloning
4. To understand the concept of gene multiplication

Course Outcome:

CONO	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	Illustrate the principle behind any genetic engineering practical	2	Un
CO-2	Develop basic handling skill in genetic engineering practical	2	Ap
CO-3	Experiment with isolation of Nucleic acids from Different sources	4	Ap
CO-4	Interpret Transformation	1	Un
CO-5	Test for the quantification of nucleic acids	2	An
CO-6	Distinguish the quantification of DNA and RNA	2	An
CO-7	Distinguish the isolation of DNA and RNA	4	An
CO-8	Compare the theory with the protocol of PCR	2	An

SEMESTER-III			
Allied practical III–Laboratory in Genetic Engineering			
Course code:21UMIAR3	**Hrs/Week:2**	**Hrs/Sem:30**	**Credit:1**

1. Isolation of genomic DNA from bacteria.
2. Isolation of genomic DNA from plant source.
3. Isolation of DNA from animal source.
4. Isolation of RNA from bacteria.
5. Isolation of RNA from plant source.
6. Isolation of RNA from animal source.
7. Polymerase Chain Reaction (Demonstration).
8. Quantification of DNA.
9. Quantification of RNA.
10. Restriction – Digestion of E.CoR1 enzyme

11 Ligation of Restricted fragment using Ligase enzyme

12. Determination of unknown fragment using marker DNA – Demonstration

Books for Reference:

1. Janarthanan. S. and Vincent.S. *Practical Biotechnology*: *Methods and Protocols.* Hyderabad : Universities Press (India) private limited. 2007.
2. Jyoti Saxena, Mamta aunthiyal, InduRavi. *Laboratory manual for Microbiology, Bio-chemistry and Molecular Biology*. India : Scientific Publishers, 2012.
3. Sambrook and Russell. *Molecular Cloning laboratory manual.* New York: Vol 1,2,3.Third edition. ColdSpring Harbor Laboratory Press, Cold Spring Harbor. 2016.

SEMESTER - I			
Core – I - Introduction to Microbiology			
Course Code: 21UMIC11	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 6**

Objectives:

To highlight the basic concepts and principles about the different aspects of microbiology including recent developments in the area.

To inculcate about the techniques involved in culturing microorganisms.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	get an idea about the historical events in microbiology.	1	Un
CO -2	understand the diversity in microbiology.	1	Un
CO-3	know the scope of microbiology	4	An
CO-4	know parts of microscope, type and its principle	1, 2	An
CO-5	get the theoretical concepts of related stain	2	Un
CO-6	distinguish different methods of staining techniques	2	Ev
CO-7	analyse nutritional requirements of microbes.	2	An
CO-8	understand the techniques involved in culturing microorganisms.	2	Un

SEMESTER - I			
Core – I Introduction to Microbiology			
Course Code: 21UMIC11	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 6**

Unit –I: The scope of Microbiology

The History and contributions of Antony Van Leewenhoek, Joseph Lister, Louis Pasteur, Robert Koch, Edward Jenner, Winogradsky and Beijerinck and development of microbiology
Applied fields of Microbiology.

Unit II: Microscopy

Resolving power, Numerical aperture – Limit of resolution - Magnification Types of Microscopy – Dark field microscopy – Bright field microscopy – Phase contrast microscopy – Electron microscopy.

Unit III: Microbiological staining

Types – Simple, Differential staining, Gram's staining, Endospore staining, Capsule, Flagella, Cytoplasmic inclusion staining, Giemsa staining and their applications.

Unit IV: Structure of bacterial cells

Structure and functions of capsule, flagella, Fimbrae or pili: The cell wall- chemical composition , characteristics and functions of cell wall, Plasma membrane (Fluid mosaic model), mesosomes, cytoplasm: Subunits and chemical compositon, Nucleoids: Cytoplasmic inclusions, Spores and cysts.

Unit V: Sterilization

Principles – Dry heat, Moist heat, Filtration, Pasteurization, Radiation, Disinfectant – Development of Pure culture techniques – Basic component of growth media – Types of growth media, purpose – General, selective&, differential-Nutrient and Mac Conkey agar, enrichment-blood agar, transport and preservation media. Isolation and purification of pure culture.

Text Books:

1. Rajan S., Selvi Christy R. *Essentials of Microbiology*. Chennai: CBS Publishers and Distributers. 2015
2. Rao A.S. *Introduction to Microbiology*. New Delhi: PHI Learning PVT Ltd. 1997

Books for Reference:

1. Prescott L.M., Harley J.P., and Klein D.A., *Microbiology* New York: McGraw-Hill Inc, 7th edition, 2008.
2. Tortora, Funke Case Addison, *Microbiology – An Introduction* Wesley Longman Inc. 7th edition, 2001.
3. Dubey R.C., and Maheswari, S. A *Text Book of Microbiology*, New Delhi: S.Chand & Co. 2003.
4. Pelczar Jr., M.J. Chan E.C.S., and Kreig N.R. *Microbiology*- , New York: McGraw- Hill Inc 1993.
5. Jogn L. Ingraham & Catherine A, *Introduction to Microbiology,* Newyork : Ingraham, Brooks / Cole,. 2nd Edition 2000
6. Jeffrey C. Pommerville., Alcamo's *Fundamentals of Microbiology.* Ninth edition. Jones & Bartlett learning. 2010.

SEMESTER - II			
Core – II Microbial Diversity			
Course Code : 21UMIC21	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 6**

Objectives:

To illustrate the evolutionary approaches and diversified nature of microorganisms

To demonstrate the students to be aware of ubiquitous nature of micro organisms and their detailed account on taxonomic approaches and survey of prokaryotic phylogeny and phylogenetic groups of eukaryotes.

Course Outcome:

CO .No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	list out the general classification of microbes.	1,5	Kn
CO -2	distinguish the taxonomic ranks of micro organisms	2	An
CO-3	illustrate the Bergey's manual classification about bacteria	2,4	Co
CO-4	know the Alexopoulous classification of fungi and their general features	1	Kn
CO-5	interpret the general morphological characteristics and the algal diversity	1,2	Co
CO-6	demonstrates the morphology and genetic material of viruses	2	Co
CO-7	know about diversification of microbes	2	Kn
CO-8	analyse the classification, replication, cytocidal effects of plant and animal viruses	2,5	An

SEMESTER - II			
Core – II Microbial Diversity			
Course Code : 21UMIC21	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 6**

Unit-I – Introduction to Taxonomy and classification

General principles of classification. Evolution methods in classification – International codes of nomenclature – Taxonomic approaches and phylogeny.

Unit-II – Bacteria and its classification

General introduction – type study: gram positive bacteria (*Bacillus*), Gram negative bacteria (*E.coli*) – Archaebacteria, Methanogens, Appendage bacteria. Determinative classification of Bergey's manual, cyanobacteria.

Unit-III – Fungi and its classification

– General introduction, morphology, Alexopoulous classification and their general features – Life cycle – filamentous fungi (*Actinomycetes*), molds (*Aspergillus*), macroscopic fungi (*mushroom-Agaricus bisporus*) – unicellular fungi (*Yeast-Saccharomyces cerevisiae*)

Unit- IV – Algae, Protozoa - classification

General characteristics – algal diversity - morphology –classification- General features and Life cycle –blue green algae (*Nostoc*) – Red algae (*Gracilaria*) Protozoa - General introduction –morphology –classification – General features and Life cycle - Sarcodina (*Entamoeba histolytica*) – Mastigophora (*Euglena gracilis*)

Unit- V – Viruses and its classification

Introduction –structure –classification based on morphology and genetic material. Plant virus (TMV) –Animal virus (*Adeno virus*) –Bacteriophage (*T4 phage*).

Text Book:

1. Rajan S., Selvi Christy R., *Essentials of Microbiology*. CBS Publishers and Distributors. 2015

Books for Reference:

1. Stanier, Y. Roger, John L. Ingrahm, Mark L. Wheelis and Page R. Painter. *General Microbiology.* New Jersey: V Ed. MacMillan Press Ltd. 2003.
2. R.C. Dubey. *Text Book of Microbiology* S. Chand and Company Ltd., 2004
3. Pelczar*, Microbiology*, Tata McGraw-Hill Education. 1998.
4. Lansing M. Prescott, John P. Harly and Donald A. Klein. *Microbiology,*. WCB/ McGraw Hill Company. 5th edition, 1999.

SEMESTER-III	
Self-Study (Optional) - Food Packaging Technology	
Course Code: 21UMISS1	**Credits: +2**

Objectives:

To provide the learners with the best learning experience in packing by self-study education andenabling the students to become entrepreneurs and socially responsible.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	To provide understanding on the consequence of Food microbiology	1,4	Un, An
CO -2	Acquire a brief knowledge on food packing	1	Un
CO-3	Acquire knowledge on various types of food packing	6	Co
CO-4	Provide information about the principle of Packing	1,6	Un
CO-5	Acquire knowledge on special packing techniques	1,6	Un
CO-6	Acquire knowledge on packing techniques and their types	1	Un
CO-7	To provide understanding on the consequence of Labelling and packing rules	1	Un
CO-8	Acquire knowledge on bar coding	1	Un

SEMESTER-III	
Self-Study (Compulsory) - Food Packaging Technology	
Course Code: 21UMISS1	**Credits: +2**

Unit I: Introduction

Introduction – packaging strategies for various environments – functions of package

Unit II: Packaging materials

Packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.

Unit III: Special Packaging Techniques

Special Packaging Techniques- Vacuum and gas packaging – aseptic packaging

Unit IV: Types of Packaging

Retort pouching –edible film packaging – tetra packaging – antimicrobial packaging – shrinks and stretches packaging.

Unit V: Packaging Rules

Packaging Rules- Labeling- Packaging Techniques - Bar coding.

Text Books:

1. Robertson, G.L. *Food Packaging: Principles and Practice*. 2nd Edition. Taylor and Francis, 2006.
2. Han, Jung H. *Innovations in Food Packaging*. Elsevier, 2005.
3. Ahvenainen, Raija. *Novel Food Packaging Techniques*. Wood Head Publishing, 2003.
4. Mathlouthi, M. *Food packaging and Preservation*. Aspen Publications, 1999.

Books for Reference:

1. Mahadevia, M., Gowramma, R.V. *Food Packaging Materials*. Tata McGraw Hill 2007.
2. Robertson, G. L. *Food Packaging and Shelf life*: A Practical Guide. Narendra Publishing House. 2001.
3. 3. John, P.J. *A Handbook on Food Packaging* Narendra Publishing House 2008.

SEMESTER- IV	
Self-Study (Optional) -Probiotics	
Course Code: 21UMISS2	**Credits: +2**

Objectives:

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.

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	acquaint with characteristics of probiotics	1,2	Kn
CO-3	analyse the aware the probiotics organisms.	2	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	Un, Ap
CO-7	grasp the knowledge about prebiotics.	2,3	An
CO-8	know the wealth of the probiotics and prebioticsm	2	Kn

SEMESTER-IV	
Self-Study (Optional) -Probiotics	
Course Code: 21UMISS2	**Credits: +2**

Unit I: Probiotics

Probiotics: Introduction and history of Probiotics, Probiotic microorganisms.

Unit II: Characteristics of Probiotics

Characteristics of Probiotics for selection: 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 gastero-intestinal bacterial infection treatment of chronic urinary tract infection, antitumor and cholesterol level

Unit IV: Mechanism of probiotics

Mechanism of probiotics: production of antimicrobial substances, modulation of immune system, alteration of intestinal bacterial metabolite action

Unit V: Prebiotics concepts

. 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 in foods.

Books for References:

1. Salminen. S and Wright , A. V. *Lactic Acid Bacteria*, Marcel Dekker.1998.
2. Glenn R. G. Marcel R. *Handbook of Prebiotics* CRC press. 2008.
3. LeeY K, Salminen S . *Handbook of Probiotics and Prebiotics* . AJohn Willeyand Sons Inc. Publication 2009.
4. SandholmT. M. Saarela M. *Functional Dairy Products* CRC Wood-head Publishing Limited 2003.

.