"Dissemination of Education for Knowledge, Science and Culture"

-Shikshanmaharshi Dr. Bapuji Salunkhe.

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE (EMPOWERED AUTONOMOUS), KOLHAPUR

DEPARTMENT OF MICROBIOLOGY

B.Sc. Part-III

Semester - V & VI

SYLLABUS

SYLLABUS TO BE IMPLEMENTED FROM AUGUST 2023

STRUCTURE OF COURSE

Sr. No	Course code	Title of the course	Theory	Internal	Total Marks
Semester V					
1	DSE-1010E1	Immunology	35	15	50
2	DSE-1010E2	Medical Microbiology	35	15	50
3	DSE-1010E3	Industrial Microbiology	35	15	50
4	DSE-1010E4	Microbial Biochemistry	35	15	50
3	Practical I	Immunology and Medical Microbiology	-	-	50
	Practical II	Food and Industrial Microbiology			50
4	SEC-SE	Management of Human Microbial Diseases	-	-	50
5	AECC-E	English			50
Semester VI					
5	DSE-1010F1	Virology	35	15	50
	DSE-1010F2	Microbial Genetics	35	15	50
6	DSE-1010F3	Agricultural Microbiology	35	15	50
	DSE-1010F4	Environmental Microbiology	35	15	50
7	Practical III	Virology and Microbial Genetics			50
	Practical -IV	Agriculture and Environmental Microbiology			50
8	SEC-SF	Food Fermentation Techniques			50
9	AECC-F	English			50

- **Theory and Practical Lectures: 48 Min. Each**
- **Total Credits for B.Sc.-III (Semester V & VI): 44**

- **Total Marks for B.Sc.-III (Including AECC (E & F): English and SEC-S) : 800**
- **Total Marks for B.Sc.-III (Excluding AECC (E & F): 700**

- **DSE- Discipline Specific Elective. AECC- Ability Enhancement Compulsory Course (E & F): English**
- **SEC-S - Skill Enhancement Course for Science,**
- **SEC-S Examination will be conducted annually (E &F Combine) for 100 marks, passing for SEC shall be 40%Practical Examination will be conducted annually for 200 Marks per course (subject).**
- **There shall** ***Separate passing is mandatory for Theory, Internal and Practical***

SEMESTER –V

Paper IX **DSE:1010E1**	**IMMUNOLOGY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course Outcomes - Upon successful completion of course, students are expected to be able to – **CO1: Understand the overall organization of the Immune system.** **CO2: Explain the salient features of antigen antibody reaction & its use in diagnostics and in various other studies.** **CO3: Understand various viral, bacterial & fungal diseases, their causative agent , mode of infection, epidemiology lab diagnosis, treatment and prophylaxis.** **CO4: Explain different antimicrobial agents with respect to their mode of action uses.**		
UNIT I	1.Cells of Immune system – a. Hematapoiesis-characteristics & types of stem cells. b. Classification of cells of immune system – lymphoid & myeloid cells. c. Structure & function of lymphoid cells – T cell & T cell subsets, NK cells, B cells & dendritic cells. d. Structure & function of myeloid cells- Granulocytes, monocytes & macrophages. 2. Membrane receptors for antigen and their role in antigenrecognition a. B cell surface receptor for antigen (BCR) b. T cell surface receptor for antigen (TCR) c. NK receptors 3. Molecular mechanism of antibody production.	**15**

	a. Processing and presentation of antigen by Antigen presenting cell. b. Interaction of APC with T_H Cell. c. Interaction of B cell and T_H Cell d. Clonal proliferation and differentiation of activated B cell. e. Role of follicular dendritic cells in selection of high affinity B cell. f. Role of cytokines in proliferation and differentiation. 4. Cytokines - a. Properties, types and function of cytokines produced by TH cell and Macrophages 5. Interferon - a. Nature and types of Interferons b. Induction of Interferon c. Mechanism of action. 6. Immunological tolerance: a. Tolerance induction in adults and neonates by drug and monoclonal antibody b. Cellular mechanism of immunological tolerance. c. Termination of tolerance.	
UNIT II	1. Complement – a. Nature and Properties of Complement b. Complement activation by classical and alternate pathway. c. Biological consequences of complement activation. 2.Monoclonal antibodies - a. Basic concepts - Mouse, Human and Humanized antibodies. b. Production of monoclonal antibodies by hybridoma technology. c. Production of Humanized Monoclonal antibodies by recombinant DNA technology. d. Applications of monoclonal antibodies in diagnosis, treatment and research. 3.New diagnostic techniques: - a. RIA b. Dot Blot Technique	**15**

	4. Hypersensitivity – a. Basic concept, Gell and Coombs classification b. Type I - Anaphylaxis c. Type II - Blood transfusion reactions d. Type III - Serum sickness e . Type IV- Delayed type hypersensitivity - Allograft rejection. 5. Autoimmune disease: a. Types of autoimmune diseases. i) Organ specific –ex. Hashimotos thyroiditis , Good Pasture syndrome, Graves disease, Insuline dependent diabetes , Myosthenia gravis , Addison's disease ii) Systemic autoimmune diseases- ex. Systemic Lupus erythematosus & MS b. Treatment of autoimmune diseases.	

Reference Books:

1) Immunology - 6th edition - Kubay, Kindt, Goldsby & Osborne.
2) Essential Immunology - 11th edition - Delves, Martin, Burton and Roitt.
3) Immunology - An Introduction, 4th edition – Tizzard.
4) Basic and Clinical Immunology 5th edition- Stites, Stobo, H. H. Fudenberg.
5) Essentials of Immunology - S. K. Gupta
6) Immunology – M. P. Arora

Paper X DSE:1010E2	**MEDICAL MICROBIOLOGY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course Outcomes - Upon successful completion of course, students are expected to be able to – **CO1: Correlate disease symptoms with causative agent, isolate and identify pathogens.** **CO2: Understand mechanism of action of antimicrobial drugs and their uses as prophylactic agents.** **CO3: Explain pathogenicity of organisms associated with human infections.** **CO4: Explain different antimicrobial agents with respect to their mode of action uses.**		
UNIT I	1. Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by – a. *Mycobacterium leprae* b. *Clostridium perfringens,* c. *Treponema pallidum* 2. Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by – a. *Pseudomonas aeruginosa* b. *Vibrio cholera* c. *leptospira interrogans* d. *Helicobacter pylori*	**15**
UNIT II	1. Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by - a. Protozoa: *Plasmodium falciparum* (malaria) b. Viruses: i) Hepatitis A & B virus ii) Rabies virus iii) Dengue virus c Fungi: *Candida albicans*	**15**

	2. Chemotherapy a. General principles of chemotherapy b. Mode of action of Penicillin, Streptomycin, Bacitracin, , sulphonamide and Quinolones on microorganisms. c. Antiviral drug: AZT d. Antifungal drugs: Ketoconazole e. Antiprotozoal drugs: Metronidazole f. Mechanism of drug resistance g. Chemoprophylaxis 3. Gene therapy – Concept, advantages & disadvantages. 4. Immunoprophylaxis – Vaccines and Immune Sera a. Vaccines - live attenuated, heat killed, subunit, conjugate and DNA vaccines b. Immune Sera – examples with applications	

Reference Books:

1) Microbiology - Davis
2) Immunology & serology - Ashim Chakravarty
3) Medical Microbiology 16th edition by David Greenwood, Richard C B Slack, John Peutherer
4) Medical Bacteriology - Dey & Dey
5) Medical Bacteriology including Medical Mycology & AIDS - NC Dey & T. K. Dey
6) Principals and Practice of Clinical Bacteriology – A.M. Emmerson

Paper XI **DSE:** **1010 E 3**	**INDUSTRIAL MICROBIOLOGY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course Outcomes - On completion of course, student will be able to – **CO1: Know methods used for industrial production of various products using microorganisms.** **CO2: Explain various techniques for product recovery after fermentation.** **CO3: Understand the cause of spoilage of food** **CO4: Understand the methods for preservation of food.**		
UNIT I	**1.Food Microbiology** a. Food as a substrate for microorganisms. b. Food born diseases – i. Role of microorganisms in food born diseases ii. Food poisoning - i) Staphylococcal ii) Fungal (aflatoxin) iii. Food infections –Salmonellosis. iv. Food spoilage and its preservation **2. Industrial Microbiology** a. Strain Improvement b. Scale up of fermentations c. Microbiological assays d. Preservation of industrially important microorganisms - Methods, Culture collection centers	**15**
UNIT - II	**1. Industrial production of -** a. Amylase - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. b. Grape wine - Definition, types, production of table wine (Red and White), microbial defects of wine c. Penicillin - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction	**15**

	and Recovery. Concept of semi synthetic penicillin d. Citric acid - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. e. SCP by using yeast **2. Microbial Production of –** a. Vitamins - Vit. B_{12} b. Amino acids – Lysine **3. Probiotics**- Concept, Production by using *Lactobacillus* and applications **4. Downstream processing & product recovery-** a. Centrifugation b. Flocculation c. Filtration d. Solvent extraction e. Distillation f. Precipitation g. Crystallization h. Chromatography. **5. Testing of sterility, pyrogen, carcinogenicity, toxicity and allergens**	

Reference Books:

A. For Food microbiology and industrial microbiology

1. Principles of fermentation technology- Peter F. Stanbury & Allan Whitaker (Pergamon Press).
2. Principles of Microbial technology - Peppler, Vol. I & II.
3. Industrial Microbiology - Casida
4. Industrial Microbiology - A. H. Patel
5. Industrial Microbiology - Prescott & Dunn
6. Industrial Microbiology - Miller
7. Pharmaceutical Microbiology - Huggo & Russel
8. Food Microbiology – Frazier

Paper XII **DSE:** **1010 E 4**	**MICROBIAL BIOCHEMISTRY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course Outcomes - Upon successful completion of course, students are expected to be able to – **CO1: Explain Metabolic pathways and Bioenergetics** **CO2: Understand Various downstream processing** **CO3: Understand Basic concept related to enzyme** **CO4: Determine enzyme production and its activity**		
UNIT I	**1. Enzymes -** a. Definition, properties, structure, specificity, classification and mechanism of action (Lock & Key, Induced fit hypothesis) b. Allosteric enzymes - Definition, properties, models explaining mechanism of action. c. Ribozymes – concept, significance. dIsozymes- definition, properties, example. e. Factors affecting catalytic efficiency of enzymes i. Proximity and orientation ii. Strain and distortion. iii. Acid base catalysis iv. Covalent catalysis f. Enzyme kinetics - Derivation of Michaelis-Menten equation, Lineweaver Burk Plot, Significance of Km and Vmax. g. Regulation of enzyme synthesis. i.Positive control - Ara operon ii.Negative control - Lac operon iii.Catabolite repression **2. Extraction & purification of enzymes.** a. Methods of extraction of intracellular and extracellular enzymes. i. Choice of source and biomass development ii.Methods of homogenization - cell disruption methods	**15**

	iii .Purification of enzymes on the basis of - • Molecular size • Solubility differences • Electrical charge • Adsorption characteristic differences **3. Assay of enzymes - Based on substrate and product estimation**. **4. Immobilization of enzymes - Methods & applications** **5. Confirmation of purified enzymes**	
UNIT II	**1. Basic concepts of -** a.Glyoxylate bypass b.Phosphoketolase pathway c.Bioluminescence – Occurrence, mechanism & applications. **2. Assimilation of -** a.Carbon b.Nitrogen with respect to N_2 and NH_3 (GOGAT) c.Sulphur 3**. Prokaryotic Biosynthesis of -** a.RNA b.DNA c.Proteins d. Peptidoglycan	**15**

Reference Books:

1. Enzymology - Prise & Stevens
2. Enzymes - Biochemistry, Biotechnology, clinical chemistry - Trevor Palmer.
3. Enzymes - Dixon and Webb
4. Lehnigers Principles of Biochemistry by David Nelson & Michale Cox, Fifth edition.
5. General Microbiology - Stanier
6. Principles & techniques of Biochemistry - Wilson & Walker, 6th edition.
7. Biochemistry - Lubert Stryer

SEC-SE	Management of Human Microbial Diseases Theory :30 Hours (Credits -2)	No. of Hours per unit/ credit
Course Outcomes – Upon successful completion of course, students are expected to be able to – **CO1: Explain the causes of immune deficiency diseases.** **CO2: Understand the cause and transmission of diseases.** **CO3: Design the diagnostic test and therapeutic agents.** **CO4: Apply their knowledge to prevent diseases**		
UNIT I	**a. Human Diseases** Infectious and non infectious diseases, microbial and non microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections **b. Microbial diseases** Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases, Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/Ebola) – causes, spread and control, Mosquito borne disease – Types and prevention.	**15**
UNIT II	**a. Therapeutics of Microbial diseases** Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART. **b . Prevention of Microbial Diseases** General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect	**15**

	vectors.	
	Suggested Readings – Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication **1.** Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Edu.	

SEMESTER VI

PAPER VII **DSE:1010F1**	**VIROLOGY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credits**
Course Outcomes - Upon successful completion of course, students will be able to – **CO1: Describe various stages involved in multiplication cycle of viruses** **CO2: Understand methodological approaches in isolation, cultivation & purification of viruses.** **CO3: Distinguish characteristics of normal cell and cancerous cell.** **CO4: Explain various methods for enumeration of viruses.**		
UNIT – I	**1. a. The Structural properties of viruses**: Capsids, Nucleic acids and envelope. b.Structure of T4 bacteriophage, TMV and HIV, Viroids & prions. c. One step growth experiment. **2. Isolation, cultivation and Purification of viruses** a. Isolation and cultivation of viruses - i.Animal virus - Tissue culture, chick embryo and live animals. ii.Plant virus – Protoplasts culture technique, Insect tissue culture iii. Bacteriophages - Plaque method. b. Purification of viruses using physico-chemical properties i.Density gradient centrifugation ii. Precipitation	**15**

	3. Methods of Enumeration of viruses i. Latex droplet method (Direct microscopic count) ii. Plaque and pock method.	
UNIT – II	**1. a) Lysogeny** - Definition of lysogeny and temperate phage, types, lysogeny by lambda phage - adsorption & penetration, genetic map for lysogenic interaction, expression of λ genes, establishment of repression, maintenance of repression, integration of λ genome in host chromosome. b. Reproduction of animal viruses - Adenovirus. c. Reproduction of plant viruses – TMV d. Reproduction of T4 phage. **2. Oncogenesis:** a. Definition of oncogenesis b. Types of cancer c. Characteristics of cancer cells. d. Tumor suppressor genes and protooncogenes e. Hypothesis about cancer. I. Somatic mutation hypothesis II. Viral gene hypothesis i. Role of DNA viruses with special emphasis on Papova viruses. ii. Role of RNA tumor viruses iii. Provirus theory, Protovirus theory, Oncogene theory. III . Defective immunity hypothesis	

Reference Books:

1.General Microbiology - Stanier

2.Microbiology - Prescott, Klein

3. Microbiology - Davis

4.General Virology – Luria

5.Genetics of Bacteria and their Viruses - William Hayes.

6.General Microbiology Vol. II - Powar and Daginawala

7.Virology - Biswas and Biswas

PAPER VII DSE:1010F1	MICROBIAL GENETICS Theory: 30 Hours (Credits -2)	No. of Hours per unit/ credits
Course Outcomes - Upon successful completion of course, students will be able to – **CO1: Understand molecular mechanism involved in gene regulation** **CO2: Understand the basic concept of operon and mutation.** **CO3: Discuss the principle, working and applications of molecular biology techniques including PCR and DNA sequencing.** **CO4: Explain techniques used to manipulate genes & formation of clones**		
UNIT-I	1. One cistron - one polypeptide hypothesis. 2. Molecular mechanism of gene expression a. Concept of operon b. Pribnow box c. Genetic regulation in tryptophan operon 3. Mutations a. Expression of mutations - i. Time course of phenotypic expression. ii. Conditional expression of mutation. b. Suppressor mutations (with examples) - Genetic and non-genetic. 4. Methods of isolation and detection of mutants based on - a. Relative survival b. Relative growth c. Visual detection	**15**
UNIT – II	**1.Genetic complementation** - Cis-trans test **2.Extrachromosomal inheritance:** a. Kappa particles. b. Transposable elements - general properties and types. **3.Techniques in Molecular Biology –** a. DNA sequencing (Sanger's method)	**15**

b. DNA Finger printing

c. PCR

d. Blotting techniques- Southern, Western, Northern

4. Genetic engineering

a. Introduction

b. Tools of genetic engineering –

i. Enzymes

ii. Vectors-phage, plasmid and cosmid

iii. DNA probe – methods of preparation and detection.

iv. Linkers and adaptors

v. Cloning organisms - (Bacteria and Yeasts)

vi. Genomic library and cDNA library

c. Techniques –

i. Isolation of desired DNA segment- Shotgun Method, cDNA synthesis, Chemical synthesis

ii. Construction of r-DNA using appropriate vector- Use of restriction enzymes,
Linkers, Adaptors Homopolymer tails

iii. Transfer to cloning organisms (Bacteria and Yeasts)

iv. Selection of recombinant bacteria and yeasts – Blue and white screening, Colony hybridization technique.

d. Application of genetic engineering in –

i. Medicine-

ii.Agriculture

iii.Industry

iv. Environment

v. Understanding biology

Books Recommended:

1.Genetics - Stickberger.

2. Genes - Benjamin Lewin IX ed.

3.Principles of gene manipulation - Primrose and Old

4.Genetic Engineering - Second Ed. Desmond S. T. Nicholl

5.Recombinant DNA - J. D. Watson

6.Biochemistry – Lehninger

7.Molecular Biology of Gene - J. D. Watson

PAPER VIII **DSE:1010F2**	**AGRICULTURAL MICROBIOLOGY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course Outcomes - Upon successful completion of course , students will be able to – **CO1: Understand various plant microbe interactions especially rhizosphere and their applications especially the biofertilizers and their production techniques** **CO2: Understand various biogeochemical cycles – C,N,P cycle and microbes involved** **CO3: Perform isolation of agriculturally important microorganisms and formulate biofertilizers.** **CO4: Explain role of microorganisms and common symptoms of plant diseases.**		
UNIT –I	**1. Soil Microbiology**. a. Physical characters. b. Chemical characters. c. Types of microorganisms in soil and their role in soil fertility. d. Microbiological interactions - Symbiosis, Commensalism, Amensalism, Parasitism, Predation. **2. Role of microorganisms in elemental cycle** e. Carbon cycle. f. Nitrogen cycle g. Phosphorous cycle	**15**

	h. Sulfur cycle **3. Manure and Compost** a. Methods of Production - i. Green manure and farm yard manure ii. City compost- Windrow and pit method. iii Vermicompost b. Optimal conditions for composting with reference to - Composition of organic waste, Availability of microorganisms, Aeration, C:N:P ratio, Moisture content, Temperature, pH, Time.	
UNIT – II	**1. Types, production, methods of application and uses of -** a. Biofertilizers i. Nitrogen fixing - Azotobacter, Rhizobium, Azospirillum. ii. Phosphate Solubilizing Microorganisms. b. Biopesticides *i.Bacillus thuringiensis* *ii. Tricoderma spp.* **2. Biodegradation by bacteria & fungi-** a. Cellulose b. Pesticides **3. Plant Pathology** a. Common symptoms produced by plant pathogens b. Modes of transmission of plant diseases. c. Plant diseases - i. Citrus Canker ii. Tikka disease of groundnut iii. Bacterial Blight of Pomegranate. iv. Control of plant disease caused by bacteria.	**15**

Reference Books:

1. Soil Microbiology - An exploratory approach - Mark Coyne.
2. Agricultural Microbiology - N. Mukherjee and J. Ghosh.
3. Introduction to Soil Microbiology - Martin Alexander IInd Edition.
4. Agricultural Microbiology - Rangaswamy and Bhagyaraj IInd Edition

5. Plant diseases - R. S. Singh.
6. Diseases of crop plants in India - G. Rangaswamy.
7. Soils and Soils Fertility- 6th edition-Frederick R.Troeh (Blackwell publishing Co.)
8. Soil Microbiology- Singh, Purohit, Parihar. (Agrobios India , 2010)
9. Soil Microbiology and Biochemistry – Ghulam Hassan Dar (New India Publishing Agency, 2010)

PAPER VIII **DSE:1010F2**	**ENVIRONMENTAL MICROBIOLOGY** Theory: 30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course outcomes - Upon successful completion of course, students will be able to – CO1: Understand the basic principle of environment microbiology and be able to apply these principles to understanding and solving environmental problems. CO2: Know the Microorganisms responsible for water pollution and their transmission CO3: Describe classification of lakes, sources, consequences and control of eutrophication. CO4: Explain various bioburden tet and clean room concepts.		
UNIT – I	1.General characteristics of waste- a.Liquid waste - pH, electrical conductivity, COD, BOD, total solids, total dissolved solids, total suspended solids, total volatile solids, chlorides, sulphates, oil & grease. b. Solid waste- pH, electrical conductivity, total volatile solids, ash. c. Standards as per MPCB 2.Sewage Microbiology a. Physico-chemical and Biological characteristics b. Treatment methods- i. Physical treatment: Screening, Sedimentation	

	ii. Biological treatment: Trickling filter, Activated sludge process, Oxidation ponds, Anaerobic digestion (Biomethanation), Septic tank. iii. Chemical treatment - Chlorination 3.Characteristics of waste generated by a. Sugar Industry b. Dairy Industry 4.Characteristics and treatment of waste generated by Hospitals 5.Eutrophication a. Classification of lakes b. Sources c. Consequences d. Control	
UNIT – II	**1. Biological safety in laboratory** a. Good Laboratory Practices b. Bio safety levels (BSL) **2. Environmental monitoring** a. Definition and purpose b. Cleanroom- Concept, classification, prevention of contamination in clean rooms c. Routine Environmental monitoring programme in pharmaceutical industries- Air monitoring, Surface monitoring and Personnel monitoring. d. Bioburden test **3. Environmental Impact Assessment**- Concept and Brief introduction **4. Bioremediation and Bioleaching** a. Bioremediation i.Definition ii.Types iii. Applications. b. Bioleaching	**15**

	i. Introduction ii. Microorganisms involved iii. Chemistry of Microbial leaching iv. Laboratory scale and pilot scale leaching v. In situ leaching - Slope, heap vi. Leaching of Copper and Uranium	

Reference Books:

1. Environmental Pollution by Chemicals - Walker, Hulchiason.
2. Biochemistry and Microbiology of Pollution - Higgins and Burns.
3. Environmental Pollution - Laurent Hodge, Holt.
4. Waste Water Treatment - Datta and Rao (Oxford and IBH)
5. Sewage and waste treatment – Hammer
6. Environment Chemical Hazards - Ram Kumar (Swarup and Sons, New Delhi).
7. Environment Pollution - Timmy Katyal (Satke Anmol Pub. New Delhi).
8. Ecology of Polluted Water - Vol. II - Anand Kumar (Aph Pub. Co. New Delhi).
9. Environment Pollution and Management of waste waters by Microbial Techniques - Pathade and Goel (ABD Pub. Jaipur).
10. Current Topics in Environmental Sciences - Tripathi and Pandey (ABD Pub. Jaipur).
11. Environmental Impact Assessment - R. K. Trivedy

Microbial Limit and Bioburden Tests, 2nd edition - Lucia Clontz (CRCpress)

SEC-SF	**FOOD FERMENTATION TECHNIQUES** Theory :30 Hours (Credits -2)	**No. of Hours per unit/ credit**
Course Outcomes - Upon successful completion of course, students are expected to be able to – **CO1: Understand the role of microorganisms in fermentation process** **CO2: Start small scale food industry** **CO3: Apply their knowledge in designing techniques for food processing** **CO4: Explain the role and health benefits of microorganism in probiotic food.**		
UNIT I	**1. Fermented Foods** Definition, types, advantages and health benefits **2. Milk Based Fermented Foods**	**15**

	Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process **3. Grain Based Fermented Foods** Soy sauce, Bread, Idli and Dosa: Microorganisms and production process	
UNIT II	**1. Vegetable Based Fermented Foods** Pickels, Saeurkraut: Microorganisms and production process **2. Fermented Meat and Fish** Types, microorganisms involved, fermentation process **3. Probiotic Foods** Definition, types, microorganisms and health benefits	**15**

Reference Books -

1. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan
2. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

PRACTICAL

SEMESTER V

PRACTICAL – I	**IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Credits -4)**
	Major: 1. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics. *a. Pseudomonas aeruginosa* b *Klebsiella pneumoniae* c. *Candida albicans* 2. Determination of MIC of streptomycin against *E.coli* by broth method

	Minor : 1. Determination of sensitivity of common pathogens to antibiotics by paper disc method. 2. Serological tests: a. Widal test - Quantitative b. Demonstration of Enzyme Linked Immunosorbent Assay (ELISA) 3. Haematology : a. Estimation of haemoglobin by Sahli's method. b. Determination of ESR of the blood sample (Westergren method) c. Determination of PCV d. Total and differential blood cells count. 4. Urine analysis a. Physical and chemical examination of urine. b. Test for protein (Acetic acid test) c. Test for ketone bodies (Rothra's test) d. Test for bile salt.
PRACTICAL II	**FOOD AND INDUSTRIAL MICROIOLOGY** **(Credits -4)**
	Major: 1. Assay of amylase by DNSA method (Graphical estimation) 2. Bio-assay of Vitamin B12 3. Bio-assay of Penicillin. 4. Microbial testing of Water: a. Presumptive, confirmed and completed test. b. MPN c. SPC of tomato sauce. 5. Production of wine and examination for pH, colour and alcohol content. **Minor:** 1. Citric acid fermentation, recovery and estimation by titration. 2. Amylase production by using *Bacillus* species.

	3. Isolation of lactic acid bacteria from fermented food. 4. Examination of milk by Direct microscopic count (DMC) 5. Sauerkraut production.

SEMESTER VI

PRACTICAL III	**VIROLOGY AND MICROBIAL GENETICS (Credits -4)**
	Major: 1. Isolation of coliphages from sewage. 2. Effect of U.V. light on bacteria and graphical presentation of result. 3. Isolation of auxotrophic mutants by replica plate technique 4. Transfer of genetic material by transformation in *E. coli* 5. Isolation of chromosomal DNA from bacteria (J. Marmurs method) **Minor:** 1. Electrophoretic separation of DNA. 2. Isolation of streptomycin - resistant mutants (gradient plate technique) 3. Isolation of Lac negative mutants of *E. coli*
PRACTICAL IV	**AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY (Credits -4)**
	Major: 1. Isolation of Azotobacter from soil. 2. Isolation of Xanthomonas from infected citrus fruit. 3. Isolation of Rhizobium from root nodules. 4. Isolation of phosphate solublising bacteria from soil. 5. Determination of BOD of sewage **Minor:** 1. Determination of texture, color, pH of soil. 2. Estimation of Calcium and Magnesium from soil (EDTA method) 3. Determination of organic carbon content of soil (Walkley and Black method) **4.** Determination of COD of sewage.

Reference Books:

1. Medical Lab Technology- Ramnikand Sood, Jaypee brothers (Medical pub. New Delhi)
2. Practical Biochemistry -Plummer
3. APHA (American Public Health Association) Handbook
4. Soil, Plant and Water Analysis-P. C. Jaiswal
5. Biochemical methods-S. Sadasivam, A. Manickam
6. Practical Biochemistry- J. Jayraman
7. Practical Microbiology – R.C. Dubey, D. K. Maheshwari, S. Chand & Co. Ltd.

Practical Examination

A) The practical examination will be conducted on three (3) consecutive days for not less than 6 hours on each day of the practical exanimation.

B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the least

Two (2) places of Microbiological interest (Pharmaceutical industry, Dairy, Research institutes etc.) and submit the report of their visit at the time of examination. The report should be duly certified by the Head of the Department.

Nature of question paper and distribution of marks for B.Sc. Part III Microbiology Practical Examination

Practicals I, II, III & IV

Q.1 Major Experiment	20 Marks
Q. 2 Minor Experiment	15 Marks
Q.3 Journal	05 Marks
SPOTTING	10 Marks
VIVA-VOCE	10 Marks

(On practicals not attempted in the examination)

TOUR REPORT:	20 MARKS

Nature of Question Paper

Instructions: 1) All the questions are **compulsory**.

2 Figures to the right indicate **full** marks.

3)Draw neat labeled diagrams **wherever** necessary.

4) Use of calculator is allowed.

Time: 2 hours **Total Marks: 35**

PAPER IX/X/XI/XII

Q.1.A Select correct alternative. **(5)**

i)

a) b) c) d)

ii)

a) b) c) d)

iii)

a) b) c) d)

iv)

a) b) c) d)

v)

a) b) c) d)

Q.1 B Fill in the blanks

(2)

i)

ii)

Q.2. Attempt any Two.

(16)

i)

ii)

iii)

Q.3. Attempt any three **(12)**

i)

ii)

iii)

iv)

v)

Instruction to paper setters: Equal weight age should be given to all units.

For Continuous Internal Examination: (15 marks)

Mandatory 1) Presenty ---- **(5 marks)**

***Select any one for B.Sc.III ---- (10 marks)**

1) Unit test

2) Home assignment

3) Project

4) Seminar

*Yet it is not finalized

SCHEME OF MARKING (THEROY)

Sem.	Core Course	Marks	Evaluation	Paper	Answer Books	Standard of passing
V	DSE E 1	35	Semester wise	Each paper of 35 marks	As per Instruction	35% (12 marks)
V	DSE E 2	35	Semester wise	Each paper of 35 marks	As per Instruction	35% (12 marks)
V	DSE E 3	35	Semester wise	Each paper of 35 marks	As per Instruction	35% (12 marks)
V	DSE E4	35	Semester wise	Each paper of 35 marks	As per Instruction	35% (12 marks)

SCHEME OF MARKING (CIE) Continuous Internal Evaluation

Sem.	Core Course	Marks	Evaluation	Paper	Answer Books	Standard of passing
V	DSE E 1	15	Semester wise	one	As per Instruction	35% (6 marks)
	DSE E 2	15	Semester wise	one	As per Instruction	35% (6 marks)
	DSE E 3	15	Semester wise	one	As per Instruction	35% (6 marks)
	DSE E 4	15	Semester wise	one	As per Instruction	35% (6 marks)

SCHEME OF MARKING (PRACTICAL)

Sem.	Course	Marks	Evaluation	Sections	Standard of passing
V AND VI	Practical I, II, III &IV	200	Annual	As per Instruction	35%

*A separate passing is mandatory