John Wilson Education Society's

WILSON COLLEGE (AUTONOMOUS)

Chowpatty, Mumbai-400007
RE-ACCREDITED 'A' grade by NAAC

Affiliated to the

UNIVERSITY OF MUMBAI

Syllabus for Second Year

Program: B.Sc.

Program Code: WSMIC (MICROBIOLOGY)

Choice Based Credit System (CBCS) with effect from Academic year 2024–2025

Based on the National Education Policy 2020

PROGRAM OUTLINE 2024-2025 FOR MAJOR SUBJECT

YEAR	SEM	COURSE CODE		COURSE TITLE	CREDITS
SYBSc	3	WSMICMJ231	Discipline specific course (DSC: Mandatory) (Major) Theory	INTRODUCTION TO GENETICS AND VIROLOGY	2
		WSMICMJ232	Discipline specific course (DSC: Mandatory) (Major) Theory	FUNDAMENTALS OF IMMUNOLOGY AND MEDICAL MICROBIOLOGY	2
		WSMICMJ233	Discipline specific course (DSC: Mandatory) (Major) Practical	TECHNIQUES BASED ON GENETICS, VIROLOGY, IMMUNOLOGY AND MEDICAL MICROBIOLOGY	2
		WSMICSE231	Skill Enhancement Course (SEC)	MICROBIOLOGICAL EXAMINATION OF SOIL, AIR AND WATER	2
	4	WSMICMJ241	Discipline specific course (DSC: Mandatory) (Major) Theory	INTRODUCTION TO BIOCHEMISTRY	2
		WSMICMJ242	Discipline specific course (DSC: Mandatory) (Major) Theory	FOOD AND FERMENTATION TECHNOLOGY	2
		WSMICMJ243	Discipline specific course (DSC:	TECHNIQUES BASED ON BIOCHEMISTRY, FOOD AND	2

			Mandatory) (Major) Practical	FERMENTATION TECHNOLOGY	
		WSMICVS241	Vocational Skill Course	ANALYTICAL INSTRUMENTATIONS	2

PROGRAM OUTLINE 2024-2025 FOR MINOR SUBJECT

YEAR	SEM	COURSE CODE		COURSE TITLE	CREDITS
SYBSc	3	WSMICMN231	Discipline specific course (DSC: Mandatory) (Minor) Theory	FOOD MICROBIOLOGY	2
		WSMICMN232	Discipline specific course (DSC: Mandatory) (Minor) Practical	MICROBIAL FOOD TECHNOLOGY	2
	4	WSMICMN241	Discipline specific course (DSC: Mandatory) (Minor) Theory	SOIL, AIR AND WATER MICROBIOLOGY	2
		WSMICMN242	Discipline specific course (DSC: Mandatory) (Minor) Practical	MICROBIOLOGICAL EXAMINATION OF SOIL, AIR AND WATER	2

PROGRAM OUTLINE 2024-2025 FOR OPEN ELECTIVE

YEAR	SEM	COURSE CODE		COURSE TITLE	CREDITS
SYBA	3	WAMICOE231	Inter-disciplinary Generic/Open Elective: (OE)	BIOTECHNOLOGY AND HUMAN WELFARE	2
	4	WAMICOE241	Inter-disciplinary Generic/Open Elective: (OE)	BIOTECHNOLOGICAL INNOVATIONS IN AGRICULTURAL AND ENVIRONMENTAL FIELD	2

PROGRAMME SPECIFIC OUTCOMES (PSOs).

The Microbiology graduates shall:

PSO1 Impart knowledge and understanding of fundamental concepts of genetics, biochemistry, molecular biology, virology, immunology and medical microbiology.

PSO2 Develop fundamental understanding of the role of microorganisms in the fields of environment, food and fermentation industry.

PSO3 Acquire skills through training and practice for the analysis of biomolecules.

PSO4 Understand the working and handling of different instruments like colorimeter, spectrophotometer, pHmeter, centrifuge, laminar air flow, electrophoresis apparatus to be used in research and industry.

PSO5 Develops a fundamental understanding of the role of microorganisms in transmission and control of diseases

PO6 Understand the principles used in pathogen detection and different diagnostic tools for their identification

PSO7 Understand the working and handling of different instruments like colorimeter, pHmeter, centrifuge, laminar air flow, electrophoresis apparatus to be used in research and industry

PSO8 Acquire life long abilities like problem solving, logical reasoning, documentation of data and its analysis.

PSO9 Practice flexible professional skills needed for careers in microbiology and related scientific and professional fields.

PSO10 Communicates scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.

PREAMBLE:

With the introduction of National Education Policy 2020 from the academic year 2022-23 and the introduction of Choice Based Credit System (CBCS), the existing Mumbai University syllabus of B.Sc. Microbiology is restructured to suit the CBCS pattern for its implementation from 2022. The earlier revision of the syllabi took care of balancing both the basic techniques and some of the advanced techniques in Microbiology, however, necessary foundations for certain topics must be laid before advanced learning commences.

The new syllabi under NEP 2020 is designed to facilitate the undergraduate students to be well equipped with the understanding of various fields in microbiology and allied areas, which will allow them to build upon their existing knowledge and pursue higher studies in Microbiology. At the same time the syllabus will help prepare the learners for competitive exams required to qualify for pursuing careers in this field.

These syllabi were set after rigorous discussions and consultation with subject and industry experts, research personnel, as well as a few past and present students. The learners will be well-versed with knowledge of diverse areas of Biochemistry, Food and Environmental Microbiology, Genetics, Industrial Microbiology, Immunology and Medical Microbiology. A progressive introduction to the allied fields of Microbiology would allow the students to have a sound understanding with a background that they can build on in higher studies. The learners will be at par with national and international standards and be well-versed with extensive laboratory techniques and skills for employability.

PROGRAM: S.Y.B.Sc.	SEMESTER: III	MAJOR COURSE
COURSE: INTRODUCTION TO GENETICS AND VIROLOGY	COURSE CODE: WSMICMJ231	

Teaching Scheme:				Evaluation scheme:	
Lectures per week	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
02	-	-	02	40	60

Learning Objectives:

LO1: To help the learner understand the different disciplines of genetics.
LO2: To appreciate the scientific experimentations conducted to discover DNA as genetic material.
LO3: To introduce genetics and the principles of inheritance of genetic traits.
LO4 : To understand Nucleic Acid Structure & its chemistry
LO5: To learn differences occurring in both Prokaryotic and Eukaryotic DNA
LO6: To comprehend the discovery, nature, and definition of viruses.
LO7: To acquaint students with the structure of viruses of plants, animals, and bacteria, their genome organization, and replication strategies within the host cell.

Course Outcomes:

At the end of the course, the learner shall be able to:

CO1: Summarize the various experiments leading to the discovery of DNA as the genetic material.
CO2: Explain the structural organization, chemical composition of DNA in the eukaryotes and prokaryotes..
CO3: Solve problems related to DNA structure and size.
CO4: Illustrate the eukaryotic cell cycle, mitosis and meiosis.
CO5: Describe the nature, properties and structure,classification of viruses affecting different types of hosts and acquire knowledge of taxonomy of different groups of viruses.
CO6: Discuss the differences in virus architecture and how these may be used to classify viruses
CO7: Compare between lytic and lysogenic cycles of bacteriophage

DETAILED SYLLABUS

Course Code: WSMICMJ231/ Unit		Course/ Unit Title: Introduction to Genetics and Virology	Credits/ Lectures
1		**Genetics**	**15 lectures**
	1.1	**Introduction to Genetics** 1.1.1 Classical and Modern Genetics 1.1.2 Subdisciplines of Genetics	**02**
	1.2	**DNA as a genetic material** 1.2.1 Griffith's experiments 1.2.2 Avery, MacLeod, McCarty experiments 1.2.3 Hershey and Chase experiments	**02**
	1.3	**Nucleic Acid Structure & Chemistry**	**02**
	1.4	**Discovery of RNA as Viral Genetic Material**	**01**
	1.5	1.5.1 Difference between prokaryotic and eukaryotic DNA 1.5.2 Organization of DNA in chromosome in prokaryotes and eukaryotes	**04**
	1.6	**Chromosomal Basis of Inheritance in Eukaryotes** 1.6.1 Chromosome & Cellular Reproduction 1.6.2 Introduction to Mitosis & Meiosis 1.6.3 Sex chromosome & Sex Linkage	**04**
2		**Virology**	**15 lectures**
	2.1	**Viral architecture (with reference to T4 Phage, TMV & Influenza virus)** 2.1.1 Viral Capsid 2.1.2 Viral Genome 2.1.3 Viral Envelope	**02**
	2.2	**Viral classification (Baltimore classification)**	**01**
	2.3	**Viral replication cycle (w.r.t. T4 phage, TMV and influenza virus)** 2.3.1 Attachment 2.3.2 Penetration 2.3.3 Uncoating 2.3.4 Replication	**04**

		2.3.5 Basics of Lysogeny, 2.3.6 Assembly, maturation & release	
	2.4	**Visualization and detection of virus particles** 2.4.1 Formation of Plaques 2.4.2 Electron microscopy 2.4.3 Atomic force microscopy 2.4.4 Haemagglutination	**05**
	2.5	**Cultivation of viruses** Cell culture methods: Equipment required for animal cell culture, Isolation of animal tissue, embryonated egg technique, laboratory animals	**03**

References:

1. Peter J. Russell (2006), I Genetics-A Molecular Approach, 2nd edition.
2. Benjamin A. Pierce (2008), Genetics - A conceptual approach", 3rd edition, W. H. Freeman and company.
3. R. H. Tamarin, (2004), Principles of Genetics, Tata McGraw Hill.
4. M. Madigan, J. Martinko, J. Parkar, (2009), Brock Biology of Microorganisms, 12th edition, Pearson Education International.
5. Edward Wagner and Martinez Hewlett, (2005) "Basic Virology", 2nd edition, Blackwell Publishing
6. Teri Shors,.(2009), "Understanding Viruses", Jones and Bartlett publishers.
7. Flint, Enquist, Racanillo and Skalka (2015), "Principles of Virology", 4th edition. ASM press.

<table>
<tr><td colspan="2">PROGRAM: S.Y.B.Sc.</td><td colspan="3">SEMESTER: III</td><td>MAJOR COURSE</td></tr>
<tr><td colspan="2">COURSE: FUNDAMENTALS OF IMMUNOLOGY AND MEDICAL MICROBIOLOGY</td><td colspan="4">COURSE CODE: WSMICMJ232</td></tr>
<tr><td colspan="4">Teaching Scheme:</td><td colspan="2">Evaluation scheme:</td></tr>
<tr><td>Lectures per week</td><td>Practical (Hours per week)</td><td>Tutorial (Hours per week)</td><td>Credit</td><td>Continuous Internal Assessment (CIA)</td><td>Semester End Examination</td></tr>
<tr><td>02</td><td>--</td><td>-</td><td>02</td><td>40</td><td>60</td></tr>
<tr><td colspan="6">Learning Objectives:
LO1: To study the role of physical and chemical barriers in host defense
LO2: To describe the role of skin and mucous membranes in innate immunity,
LO3: To express the importance of normal microbiota in innate immunity.
LO4: To understand the process of phagocytosis, Inflammatory reactions and pathways of the complement system.
LO5: To study humoral and cellular immunity.
LO6: To define antigens, its types, epitope, haptens and factors influencing antigenicity.
LO7: To explain the function, structure and chemical characteristics of antibodies.
LO8: To explore the predisposing factors which help a pathogen establish disease in the host.
LO9: To understand the role of virulence factors of a pathogen.</td></tr>
<tr><td colspan="6">Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Differentiate between innate and adaptive immunity.
CO2: Illustrate the significance of host physical barriers and their role in innate immunity
CO3: Correlate the microbiota with disease protection.
CO4: Explain the concepts of antigens, and antibodies.
CO5: Enlist the different factors that contribute to disease establishment.
CO6: Summarize the significance of virulent factors and how they assist in pathogenesis.</td></tr>
</table>

DETAILED SYLLABUS

Course Code: WSMICMJ232/ Unit		Course/ Unit Title: Fundamentals of Immunology and Medical Microbiology	Credits/ Lectures
1		**Nonspecific (Innate) Host Resistance:**	**15 lectures**
	1.1	**A Historical Perspective of Immunology**	**01**
	1.2	**Cells & Organs of the Immune System** 1.2.1 Hematopoietic Stem cell, Antigen Presenting cells, T cell and its subtype, B cell ,Macrophages, NK cells, Granulocytes. 1.2.2 Bone marrow, Thymus, Spleen and Lymph node, SALT, GALT, MALT	**04**
	1.3	**The Skin and the Mucosal Surfaces Provide Protective Barriers Against Infection**	**01**
	1.4	**Phagocytosis and Inflammation**	**02**
	1.5	**Study of Lymphocytes and Antigen-Presenting Cells** **Humoral Immunity vs Cellular Immunity** **Recognition of Antigen by B and T Lymphocytes.**	**07**
2		**Study of Microbial Virulence and Pathogenesis**	**15 lectures**
	2.1	**Patterns of disease** 2.1.1 Predisposing factors development of disease	**02**
	2.2	**Establishing a disease**	**01**
	2.3	2.3.1 Portals of entry 2.3.2 Attachment to the host 2.3.3 Establishment of the disease 2.3.4 Study of Microbial virulence factors: 2.3.4.1 Hemolysin, lecithinase 2.3.4.2 Enzymes: hyaluronidase, collagenase, streptokinase, coagulase 2.3.4.3 Exotoxins: cytolytic toxins,	**06**

		diphtheria, tetanus, botulinum toxin, enterotoxin 2.3.4.4 Endotoxins: structure and function, Limulus assay for endotoxin 2.3.4.5 Other virulence factors: capsule, cell wall components 2.3.4.6 Biofilms 2.3.4.7 Antigenic variations	
	2.4	2.4.1 Stages of clinical infection 2.4.2 Signs and symptoms 2.4.3 Portals of exit 2.4.4 Persistence of microbes and pathologic conditions	**04**
	2.5	Case Study of a virulent organism: skin pathogen- *S. aureus*	**02**

References:

1. Kathleen Park Talaro, Barry Chess, (2015) Foundations in Microbiology- , 9th Edition McGraw Hill education.
2. Gerard J .Tortora,Berdell R . Funke and Christine L.Case.(2018) Microbiology An Introduction.13th Edition. ASM,Pearson Publications.
3. Wiley, Sherwood, Woolverton, (2008), Prescott, Harley, Klein's Microbiology, 7th edition, McGraw Hill.
4. Judith A Owen, Jenni Punt, Sharon A Stranford, Patricia P Jones, Janis Kuby, (2013) Kuby Immunology, 6th edition,, W.H. Freeman, New York
5. Michael.T.Madigan, John.M.Martinko, Paul V. Dunlap, David P. Clark, (2013), Brock Biology of Microorganisms, 13th edition, Pearson International edition
6. Sulabha Pathak, Urmi Palan , Immunology : Essential and Fundamental,3rd ed
7. Capital Publishing company,Fahim Halim Khan,(2011) "The elements of Immunology",. Pearson Education.

PROGRAM: S.Y.B.Sc.	SEMESTER: III (DSC: Major - Practicals)		
COURSE: **TECHNIQUES BASED ON GENETICS, VIROLOGY, IMMUNOLOGY AND MEDICAL MICROBIOLOGY**	**Course Code: WSMICMJ233**		
Teaching Scheme			**Evaluation Scheme**
Practical (Hours per week)	**Credit**	**Continuous Internal Assessment (CIA) (40%)**	**Semester End Examination (60%)**
4	**2**	**40**	**60**

Learning Objectives:
LO1: To study the DNA extraction and estimation techniques.
LO2: To acquaint to different stages of eukaryotic cell cycle
LO2: To understand the lytic cycle of bacteriophages
LO3: To demonstrate immunological reactions
LO4: To study the virulence factors and biochemical tests for identification of pathogens
LO5: To plan and execute experiments.

Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Perform extraction, isolation and estimation of genetic material
CO2: Demonstrate squash technique to microscopically visualize and identify stages of eukaryotic cell cycle
CO3: Recognise phage induced infection centers on bacterial host
CO4: Use specialize media for cultural characterization of pathogens
CO5: Apply biochemical tests for identification of pathogens
CO6: Interpret the various antibody antigen reactions.

DETAILED SYLLABUS

Course code: WSMICMJ23	PRACTICAL (For Major Students)	Credits/ Lectures 2
	1. Isolation of genomic DNA from plant source 2.Isolation of genomic DNA from *E.coli* 3. Detection of separated DNA by AGE 4. Calculations based on structure of DNA 5. Qualitative and Quantitative estimation of DNA 6. Qualitative and Quantitative estimation of RNA. 7. Study of Mitosis 8. Study of Meiosis. 9. Visit to Genetic Testing Laboratory for studying karyotyping for chromosomal disorders 10. Cultivation of viruses in Chick embryo (Demo) 11. Detection of coliphages 12. Cultivation of viruses by Animal Tissue Culture (Laboratory Visit) 13. Study of Virulent factors: a. Lecithinase, b. hemolysin, c. coagulase 14. Study of cultural media used for identification: MacConkey's, Salt Mannitol Agar, Baird Paker and Salmonella-Shigella agar, BHI. 15. Use of biochemical media for identification of pathogens: Indole test, Methyl red test,Voges-Proskauer test, Citrate utilization test, Urease, Nitratase, TSI, H_2S production. 16. Isolation of organisms from fomites (coins, currency) 17. Cough plate technique SIBA 18. Isolation of organisms from face (pimples) 19. Study of Agglutination reaction: ABO and Rh (Direct) 20. Reverse blood typing 21. Study of precipitation reaction: Ouchterlony test 22. Study of precipitation reaction: SRID 23. Commercially available immunological tests- Pregnancy strip	

Suggestions for Practical CIA:

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo, hepatitis B and retroviruses) using electron micrographs.
2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ringspot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs.
3. Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph.

PROGRAM: S.Y.B.Sc.	SEMESTER: III			MINOR COURSE	
COURSE: FOOD MICROBIOLOGY	COURSE CODE: WSMICMN231				
Teaching Scheme:				Evaluation scheme:	
Lectures per week	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
02	--	-	02	40	60

Learning Objectives:

LO1: To study the significance and activities of microorganisms in food the role of intrinsic and extrinsic factors on growth and survival of microorganisms and attain information on microbial food spoilage.
LO2: To understand the principles in traditional food preservation techniques including salting, pickling, refrigeration, freezing, oxidation, and canning/bottling and chemical preservation
LO3: To identify the role of microorganisms in food borne diseases and control measures
LO4: To acknowledge the application of microbes and microbial products in the food industry.
LO5: To provide awareness on Food acts/laws and food adulteration practices

Course Outcomes:

At the end of the course, the learner shall be able to:
CO1: Enlist the intrinsic and extrinsic factors contributing to food spoilage
CO2: Describe different processing and food preservation techniques based on different food
CO3: Summarize the food borne diseases
CO4: Explain the applications of microbes in the food industry.
CO5: Discuss the food acts, HACCP principles for food protection.

DETAILED SYLLABUS

Course Code: WSMICMN231 / Unit		Course/ Unit Title: Food Microbiology	Credits/ Lectures
1		**Introduction to Food Microbiology**	**15 lectures**
	1.1	**Food as a substrate for microorganism:** 1.1.1 Intrinsic 1.1.2 Extrinsic factors A) pH B) aw C) O-R potential D) Nutrient Content E) Accessory food substances F) Inhibitory substances & biological structure G) Combined effects of factors affecting growth	**03**
	1.2	**Food Control Enforcement & Control Agency**: International agencies, Federal agencies (FDA, USDA),FSSAI[website], Introduction to HACCP	**02**
	1.3	**Important Microorganisms in Food Microbiology:** General characteristics of the enlisted organisms to be studied wrt spoilage and transmission of infection/ intoxication (no clinical features and structural details) 1.3.1 Spoilage causing microorganisms *a.* Yeast & Molds: *Saccharomyces, Aspergillus & Penicillium* *b.* Bacteria: *Bacillus, Clostridium, Flavobacterium, Pseudomonas* 1.3.2 Food-borne Illness associated Microorganisms: Classification of Food-borne diseases (Schematic). 1.3.3 Bacteria responsible for food-borne intoxication and infections-overview/tabulation. Examples of non-bacterial food-borne pathogens(list) Details of :	**04**

		a) Staphylococcus food intoxication (organism, enterotoxin, incidence, foods involved, prevention of outbreaks) b) Salmonellosis (organism, source, incidence, foods involved, outbreak conditions & prevention)	
	1.4	**Microorganisms used in food fermentations: yeasts, molds and lactic acid bacteria**.	**02**
	1.5	**Food ingredients of microbial origin:** 1.5.1 SCP, 1.5.2 Amino Acids, 1.5.3 Vitamins 1.5.4 Colours 1.5.5 Nutraceuticals 1.5.6 Flavors.	**02**
	1.6	**Probiotics and intestinal bacteria.**	**02**
2		**Food preservation and sanitation**:	**15**
	2.1	**General Principles of Food Preservation:** 2.1.1 Preservation using High temperature (including TDT, TDP D, F, Z values, 12D concept), principle of canning. 2.1.2 Low temperature. 2.1.3 Drying. 2.1.4 Food preservatives (organic acids & their salts, Sugar & salt.) 2.1.5 Ionizing radiation.	**04**
	2.2	**Food Sanitation & Hygiene**: 2.2.1 Water 2.2.2 Potable water 2.2.3 Sources of contamination of water, 2.2.4 Treatment of water, pesticide residue.	**02**
	2.3	Food Handling and contamination, equipment, Control of insects & Rodents, Toxins from plants, toxins from animals, Mycotoxins, Toxic Agricultural Residues, Poisoning by chemicals.	**02**
	2.4	**Practical rules for good sanitation.**	**03**
	2.5	**Food laws and food adulteration.**	**02**

	2.6	**Consumer protection & consumer guidance society.**	**02**

References:

1. Jay, J. M., Golden, D. A., Loessner, M. J. (2005). Modern food microbiology. India: Springer.
2. McClure, P. J., Adams, M. R., Moss, M. O. (2016). Food Microbiology. United Kingdom: Royal Society of Chemistry.
3. Montville, Thomas J._ Matthews, Karl R.-Food Microbiology- (2008) An Introduction-American Society for Microbiology (ASM)
4. Westhoff, D. C., Frazier, W. C. (1981). Food Microbiology. India: Tata McGraw-Hill.
5. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
6. Willey, Joanne M, Linda Sherwood, Christopher J. Woolverton, and Lansing M. Prescott (2008) Prescott, Harley, and Klein's Microbiology. 7th edition. McGraw-Hill Higher Education, New York.
7. Michael T. Madigan, J. M. Martinko, David A. Stahl and David P. Clark (2012), Brock Biology of Microorganisms. 13th edition. Pearson Education, Inc., publishing as Benjamin Cummings.

PROGRAM: S.Y.B.Sc.	SEMESTER: III			MINOR COURSE
COURSE: Microbial Food technology	COURSE CODE: WSMICMN232			
Teaching Scheme:			Evaluation scheme:	
Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
04	-	02	40	60

Learning Objectives:
LO1: To perform microscopic, cultural tests on microbes from spoilt food
LO2: Understand the role of temperature time combination to preserve food
LO3: Appreciate the different types of food preservatives,mode of action
LO4: Learn role of microbes in producing fermented foods
LO5: Study *Staphylococcus aureus* from sweets and demonstrate its virulence

Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Practice broth dilution assay to estimate the minimum inhibitory concentration of chemical preservative
CO2: Use microbiological standards to grade milk samples
CO3: Discuss importance of amylase ,protease and lipase producers in food spoilage.
CO4: Conduct food fermentation like Bread dough fermentation,Wine production.
CO5: Isolate *Staphylococcus aureus* from sweets and demonstrate its virulence

DETAILED SYLLABUS

Course code: WSMICMN232	PRACTICAL (For Minor Students) Microbial Food Technology	Credits/ Lectures
	1. Isolation of food spoilage agent: a. a) Fruit/Vegetable- Physical & Microscopic & Pectinolytic agent. b. b) Meat - Proteolytic, lipolytic, saccharolytic. 2. Determination of TDT and TDP. 3. Determination of Salt and sugar tolerance. 4. Determination of MIC of a Chemical preservative. 5. Visit to the Food/Dairy industry. 6. RPT of Milk– RRT, MBRT, DMC. 7. Microbiological Quality Control of Milk as per BIS/FSSAI.. 8. Wine and Bread making. 9. Isolation of lactic acid bacteria from fermented food-eg Idli, curd. 10. Isolation of *Staphylococcus aureus* from sweets and demonstrating its virulence	

<table>
<tr><td>PROGRAM: S.Y.B.Sc.</td><td colspan="3">SEMESTER: III</td><td>SKILL ENHANCEMENT COURSE (SEC)</td></tr>
<tr><td>COURSE: MICROBIOLOGICAL EXAMINATION OF SOIL, AIR AND WATER</td><td colspan="4">COURSE CODE: WSMICSE231</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="2">Evaluation scheme:</td></tr>
<tr><td>Practical (Hours per week)</td><td>Tutorial (Hours per week)</td><td>Credit</td><td>Continuous Internal Assessment (CIA)</td><td>Semester End Examination</td></tr>
<tr><td>04</td><td>-</td><td>02</td><td>--</td><td>60</td></tr>
<tr><td colspan="5">Learning Objectives:
LO1: To appreciate the omnipresence and significance of microbes in environment
LO2: To study the techniques to enumerate microbes from various natural sources
LO3: To learn enrichment techniques for cultivation of guilds of microbes
LO4: To design and set up in vitro habitats like lake, ponds etc using Winogradsky’s column
LO5: To plan and execute experiments.</td></tr>
<tr><td colspan="5">Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Examine potability of water
CO2: Comment on the efficiency of wastewater treatment.
CO3: Record the flora present in air, water, soil, raw and treated sewage samples
CO4: Detect the presence of E.coli in water using a rapid test
CO5: Analyze the different microbial communities and their interactions using Winogradsky’s column
CO6: Study different types of enriched agricultural important organisms</td></tr>
</table>

DETAILED SYLLABUS

Course code: WSMICSE231	SEC PRACTICAL	Credits/ Lectures
	Microbiological examination of soil, air and water 1. Enumeration of microorganisms in air and study of its load after fumigation 2. Study of air microflora and determination of sedimentation rate 3. Routine analysis of water: a. Standard Plate Count b. Detection of Coliforms in water: Presumptive Test, Confirmed Test and Completed Test c. Rapid Detection of *E.coli* by MUG Technique (Demonstration) 4. Waste water analysis: a. Study of microbial flora in raw and treated sewage b. Determination of total solids in wastewater c. Determination of BOD and COD of wastewater d. Membrane filtration technique (to detect and concentrate indicator organisms) 5. Total viable count of soil microflora 6. Isolation of bacteria, Actinomycetes and fungi from soil 7. Study of symbiotic association of *Rhizobium sps* with leguminous plants 8. Enrichment and isolation of Nitrifiers, Nitrifiers, Cellulose degraders, Sulphate reducers and Phosphate solubilizers from soil 9. Winogradsky's column 10. Visit to a sewage treatment plant or water purification plant	

<table>
<tr><td colspan="2">PROGRAM: Second Year Bachelor's Degree</td><td colspan="3">SEMESTER: III</td><td>OPEN ELECTIVE</td></tr>
<tr><td colspan="2">COURSE: BIOTECHNOLOGY AND HUMAN WELFARE</td><td colspan="4">COURSE CODE: WAMICOE231</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="3">Evaluation scheme:</td></tr>
<tr><td>Lectures per week</td><td>Practical (Hours per week)</td><td>Tutorial (Hours per week)</td><td>Credit</td><td>Continuous Internal Assessment (CIA)</td><td>Semester End Examination</td></tr>
<tr><td>02</td><td>--</td><td>-</td><td>02</td><td>--</td><td>60</td></tr>
<tr><td colspan="6">Learning Objectives:
LO1: To understand the potentials of Modern Biotechnology in human welfare.
LO2: To appreciate the impact of human genome project on the current medical field
LO2: To appreciate the recombinant products used in medical field that have changed the lifestyle
LO3: To learn the modern diagnostic approaches available.
LO4: To make them aware about genetic testing, screening for disorders, genetic counseling.
LO5: To expose them to the new treatment methods including regenerative therapy.</td></tr>
<tr><td colspan="6">Course Outcomes: not more than 6 (no theory paper so change accordingly)
At the end of the course, the learner shall be able to:
CO1: Enlist the scientific breakthroughs in different area of healthcare and biotech products which are available for common man
CO2:Discuss the different modern investigative, predictive diagnostic genetic approaches which are available as a result of the human genome project.
CO3:Summarize the impact of recombinant DNA technology to generate therapeutics of human origin.
CO4: Describe the role of Modern vaccines in disease prevention
CO5: Summarize the reproductive manipulations and the need for prenatal and cancer genetic screening available
CO6 : Discuss the ethical issues involved in medical biotechnology</td></tr>
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DETAILED SYLLABUS

Course Code: WAMICOE 231		Course/ Unit Title: BIOTECHNOLOGY AND HUMAN WELFARE	Credits/ Lectures
1	**1.1**	**Introduction to Biotechnology History of Biotechnology**	**15 lectures**
		1.1.1 Traditional and Modern Biotechnology 1.1.2 Biotechnology as an interdisciplinary area 1.1.3 Potentials of Biotechnology 1.1.4 Different fields of Biotechnology 1.3 Breakthrough Inventions in Biotechnology and Patents 1.4 Genomics, Ethics and Society	**02** **02** **01** **01** **04** **05**
2		**Impact of biotechnology on Human health and reproduction**	
	2.1	2.1.1 Breakthroughs of Human Genome Project revolutionizing the medical field 2.1.2 Recombinant Products in Treatment, diagnostics and preventive measures Fields of a) Diagnostics - Probes for detection of diseases (TB/MDR-TB, Sickle cell anemia, thalassemia, Downs Syndrome) , Monoclonal antibodies, Prenatal diagnosis, Genetic screening b) Treatment (one example of each) - Hormones, monoclonal antibodies, Nanomedicines, c) Preventive – vaccines 2.1.3 Reproductive manipulations- I. Test tube babies (IVF) II. Sperm cell banking, Ova Banking III. Designer babies IV. Genetic Counseling	**03** **03** **03** **02** **04**

References

1. Aluizio Borem , Fabricio R. Santos , David E. Bowen (2003) Understanding Biotechnology Prentice Hall
2. George Acquaah, Pearson Education, fnc. Prentice HalL (2004) Understanding Biotechnology: An Integrated and Cyber-Based Approach,

3. William Thieman, Michael Palladino(2019) Introduction to Biotechnology, Global Edition 4th edition. Pearson
4. R. C. Dubey. A Textbook of Biotechnology. 2006 S. Chand and Company Ltd. ·
5. B. D. Singh. Biotechnology. Kalyani Publishers.
6. Buiser Bourgaize,Jewell, Biotechnology : Demystifying The Concepts

MODALITY OF ASSESSMENT

COURSE	COURSE CODE	COURSE TITLE	CREDITS	CIA	SEM END	TOTAL
DSC MAJOR-1	WSMICMJ 231	INTRODUCTION TO GENETICS AND VIROLOGY	2	40	60	100
DSC MAJOR-2	WSMICMJ 232	FUNDAMENTALS OF IMMUNOLOGY AND MEDICAL MICROBIOLOGY	2	40	60	100
DSC MAJOR PRACTICAL	WSMICM J233	TECHNIQUES BASED ON GENETICS, VIROLOGY, IMMUNOLOGY AND MEDICAL MICROBIOLOGY	2	40	60	100
DSC MINOR-1	WSMICM N231	FOOD MICROBIOLOGY	2	40	60	100
DSC MINOR PRACTICAL	WSMICMN 232	MICROBIAL FOOD TECHNOLOGY	2	40	60	100
SEC	WSMICSE 231	MICROBIOLOGICAL EXAMINATION OF SOIL, AIR AND WATER	2	-	60	60
OE	WAMICOE 231	BIOTECHNOLOGY AND HUMAN WELFARE	2	-	60	60

Examination Pattern: For Discipline specific courses:

A. Internal Assessment- 40%- 40 Marks per paper

Sr. No.	Evaluation Type	Marks
1.	Written Objective Examination	20M
2.	Assignment/ Case study/ field visit report/ presentation/ project Multiple assignments may be given	20M
	Total	**40M**

B. External Examination- 60%- 60 Marks per paper

Semester End Theory Examination:

1. Duration - These examinations shall be of two hours duration.
2. Theory question paper pattern:

a. There shall be questions each of 20 marks based on two units and the third unit will be a mixed bag question .

b. All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Describe /Explain/ Short notes/Answer the following	4 / 6	5 marks each - 20M	UNIT 1
Discuss / Short notes /Answer the following	4/6	5 marks each -20M	UNIT 2

Do as Directed: three sub questions Define/Explain/ Give examples, State true or false/Match the columns/Analogy/	10/12	1/ 2 marks each- 20 M	Mixed Bag (All Units)

Practical Examination Pattern

A.Internal Examination: 40%- 40 Marks - **B. External Examination: 60%- 60 Marks**

Two CIA each of 20M **Semester End Practical Examination:**

For one CIA:

Particulars	Marks
Experimental tasks /Assignment	15 marks
Participation/ Attendance	5 marks
Total	**20 marks**

Particulars	Marks
Laboratory work **Major Tech** **Minor Tech**	 25 marks 15 marks
Spots/Quiz/	10 marks
Viva	05 marks
Journal	05 marks
Total	**60 marks**

PRACTICAL BOOK/JOURNAL :
The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Examination Pattern: Open Elective:
1. Two assignments of 30 marks each. (Oral Presentations/Written assignments/ Case studies)

Examination Pattern: Skill Enhancement Course:60M

Particulars	Marks
Laboratory work **Major Tech** **Minor Tech**	 25 marks 15 marks

Spots/Quiz/	10 marks
Viva	05 marks
Journal	05 marks
Total	**60 marks**

PROGRAM: S.Y.B.Sc.	SEMESTER: IV	MAJOR COURSE
COURSE: INTRODUCTION TO BIOCHEMISTRY	COURSE CODE: WSCMICMJ241	

Teaching Scheme:				Evaluation scheme:	
Lectures per week	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
02	--	-	02	40	60

Learning Objectives:
LO1: To understand structures of various biomolecules
LO2: To correlate functions of biomolecules to their structures
LO3: To understand presence of chemical elements in the functional units of cell
LO4: To evaluate the properties of enzymes and classify accordingly
LO5: To understand the kinetics of various enzymatic reactions
LO6: To evaluate effect of different physicochemical factors on enzyme activity

Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Develop an understanding of the relevance of chemical reactions in a living cell
CO2: Relate the functions of chemical elements relevant to cell functioning
CO3: Apply the knowledge of colorimetry for quantification of biomolecules
CO4: Demonstrate clear understanding of enzyme activities and enzyme kinetics
CO5: Design experiments to isolate microorganisms based on their characteristic enzymes
CO6: Understand the effect of pH, temperature and inhibitors on different enzymes.

DETAILED SYLLABUS

Course Code: WSCMICMJ 241/ Unit		Course/ Unit Title: Introduction to Biochemistry	Credits/ Lectures
1		**Biomolecules: Proteins and Lipids**	**15 lectures**
	1.1	**Proteins** Detailed study of primary, secondary, tertiary, quaternary structures and functions with examples: 1.1.1 Keratin 1.1.2 Collagen 1.1.3 Cytochrome c **1.1.4** Lysozyme 1.1.5 Ribonuclease **Enzymes** 1.1.6 General properties of enzymes 1.1.7 How do enzymes accelerate reaction 1.1.8 Classification of enzymes	**03**
	1.2	**Proteins as enzymes** 1.2.1 Concept of regulatory & Non-regulatory enzymes 1.2.2 Regulatory enzymes: Allosteric effect on Enzyme-catalyzed reactions, Models for catalysis of allosteric enzymes: Koshland-Nemethy and Filmer model & Monod, Wyman and Changeux model 1.2.3 Rate law for a simple catalyzed reaction, Derivation of Michaelis-Menten equation and Lineweaver Burk plot	**03**
	1.3	**Enzyme Kinetics** 1.3.1 Saturation kinetics 1.3.2 Effect of temperature and pH	**04**

		1.3.3 Effect of Inhibitors: Irreversible and Reversible (competitive, non competitive and uncompetitive) inhibitors 1.3.4 Multisubstrate reactions: ordered, random and ping pong reactions	
	1.4	**Vitamins and Coenzymes** **Vitamins & Coenzyme: Structure, occurrence &** **biochemical function:** 1.4.1 Thiamin 1.4.2 Riboflavin 1.4.3 Nicotinic acid 1.4.4 Pantothenic acid 1.4.5 Biotin 1.4.6 Folic acid 1.4.7 Vitamin B12 1.4.8 Pyridoxine 1.4.9 Lipoic acid	**03**
	1.5	**Lipids** 1.5.1 Lipids: Types of lipids and their functions 1.5.2. Storage lipids - Triacylglycerols, Waxes. 1.5.3 Structural lipids - Phospholipids, Glycerophospholipids, Galactolipids, Sphingolipids, Glycolipids, and Sterols.	**02**
2		**Universal fundamentals of metabolism**	**15**
	2.1	High energy comp (ATP PEP, 1,3 BPGA, Thioester), redox potential and laws of thermodynamics	**03**
	2.2	Nernst Equation and Correlation between $\triangle G^{\circ\prime}$ and $\triangle E^{\circ\prime}$	**01**

	2.3	Introduction to metabolism : Details of Fermentation Respiration, and photosynthesis. Glucose catabolism: EMP.	**05**
	2.4	PDH, Multienzyme Complex and TCA cycle with calculation for ATP synthesis using balance sheet	**06**

References:

1. Conn, E. E. (1987). Outlines of Biochemistry. India: Wiley.
2. Nelson, D. L. and M.M. Cox (2005), Lehninger: Principles of biochemistry. 4th edition,
3. W. H. Freeman and Company.
4. Jayaraman, J. (2007). Laboratory Manual in Biochemistry. India: New Age International (P) Limited Publishers.
5. Methods in Microbiology. (1970). United Kingdom: Elsevier Science.

PROGRAM: S.Y.B.Sc.	SEMESTER: IV	MAJOR COURSE
COURSE: FOOD AND FERMENTATION TECHNOLOGY	COURSE CODE: WSMICMJ242	

Teaching Scheme:				Evaluation scheme:	
Lectures per week	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
02	--	-	02	40	60

Learning Objectives:

LO1: To gain knowledge of significant activities of microorganisms in food and to study general principles of food microbiology and food preservation.

LO2: To learn about microbiology of milk

LO3: To study microbiological examination of foods, microbiological quality control and quality schemes.

LO4: To understand the epidemiology of food-borne microorganisms of public health significance and food spoilage microorganisms.

LO5: To appreciate the role of microorganisms in association with foods, highlighting both their beneficial and harmful activities and their applications in the food industry.

LO6: To acquaint students with the various aspects of industrial microbiology

Course Outcomes:

At the end of the course, the learner shall be able to:

CO1: Enlist the possible sources of contamination of foods and the parameters affecting microbial growth in foods.

CO2 : Apply tests to carry out microbiological examination of milk and grade milk samples

CO3: Acquire an in-depth knowledge of various physical and chemical methods used for food preservation

CO4: Enlist the different types of fermentation products and illustrate fermentation process

CO5 : Compare and contrast between different types of fermentations

CO6: Describe basic fermenter design and enlist the functions of different parts of the fermentor

CO7: Discuss the concepts of media formulation and screening

DETAILED SYLLABUS

Course Code: WSMICMJ24 2/ Unit		Course/ Unit Title: Food and Fermentation Technology	Credits/ Lectures
1		**Basic Concepts in Fermentation technology**	**15 lectures**
	1.1	1.1.1 Range of fermentation processes and products 1.1.2 The fermentation process outline	**02**
	1.2	**Fermentation Media** 1.2.1 Criteria for an ideal fermentation media 1.2.2 Types and composition of fermentation media (simple, complex, crude and synthetic) 1.2.3 Raw materials for fermentation media 1.2.3.1 Carbon sources- Carbohydrates, molasses and its types, barley, Sulphite waste liquor, Oils, fats and hydrocarbons 1.2.3.2 Nitrogen sources- Inorganic and synthetic organic nitrogen sources and natural sources (Corn steep liquor, Soyabean meal) 1.2.3.3 Growth factors 1.2.3.4 Inorganic mineral salts 1.2.3.5 Buffers 1.2.3.6 Precursor 1.2.3.7 Inhibitors 1.2.3.8 Inducers 1.2.3.9 Antifoam agents 1.2.3.10 Water	**03**
	1.3	**Screening** 1.3.1 Primary and Secondary (Antibiotics and amino acids)	**03**
	1.4	Preparation of inoculum	**02**
	1.5	Types of Fermentations – 1.5.1 Anaerobic 1.5.2 Surface 1.5.3 Submerged 1.5.4 Batch 1.5.5 Fed-batch 1.5.6 Continuous 1.5.7 Solid substrate 1.5.8 Dual or multiple fermentation	**03**

	1.6	Basic design of stirred tank Fermenter	**02**
2		**Basic Concepts in Food Technology**	**15 Lectures**
	2.1	**Introduction: Significance, food as a substrate and sources**	**01**
	2.2	**Microbial growth in foods**	**01**
	2.3	**Intrinsic and extrinsic factors**	**02**
	2.4	**General principles of food preservation (principle of each method and example of foods only):** 2.4.1 High temperature, low temperature, drying, radiations and food additives and preservatives (tabular representation) 2.4.2 Asepsis with introduction to HACCP 2.4.3 Food borne diseases and intoxications:	**04**
	2.5	**Methods of detection of microorganisms in food:** overview of cultural, microscopic, physical, chemical and bioassay methods:	**02**
	2.6	**Microbiological standards for milk**	
	2.7	Milk- Definition, composition, Sources of contamination of milk	**02**
	2.8	Pasteurization of milk - LTLT, HTST method	
	2.9	Quality control of milk 2.9.1 Rapid platform test 2.9.2 Microbiological analysis of milk.:- SPC, Coliform count, LPC, Psychrophiles, Thermophilic count, Dye Reduction Tests (MBRT and RRT)	**03**

References:

1. Jay, J. M., Golden, D. A., Loessner, M. J. (2005). Modern food microbiology. India: Springer.
2. McClure, P. J., Adams, M. R., Moss, M. O. (2016). Food Microbiology. United Kingdom: Royal Society of Chemistry.

3. Montville, Thomas J._ Matthews, Karl R.-(2008) Food Microbiology- An Introduction-American Society for Microbiology (ASM)
4. Westhoff, D. C., Frazier, W. C. (1981). Food Microbiology. India: Tata McGraw-Hill.
5. Quantitative and Predictive Food Microbiology link: https://www.combase.cc/index.php/en/
6. Casida L. E., "Industrial Microbiology" (2009) Reprint, New Age International (P) Ltd, Publishers, New Delhi.
7. Stanbury P. F., Whitaker A. & Hall S. J., (1997), "Principles of Fermentation Technology", 2nd edition, Aditya Books Pvt. Ltd, New Delhi.
8. Stanbury P. F., Whitaker A. & Hall S. J 3rd edition (2017) "Principles of Fermentation Technology"
9. Peppler, H. J. and Perlman, D. (1979), "Microbial Technology''. Vol. 1 & 2, Academic Press
10. H. A. Modi, (2009). ''Fermentation Technology'' Vol. 1 & 2, Pointer Publications, India.
11. Okafor Nduka (2007) ''Modern Industrial Microbiology and Biotechnology'', Science Publications Enfield, NH, USA.
12. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial
13. Prescott and Dunn's ''Industrial Microbiology''(1982) 4th edition, McMillan Publishers

PROGRAM: S.Y.B.Sc.	SEMESTER: VI			MAJOR COURSE
COURSE: TECHNIQUES BASED ON BIOCHEMISTRY, FOOD AND FERMENTATION TECHNOLOGY	**COURSE CODE: WSMICMJ243**			
Teaching Scheme:			**Evaluation scheme:**	
Practical (Hours per week)	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA)**	**Semester End Examination**
04	**-**	**02**	**40**	**60**

Learning Objectives:
LO1: To apply various standard plot assay methods for estimation of biomolecules
LO2: To appreciate the negative interactions between microbes and its industrial applications
LO3: To understand the methods used in isolation of food spoilage organisms
LO4: To study the effect of temperature on spoilage organism and its use in food preservation
LO5: To create awareness on microbiology of milk and methods used for grading of milk samples.
LO6: To acquaint to the dilution method used for determining MIC of chemical preservative
LO7: To plan and execute experiments.

Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Colorimetrically estimate biomolecules (sugar and proteins) in various samples using standard plot method
CO2: Demonstrate the screening methods for isolation of antibiotic producer
CO3: Practice broth dilution assay to estimate the minimum inhibitory concentration of chemical preservative
CO4: Isolation of spoilage causing microbes and detecting the presence of various enzymes
CO5: Employ methods to deduce minimum temperature time regime for killing of spoilage causing organisms
CO6: Examine the microbial quality of raw and pasteurized milk

DETAILED SYLLABUS

Course code: WSMIC243	PRACTICAL (For Major Students)	Credits/ Lectures
	1. Estimation of total sugar by Anthrone method (Demo) 2. Estimation of reducing sugar by DNSA method 3. Estimation of protein Biuret method (direct) 4. Extraction of lipid by Soxhlet method (Demonstration) qualitative detection of lipids in the extract. 5. Primary screening of antibiotic producers from soil 6. Secondary screening of antibiotic producer 7.Isolation of food spoilage agent 8.Determination of TDT and TDP 9.Determination of MIC of a chemical preservative 10. Rapid platform tests of raw and pasteurized milk. 11. Microbiological analysis of raw and pasteurized Milk. 12. Visit to Food/Dairy industry	

<table>
<tr><td colspan="2">PROGRAM: S.Y.B.Sc.</td><td colspan="3">SEMESTER: IV</td><td>MINOR COURSE</td></tr>
<tr><td colspan="2">COURSE: SOIL, AIR AND WATER MICROBIOLOGY</td><td colspan="4">COURSE CODE: WSMICMN241</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="3">Evaluation scheme:</td></tr>
<tr><td>Lectures per week</td><td>Practical (Hours per week)</td><td>Tutorial (Hours per week)</td><td>Credit</td><td>Continuous Internal Assessment (CIA)</td><td>Semester End Examination</td></tr>
<tr><td>02</td><td>--</td><td>-</td><td>02</td><td>40</td><td>60</td></tr>
<tr><td colspan="6">Learning Objectives:
LO1:To understand behavior & activities of microorganisms in their natural environments
LO2: To gain awareness of the microbial processes that occur in different environments
LO3: To learn important tools & techniques in Microbial Ecology
LO4: To appreciate the microbial diversity in the environment
LO5: To study the significance of microbes in biogeochemical cycles</td></tr>
<tr><td colspan="6">Course Outcomes:
At the end of the course, the learner shall be able to: (Complexity of LO And Co arrangement as well as references)
CO1: To describe the different methods for detection and enumeration of microbes in soil, water and air samples
CO2: To discuss the agricultural importance of microbes in soil and explain the bioremediation techniques in soil
CO3: To exhibit the role of air and water in disease transmission
CO4: To summarize the various methods used in detection and control of pathogens in air and water
CO5: To narrate the significance of microbes in the biogeochemical cycles</td></tr>
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DETAILED SYLLABUS

Course Code: WSMICMN241/ Unit		Course/ Unit Title: Soil, air and Water Microbiology	Credits/ Lectures
1		**Air and Fresh Water Microbiology**	**15 lectures**
	1.1	**Air Microbiology** 1.1.1 Origin, distribution, number and kinds of microorganisms in air, Factors affecting microbial survival in air 1.1.2 Enumeration of microorganisms in air : Impingement in liquids, Impaction on solids, Filtration, Sedimentation, Centrifugation, Electrostatic Precipitation. 1.1.3 Air borne pathogens and diseases, droplets and droplet nuclei 1.1.4 Air sanitation- methods and application	**05**
	1.2	**Freshwater microbiology** 1.2.1 General: Hydrologic cycle, groups of natural waters, factors affecting kinds of microorganisms found in aquatic environments and nutrient cycles in aquatic environments 1.2.2 Fresh Water environments and microorganisms found in Lakes , ponds, rivers, marshes, bogs and springs 1.2.3 Potable water: Definition, water purification and pathogens transmitted through water. 1.2.4 Microorganisms as indicators of water quality 1.2.5 Bacteriological examination of water-sampling, routine analysis, SPC, membrane filter technique	**10**
2		**Soil and Geo microbiology**	**15 lectures**
	2.1	**Terrestrial environment** 2.1.1 Soil – Definition, composition, function, Textural Triangle	**03**

		2.1.2 Types Of Soil microorganisms & their activities	
	2.2	**Methods of studying soil microorganisms** Sampling, Cultural methods, Physiological methods, Immunological methods, NA based methods, Radioisotope techniques	**05**
	2.3	**Biogeochemical Cycles** Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorus cycle	**05**
	2.4	**Soil Bioremediation**	**02**

References:

1. Raina M. Maier, Ian L. Pepper, Charles P.Gerba, (2010) Environmental Microbiology , 2nd Edition;Academic Press
2. Fundamental Principles of Bacteriology ,7th Edition; A.J. Salle ,Tata Mc Graw Hill Publishing Company
3. Air Quality Standards- NAAQS Manual , Volume I
4. Joanne M. Willey, Linda M. Sherwood, Christopher J.Woolverton (2011), Prescott's Microbiology, 8th Edition; Mc Graw Hill International Edition
5. Frobisher, Hinsdill, Crabtree, Goodheart (1974) Fundamentals of Microbiology, 9th Edition , Saunders College Publishing
6. Barbara Kolwzan, Waldemar Adamiak (E Book) Introduction to Environmental Microbiology
7. N.S Subba Rao (2000) Soil Microbiology-4th Edition Oxford and IBH Publishing Co. Pvt Ltd
8. R. M. Atlas and R. Bartha - (1998) - Microbial Ecology - Fundamentals and applications. AddisonWesley Longman, Inc.
9. Madigan,Martinko,Dunlap,Clara,Brock Biology of microorganisms 12th ed Pearson Intl Ed

PROGRAM: S.Y.B.Sc.	SEMESTER: IV			MINOR COURSE
COURSE: MICROBIOLOGICAL EXAMINATION OF SOIL, AIR AND WATER	**COURSE CODE: WSMICMN242**			
Teaching Scheme:			**Evaluation scheme:**	
Practical (Hours per week)	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA)**	**Semester End Examination**
04	**-**	**02**	**40**	**60**

Learning Objectives:
LO1: To appreciate the omnipresence and significance of microbes in environment
LO2: To study the techniques to enumerate microbes from various natural sources
LO3: To learn enrichment techniques for cultivation of guilds of microbes
LO4: To design and set up in vitro habitats like lake, ponds etc using Winogradsky's column
LO5: To plan and execute experiments.

Course Outcomes:
At the end of the course, the learner shall be able to:
CO1: Examine potability of water
CO2: Comment on the efficiency of wastewater treatment.
CO3: Record the flora present in air, water, soil, raw and treated sewage samples
CO4: Detect the presence of *E.coli* in water using a rapid test

DETAILED SYLLABUS

Course code: WSMICMN242	PRACTICAL (For Minor Students)	Credits/ Lectures
	Microbiological examination of soil, air and water 1. Enumeration of microorganisms in air 2. Effect of fumigation on air flora 3. Determination of sedimentation rate of air microflora. 4. Routine analysis of water: a. Standard Plate Count b. Detection of Coliforms in water: Presumptive Test, Confirmed Test and Completed Test c. Rapid Detection of *E.coli* by MUG Technique (Demonstration) 5. Waste water analysis: a. Study of microbial flora in raw and treated sewage b. Determination of total solids in wastewater c. Determination of BOD and COD of wastewater d. Membrane filtration technique 6. Total viable count of soil microflora 7. Isolation of bacteria, Actinomycetes and fungi from soil 8. Enrichment and isolation of Nitrosifiers, Nitrifiers, Cellulose degraders, Sulphate reducers and Phosphate solubilizers from soil 9 Study of Winogradsky's column 10. Visit to a sewage treatment plant or water purification plant	

PROGRAM: S.Y.B.Sc.	SEMESTER: IV			VOCATIONAL SKILL COURSE (VSC)
COURSE: ANALYTICAL INSTRUMENTATION	COURSE CODE: WSMICVS241			
Teaching Scheme:			Evaluation scheme:	
Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
04	-	02	--	60

Learning Objectives:

LO1: To learn about the principle, working of commonly used instruments in microbiology.

LO2: To study applications of different separation techniques such as electrophoresis, centrifugation and chromatography etc.

LO3: To handle, use the instruments and observe the precautions

Course Outcomes:

At the end of the course, the learner shall be able to:

CO1: Perform separation and identification of amino acids and sugars using chromatographic principles

CO2: Apply the centrifugation techniques for separation of organelles and organisms

CO3: Elucidate spectral analysis of extracted plant pigments and nucleic acids

CO4: Apply electrophoretic techniques for separation of peptides and determine their molecular weights

DETAILED SYLLABUS

Course code: WSMICVS241	VSC PRACTICAL Analytical instrumentation	Credits/ Lectures
	1. Separation and identification of amino acids and sugars by ascending paper chromatography 2. Separation and identification of amino acids and sugars by TLC *3.* Density Gradient Centrifugation to separate mixture of Yeast cells and *E.coli* 4. Isolation and extraction of organelle using differential centrifugation method 5. Extraction and separation of plant pigments by thin layer chromatography 6. Spectral analysis of Nucleic acids 7. Analysis of pigments using UV/visible spectrophotometer 8. Separation of proteins byNative PAGE 9. Separation of proteins by SDS PAGE 10. HPLC (Demo) 11. Atomic Absorbance spectra (Demo)	

PROGRAM: Second Year Bachelor's Degree	SEMESTER: IV	OPEN ELECTIVE
COURSE: BIOTECHNOLOGICAL INNOVATIONS IN AGRICULTURE, ENVIRONMENT AND ENERGY	COURSE CODE: WAMICOE241	

Teaching Scheme:				Evaluation scheme:	
Lectures per week	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
02	--	-	02	--	60

Learning Objectives:

LO1: To understand the potentials of Modern Biotechnology in the Agricultural field to provide food to masses.

LO2: To appreciate the innovative nutrient sources like, crops with improved nutrients,SCP, lab grown meat

LO2: To appreciate the recombinant products used in agricultural fields like herbicide resistant, pest resistant , virus resistant crops.

LO3: To learn the alternate sources of energy

LO4: To make them aware about carbon footprint,greenhouse gasses and drawbacks of fossil fuels

LO5: To emphasis on renewable energy sources and their benefits

Course Outcomes:

At the end of the course, the learner shall be able to:

CO1: Enlist the different biotechnological breakthroughs in the agriculture field

CO2: Express about the scientific breakthroughs

CO3: Discuss the applicative economically important biofuels.

CO4: Compare the benefits and drawbacks of fossil fuels and biofuels.

CO5: Summarize the impact of recombinant DNA technology to generate pest resistant crops, virus resistant and herbicide resistant plants

CO6: Describe the role of Microbes in soil fertility and their applications as biofertilizers

DETAILED SYLLABUS

Course Code: WAMICOE241 / Unit		Course/ Unit Title: Biotechnological innovations in Food, Agriculture, Environment and Energy	Credits/ Lectures
1		**Unit 1: Food and agriculture**	**15 Lectures**
		1.1 Probiotics,Nutraceuticals ,Disease resistant crops, Herbicide resistant crops, Modified nutrient contents, 1.2 Food For population - SCP, Agriculture - Bioaugmentation, Biostimulation, and Biocontrol in Soil Biology , Green Manuring , crop rotation, 1.3 Microorganisms as Biofertilizer and biopesticide: Introduction, advantages over chemical pesticides and fertilizers, Important examples -- *Rhizobium*, *Azotobacter*, *Azolla*,cyanobacteria, VAM, Phosphate solubilizing bacteria, *Bacillus thuringiensis*,Viral insecticide	**04** **04** **03** **04**
2		**Unit 2: Environment and Bioenergy**	**15 Lectures**
		2.1 Environment- 2.1.1 Anthropogenic Pollutants - Organic, Inorganic 2.1.2 Bioaccumulation Biomagnification 2.1.3 Bioremediation of air, 2.1.4 Bioremediation of water, 2.1.5 Bioremediation of soil. 2.1.6 Phytoremediation , Case studies 2.2 Bio - Energy - 2.2.1 Renewable sources of energy -Biomass 2.2.2 Non Renewable and Renewable forms of energy 2.2.3 Biofuels - Biogas, Bio ethanol, Biodiesel	**08** **07**

References:

1. Aluizio Borem , Fabricio R. Santos , David E. Bowen (2003) Understanding Biotechnology Prentice Hall
2. George Acquaah, Pearson Education, fnc. Prentice HalL (2004) Understanding Biotechnology: An Integrated and Cyber-Based Approach,
3. William Thieman, Michael Palladino(2019) Introduction to Biotechnology, Global Edition 4th edition. Pearson

4. R. C. Dubey (2006). A Textbook of Biotechnology. S. Chand and Company Ltd. ·
5. B. D. Singh. Biotechnology. Kalyani Publishers.
6. Buiser Bourgaize,Jewell, Biotechnology : Demystifying The Concepts
7. Allan Scragg- Environmental Biotechnology, 2nd Edn
8. R. M. Atlas and R. Bartha - (1998) - Microbial Ecology - Fundamentals and applications. AddisonWesley Longman, Inc.

MODALITY OF ASSESSMENT

COURSE	COURSE CODE	COURSE TITLE	CREDITS	CIA	SEM END	TOTAL
DSC MAJOR-1	WSMICMJ241	INTRODUCTION TO BIOCHEMISTRY	2	40	60	100
DSC MAJOR-2	WSMICMJ242	FOOD AND FERMENTATION TECHNOLOGY	2	40	60	100
DSC MAJOR PRACTICAL	WSMICMJ243	TECHNIQUES BASED ON BIOCHEMISTRY, FOOD AND FERMENTATION TECHNOLOGY	2	40	60	100
DSC MINOR-1	WSMICMN241	SOIL, AIR AND WATER MICROBIOLOGY	2	40	60	100
DSC MINOR PRACTICAL	WSMICMN242	MICROBIOLOGICAL EXAMINATION OF SOIL, AIR AND WATER	2	40	60	100
VSC	WSMICVS241	ANALYTICAL INSTRUMENTATIONS	2	-	60	60
OE	WAMICOE241	BIOTECHNOLOGICAL INNOVATIONS IN AGRICULTURE, ENVIRONMENT AND ENERGY	2	-	60	60

Examination Pattern: For Discipline specific courses

C. Internal Assessment- 40%- 40 Marks per paper

Sr. No.	Evaluation Type	Marks
1.	Written Objective Examination	20M
2.	Assignment/ Case study/ field visit report/ presentation/ project Multiple assignments may be given	20M
	Total	**40M**

D. External Examination- 60%- 60 Marks per paper

Semester End Theory Examination:

1. Duration - These examinations shall be of two hours duration.
2. Theory question paper pattern:

a. There shall be questions each of 20 marks based on two units and the third unit will be a mixed bag question .

b. All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Describe /Explain/ Short notes/Answer the following	4 / 6	5 marks each - 20M	UNIT 1
Discuss / Short notes /Answer the following	4/6	5 marks each -20M	UNIT 2
Do as Directed: three sub questions Define/Explain/ Give examples, State true or false/Match the columns/Analogy/	10/12	1/ 2 marks each- 20M	Mixed Bag (All Units)

Practical Examination Pattern

A.Internal Examination: 40%- 40 Marks -

Two CIA each of 20M
For one CIA:

Particulars	Marks
Experimental tasks /Assignment	15 marks
Participation/ Attendance	5 marks
Total	**20 marks**

B. External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Marks
Laboratory work **Major Tech** **Minor Tech**	25 marks 15 marks
Spots/Quiz/	10 marks
Viva	05 marks
Journal	05 marks
Total	**60 marks**

PRACTICAL BOOK/JOURNAL The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Examination Pattern: Open Elective.

1. Two assignments of 30 marks each. (Oral Presentations/Written assignments/ Case studies)

Examination Pattern: Skill Enhancement Course:60M

Particulars	Marks
Laboratory work **Major Tech** **Minor Tech**	25 marks 15 marks
Spots/Quiz/	10 marks
Viva	05 marks
Journal	05 marks
Total	**60 marks**