Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur (C.G.)

Scheme and Syllabus

Of

M. Sc. (Microbiology)

Program Code: MSCMICR

Semester system for affiliated college

(As per LOCF and credit system)

w.e.f. 2024-2025

(As approved AC and EC meeting held on 16.08.2023 and 18.04.2023 respectively)

अटल बिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)
कोनी पुलिस थाना के सामने, बिलासपुर–रतनपुर मार्ग, कोनी, बिलासपुर (छ.ग.) 495009
Website : www.bilaspuruniversity.ac.in

Scheme for M.Sc. Microbiology
Program Code: MIC

Semester	Course Code	Subject Name	Credit			Total Credit	Marks			
							ESE	IA	Total	
			L	T	P				Max	Min
Third	MICT301	Medical and Veterinary Microbiology	3	1	-	4	80	20	100	36
	MICT302	Environmental Microbiology	3	1	-	4	80	20	100	36
	MICT303	Biostatistics and Bioinformatics	3	1	-	4	80	20	100	36
	MICT304(A)	Immunology (Elective)	3	1	-	4	80	20	100	36
	MICT304(B)	Fermentation Technology (Elective)								
	MICT304(C)	Food Microbiology (Elective)								
	MICP301	Lab 5	-	-	2	2	100	-	100	36
	MICP302	Lab 6	-	-	2	2	100	-	100	36
	Subtotal		**12**	**4**	**4**	**20**	-	-	**600**	
Fourth	MICT401	Industrial Microbiology	3	1	-	4	80	20	100	36
	MICT402	Enzymology	3	1	-	4	80	20	100	36
	MICT403	Computer Fundamentals and Research Techniques	3	1	-	4	80	20	100	36
	MICT404(A)	Microbial Ecology (Elective)	3	1	-	4	80	20	100	36
	MICT404(B)	Intellectual Property Rights (Elective)								
	MICT404(C)	Plant Pathology and Disease Management (Elective)								
	MICP401	Lab 7	-	-	2	2	100	-	100	36
	MICP-1D	Project work	-	-	2	2	100	-	100	36
	Subtotal		**12**	**4**	**4**	**20**	-	-	**600**	
Total			**48**	**16**	**16**	**80**	-	-	**2400**	

Note: *Students have to opt one paper from the pool of Elective I of 2nd Semester, one paper from the pool of Elective II of 3rd Semester and Elective III of 4th Semester.*

Abbreviations used: **ESE:** End Semester Exam; IA: Internal Assessment

As approved by academic council and executive council meetings

Semester III

Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT301		
2.	Course Title	Medical and Veterinary Microbiology		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand the basics of Medical and Veterinary microbiology. 2. Understand the Principle behind disease and causative agent. 3. Types of responses of Host against diseases.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Introduction of medical microbiology:** History, Contribution of Eminent Scientists, Koch & River's postulates, role of microbiology in medicine Medically important microbes; normal microbial flora of human body; role of resident flora.	12 Periods / 08 Hours
II	**Infection**: Definition, types, stages of infection, process of infection. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Role of aggressions, depolymerizing enzymes, organo-tropism, variation and virulence.	12 Periods / 08 Hours
III	**Clinical Bacteriology:** Pathogenic Bacteria: morphological characteristics, patho-genesis and laboratory diagnosis including rapid methods of following pathogenic bacteria; Staphylococcus aureus, Group A Streptococci, Pneumococci, Neisseria, members of the family Enterobacteriaceae, Vibrio, Corynebacterium. Clostridia. Mycobacterium tuberculosis, atypical Mycobacterium. New emerging infections: Streptococcus suis; community associated methicillin resistant Staphylococcus aureus (MRSA), Clostridium difficile, Multi drug resistant tuberculosis.	12 Periods / 08 Hours
IV	**Clinical Mycology:** Superficial, subcutaneous, cutaneous and systemic mycoses. General description of mycotic pathogens, diagnosis and prevention. Pathogenic fungi: morphological characteristics, pathogenesis and laboratory diagnosis including rapid methods of following pathogenic fungi Microsporum, Trichophyton, Histoplasma capsulatum, Blastomyces dermatitidis. Candida albicans, Cryptococcus neoformans.	12 Periods / 08 Hours
V	**Veterinary Microbiology:** General concept of veterinary microbiology, impact of diseases on poultry industry, mechanism of disease transmission. Fowl cholera, gangrenous dermatitis, avian pox, avian influenza, swine fever, mycoplasmosis, anthrax, coccidiosis, foot and mouth disease, their prevention and control.	12 Periods / 08 Hours

Part C – **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. Clinics in laboratory medicine, Emerging Infections and their causative agents. September 2004 vol. 24 no. 3.
2. Textbook of Microbiology 8th edition 2009-Ananthnarayan & Paniker-University Press.
3. Concerned Website and latest literature.

Reference Books:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier

E-Resources:

https://docs.google.com/file/d/0B0Izh6GcIA_DdUxuWFhMWDNOSFE/edit?pli=1&resourcekey=0-Gxm4B8zdfp683lD7LbysmA

https://www.academia.edu/23738538/Immunology_Lecture_Notes_Immune_Responses

https://www.libraryofbook.com/books/lecture-notes-medical-microbiology-and-infection

Declaration

Syllabus is framed as per the ToR

Name	Signature
Dr. DSVGK Kaladhar, Chairman BOS, Microbiology, Professor, Atal Bihari Vajpayee University, Bilaspur	
Dr.Seema A Belorkar, Member BOS, Microbiology, Assistant Professor, Atal Bihari Vajpayee University, Bilaspur	
Dr. Swati Rose Toppo, Member BOS, Microbiology, Assistant Professor, Atal Bihari Vajpayee University, Bilaspur	
Dr. Reshmi Parihar, Member BOS, Microbiology, Assistant Professor, ERR Science PG College, Bilaspur (CG)	
Dr.Subhraja Pandey, Member BOS, Microbiology, Assistant Professor, DP Vipra College, Bilaspur (CG)	

Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT302		
2.	Course Title	Environmental Microbiology		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand the components of Environment. 2. Understand role of microbes in maintaining balance. 3. Understand the beneficial effects of microbes in Environment.		
6.	**Credit Value**	04		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Aeromicrobiology:** Bioaerosol, Droplet Nuclei. Phylloplane and Phyllosphere microflora. Air borne microorganisms and their significance in human health and plant disease development. Techniques for analysis of air borne microorganisms- The settling plate technique, slit type sampler, liquid impinger, sieve sampler, Anderson's sampler, cascade sampler; Filtration methods. Control of air borne microbes.	12 Periods / 08 Hours
II	**Soil Microbiology:** Classification of soil - physical and chemical characteristics, Soil as a habitat for Microbial Growth. Microbial Interactions. Rhizosphere, Rhizoplane. Role of Microorganisms in mineral cycling and soil fertility. Biodegradation of organic compounds in soil.	12 Periods / 08 Hours
III	**Aquatic Microbiology:** Microbiology of Fresh water (pond and lakes) and Marine water (estuaries, deep sea, hydrothermal vents) Ecosystem. Potability of water, Microbial assesstment of water quality. Methods of Purification of water. Waste water (sewage) treatment.	12 Periods / 08 Hours
IV	**Biowaste Management and Treatment:** Treatment of dairy and Industrial effluent. Solid waste treatment and management. Use of waste for production of food (Mushroom), Biofertilizer (Compost) and biofuel (biogas and ethanol). Biodegradation of xenobiotics, Plastic, oil spills, and oil refinery waste.	12 Periods / 08 Hours
V	**Microbial activities:** Biodeterioration of paper, pulp textile and paints, Biomagnification, Bioaugumentation, Biomining and bioleaching, Biodiesel production from Jatropa, Biomonitoring.	12 Periods / 08 Hours

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. Medigan, M.T., Martinko, J. M. and Parker, J. Brock Biology of Microorganisms. Pearson Education Inc. , New York
2. Alexander, M John. Microbial ecology. Wiley & Sons, Inc., New York.
3. Alexander, M John. Introduction to soil microbiology. Wiley & Sons Inc., New York.
4. Barker, KH, and Herson, D.S. Bioremediation. Mc Craw Hill Inc., New York.

Reference Books:

Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Madigan MT, Martinko JM and Parker J. (2014).Brock Biology of Microorganisms. 14th edition. Pearson / Benjamin Cummings.
4. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

E-Resources:

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf
https://microbenotes.com/microbial-interaction-and-its-types-with-examples/
https://microbenotes.com/category/agricultural-microbiology/
https://sites.google.com/site/soilagrlmicrobiol/

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
8.	Course Code	MICT303		
9.	Course Title	**Biostatistics and Bioinformatics**		
10.	Course Type	**Theory**		
11.	Pre-requisite (if any)	As per Govt. and University norms		
12.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand the significance of statistics in biology. 2. Will learn to apply statistical tests on biological data. 3. Will learn to use Bioinformatics as a tool for study of various molecules.		
13.	**Credit Value**	**04**		
14.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Fundamentals of Biostatistics:** Nature and Scope of statistical methods and their limitations-Collection, Classification, Tabulation of Statistical data – uses of frequency table -Diagrammatic and Graphical Representation of Statistical data. Measure of Central Tendency-Mean, Median, Mode, and their Merits and Demerits.	12 Periods / 08 Hours
II	**Measurement of Dispersion:** Range, Mean Deviation, Quartile Deviation, Standard Deviation, Co-Efficient of Variation - Skewness - Karl Pearson's and Bowley's Coefficient of Skewness. Test of Significance – Chi square test, t-test and f-test.	12 Periods / 08 Hours
III	**Probability and Correlation:** Events and Sets - Sample Space - Concept of Probability - Addition and Multiplication Theorem on Probability – Conditional Probability - Independence of Events.	12 Periods / 08 Hours
IV	**Correlation and Variance:** Analysis of Variance (ANOVA), Bivariate Frequency Table and its Uses – Correlation Analysis-Scatter diagram, Karl Pearson's Correlation Coefficient – Spearman's Rank Correlation Regression Analysis – Regression lines - Fitting of Straight-line using Method of Least Squares.	12 Periods / 08 Hours
V	**Bioinformatics:** An overview, introduction and scope of bioinformatics. Information molecules, DNA sequencing, protein structure, functions, protein folding and characterization, Biological Database: Types of databases (Entrez, SRS or sequence retrieval system).	12 Periods / 08 Hours

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1.Kenny J. F. and Keeping E. S. 1964. Mathematics of statistics, part I & II, Affiliated East-West press Ltd., New Delhi.
2.Bansi L. 1968, Mathematics of probability of statistics, Chand & Co. Delhi.
3. Snedcor G. W. & Cochram W. G. 1968. Statistical Methods, Oxford &IBH, Delhi.White R.2000.
4.Gralla P. 2000. How the internet work, Tech, Media.
5.Bailey N. T. J. 2000.Statistical Methods in Biology, English Univ. Press.
6. Campbell R. C. 1974. Statistics for Biologist, Cambridge University Press UK.
7.Shina P. K. 2002. Fundamentals of Computers, BPB Publication, New Delhi.

Reference Books:

1. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition
2. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
3. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwel

E-Resources:

https://www.researchgate.net/publication/280733465_A_TEXT_BOOK_OF_BIOSTATISTICS
https://en.wikipedia.org/wiki/Bioinformatics

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Part A: Introduction				
Program: M Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	**MICT304 (A)**		
2.	Course Title	**Immunology**		
3.	Course Type	**Theory (Elective II)**		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand concept of Ag and Ab. 2. Understand the Principle behind disease and causative agent. 3. Types of responses of Host against diseases. 4. learn the basics of immune system		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Immune system:** History of immunology, cells and organs involved in immune system; virulence and host resistance; immunity- innate immunity and acquired immunity; immunohematology- blood groups, blood transfusion and Rh-incompatibilities.	12 Periods / 08 Hours
II	**Antigens and Immunohematology:** Antigens – structure and properties, types- iso and allo- antigen; haptens and adjuvants, antigen processing and specificity. MHC class-I and class-II Molecules, Immune response Pathway for Intracellular antigen and EC antigen.	12 Periods / 08 Hours
III	**Antigens Structure and types:** Immunoglobulin – structure, heterogenecity, types and sub-types, properties (physico-chemical and biological); Immunoglobulin gene arrangement. Theories of antibody formation; monoclonal antibodies and their applications.	12 Periods / 08 Hours
IV	**Antigen and antibodies reactions:** In-vitro techniques: agglutination, precipitation, complement fixation, immune-fluorescence, ELISA and radio- immune assay. In vivo technique: skin tests and immune complex demonstration. Applications of above methods in diagnosis of clinical diseases caused by microorganisms	12 Periods / 08 Hours
V	**Hypersensitivity and complement:** Immediate and delayed; antibody mediated Type-I (anaphylaxis), Type-II; (Antibody dependent cell cytotoxicity), Type-III; (immune-complex mediated reactions) and Type-IV; (cell mediated hypersensitivity reactions); respective diseases, immunological methods for their diagnosis. Complement components, pathways and complement deficiencies.	12 Periods / 08 Hours

Part C - Learning Resource
Text Books, Reference Books, E-Resources

Text Books:

1. Immunology Janis Kuby
2. Cellular and Molecular Immunology – Abul K. Abbas, Andrew H. Lichtman and Jordan S
3. Immunology: An Introduction Ian R. Tizard.

Reference Books:

1. Fundamentals of Microbiology and Immunology: Ajit Kr. Banerjee, Nirmalya Banerjee –New Central Book Agency (P) Ltd., Kolkata.
2. Immunology: J. Kubey et al. 7th edition.
3. Immunology: Roitt et al.
4. Fundamental of Immunology: W. Paul.

E-Resources:

https://www.vedantu.com/biology/immunology
https://www.cleariitmedical.com/2019/06/biology-notes-biotechnology-principles-and-processes.html
https://www.edx.org/learn/immunology

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT304 (B)		
2.	Course Title	Fermentation Technology		
3.	Course Type	THEORY (Elective II)		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Will learn about Fermentation process. 2. Will learn about types of Fermentation process. 3. Will learn about microbial products using fermentation.		
6.	Credit Value	04		
7.	Total Marks	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	Basic concepts of Fermentation, Types of fermentations-aerobic and anaerobic fermentation, Metabolic pathways involved in fermentations. Factors like Temperature, pH, dissolved oxygen influencing Microbial Metabolism. Phenomena of mass and oxygen transfer.	12 Periods / 08 Hours
II	General design of Bioreactors, types of bioreactors and their applications- Fed batch bioreactors; Continuous stirred tank reactors (CSTR), Packed bed, Bubble column and Fluidized bed, Animal and plant cell bioreactors.	12 Periods / 08 Hours
III	Upstream processing, general outline of microbial fermentation process, Process parameters and their optimization. Large-scale processes: Specific requirements of submerged and solid state fermentation.	12 Periods / 08 Hours
IV	Downstream processing, Methods of product recovery: Filtration, Centrifugation, Distillation, Cell disintegration, Extraction, Concentration, Evaporation, Chromatographic methods: Drying - Vacuum, Freeze and spray drying.	12 Periods / 08 Hours
V	Control and monitoring of the bioprocess, Physicochemical and biological sensors. Monitoring process, control strategies and automation. Disposal of biomass and toxic materials. Sensors for the medium and gases:	12 Periods / 08 Hours

Part C - Learning Resource

Text Books, Reference Books, E-Resources

Text Books:

1. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. Industrial Microbiology: An Introduction. Blackwell Science Publishers. (2002).
2. Richard H. Baltz. Julian E. Davies, and Arnold L. Demain. Manual of Industrial Microbiology and Biotechnology, 3rd Edition, ASM Press. (201 0).

As approved by academic council and executive council meetings

3. Daniel Forciniti. Industrial Bioseparations: Principles and Practice. 1 st Edition, WileyBlackwell. (2008)
4. Reed. G, Prescott and Dunn's Industrial Microbiology, CBS Publishers. (1999).
5. Demain, A. L, Industrial Microbiology and B io t e c h no lo g y, II Edition. (2001),.
6. Iqbal Ahmad, Farah Ahmad, John Pichtel. Microbes and Microbial Technology: Agricultural and Environmental Applications. 1st Edition. Springer. (2011)
7. Casida LE. Industrial Microbiology, J. Wiley, (1968)
8. James Bailey and David Ollis, Fundamentals of Biochemical Engineering, 2nd edition, McGraw-Hill, (1986)

Reference Books:

1. Biotechnology: Fundamental & Application (2005) S.S. Purohit
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Company, New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India.

E-Resources:

https://swayam.gov.in/
https://britannica.com
https://en.wikibooks.org/
https://nptel.ac.in
https://onlinecourses.nptel.ac.in/noc21_bt41/preview
https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf
https://microbenotes.com/microbial-interaction-and-its-types-with-examples/
https://bookarchive.net/pdf/industrial-microbiology-by-l-e-casida-jr/
https://www.researchgate.net/publication/280733465

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT304 (C)		
2.	Course Title	Food Microbiology		
3.	Course Type	Theory (Elective II)		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Will understand the reason of food spoilage. 2. Will understand the principles of Food Preservation. 3. Role of microbes in Food Spoilage and their control.		
6.	Credit Value	04		
7.	Total Marks	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Microbial spoilage of various foods. Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned foods	12 Periods / 08 Hours
II	**Principles and methods of food preservation:** Principles, physical methods of food preservation: temperature (low, high, canning, and drying), irradiation, Hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins in food preservation.	12 Periods / 08 Hours
III	**Fermented foods:** Fermented food and its importance. Fermented food in India - Traditional and modern. Dairy starter cultures fermented dairy products: yogurt, acidophilus milk, kumises, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tempeh and probiotics.	12 Periods / 08 Hours
IV	**Food borne diseases and food sanitation:** Causative agents, foods involved, symptoms and preventive measures. Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins.	12 Periods / 08 Hours
V	**Food borne infections:** Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni. Food sanitation and control. HACCP, Indices of food sanitary quality and sanitizers.	12 Periods / 08 Hours

अटल बिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)
कोनी पुलिस थाना के सामने, बिलासपुर–रतनपुर मार्ग, कोनी, बिलासपुर (छ.ग.) 495009
Website : www.bilaspuruniversity.ac.in

Part C - Learning Resource
Text Books, Reference Books, E-Resources

Text Books:

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987) Basic Food Microbiology. 1 edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen A.L. (1993). Antimicrobials in Foods. Marcel Dekker, New York. 4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
4. Frazier WC and Westhoff DC. (1992). Food Microbiology.3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
5. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.

Reference Books:

1. Basic Food Microbiology by Banwart, GJ (1989) CBS Publishers and Distributors, Delhi.
2. Food poisoning and Food Hygiene by Hobbs BC and Roberts D. Edward Arnold (A division of Hodder and Stoughton) London.
3. Dairy Microbiology by Robinson R.K. Elsevier Applied Sciences. London. Food Microbiology. 2nd Edition by Adams
4. Food Microbiology: Fundamentals and Frontiers by Dolle
5. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
6. Fundamentals of Dairy Microbiology by Prajapati

E-Resources:

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf
https://microbenotes.com/microbial-interaction-and-its-types-with-examples/
https://bookarchive.net/pdf/industrial-microbiology-by-l-e-casida-jr/
https://www.researchgate.net/publication/280733465

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICP301		
2.	Course Title	Lab 5		
3.	Course Type	Laboratory Course		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1.learn about basics of Medical, Veterinary and environmental microbiology and its management 2.learn the basics of biological analysis of microflora 3. learn the practicals on solation of pathogens and its management		
6.	**Credit Value**	**02**		
7.	**Total Marks**	**Internal Marks: --** **External Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
	Topics	Total Hours
	1. Evaluation of alcohol as skin disinfectant. Filter paper disc method for evaluation of antiseptics. 2. Different Staining techniques- Acid Fast staining, Geimsa staining and Leishmann staining. Special staining methods to demonstrate granules, capsule, and spore. 3. Isolation of pathogen from Clinical samples- pus, blood, urine etc. 4. Antibiotic sensitivity test by disc diffusion method. Determination of minimum inhibitory concentration (MIC) of an antibiotic. 5. Determination of susceptibility to dental caries by Snyder test 6. Isolation and identification of following pathogenic bacteria and fungi:Bacteria: *Staphylococcus aureus, Escherichia coli, Proteus vulgaris, Proteus mirabilis, Salmonella typhi, Salmonella paratyphi, Shigella dysenteriae and Shigella felexneri*.Fungi: *Candida albicans, Microsporum and Trichophyton* 7. Isolation of Microflora from different habitats of air and water 8. Water potability Test (MPN and H_2S) 9. Physical, Chemical and Microbial analysis of water: colour, pH, COD, BOD, total and dissolved solids. 10. Study of indoor and outdoor microflora of air sampling devices. 11. Study of microflora from industrial wastes and effluents.	60 Periods / 40 Hours

Part C - Learning Resource

Text Books, Reference Books, E-Resources

Text Books:

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987) Basic Food Microbiology. 1 edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen A.L. (1993). Antimicrobials in Foods. Marcel Dekker, New York. 4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
4. Frazier WC and Westhoff DC. (1992). Food Microbiology.3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
5. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.

Reference Books:

1. Basic Food Microbiology by Banwart, GJ (1989) CBS Publishers and Distributors, Delhi.
2. Food poisoning and Food Hygiene by Hobbs BC and Roberts D. Edward Arnold (A division of Hodder and Stoughton) London.
3. Dairy Microbiology by Robinson R.K. Elsevier Applied Sciences. London. Food Microbiology. 2nd Edition by Adams
4. Food Microbiology: Fundamentals and Frontiers by Dolle
5. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
6. Fundamentals of Dairy Microbiology by Prajapati

E-Resources:

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf
https://microbenotes.com/microbial-interaction-and-its-types-with-examples/
https://bookarchive.net/pdf/industrial-microbiology-by-l-e-casida-jr/
https://www.researchgate.net/publication/280733465

Declaration

Syllabus is framed as per the ToR

Name	Signature
Dr. DSVGK Kaladhar, Chairman BOS, Microbiology, Professor, Atal Bihari Vajpayee University, Bilaspur	
Dr.Seema A Belorkar, Member BOS, Microbiology, Assistant Professor, Atal Bihari Vajpayee University, Bilaspur	
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Dr. Reshmi Parihar, Member BOS, Microbiology, Assistant Professor, ERR Science PG College, Bilaspur (CG)	
Dr.Subhraja Pandey, Member BOS, Microbiology, Assistant Professor, DP Vipra College, Bilaspur (CG)	

Part A: Introduction				
Program: M.Sc. Microbiology		Semester: III	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICP302		
2.	Course Title	Lab 6		
3.	Course Type	LABORATORY COURSE		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand on fundamentals of bioinformatics 2. Understand the concept of databases and sequence alignments. 3. Understand about genome and proteome		
6.	**Credit Value**	**02**		
7.	**Total Marks**	**Internal Marks: --** **External Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course		
	Topics	**Total Hours**
A	1. Determination of Statistical Averages/Central Tendencies: a) Arithmetic mean b) median c) Mode. 2. Determination of measures of dispersion. a) Mean deviation b) Standard Deviation c) Standard Error d) Coefficient of Variation. 3. Representation of Statistical data by- a) histogram b) ogive curves c) pie diagrams. 4. Testing of significance – Application of a) Chi-Square test b) T -test c) ANOVA 5. Search of nucleic acid sequence database (GenBank/ DDBJ) 6. Conducting BLAST analysis for identification of nucleic acids and proteins 7. Alignment Construction of phylogenetic tree 8. Modelling of 3D structure of proteins using primary sequence. 9. Designing ligands from plant resources 10. Docking and virtual screening of compounds for microbial diseases 11. Conduct of Protein-Protein interaction studies using Sting 12. Analysis of systems mechanisms using KEGG 13. Characterization studies of genes and proteins using EMBOSS/ online servers	60 Periods 40 Hours

B	**Note: Any one choice of MCIP302 (A)/ MCIP302 (B)/ MCIP302 (C) as per chosen elective** **MICP302 (A): Immunology** 1. Determination of blood group and Rh typing. 2.Study of Ag-Ab reaction by immunodiffusion. 3.Detection of specific Antigen by using ELISA test 4. Separation and characterization lymphocyte population. 5.WIDAL (Slide) test for Typhoid by antigen-antibody reaction. 6. Pregnancy testing through economically available method. 7. Rheumatoid Arthritis (RA) by Ag-Ab Reaction. 8. RPR- Rapid Plasma Reagin test for Syphilis **MICP302 (B): Food Microbiology** Detection of number of bacteria in milk by SPC. 2 Determination of quality of raw milk by MBRT 3.Phosphatase test of milk to check efficacy of pasteurization. 4.Production of fermented milk by *Lactobacillus acidophillus* 5.Production and estimation of lactic acid by *Lactobacillus sp.* or *Streptococcus sp.* 5. Role of yeast in bread making. 6. Isolation of lipolytic bacteria from butter. 7. Production of Sauerkraut by lactic acid bacteria 8. Isolation of food poisoning bacteria from contaminated food and dairy products. 9. Preservation of potato /onion by UV radiation. 10. Extraction and detection of afla toxin for infected foods. 11. Isolation of Microorganism from various spoiled food materials. 12. Preparation of various fermented food. **MICP302 (C): Fermentation Technology** 1. Basic parts of fermenter. 2. Sterilization of lab fermenter. 3. Loss of CO_2 during fermentation. 4. Fermentation of fruit juice. 5.Isolation of penicillin producing organism. 6. Thermal death point (TDP) and thermal death time of an organism (TDT) of an organism. 7. Demonstration of wine production using Grape juice. 8. Demonstration of acetic acid oxidation (vinegar production) in lab	

Part C - Learning Resource
Text Books, Reference Books, E-Resources

Text Books:

1. Gupta, S.P, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

2.Rastogi S.C., Mendiratta N. and Rastogi P. Bioinformatics: methods and applications, genomics, proteomics and drugdiscovery, Prentice Hall India Publication

3.Primrose and Twyman. Principles of Genome Analysis &Genomics. Blackwell

4. Biostatistics: A Foundation for Analysis in the Health Sciences (2009) 9th ed., Daniel W.W., John Wiley and Sons Inc.

Reference Books:

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House

2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications

3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication,

3rd International Student Edition

4. Statistics at the Bench: A Step-by-Step Handbook for Biologists (2010) Bremer, M. and Doerge, R.W., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-0-879698- 57-7.

E-Resources:

https://britannica.com
https://nptel.ac.in
https://en.wikipedia.org/wiki/Bioinformatics
https://www.youtube.com/results?search_query=dsvgk+kaladhar
https://www.academia.edu/5134081/Bioinformatics_Lecture_Notes
https://www.academia.edu/40309984/LECTURE_NOTES_Research_Methodology

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Semester IV

Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT401		
2.	Course Title	Industrial Microbiology		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand the role of microbes in Industries. 2. Understand the products which are produced by microbes. 3. Understand the microbial processes and modifications involved in industries.		
6.	Credit Value	04		
7.	Total Marks	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	Development and scope of industrial microbiology: Microbes, their growth curves and production of primary and secondary metabolites. Screening of economically important cultures - Preliminary and secondary screening. Preservation of stock cultures.	12 Periods / 08 Hours
II	Fermentation equipments: General design of a fermenter, their types and applications. Characteristics of fermentation media, Raw materials, Scale up of fermentation processes, product recovery methods.	12 Periods / 08 Hours
III	Industrial Healthcare productions: Industrial production of Antibiotics - Penicillium, streptomycin and their derivatives. Production and application of large-scale production of recombinant molecules interferon, human proteins –insulin, vaccines, anticancer agents and siderophores.	12 Periods / 08 Hours
IV	Microbiology and production of alcoholic beverages: Malt beverages, distilled beverages, wine and champagne, Commercial production of organic acids like acetic, lactic, citric and gluconic acids	12 Periods / 08 Hours
V	Applied Industrial Microbiology: Industrial production of Amino acid (L-lysine, L-Glutamic acid), Vitamin B & C, Steroid transformation, Role of microorganisms in petroleum and mining industries, bioleaching of metals.	12 Periods / 08 Hours

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. Nduka Okafor. Modern Industrial Microbiology and Biotecnology. 1st Edition. Science Publishers. (2007).
2. Waites, M.J., Morgan, N.L., Rockey, J.S. and Hington, G. Industrial Microbiology: An introduction. Blackwell science Publishers. (2002).

Reference Books:

1) Richard H. Baltz. Julian E Davies and Arnold L.DemainManual of Industrial Microbiology and Biotechnology.3rd edition, ASM Press (2010).
2) Daniel Forciniti. Industrial Bioseperation :Principles and practice. 1st edition edition, Wiley-Blackwell (2008).
3) Reed. G. Prescott and Dunn's Industrial Microbiology. CBS Publishers. (1999).
4) Demain, A. L. Industrial Microbiology and Biotechnology. 2nd Edition. (2001).
5) EL Mansi. E.M.T., Fermentation Microbiology and Biotechnology. 2nd Edition, CRC Taylor & Francis (2007).
6) Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. Industrial M icr o bio lo g y: An Introduction. Blackwell Science Publishers (2002).
7) Richard H. Baltz. Julian E . Davies, a n d Ar no ld L. Demain Manual of Industrial Microbiology and Biotechnology, 3rd Edition, ASM Press (201 0). 27
8) Daniel Forciniti Industrial Bioseparations: Principles and Practice. I st Edition, WileyBlackwell (2008).
9) Reed. G, Prescott and Dunn's Industrial Microbiology, CBS Publishers (1999) .
10) Demain, A. L, Industrial Microbiology and B io t e c h no lo g y, II Edition (2001),.
11) Casida LE, Industrial Microbiology, J. Wiley, (1968)
12) James Bailey and David Ollis, Fundamentals of Biochemical Engineering, 2nd edition, McGraw-Hill, (1986)

E-Resources:

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf
https://microbenotes.com/microbial-interaction-and-its-types-with-examples/
https://bookarchive.net/pdf/industrial-microbiology-by-l-e-casida-jr

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT402		
2.	Course Title	Enzymology		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand Enzymes at molecular level. 2. Understand the mechanism of Enzymes action. 3. Application of Enzymes in daily life.		
6.	Credit Value	04		
7.	Total Marks	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Basic concepts of enzymes:** Nomenclature, classification, methods for determination of enzyme activity. Isolation and purification of enzymes. Enzyme kinetics: Michaelis-Menten equation, effect of pH, substrate concentration, temperature and inhibitors. Iso-enzymes and allosteric enzymes. Enzyme inhibition- competitive and non-competitive inhibition. Mechanism based inhibitors - antibiotics as inhibitors.	12 Periods / 08 Hours
II	**Mechanism of enzyme action:** Action of ribonuclease, chymotrypsin, and trypsin. Coenzyme catalysis. Mechanism of action of thiamine pyrophosphate enzyme. Control and regulation of enzyme activity and feedback mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and secondary metabolites.	12 Periods / 08 Hours
III	**Microbial growth kinetics:** Batch kinetics - Monod's model (single substrate), deviations from Monod's model, dual substrates - sequential utilization, multiple Substrates simultaneous utilization, substrate inhibition, toxic inhibition.	12 Periods / 08 Hours
IV	Bisubstrate reactions: Types of bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange). Regulation of enzyme activity: Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbomoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage- zymogen. Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).	12 Periods / 08 Hours

V	**Enzyme engineering & applications of microbial enzymes**: Chemical modification and site-directed mutagenesis structure & function relationship of industrially important enzymes. Microbial enzymes in textile, leather, wood industries and detergents. Enzyme sensors for clinical processes and environmental analysis. Enzymes as therapeutic agents.	12 Periods / 08 Hours

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Biochemistry by Lehninger
2. Principles of Biochemistry and molecular biology: Wilson & Walker 3. Biochemistry of Nucleic acids by Davidson

Reference Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H.Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1- 4292-3414-8.
2. Physical Biochemistry (2009) 2nd ed., Sheehan, D., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.
3. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.
4. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X. .

E-Resources:

https://ncert.nic.in/textbook/pdf/lech205.pdf
https://www.pdfdrive.com/biomolecules-books.html
https://schools.aglasem.com/ncert-books-class-11-biology-chapter-9/
https://swayam.gov.in/
https://www.edx.org/search?q=biomolecules&tab=course
https://britannica.com
https://en.wikibooks.org/wiki/Biochemistry
https://nptel.ac.in

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT403		
2.	Course Title	Computer Fundamentals and Research Techniques		
3.	Course Type	Theory		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: 1. Understand basics of Computers. 2. Role of computers in Biology. 3. Understand basic techniques used in Research.		
6.	Credit Value	04		
7.	Total Marks	Internal Marks: 20 External Marks: 80	Min Passing Marks:36	

Part B: Content of the Course		
Unit	Topic	Total Hours
I	**Basic Concepts of Computer and computer application in Biology:** History of Computer, Concept of Computer hardware, Concept of Computer languages, Concept of Computer Software. Computer applications in Biology Spreadsheet tools: Introduction to spreadsheet applications, features, using formulas and functions; Data storing, Features for Statistical data analysis, Generating charts /graph and other features.	12 Periods / 08 Hours
II	**Advanced Tools -** Microsoft Excel or similar. Presentation tools: Introduction, features and functions, Power Point Presentation, Customizing presentation. Web Search: Introduction to Internet, Use of Internet, WWW; Use of search engines, biological data bases.	12 Periods / 08 Hours
III	**Biostatistics and Quantitative Techniques:** Measures of Central tendency and Dispersion. Probability distribution: Binomial, Poisson and Normal. Parametric and Nonparametric statistics, Confidence Interval, Errors. Quantitative Techniques: Levels of significance, Regression and Correlation, Use of Statistics in Biosciences, Use of Computers in Quantitative analysis.	12 Periods / 08 Hours
IV	**Scientific Writing:** An Insight into Research: Definition and basic concepts, objectives, significance and techniques of research, finding research materials - literature survey. compiling records. Definition and kinds of scientific documents - research paper, review paper, book reviews, theses, conference and project reports (for the scientific community and for funding agencies). Components of a research paper- the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations.	12 Periods / 08 Hours

V	**Research Techniques:** Enzyme assay, enzyme activity and specific activity determination. Cell disintegration and extraction techniques, separation of proteins by fractionation (ammonium sulphate, organic solvents). Ion exchange chromatography, molecular sieve chromatography, affinity chromatography, paper chromatography, thin layer chromatography, ultra filtration, Ultracentrifugation. Gel electrophoresis, isoelectric focusing and immune-electrophoresis, capillary electrophoresis, pulse field electrophoresis. Microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR, AAS	12 Periods / 08 Hours

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Biostatistics: A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics, Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons(ASIA) Pvt. Ltd. 3. Bioinformatics Methods and Applications Genomics, Proteomics, and DrugDiscovery (S. C. Rastogi, N. Mendiratta, and P. Rastogi).
3. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
4. Protein Purification by Robert Scopes, Springer Verlag Publication, 1982 6. Tools in Biochemistry David Cooper
5. Methods of Protein and Nucleic acid Research, Osterman Vol I-III
6. Centrifugation D. Rickwood
7. Practical Biochemistry, V th edition, Keith Wilson and Walker.

Reference Books:

1. Research in Education (1992) 6th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd.
2. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers.
3. Computer Fundamentals architecture and organization by B.Ram and Sanjay Kumar, New Age International Publisher.
4. Microsoft Office System Step by step by Cox, Joyce etc. all, PHI Learning India.
5.Research Methodology: R. Panneerselvam, PHI learning publication, India, second edition.
6.Research methodology in Behavior Sciences (English and Hindi), S.K. Mangal, S. Mangal, PHR learning publication, India.

E-Resources:

https://britannica.com
https://www.academia.edu/40309984/LECTURE_NOTES_Research_Methodology
https://nptel.ac.in
http://ihmgwalior.net/pdf/research_methodology.pdf
Research Ethics in SWAYAM https://onlinecourses.swayam2.ac.in/cec22_ge28/preview.
Research ethics using research methodology in SWAYAM
https://onlinecourses.swayam2.ac.in/aic21_ge02/preview?

Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT404 (A)		
2.	Course Title	Microbial Ecology		
3.	Course Type	Theory (Elective III)		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. To understand concepts in ecology. 2. The different features of ecology. 3. Role of microbes in ecology.		
6.	**Credit Value**	04		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**History, significance and developments in the field of microbial ecology:** Contributions of Beijerinck, Winogradsky, Kluyver, Van Niel, Martin Alexander, Selman A. Waksman. Atmosphere: Stratification of the Atmosphere, Environmental chemistry. Microbes in different strata of Atmosphere, Atmospheric pollutants, Types of wastes, Organization of life. Ecosystems and microorganisms.	12 Periods / 08 Hours
II	**Microorganisms & their natural habitats and biogeochemical cycles:** Terrestrial Environment: Soil characteristics, Soil profile, Soil formation, Soil as a natural habitat of microbes, Soil micro-flora. Aquatic Environment: Stratification & Micro-flora of Freshwater & Marine habitats. Aero-micro-flora, Dispersal of Microbes. Animal Environment: Microbes in/on human body (Micro-biomics) & animal (ruminants) body. Extreme Habitats: Extremophiles, Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Biogeochemical cycles	12 Periods / 08 Hours
III	**Biological Interactions and Forest Microbiology:** Microbe-Microbe Interactions; Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation. Microbe Plant Interactions; Symbiotic and non- symbiotic (Roots, Aerial Plant surfaces). Microbe-Animal Interactions. Role of Microbes in Ruminants, Nematophagus fungi. Luminescent bacteria as symbiont	12 Periods / 08 Hours
IV	**Nitrogen fixation and bio-fertilizers Technology:** Nitrogen fixation; nitrification and denitrification. symbiotic, non-symbiotic or free-living N-fixation, associative types; Rhizobium- tree legume symbiosis, Frankia non legume symbiosis. Microbial transformation of phosphorus, mycorrhizae; ecto and endomycorrhizae, Role of	12 Periods / 08 Hours

	mycorrhizae in mobilization of macro and micronutrients and in aforestation of waste land. Microbial transformation of iron and sulphur. Role of biofertilizers in afforestation, types of biofertilizers; bacterial biofertilizers, fungal biofertilizers and quality control.	
V	**Forest Microbiology**: Forest Microbiology History, scope and significance. Microorganisms in various forest ecosystems. Isolation and enrichment methods. Factors affecting microbial population in forest soil. Microbial decomposition of organic matter. Compositing, methane and methanogenesis.	12 Periods / 08 Hours

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4 edition. Benjamin Cummings Science Pub, USA
2. Atlas RM. (1989), Microbiology: Fundamentals and Applications, 2nd Edition, MacMilla Publishing Company, New York.
3. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12 edition. Pearson Benjamin Cummings.
4. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England. 5. Hattori, T. 1973. Microbial life in the soil. Marcel Dekker Inc. New York.
5. Lynch, J.M. 1983, Soil Biotechnology. Blackwell Scientific publications, London.
6. Mehta, S.L., M.L. Lodha and P.V. Sane. 1993. Recent advances in plant biochemistry, Pub, and Info, Division,ICAR, New Delhi.
7. Motsara, I. M. R., P. Battacharya and Beena Srivastava. 1995. Biofertilizertechnology, marketing and usage A source book cum glossary, FDCO, New Delhi.
8. Subba Rao, N. S. 1977. Soil Microorganisms and Plant growth, Oxford and IBH; Publications, New Delhi.
9. Subba Rao, N. S. 1993. Biofertilizers in agriculture and forestry. Oxford and IBH Publ.Co.New Delhi, p.242.

Reference Books:

1. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Madigan MT, Martinko JM and Parker J. (2014).Brock Biology of Microorganisms. 14th edition. Pearson / Benjamin Cummings.
4. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

E-Resources:

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf
https://microbenotes.com/microbial-interaction-and-its-types-with-examples/
https://microbenotes.com/category/agricultural-microbiology/
https://sites.google.com/site/soilagrlmicrobiol/

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT404(B)		
2.	Course Title	Intellectual Property Rights		
3.	Course Type	Theory (Elective III)		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 01. Understand intellectual property right. 02. Understand types of intellectual property right 03. Understand the process of all types.		
6.	Credit Value	04		
7.	Total Marks	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	Concepts and scope: Overview of Intellectual Property and property rights (IPR), TRIP (Trade related aspects of IPR), General agreement on tariffs and trade and Post GATT scenario.	12 Periods / 08 Hours
II	Patents: patentable inventions and discoveries, claims patent terms Product patents, process patents, Industrial patents, biological patents, Patent acts.	12 Periods / 08 Hours
III	Trademarks and Copyrights: Geographical Indicators, Trade Secrets and Unfair Competition, Bio piracy Copyright and Related Rights, Protection of Intellectual property at the National Level	12 Periods / 08 Hours
IV	Ethical and legal issues: Filing and issuing of patents, Enforcement of Intellectual property Rights, Contemporary Intellectual Property Issues, Legal provisions related to IPR.	12 Periods / 08 Hours
V	Repository and regulatory bodies: GMO patents, microbial repositories, genebanks, Indian scenario and regulatory bodies.	12 Periods / 08 Hours

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1.IPR, Biosafety and biotechnology Management.Senthil Kumar Sand Mohammed Jaabir,-Jasen Publications
2. Intellectual Property Law, Lionel Bently& Brad Sherman, OUP.
3.IPR, Biosafety and Bioethics,Goel D &Prashar S – Pearson
4. Parekh U and Rao T.P. 1978 - Personal efficiency in developing Entrepreneurship learning system - New Delhi

Reference Books:

1.B. S. Rathore & J. S. Saini, B. R. Gurjan - Entrepreneurial opportunities in modernizing economy abhishek publication – Chandigadh
2. Indian entrepreneurship theory practice D. D.Sharma, S. K. Dhameha – Abhishekh Publication - New Delhi

E-Resources:

https://britannica.com
https://en.wikibooks.org/wiki/Biochemistry
https://nptel.ac.in

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Dr.Subhraja Pandey, Member BOS, Microbiology, Assistant Professor, DP Vipra College, Bilaspur (CG)	

Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICT404(C)		
2.	Course Title	**Plant Pathology and Disease Management**		
3.	Course Type	**Theory (Elective III)**		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. Understand the plants and their pathogens. 2. Understand host parasite relationship. 3. Understand Mechanism of control of plant pathogens.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I	**Introduction and History of plant pathology:** Concept of plant disease- definitions of disease, Classification of Plant diseases, Symptomatology, disease cycle and concern terminology, disease description and diagnosis, Modern concept of Plant pathology. Importance of plant diseases, Contributions of eminent Indian plant pathologists.	12 Periods / 08 Hours
II	**Defence mechanism:** Host defenses Structural and Chemical. Systemic acquired resistance. Host resistance, Gene-for-gene concept, Host resistance, Principle of plant disease control.	12 Periods / 08 Hours
III	**Pathogenesis:** Pathogens. Life strategies of plant pathogens Infection processes. Incubation and disease development. Role of Enzymes and Toxins in plant disease development. Host-Parasite interaction/relationship, Disease dynamics.	12 Periods / 08 Hours
IV	**Important plant diseases:** Fungal diseases Downy mildew of Pea, Powdery mildew of Apple, Bunt of Rice, Rust of Beans, Early Blight of Potato. Bacterial diseases -Brown Rot of Potato, Tundu disease of Wheat, Fire blight of Apples, Black arm of cotton, Leaf Blight of Paddy. Viral diseases -Bean Mosaic, Vein clearing of Bhindi, Tomato Spotted Wilt, Bunchy Top of Banana. Mycoplasmal disease- Grassy shoot of Sugarcane, Little leaf of Brinjal, Sesamum Phyllody, Bunchy Top of Papaya, Sandal Spike.	12 Periods / 08 Hours

V	**Diseases management & control:** Disease assessment, Disease epidemiology: temporal and spatial processes Biological control of diseases, Virus diseases and virus vectors, Life of a Virus, Transgenic viral resistance. Chemical Control of plant disease, Certification and Regulation Cultural management, Protection, Eradication, review and evaluation.	12 Periods / 08 Hours

Part C - Learning Resource

Text Books, Reference Books, E-Resources

Text Books:

1. Plant Pathology: Agrios G. N. (2006). 5th edition; Academic press, San Diego,
2. Plant Pathology and Plant Peathogens; Lucas JA. (1998); 3rd edition. Blackwell Science, Oxford.
3. Plant Pathology; Mehrotra R. S. (1994); Tata McGraw-Hill Limited.
4. Diseases of Crop Plants in India; Rangaswami G. (2005); 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.

Reference Books:

1. Plant Diseases Management; Singh RS. (1998); 7th edition; Oxford & IBH, New Delhi
2. Laboratory Manual Of Microbiology And Biotechnology, Medtech; 1st edition, 2017

E-Resources:

https://thebookee.net/
http://site.iugaza.edu.ps/mwhindi/files/Laboratory_Manual_And_Workbook_In_Microbio
http://site.iugaza.edu.ps/ydahdouh/files/General-Microbiology-Laboratory-pdf.pd

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1.	Course Code	MICP401		
2.	Course Title	Lab 7		
3.	Course Type	Laboratory Course		
4.	Pre-requisite (if any)	As per Govt. and University norms		
5.	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** 1. understand on fundamentals of enzymes, enzyme action and metabolic reaction 2. understand the concept of secondary metabolites and Fermentation process 3. understand the types of Bio-reactor and its application 4. Analyze research related information. 5. Use different tools useful for research work. 6. Follow research ethics while doing research work. 7. Understand fundamental of computer and make use of computer in research work.		
6.	**Credit Value**	02		
7.	**Total Marks**	**Internal Marks: --** **External Marks: 100**	**Min Passing Marks:36**	

Part B: Content of the Course	
Topics	Total Hours
1. To isolate industrially important enzyme producer from soil. 2. Qualitative and quantitative assay of the selected enzyme. 3. Optimization of the enzyme production. 4. Scaling of the enzyme production in lab fermenter. 5. Analysis of substrate utilization and product formation. 6. Ammonium sulphate precipitation for enzyme concentration. 7. Column chromatography for purification. 8. SDS PAGE for enzyme purification. 9. Qualitative detection of dehydrogenase, amylase, urease, cellulase, caseinase, catalase. 10. Determination of kinetic constant of amylase activity, Vmax, Km. 11. Effect of pH and temperature on amylase activity. 12. Production of protease by microorganism. 13. Demonstration of ethanol production by yeast. 14. Immobilization of cells and enzyme using sodium alginate and egg albumin and measurement of enzyme activity 15.Creating files, folders and directories. 16. Applications of computer in biology and working with MS Word, Excel and PowerPoint. 16. Writing a review paper.	60 Periods 40 Hours

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books:

1. Principles of Biochemistry and molecular biology: Wilson & Walker
2. Biochemistry of Nucleic acids by Davidson
3. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Company, New Delhi.
4.4. Patel AH. (1996). Industrial Microbiology. 1st edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
5. Research in Education (1992) 6th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Computer Fundamentals architecture and organization by B.Ram and Sanjay Kumar, New Age International Publisher.
2. Microsoft Office System Step by step by Cox, Joyce etc. all, PHI Learning India.
3.Research Methodology: R. Panneerselvam, PHI learning publication, India, second edition.
4.Research methodology in Behavior Sciences (English and Hindi), S.K. Mangal, S. Mangal, PHR learning publication, India.

learning Resources

https://britannica.com
https://www.academia.edu/40309984/LECTURE_NOTES_Research_Methodology
https://nptel.ac.in
http://ihmgwalior.net/pdf/research_methodology.pdf
https://onlinecourses.swayam2.ac.in/cec22_ge28/preview
https://onlinecourses.swayam2.ac.in/aic21_ge02/preview?

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Part A: Introduction				
Program: M.Sc. Microbiology		Semester: IV	Year: II	w.e.f.: 2024-2025
1	Course Code	MICP-1D		
2	Course Title	Dissertation		
3	Course Type	Major Project		
4	Pre-requisite (if any)	As per Govt. and University norms		
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: 1. Understand on research project. 2. Understand on research writing. 3. Understand on the activities on research.		
6	**Credit Value**	**02**		
7	**Total Marks**	**Internal Marks: --** **External Marks: 100**		**Min Passing Marks:36**

Part B: Content of the Course
Total No. of Teaching Hours – 40 / Periods - 60
This paper would focus on the project work / dissertation to be carried out by the students in the supervision of the teachers in the colleges. The topic of the project would be selected by each student in consultation with the teacher (Supervisor/Advisor). This would train the student to retrieve the literature and collate the information sufficient to make a presentation, the collated literature would also prepare the base for initiating the research. The student would carryout experiments to achieve the planned objectives, collation and analysis of data, presentation of the result in the form of a Dissertation. The grading would be based on continuous evaluation that would include punctuality, hard work, record keeping, intellectual inputs, data presentation, interpretation etc.

Part C - Learning Resource
Text Books, Reference Books, Other Resources
Suggested Readings: -- **E-learning Resources:** --

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