Anekant Education Society's

Tuljaram Chaturchand College, Of Arts, Science & Commerce Baramati – 413102

(Autonomous)

Syllabus (CBCS) for M.Sc. Microbiology

w.e.f. June 2022

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TuljaramChaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)

Course Structure for M.Sc. (Microbiology)
(With effect from Academic year 2022-23)

Semester	Paper Code	Title of the Paper	No. of Credits
III	**PSMB231**	Immunology	**4**
	PSMB232	Molecular Biology I	**4**
	PSMB233	Industrial waste water treatment	**4**
	PSMB234 (A)	Biophysical Techniques	**4**
	PSMB234 (B)	Developmental Biology	**4**
	PSMB235	Practical course based on Immunology, Pharmaceutical Microbiology and Industrial waste water treatment	**4**
	PSMB236	Practical course based on Molecular Biology and Microbial Technology	**4**
	SD23	Skill development I	**2**
IV	**PSMB241**	Pharmaceutical Microbiology	**4**
	PSMB242	Molecular Biology II	**4**
	PSMB243	Microbial Technology	**4**
	PSMB244 (A)	Medical Microbiology	**4**
	PSMB244 (B)	Mathematics for Biological Science	**4**
	PSMB245	Dissertation I	**4**
	PSMB246	Dissertation II	**4**
	SD24	Skill development II	**2**

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SYLLABUS (CBCS) FOR M.Sc. II Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: PSMB241
Paper: I
Title of Paper: Pharmaceutical Microbiology
Credit: 4
No. of lectures: 60

Course Objective:

- To inculcate the knowledge regarding the drug designing, pharmacokinetics and pharmacodynamics
- To aware students with the concepts of pharmaceuticals.
- To understanding Drug Discovery Process
- To gain a comprehensive understanding of the drug discovery process, from target identification to clinical trials.
- To explore the principles of rational drug design and computational methods for designing new drugs.
- ToLearn the basics of drug toxicology and safety assessments.
- Understand preclinical testing, including in vitro and in vivo models for assessing drug efficacy
- Explore the regulatory requirements and processes involved in bringing a drug from discovery to market

Course Outcome:

CO1. In addition to drug development students will also understand the concepts of drug discovery
CO2. They will be able to know pharmacokinetics and pharmacodynamics.
CO3. Proficiency in various drug screening methods, including high-throughput screening, virtual screening, and biochemical assays.
CO4. They will be able to know medicinal chemistry principles to design and optimize drug candidates.
CO5. An understanding of the pharmacological aspects of drug development, including mechanisms of action, pharmacokinetics, and pharmacodynamics.
CO6. Knowledge of safety assessment procedures and understanding of potential toxicity issues associated with drug candidates.
CO7. Proficiency in developing drug formulations and delivery systems.
CO8. Awareness of the regulatory pathways for drug approval, as well as ethical considerations in drug development.

Content

UNIT 1: Drug Discovery and Development (15L)

A. Drug Discovery:

- Conventional Process Bio-prospecting, Extraction and Purification and characterization of bioactive molecules from natural sources
- Rational Drug Design – Principle (Structure activity relationship-SAR, High Through Put Screening, Combinatorial synthesis, Pharmacogenomics)

B. Drug Development

- Preclinical development: Toxicity testing – acute, sub-acute and chronic toxicity
- Clinical development: Clinical trials – (Aims, Objectives, Conduct): I, II, III and IV

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UNIT 2: Biopharmaceuticals –Regulations and Sources (15L)

- Regulatory authorities and its role: FDA and Pharmacopeia (IP, UK, US)
- Drug formulations - Carriers and delivery systems, targeted drug delivery, sustained release
- Pharmacokinetic – ADME / Bioavailability studies

UNIT 3: Development of Anti-infective: (15L)

Susceptibility Testing:

- Use of liquid and solid media(Therapeutic ratio, MIC and MBC)
- Factors affecting susceptibility testing,
- Diffusion methods –agar dilution technique, gradient plate techniques, E-test, Kirby Bauer, Stokes method
- Susceptibility testing for: Anti-mycobacterial agents, Anti-fungal agents, Anti-protozoan agents, Anti-viral agents

UNIT 4: Quality assurance and quality control in Pharmaceutical Industry (15L)

- Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in Pharmaceutical industry.
- Concept of Quality assurance and quality control in pharmaceutical industry
- Safety profile of drugs:
  i. Pyrogenicity testing
  ii. Mutagenicity and Carcinogenicity testing
  iii. Teratogenicity testing
  iv. Adverse Drug Reactions
  v. In vivo and in vitro drug interactions

Textbook and references

1. AgarwalS.S.andParidhaviM.,(2007),*HerbalDrugTechnology*,UniversitiesPress(India) Pvt.Ltd
2. Altreuter D., and D S. Clark, (1999), *Combinatorial Biocatalysis: Taking the Lead FromNature*,Curr.Opin.Biotechnol.10,130.
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17. WalshGary,(2003),*BiopharmaceuticalsBiochemistryAndBiotechnology*,2ndEd.,JohnWiley&SonsLtd, England
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Mapping of Program Outcomes with Course Outcomes

Weightage:1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2		2	2	2				
CO2	2	2							
CO3									
CO4		2							
CO5	2								
CO6						2			
CO 7									
CO8									3

Justification for the mapping

1. **Disciplinary Knowledge:**

CO1: Understanding drug discovery is essential for students pursuing careers in drug development, pharmacology, and healthcare

Co2: understanding pharmacokinetics is justified in the field of pharmaceutical and medical sciences because it is a core component of disciplinary knowledge

CO5: A strong grasp of pharmacokinetics is essential for optimizing drug dosing, ensuring therapeutic efficacy, and minimizing adverse effects.

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2. **Critical Thinking and Problem solving:**

   CO 2: Pharmacokinetics involves the study of how the body absorbs, distributes, metabolizes, and eliminates drugs, which is essential for optimizing drug dosages, minimizing side effects, and ensuring their therapeutic efficacy.

   CO4: In the field of pharmacokinetics, students need to critically assess research papers, clinical trials, and data. Critical thinking enables them to discern the validity and relevance of various sources of information.

3. **Social competence:.**

   CO 1: This knowledge is crucial for students to contribute to advancements in healthcare and the pharmaceutical industry.

4. **Research-related skills and Scientific temper:**

   CO 1: Drug Discovery is at forefront of Scientific Innovation And Research By grasping this concept student are better equipped to engage in innovative research project and potentially to break ground breaking discoveries

5. Trans-disciplinary knowledge

   CO 1: Drug discovery involves multidisciplinary approach encompassing chemistry biology and pharmacology .teaching drug discovery

6. **Personal and professional competence:**

   CO6: Understanding drug discovery is essential for students pursuing careers in drug development, pharmacology, and healthcare

9. **Self-directed and Life-long learning: .**

   CO8: Healthcare professionals, researchers, and regulators need this knowledge to make informed decisions about drug administration and patient safety.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: **PSMB242**
Paper: II
Title of Paper: Molecular biology II
Credit: 4
No. of lectures: 60

Course objective:

1. To grasp various gene cloning methods, including the creation of gene and genome libraries, cDNA libraries, PCR cloning, and alternative approaches.
2. To acquire expertise in site-directed mutagenesis techniques and protein engineering methods to modify and design proteins with specific properties.
3. To comprehend techniques for manipulating large DNA fragments (YAC, BAC, HAC) and gene transfer methods used to introduce foreign DNA into host cells.
4. To grasp the principles and applications of expression vectors for effectively expressing genes within host cells.
5. To investigate the production of commercial products (amino acids, ascorbic acid, antibiotics, peptide antibodies, biopolymers) using recombinant DNA technology.
6. To be introduced to unconventional microbial systems utilized for the production of high-quality protein drugs.
7. To comprehend the process of bioremediation, involving the degradation of xenobiotics, and the engineering of pathways for degradation in genetically modified organisms.
8. To understand the utilization of starch and cellulose in the production of fructose, alcohol, and silage, utilizing genetically modified organisms.
9. To critically assess and discuss the social and ethical issues associated with genetically modified organisms.
10. To explore the applications of GMOs in medicine, including disease prevention, early detection, therapies, as well as their uses in agriculture. They will analyze the pros, cons, and instances of transgenic plants producing beneficial molecules.

Course outcome:

CO1. Students will gain extensive knowledge encompassing a variety of gene cloning techniques, comprising the preparation of gene and genome libraries, cDNA libraries, PCR cloning, and alternative methodologies.
CO2. Students will demonstrate comprehension of techniques involved in manipulating large DNA fragments (YAC, BAC, HAC) and gene transfer methods utilized for introducing foreign DNA into host cells.
CO3. Students will explore and grasp the process of synthesizing diverse commercial products (amino acids, ascorbic acid, antibiotics, peptide antibodies, biopolymers) utilizing recombinant DNA technology.
CO4. Students will comprehend the process of bioremediation, encompassing the degradation of xenobiotics and the engineering of pathways for degradation within genetically modified organisms.
CO5. Students will understand the utilization of starch and cellulose for producing fructose, alcohol, and silage by employing genetically modified organisms.
CO6. Students will critically evaluate and discuss the social and ethical considerations associated with genetically modified organisms.

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CO7. Students will explore the diverse applications of GMOs in medicine, encompassing disease prevention, early detection, therapies, as well as their agricultural uses. They will analyze the advantages, disadvantages, and instances of transgenic plants yielding beneficial molecules.

UNIT 1: Gene technology (15L)

- Gene cloning strategies: preparation of gene, genome libraries, cDNA libraries, PCR cloning and alternatives, Library screening
- Site directed mutagenesis and protein engineering
- Cloning and manipulating large fragments of DNA:YAC, BAC, HAC
- Gene transfer to host cells
- Expression vectors

UNIT 2: Applications of recombinant DNA technology – Production of Secondary Metabolites (15L)

- Synthesis of commercial products: Amino acids, ascorbic acid, novel antibiotics, peptide antibodies
- Biopolymers: gum, rubber, polyhydroxyalkanoates
- Unconventional microbial systems for production of high-quality protein drugs

UNIT 3: Bioremediation and biomass utilization with the help of GMOs (15L)

- Degradation of xenobiotics, engineered degradative pathways
- Utilization of starch and cellulose for fructose, alcohol and silage production

UNIT 4: Genetically modified Microbes, plants and animals (15L)

- Genetically modified organisms- social and ethical issues
- Applications in medicine – prevention, early detection and cure of diseases
- Gene augmentation, gene therapy
- Applications in agriculture – examples of transgenic plants advantages and disadvantages

Text / Reference Books:

- R. Glick, J.J. Pasterneck, Principles and applications of recombinant DNA, 3rd Ed., ASM press.
- James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) Molecular Biology of the Gene, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.
- Lewin's Genes XI, (2014) Jones and Bartelett Publishers Inc.
- Malom Campbell and L. J. Heyer, Discovering genomics, Proteomics and Bioinformatics, 2nd Ed., Pearson Publication, 2009.
- S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing
- Walker J.M., Rapley R. (eds.) Molecular Biology and Biotechnology, 4th Ed., 2009, Royal Society Press, U.K.

Mapping of Program Outcomes with Course Outcomes

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								
CO 2	3								
CO 3	3								
CO 4	3			2				2	
CO 5	3								
CO 6		3	3			2	3		
CO 7					2				

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Strong (3) relation - Extensive knowledge of gene cloning techniques contributes directly to disciplinary knowledge.

CO2: Strong (3) relation - Understanding gene manipulation techniques aligns directly with disciplinary knowledge.

CO3: Strong (3) relation - Comprehension of commercial product synthesis using recombinant DNA technology is directly linked to disciplinary knowledge.

CO4: Strong (3) relation - Understanding bioremediation and engineered degradation pathways aligns directly with disciplinary knowledge.

CO5: Strong (3) relation - Knowledge of utilizing genetically modified organisms for producing specific compounds contributes directly to disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO6: Strong (3) relation - Critical evaluation and discussion of social and ethical considerations regarding GMOs directly align with critical thinking.

PO3: Social Competence

CO6: Strong (3) relation - Discussing social and ethical aspects of GMOs directly relates to social competence.

PO4: Research-related Skills and Scientific Temper

CO4: Moderate (2) relation - Understanding bioremediation involves partial research-related skills.

PO5: Trans-disciplinary Knowledge

CO7: Moderate (2) relation - Exploring diverse applications of GMOs in medicine and agriculture contributes partially to trans-disciplinary knowledge.

PO6: Personal and Professional Competence

CO6: Moderate (2) relation - Critical evaluation and discussion of social and ethical considerations indirectly contribute to personal and professional competence.

PO7: Effective Citizenship and Ethics

CO6: Strong (3) relation - Ethical considerations associated with GMOs directly align with effective citizenship and ethics.

PO8: Environment and Sustainability

CO4: Moderate (2) relation - Understanding bioremediation partially contributes to knowledge in environment and sustainability.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: **PSMB243**
Paper: III
Title of Paper: Microbial Technology
Credit: 4
No. of lectures: 60

Course Objectives:

- To understand the different designs of bioreactors and process variables.
- To study the principle of sterilization necessary for fermentation
- To study the cell growth and product formation
- To evaluate the kinetics and mechanisms of microbial growth
- To provide students with a comprehensive understanding of microbial technology, its principles, and applications.
- To introduce students to the diversity of microorganisms and their roles in various industrial processes
- To explore the techniques and methodologies used in microbial technology, including microbial isolation, cultivation, and manipulation.

Course Outcome:

CO1. Students will learn about the different types of fermentation processes, equipment used and microbial process involved.
CO2. Students will gain knowledge of significance and activities of microorganisms.
CO3. Comprehensive understanding of the different designs of bioreactors and process variables.
CO4. Understand the fundamental principles of microbial technology, including microbial physiology, genetics, and metabolism.
CO5. Identify and classify different types of microorganisms and understand their roles in various industrial processes.
CO6. Demonstrate proficiency in techniques used for microbial isolation, cultivation, and maintenance in laboratory settings.
CO7. Apply knowledge of microbial technology to solve practical problems and design biotechnological solutions.

CONTENTS:

UNIT 1: Bioreactor Design (15L)

A. Designing of bioreactors - Design aspects CSTRs: The dimensional ratios of the outer shell, and the operational aspects such as working volume and impellers.
B. The configuration (placement) of impellers in a vessel and the different types of impellers (types of turbines and propellers, and their combinations)
C. Immobilized cell reactors- (Fixed bed reactor/packed bed reactor, Fluidized bed reactor, Trickle bed reactor) and Air-lift reactors- (Internal -loop vessel, External- loop vessel) Design and operation.
D. Batch, Fed-batch and Continuous operation: Applications, advantages and limitations of each type.

UNIT 2: Process Variables and Monitoring (15L)

A. Process Variables:

I. Aeration -

- Theory of oxygen transfer in bubble aeration
- Oxygen transfer kinetics (Oxygen Uptake Rate –OUR; Oxygen Transfer Rate OTR; Ccrit).
- Determination of KLa. Types, Advantages and limitations. (Oxygen balance technique, Dynamic method of gasing out, Sulphite oxidation technique)

II. Agitation - Functions of agitation. Flow patterns with different types of impellers.

III. Fermentation broth rheology and power requirements for agitation – Concept of Newtonian and non-Newtonian fluids, effect of broth rheology on heat, nutrient and oxygen transfer, Reynold's number, Power number, Aeration number.

B. Monitoring of process variables:

Use of various types of sensors and biosensors for monitoring environmental parameters (Pressure, pH, Temperature, DO and DCO_2), Basic principles of operation, Types of Biosensors (Electrical, Optical, Thermal, Mechanical)

UNIT 3: Microbial Processes (15L)

Upstream, Fermentation and Downstream Processing for the following:

I. Antibiotics (Rifamycin)
II. Microbial enzymes (Chitinase)
III. Exopolysaccharides (Pullulan)
IV. Use of immobilized cells / enzymes to produce protease

UNIT 4: Principles of Validation Process / Method Validation and IPR (15L)

a. The concept of ISO Certification.
b. Preparation of SOPs
c. Validation protocols for methods in:
   i.Quality Control
   ii. Process validation

The above should be discussed within WHO Norms.

Exercises on preparation of SOPs, operation and validation for analytical methods.

Intellectual Property Rights (IPR):

i. Basic concepts of IPR-

ii. Introduction to forms of IPR – Patents and Designs (Types of IP: Patent, Trademark,Copyright and Related Right)

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2. Doran Pauline (1995) Bioprocess Engineering Principles, Academic Press.
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9. Peppler H. J. and D. Perlman (1970) Microbial Technology Volume 1 and 2, AcademicPress New York.

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14. Supplementary Training Modules on Good Manufacturing Practice. Validation WHOTechnical Report Series, No.937, 2006, Annex 4.
15. The FDA's draft process validation Guidance A perspective from industry. By NaulaCalnan, Alice Redmond and Stan O' Neill. Process Validation Guidance

Mapping of Program Outcomes with Course Outcomes

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3				3				
CO 2	3	2							
CO 3	2	2							2
CO 4	3					3			
CO 5									3
CO 6						2			

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Students will demonstrate different design of bioreactor and process variables.
CO2: Students will develop a deep understanding of the principle of sterilization necessory for fermentation.
CO3: Students will able to study the cell growth and product formation.
CO4: Students will evaluate the kinetics and mechanisms of microbial growth.

PO2: Critical Thinking and Problem Solving
CO2: Students will gain knowledge of significance and activities of microorganisms.
CO3: Students will apply their knowledge in different designs of bioreactor and process variables.

PO5: Trans-disciplinary Knowledge
CO1: Students will learn about the different types of fermentation processes, equipment, used and microbial process involved.

PO6: Personal and Professional Competence
CO6: Students will demonstrate the ability of profiency in techiques used for microbial

isolation, cultivation, and maintenance in laboratory settings.
CO4: Students will understand the fundamental principles of microbial technology, including microbial physiology, genetics, and metabolism.

PO9: Self-directed and Life-long Learning
CO5: Students will identify and classify different types of microorganisms and understand their roles in various industrial processes.
CO3: To comprehensive understanding of the different design of bioreactor and process variables.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: **PSMB244 (A)**
Paper: IV (A)
Title of Paper: Medical Microbiology
Credit: 4
No. of lectures: 60

Course Objective:

1. Provide students with a comprehensive grasp of the fundamental principles of medical microbiology, encompassing the identification, pathogenesis, and epidemiology of microorganisms causing human diseases.
2. Introduce students to the techniques and methodologies employed in the laboratory diagnosis and management of infectious diseases.
3. Explore the interactions between microorganisms and the human immune system, encompassing host defense mechanisms and immune responses to microbial pathogens.
4. Develop students' knowledge of antimicrobial agents, their mechanisms of action, and the principles of antimicrobial susceptibility testing.
5. To foster critical thinking and problem-solving abilities in the context of medical microbiology, including the interpretation of clinical microbiology laboratory resultsand the selection of appropriate antimicrobial therapy.
6. To promote an understanding of the public health aspects of infectious diseases, including outbreak investigation, disease surveillance, and infection control measures.
7. To enhance student's awareness of emerging and re-emerging infectious diseases, global health challenges, and the impact of microbial resistance on public health.

Course Outcome:

CO1. Identify microorganisms associated with human diseases, understand their epidemiology and modes of transmission.
CO2. Understand the principles and techniques used in the laboratory diagnosis of infectious diseases, including specimen collection, culture, identification, and antimicrobial susceptibility testing.
CO3. Analyze and interpret clinical microbiology laboratory results, including microbial growth patterns, biochemical tests, and molecular diagnostic methods.
CO4. Understand the principles of microbial pathogenesis, including mechanisms of virulence and host-pathogen interactions.
CO5. Explain the mechanisms of action and resistance of antimicrobial agents, and apply knowledge to guide appropriate antimicrobial therapy.
CO6. Students will able to learnmultidrug resistance in bacterial pathogens
CO7. Develop critical thinking skills in the analysis of scientific literature related to medical microbiology.

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CONTENTS:

UNIT 1 & 2: Determinants of Microbial Pathogenicity (30L)

a.Adhesion and Colonization
b. Invasion
c. Evasion
d.Toxin
e. Toxigenesis (mode of action and in vitro and in vivo assay systems for diphtheria, cholera, tetanus toxins and endotoxins of Gram-negative bacteria)
f. Bacterial resistance to host defences: phagocytosis, nonspecific and specific humoral factors
g. Microbial Pathogenicity and host immune response.
h. Molecular basis of bacterial pathogenicity – cytoskeletal modulation of host cell, virulence genes and pathogenicity islands.

UNIT 3: Clinical Microbiology (15L)

Epidemiological and investigational approaches for emerging infectious diseases:
General properties, cultivation, interferon and interference of virus

A. Viral diseases:
   a) SARS (severe acute respiratory syndrome).
   b) Avian and Swine influenza
   c) COVID-19

B. Diseases by multi-drug resistant bacterial pathogens:
   a) Mechanisms of development of drug resistance
   b) Vancomycin resistant Enterococci (VRE),
   c) Methicillin resistant Staphylococcus aureus (MRSA),
   d) Vancomycin resistant Staphylococcus aureus (VRSA),
   e) Isoniazid and rifampin resistant Tuberculosis (MDR-TB)

C. Chemotherapy
   a) General Consideration.
   b) Anticancer drug
   c) Immunosuppressant

UNIT 4: Clinical evaluation of anti-infective. (15L)

A. Methods to quantify growth / inhibition and metabolic changes in microbial population on exposure to anti-infective, for evaluation of anti-infective activity and developing insight in its mode of action:

1. Direct counts (Counting chambers, calibrated smears and proportionate counts).
2. Tubidometry and nephalometry,
3. Electrical Resistance, Electrical impendence.
4. Microcalorimetry.
5. Flow cytometry and
6. Radiometric methods
7. Radiolabelling techniques

B. Laboratory methods to assess activity of antimicrobial combinations (antagonism, Synergism, and addictive effect)

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Text / Reference Books:

1. Babych E. M., Ryzhkova T. A., Kalinichenko S. V. and Sklyar N. I., (2008), General Characteristic of the methods for detection of diphtheria toxin, Annals of Mechnikov Institute, 19-21 (www.imiamn.org/journal.htm)
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14. Lorian V., (1986), Antibiotics in laboratory medicine, 2nd Ed, Williams & Wilkins Publication
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16. Vyas S. P and Dixit V. R. (2002), Pharmaceutical Biotechnology, CBS Publishers and Distributors, New Delhi.

Mapping of Program Outcomes with Course Outcomes

Weightage: 1=weakorlowrelation,2=moderateorpartialrelation,3=strongordirectrelation

	Programme Outcomes(POs)								
Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2	2		2						
CO3		2	3	3		2			
CO4				2					
CO5		3		2	3				
CO6		2		1			2		2

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CO7			1			2	3		2

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students will be able to comprehend and demonstrate proficiency in laboratory techniques utilized for the identification and characterization of microorganisms.
CO2: Students will understand the mechanisms through which microorganisms cause diseases in humans and demonstrate an understanding of host-pathogen interactions.

PO2: Critical Thinking and Problem Solving

CO3: Students will apply their understanding of the epidemiology of infectious diseases, including transmission modes and risk factors, and discuss the role of medical microbiology in public health and disease prevention.
CO5: Students will correlate microbiological concepts with the clinical manifestations of infectious diseases.
CO6: Students will apply critical thinking skills in the analysis of scientific literature related to medical microbiology.

PO3: Social Competence

CO2: Students will explore and understand host-pathogen interactions and the immune response to microbial infections.
CO3: Students will learn to analyze the epidemiology of infectious diseases, including transmission modes and risk factors.
CO7: Students will demonstrate awareness of ethical considerations in the practice of medical microbiology and understand the importance of professional conduct and communication in healthcare settings.

PO4: Research-related Skills and Scientific Temper

CO3: Students will comprehend and discuss the role of medical microbiology in public health and disease prevention.
CO4: Students will apply their knowledge of the action of antimicrobial agents and understand the development of antimicrobial resistance and its implications for treatment.
CO5: Students will comprehend the knowledge of microbiological concepts with clinical manifestations of infectious diseases.
CO6: Students will develop critical thinking skills in the analysis of scientific literature related to medical microbiology.

PO5: Trans-disciplinary Knowledge

CO5: Students will demonstrate control in correlating microbiological concepts with clinical manifestations of infectious diseases and apply this knowledge to the diagnosis and management of infectious diseases in a clinical setting.

PO6: Personal and Professional Competence

CO3: Students will showcase proficiency in interpreting knowledge and discussing the role of medical microbiology in public health and disease prevention.
CO7: Students will showcase their capacity for interpretation skills by demonstrating awareness of ethical considerations in the practice of medical microbiology and understanding the importance of professional conduct and communication in healthcare settings.

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PO7: Self-directed and Life-long Learning
CO6: Students will acquire the skill of learning and develop critical thinking skills in the analysis of scientific literature related to medical microbiology.
CO7: Students will develop the ability to communicate microbiological concepts effectively through written and oral presentations.

PO9: Self-directed and Life-long Learning
CO6: Students will develop skills in learning and developing critical thinking skills in the analysis of scientific literature related to medical microbiology.
CO7: Students will acquire proficiency in awareness of ethical considerations in the practice of medical microbiology and understand the importance of professional conduct and communication in healthcare settings.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: **PSMB244 (B)**
Paper: IV (B)
Title of Paper: Mathematics for Biological Science
Credit: 4
No. of lectures: 60

Course Objective: By the conclusion of this course, The students will

- The students will develop basic knowledge of mathematics as applied to biological phenomenon.
- The students will develop basic knowledge of linear function.
- The students will develop basic knowledge of exponential function.
- The students will develop basic knowledge of power function.

Course Outcome:

By the conclusion of this course, the students clearly -

CO1. Have developed basic knowledge of mathematics as applied to biological phenomenon.
CO2. Have developed basic knowledge of linear function.
CO3. Have developed basic knowledge of exponential function.
CO4. Have developed basic knowledge of power function.

UNIT 1: Functions **(15L)**

- Real number system
- Sets and their representation
- Graphical representation of function
- Word problems

UNIT 2: Linear function **(15L)**

- Dependant and Independent variables
- Slope of straight line
- Straight line with different slope
- Straight line with zero slope
- Slope of vertical line
- Problem based on slope
- Equation of straight line
- Problem based on linear function

UNIT 3: Exponential function **(15L)**

- Review of logarithm
- Inverse function and logarithm
- Exponential growth and Decay
- Natural log and exponential
- Semi-log plots

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UNIT 4: Power function **(15L)**

- Review of power function
- Study of power function with help of centrifugation

Text / Reference Books:

1. Biology by Numbers: An Encouragement to Quantitative Thinkingby Richard F. Burton, 1998
2. Nonlinear Dynamics, Mathematical Biology, And Social Science: Wise Use of Alternative Therapies (Santa Fe Institute Series)by Joshua M. Epstein, 1997
3. Mathematics for Biologists, 2011Arun Kumar
4. Easy Mathematics for BiologistsBy Peter C. Foster, 1998

Mapping of Program Outcomes with Course Outcomes

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	3		2					
CO 2	3				2				
CO 3	3				2				
CO 4	3				2				

Justification for the mapping

1. Disciplinary Knowledge:

CO1: By developing basic knowledge of mathematics as applied to biological phenomena, students gain a solid foundation for quantitative analysis and research in the life sciences. These mathematical skills enable them to address research questions, analyze biological data, and contribute to a deeper understanding of biological processes.

CO2: Acquiring basic knowledge of linear functions equips students with a versatile mathematical tool that can be applied across diverse fields. This foundational knowledge not only strengthens their mathematical skills but also enhances their problem-solving abilities and analytical thinking, making it a valuable asset in their academic and professional pursuits.

CO3: Acquiring basic knowledge of exponential functions equips students with a versatile mathematical tool that has practical applications across a wide range of disciplines. This foundational knowledge enhances their problem-solving skills, analytical thinking, and ability to model and understand complex natural and practical phenomena.

CO4: Acquiring basic knowledge of power functions equips students with a mathematical tool that has versatile applications in modeling and understanding relationships in various disciplines. This foundational knowledge enhances their problem-solving skills, analytical thinking, and ability to describe and interpret the behavior of systems and phenomena.

2. Critical Thinking and Problem solving:

CO1: By developing basic knowledge of mathematics as applied to biological phenomena, students gain a solid foundation for quantitative analysis and research in the life sciences. These mathematical skills enable them to address research questions, analyze biological data, and contribute to a deeper understanding of biological processes.

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4. Research-related skills and Scientific temper:
CO1: By developing basic knowledge of mathematics as applied to biological phenomena, students gain a solid foundation for quantitative analysis and research in the life sciences. These mathematical skills enable them to address research questions, analyze biological data, and contribute to a deeper understanding of biological processes.

5. Trans-disciplinary knowledge:
CO2: Developing basic knowledge of linear functions is a foundational mathematical skill that transcends disciplinary boundaries and finds applications in various fields and disciplines such as physics, environmental science, computer science, microbiology, medicine, healthcare, etc.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: **PSMB245**
Paper: V
Title of Paper: Dissertation I
Credit: 4
No. of lectures: 60

Course Objectives:

- To introduce the concepts of application and research in Microbiology
- To inculcate sense of scientific responsibilities
- To provide an understanding of the fundamental principles and concepts of research methodology.
- To develop critical thinking skills necessary for designing and conducting research studies.
- To familiarize students with different research methods and techniques used in various disciplines.
- To enable students to evaluate and critique research studies published in academic journals.
- To enhance students' skills in data collection, analysis, and interpretation.
- To promote ethical conduct in research and emphasize the importance of research integrity.
- To encourage students to communicate research findings effectively through written and oral presentations.
- To cultivate a research mindset and instill the importance of lifelong learning in the field of research.

Course Outcome:

- Understand the research process, including the formulation of research questions, hypotheses, and objectives.
- Identify appropriate research designs and methods based on the research questions and objectives.
- Critically evaluate and select relevant literature for conducting a comprehensive literature review.
- Develop research proposals that outline the research design, methodology, and ethical considerations.
- Apply various data collection techniques, such as surveys, interviews, experiments, and observations.
- Analyze and interpret quantitative and qualitative data using appropriate statistical and analytical methods.
- Effectively communicate research findings through written reports and oral presentations.
- Demonstrate ethical conduct in research by adhering to guidelines for responsible research practices. Critique and evaluate research studies published in academic journals, identifying strengths and limitations.
- Develop a research mindset and understand the importance of continuous learning in the field of research.
- Students will able to Understand philosophy and ethics of research
- Students should be able to write research proposal.

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CONTENTS:

1. A dissertation can be carried out by a single student or by group of students where the group should not contain more than four students. The dissertation report will be prepared as per the thesis format. Submission of the dissertation report will be at least three days before the date of examination. One copy of the report will be preserved in the department. If there is more than one student carrying out a single dissertation, a single report can be submitted and these students will be assessed based on single oral presentation. In such case, presentation should be carried out by all the students carrying out the same work; dividing the presentation equally among them.
2. At the time of presentation, the external and internal examiners appointed by the university will be present; the dissertation guide may or may not be present.
3. Presentation should be carried out to an audience comprising of examiners appointed by the university, departmental teaching staff and the postgraduate students of the department. Oral presentation can be carried out using posters, blackboard, transparencies, model or LCD projector. The allotted time for each oral presentation (one project) should be 10 to 12 minutes, followed by question-answer session of 5 to 8 minutes. The audience can participate in this session.
4. The assessment of the dissertation I is for total of 100 marks, out of which the end-semester - will be for 60 marks and the in-semester assessment will be for 40 marks.
5. The assessment of in-semester examination will be carried out by the guide who has supervised the work of the candidate(s) throughout the semester. The assessment will be carried out on the basis of the points, as per the accompanied format. Head of the department should communicate this point wise assessment system to the dissertation supervisor (Guide), well in advance. Guide will give appropriate marks, point-wise and submit it in a sealed envelope to the Head of the respective department, three days prior to examination and project presentation. On the day of examination, Head of the department will hand over these unopened envelopes to the examiners.

Points for Evaluation	**Max. Marks**	**Evaluation**
Intellectual potential – Understanding of the research problem by the student	4	
Research aptitude – 1. Depth of literature survey for the proposed work. 2. Inputs of student in development of plans and protocols for the experimentation 3. Ability to analyze data and formulate a solution 4. Analytical and reasoning abilities of the student for interpretation of data, inputs in discussion	 4 8 4 6	
Motivation – punctuality, meeting dead-lines and seriousness	2	

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Ability to work with others	2	
Maturity of scientific thoughts	2	
Communication skill – oral and written	8	
Total	**40**	

6. Assessment of end-semester examination will be carried out (i.e., oral presentation) for individual student at the time of examination jointly by internal and external examiners. The assessment will be carried out on the basis of the points as per the accompanied format.

Points for Evaluation	**Max. Marks**	**Evaluation**
Proficiency of presentation skills – use of audio-visual aids, preparation of graphs, charts, models, etc., use of scientific language	24	
Quality of the work, results and interpretation, outcome of the study and possible future plans, publication potential of the work	12	
Submission of progress reports, the dissertation report preparation (scientific writing) and its contents	18	
Abilities of satisfactory responses to the queries from the audience	6	
Total	**60**	

7. Students should be made aware of the assessment parameters, on which they will be assessed at the end of the fourth semester.

8. The external and internal examiners by mutual agreement will appropriately settle the marks given by the guide (reconsider, if necessary) and marks of oral presentation.

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Mapping of Program Outcomes with Course Outcomes

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1		3		3					
CO 2		3		3					
CO 3		3		3					
CO 4		3		3					
CO 5		3		3					
CO 6		3		3					
CO 7		3		3					
CO 8		3		3			2		
CO 9		3		3					2
CO 10		3		3					
CO 11		3		3					

Justification for the mapping

2. Critical Thinking and Problem solving:
CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11: Critical thinking and problem-solving skills are vital when undertaking a dissertation. A dissertation is a substantial piece of independent research that demands a high level of critical thinking, analysis, and problem-solving. These skills not only contribute to the successful completion of the dissertation but also prepare students for future academic and professional endeavors.

4. Research-related skills and Scientific temper:
CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11: Engaging in dissertation work requires a strong foundation in research-related skills and the cultivation of a scientific temper. These skills and temper are essential for planning, conducting, and completing a rigorous and independent research project like a dissertation.

7. Effective Citizenship and Ethics:
CO8: By demonstrating ethical conduct in their own research and critically evaluating published studies while adhering to ethical guidelines, students contribute to the responsible and ethical practice of research in their academic and professional communities. These principles are essential for maintaining the integrity and trustworthiness of scientific and scholarly work.

9. Self-directed and Life-long learning:
CO9: By fostering a research mindset and embracing the importance of continuous learning, student position themself to make meaningful contributions to their field and adapt to the evolving landscape of research. This approach supports self-directed and lifelong learning while helping them maintain a fresh and innovative perspective in their research endeavors.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-2024

Class: M. Sc. II (Semester- IV)
Paper Code: **PSMB246**
Paper: VI
Title of Paper: Dissertation II
Credit: 4
No. of lectures: 60

Course Objectives:

- To introduce the concepts of application and research in Microbiology
- To inculcate sense of scientific responsibilities
- To provide an understanding of the fundamental principles and concepts of research methodology.
- To develop critical thinking skills necessary for designing and conducting research studies.
- To familiarize students with different research methods and techniques used in various disciplines.
- To enable students to evaluate and critique research studies published in academic journals.
- To enhance students' skills in data collection, analysis, and interpretation.
- To promote ethical conduct in research and emphasize the importance of research integrity.
- To encourage students to communicate research findings effectively through written and oral presentations.
- To cultivate a research mindset and instill the importance of lifelong learning in the field of research.

Course Outcome:

- Understand the research process, including the formulation of research questions, hypotheses, and objectives.
- Identify appropriate research designs and methods based on the research questions and objectives.
- Critically evaluate and select relevant literature for conducting a comprehensive literature review.
- Develop research proposals that outline the research design, methodology, and ethical considerations.
- Apply various data collection techniques, such as surveys, interviews, experiments, and observations.
- Analyze and interpret quantitative and qualitative data using appropriate statistical and analytical methods.
- Effectively communicate research findings through written reports and oral presentations.
- Demonstrate ethical conduct in research by adhering to guidelines for responsible research practices.Critique and evaluate research studies published in academic journals, identifying strengths and limitations.
- Develop a research mindset and understand the importance of continuous learning in the field of research.
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CONTENTS:

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Points for Evaluation	**Max. Marks**	**Evaluation**
Intellectual potential – Understanding of the research problem by the student	4	
Research aptitude – 1. Depth of literature survey for the proposed work. 2. Inputs of student in development of plans and protocols for the experimentation 3. Ability to analyze data and formulate a solution 4. Analytical and reasoning abilities of the student for interpretation of data, inputs in discussion	 4 8 4 6	
Motivation – punctuality, meeting dead-lines and seriousness	2	

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Ability to work with others	2	
Maturity of scientific thoughts	2	
Communication skill – oral and written	8	
Total	**40**	

6. Assessment of end-semester examination will be carried out (i.e., oral presentation) for individual student at the time of examination jointly by internal and external examiners. The assessment will be carried out on the basis of the points as per the accompanied format.

Points for Evaluation	**Max. Marks**	**Evaluation**
Proficiency of presentation skills – use of audio-visual aids, preparation of graphs, charts, models, etc., use of scientific language	24	
Quality of the work, results and interpretation, outcome of the study and possible future plans, publication potential of the work	12	
Submission of progress reports, the dissertation report preparation (scientific writing) and its contents	18	
Abilities of satisfactory responses to the queries from the audience	6	
Total	**60**	

7. Students should be made aware of the assessment parameters, on which they will be assessed at the end of the fourth semester.

8. The external and internal examiners by mutual agreement will appropriately settle the marks given by the guide (reconsider, if necessary) and marks of oral presentation.

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Mapping of Program Outcomes with Course Outcomes

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Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1		3		3					
CO 2		3		3					
CO 3		3		3					
CO 4		3		3					
CO 5		3		3					
CO 6		3		3					
CO 7		3		3					
CO 8		3		3			2		
CO 9		3		3					2
CO 10		3		3					
CO 11		3		3					

Justification for the mapping

2. Critical Thinking and Problem solving:
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CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11: Engaging in dissertation work requires a strong foundation in research-related skills and the cultivation of a scientific temper. These skills and temper are essential for planning, conducting, and completing a rigorous and independent research project like a dissertation.

7. Effective Citizenship and Ethics:
CO8: By demonstrating ethical conduct in their own research and critically evaluating published studies while adhering to ethical guidelines, students contribute to the responsible and ethical practice of research in their academic and professional communities. These principles are essential for maintaining the integrity and trustworthiness of scientific and scholarly work.

9. Self-directed and Life-long learning:
CO9: By fostering a research mindset and embracing the importance of continuous learning, student position themself to make meaningful contributions to their field and adapt to the evolving landscape of research. This approach supports self-directed and lifelong learning while helping them maintain a fresh and innovative perspective in their research endeavors.

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SYLLABUS (CBCS) FOR M.Sc. II. Microbiology
(w. e. from June, 2023)
Academic Year 2023-24

Class: M. Sc. II (Semester- IV)
Paper Code: SD24
Title of Paper: Skill Development II
Credit: 2
No. of lectures: 30

Course Objectives:

- To inculcate sense of scientific responsibilities and social and environment awareness
- To help student's build-up a progressive and successful career
- To gain knowledge about the design, construction, and operation of instrumentation systems.
- To understand the importance of calibration, accuracy, and reliability in instrumentation.
- To explore the emerging trends and advancements in instrumentation technology.
- To allow students to understand about various separation and analytical techniques.

Course Outcome:

CO1. Understanding of the importance of calibration and the ability to calibrate instruments Accurately.
CO2. Ability to evaluate the accuracy, precision, and reliability of measurement systems.
CO3. Familiarity with the ethical and safety considerations associated with instrumentation practices.
CO4. Awareness of the latest advancements and emerging trends in instrumentation technology.
CO5. The student should be able to apply the knowledge regarding various separation techniques while purifying a biomolecule.
CO6. The student should be able to apply the knowledge regarding various analytical techniques while analysing purified biomolecule.

Unit 1: High Performance Liquid Chromatography (HPLC) (15L)

Fundamentals and Principles of HighPerformance Liquid Chromatography (HPLC), Instrumentation, Types of HPLC–Normal phase HPLC, Reverse Phase HPLC, Ion Exchange Chromatography (IEC), Size exclusion chromatography, Mobile phases, Sample preparation, Handson training

Unit 2: Gas Chromatography (GC) (15L)

Fundamentals and Principles of Gas Chromatography (GC), Instrumentation, Sample preparation,Mobile phases, Injectors, GC columns, GC detectorsHands-on training

Text / Reference Books:

1. Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth
2. edition, W. H. Freeman & Co. New York
3. Wilson Keith and Walker John (2005) Principles and Techniques of Biochemistry and
4. Molecular Biology, 6th Ed. Cambridge University Press, New York.

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5. Palmer Trevor (2001) Enzymes: Biochemistry, Biotechnology and Clinical chemistry,
6. Horwood Pub. Co. Chinchester, England.
7. Segel Irvin H. (1997) Biochemical Calculations 2nd Ed., John Wiley and Sons, New York

Mapping of Program Outcomes with Course Outcomes

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	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3	2	2	2				
CO2	2			2					
CO3	2								
CO4									
CO5				2					
CO6									

Justification for the mapping

1. Disciplinary Knowledge:

CO3: Many chromatography methods involve sophisticated instruments. Students learn how to operate and maintain these instruments, which is a valuable skill in both academic and industrial settings.

CO2: Students learn how to operate and maintain these instruments, which is a valuable skill in both academic and industrial setting

2. Critical Thinking and Problem solving:

CO1: Chromatography often involves troubleshooting to optimize separation conditions. Students gain problem-solving skills as they adjust parameters and overcome challenges in achieving desired results

3. Social competence:

CO 1: This knowledge is crucial for students to contribute to advancements in healthcare and the pharmaceutical industry.

4. Research-related skills and Scientific temper:

CO 1: Chromatography is a fundamental laboratory technique used in various fields of research.

CO2: Learning the principles and practical aspects of chromatography equips students with valuable laboratory skills, including sample preparation, instrument operation, and data interpretation

CO5: Understanding chromatography can open doors to research opportunities in fields like chemical analysis, environmental monitoring, and drug development.

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Students can engage in research projects and gain practical experience.

5. Trans-disciplinary knowledge

CO1: Students gain interdisciplinary knowledge, making them adaptable and versatile in their scientific careers.

6. Personal and professional competence:

CO5 AND CO6: As students gain proficiency in chromatography, they enhance their professional development, making them competitive candidates for jobs

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