MASTER OF SCIENCE (MICROBIOLOGY)

VISION

To produce intellectual mind and professionals through innovative research and inventions for the enhancement of society.

MISSION

- To establish overall competence among the students by inculcating energetic thinking and positive spirit.
- To cultivate knowledge, skills, values and confidence for the students excellence through research in their area of expertise or interest.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To provide the students with subject proficiency, environmental awareness, ethical codes and guidelines, along with life education for a successful professional career.

PEO2: To inculcate the student's professional competencies and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and related to life science.

PEO3: To train students with good technical skills in research to comprehend, analyze, design, novel products and to give solutions for the real life problems.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO1: Acquire and apply specialized skills and knowledge relevant to the needs of the society.

PO2: Develop the skills in handling instruments, planning and performing experiments to meet desired needs within realistic constraints through domain knowledge.

PO3: Expand a modern and scientific outlook with respect to science subjects and apply in all aspects of life.

PO4: Apply modern tools and technologies for sustainable development and welfare of the society.

PO5: Create and develop eco-friendly environment and microbial products through innovative research ideas.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

PSO1: Recall the fundamentals of microbiology which would enable them to comprehend the emerging and advanced scientific concepts in life sciences.

PSO2: Apply the acquired conceptual knowledge by connecting interdisciplinary aspects of microbiology.

PSO3: Evaluate the need and impact of scientific solutions on the environment for the betterment of society.

PSO4: Analyze the technical knowledge in microbiology for research and lifelong learning.

PSO5: Create and develop the employable, entrepreneur and socially responsible citizens.

REGULATIONS

ELIGIBILITY

Candidate who has passed the B.Sc., degree in any Life sciences [Microbiology/ Applied Microbiology / Industrial Microbiology/ Botany / Plant Sciences and Plant Biotechnology/ Zoology /Animal Science/Applied Animal Science and Animal Biotechnology/Biochemistry /Bioinformatics /Biology / Food Science & Nutrition/ Nutrition and Dietetics / B.Sc. Medical Lab Technology / BSMS/ BAMS/ BUMS/ Chemistry with Botany / Zoology] as Allied Subjects of this University or an Examination of any other University accepted by the Syndicate as equivalent there to shall be eligible for admission to M.Sc. Degree Course in Microbiology.

Candidate shall be admitted to the examination only if he / she has taken the qualifying degree in Science / Medical subjects as mentioned after having completed the prescribed courses consisting of twelve years of study and has passed the qualifying examination.

DURATION OF PROGRAMME

M.Sc., Microbiology is a two years program which comprised of four semesters.

MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

SCHEME OF EXAMINATION

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
FIRST SEMESTER							
Part A							
24PMBM101	DSC I: General Microbiology and Microbial Diversity	5	3	25	75	100	5
24PMBM102	DSC II: Immunology	5	3	25	75	100	5
24PMBM103	DSC III: Microbial Genetics	5	3	25	75	100	5
24PMBM104	DSC IV: Microbial Biochemistry and Physiology	5	3	25	75	100	4
24PMBM105	DSC V: Forensic Science	4	3	25	75	100	3
24PMBMP101	DSC Practical I	6	9	40	60	100	4
	Total	**30**				**600**	**26**
SECOND SEMESTER							
Part A							
24PMBM201	DSC VI: Medical Bacteriology and Mycology	6	3	25	75	100	5
24PMBM202	DSC VII: Medical Virology and Parasitology	5	3	25	75	100	4
24PMBEL201/ 24PMBEL202/ 24PMBEL203	DSE I	4	3	25	75	100	4
24PMBMP201	DSC Practical II	6	9	40	60	100	4
24PLS201	AEC I: Career Competency Skills – I	1	-	100	-	100	1
Optional Subjects							
24PBCMBI201/ 24PBTMBI201	MDC I: Diagnostic Biochemistry/ Plant Tissue Culture Technology	3	3	25	75	100	2
24PBCMBIP201/	MDC Practical I:	3	3	40	60	100	2

24PBTMBIP201	Diagnostic Biochemistry/ Plant Tissue Culture Technology						
Part B							
24PVE201	VAC : Human Rights	2	3	25	75	100	2
	Total	**30**				**800**	**24**
THIRD SEMESTER							
Part A							
24PMBM301	DSC VIII: Soil and Environmental Microbiology	4	3	25	75	100	4
24PMBM302	DSC IX: Research Methodology, Bioethics and IPR	4	3	25	75	100	3
24PMBM303	DSC X: Biostatistics	4	3	25	75	100	3
24PMBEL301/ 24PMBEL302/ 24PMBEL303	DSE II	4	3	25	75	100	4
24PMBMP301	DSC Practical III	5	9	40	60	100	4
24PMBMP302	DSC Practical IV: Statistical Software	2	3	40	60	100	2
24PMBI301	Summer Internship Training (100% Internal Evaluation)	-	-	100	-	100	2
24PLS301	AEC II: Career Competency Skills - II	1	-	100	-	100	1
Optional Subjects							
24PBCMBI301/ 24PBTMBI301	MDC II: Pharmaceutical Biochemistry/Animal Cell Culture Technology	3	3	25	75	100	2
24PBCMBIP301/ 24PBTMBIP301	MDC Practical II: Pharmaceutical Biochemistry/Animal Cell Culture Technology	3	3	40	60	100	2
	Total	**30**				**1000**	**27**
FOURTH SEMESTER							
Part A							

24PMBM401	DSC XI: Industrial Microbiology	5	3	25	75	100	5
24PMBM402	DSC XII: Food and Dairy Microbiology	5	3	25	75	100	4
24PMBPR401	Project and Viva voce	6	3	40	60	100	6
	Total	**16**				**300**	**16**
Grand Total						**2700**	**92**

Discipline Specific Elective Subjects (DSE) - I

Students shall choose any one of the following subjects as DSE from the following courses in the second semester

S.No.	Course Code	Course Name
1.	24PMBEL201	DSE I: Bioremediation
2.	24PMBEL202	DSE I: Bioinformatics
3.	24PMBEL203	DSE I: Cell Biology

Discipline Specific Elective Subjects (DSE) - II

Students shall choose any one of the following subjects as DSE from the following courses in the third semester

S.No.	Course Code	Course Name
1.	24PMBEL301	DSE II: Recombinant DNA Technology
2.	24PMBEL302	DSE II: Nanotechnology
3.	24PMBEL303	DSE II: Marine Microbiology

Additional Credit Course (ACC): Students may choose any course as ACC from MOOC course offered in SWAYAM/NPTEL/CEC, etc. Additional 4 credits as per course will be given on completion with certificate.

Mutidisciplinary Courses (MDC) offered by the Department

S.No.	Subject Code	Subject	Offered for the students of	Instruction Hours
SEMESTER II				
1.	24PMBBTI201/ 24PMBBCI201	MDC I: Clinical Microbiology	M.Sc., Biotechnology & Biochemistry	3
2.	24PMBBTIP201/ 24PMBBCIP201	MDC Practical I: Clinical Microbiology	M.Sc., Biotechnology & Biochemistry	3
SEMESTER III				
3.	24PMBBTI301/ 24PMBBCI301	MDC II: Industrial Microbiology	M.Sc., Biotechnology & Biochemistry	3
4.	24PMBBTIP301/ 24PMBBCIP301	MDC Practical II: Industrial Microbiology	M.Sc., Biotechnology & Biochemistry	3

FOR COURSE COMPLETION

Student shall complete:

- Two DSE subjects in II and III semester.
- Two MDC in II and III semester.
- Human Rights as value education in II semester.
- Internship in III semester.
- Project & Viva-Voce at the end of IV semester.

ABBREVATION

DSC : Discipline Specific Course

DSE : Discipline Specific Elective Course

SEC : Skill Enhancement Course

MDC : Multi -Disciplinary Course

VAC : Value Added Course

AEC : Ability Enhancement Course

ACC : Additional Credit Course

S.No.	COMPONENTS	MARKS	CREDITS	CUMULATIVE CREDITS
PART A				
1.	DSC	12×100=1200	5×5=25 4×4=16 3×3=09	91
2.	DSE	2×100=200	2×4=08	
3.	DSC Practical	4×100=400	3×4=12 1×2=02	
4.	MDC Theory	2×100=200	2×2=04	
5.	MDC Practical	2×100=200	2×2=04	
6.	Project &Viva -Voce	1×100=100	1×6=06	
7.	Summer Internship	1×100=100	1×2=02	
8.	AEC	2×100=200	2×1=02	
PART B				
1.	VAC	1×100=100	1×2=02	02
	Total (27 courses)	**2700**	**-**	**92**

24PMBM101	**DSC I: GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY**	**SEMESTER I**

Course Objectives:

The course aims

- To learn the principles of different types of microscopes and their applications.
- To study the cell structure, microbial nutrition and growth.
- To acquire the knowledge about microbial media and sterilization.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**History and Scope of Microbiology:** Microscopy – Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.	10	CO1
II	**Bacterial Structure:** Properties and biosynthesis of cellular components, Cell wall. **Actinomycetes and Fungi** - Distribution, morphology, classification, reproduction and economic importance. Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.	10	CO2
III	**Algae**: Distribution, morphology, classification, reproduction and economic importance. Isolation of algae from soil and water. Media and methods used for culturing algae, Strain selection and large-scale cultivation. Life cycle - *Chlamydomonas*, *Nostoc* (Cyanobacteria)	10	CO3
IV	**Microbial techniques**: Safety guidelines in Microbiology Laboratories. Sterilization, Disinfection and its validation. Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms. Maintenance and preservation of pure cultures. Culture collection centres - National and International.	10	CO4
V	**Biodiversity**: Introduction to microbial biodiversity – Significance, characteristics and economic importance of	10	CO5

	Thermophiles, Methanogens, Alkaliphiles and Acidophiles, Barophiles, Halophiles. Conservation of Biodiversity.		

Text Books:

1. Kanunga R. (2022). Ananthanarayanan and Panicker's Text book of Microbiology. (12th Edition). Universities Press (India) Pvt. Ltd.
2. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. (2023). Microbiology. (5th Edition). Mc.Graw Hill. Inc, New York.
3. Prescott L. M., Harley J. P. and Klein D. A. (2022). Microbiology. (12th Edition). McGraw - Hill company, New York.
4. White D. Drummond J. and Fuqua C. (2011). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
5. Dubey R.C. and Maheshwari D. K. (2018). Textbook of Microbiology. S. Chand, Limited.

Reference Books:

1. Tortora G. J., Funke B. R. and Case C. L. (2015). Microbiology: An Introduction (12th Edition).Pearson, London, United Kingdom.
2. Webster J. and Weber R.W.S. (2007). Introduction to Fungi. (3rd Edition). Cambridge University Press, Cambridge.
3. Schaechter M. and Leaderberg J. (2004). The Desk encyclopedia of Microbiology. Elseiver Academic Press, California.
4. Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology. (2nd Edition). Books / Cole Thomson Learning, UK.
5. Madigan M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl (2018) Brock Biology of Microorganisms. (15th Edition). Pearson.

Web Resources

1. http://sciencenetlinks.com/tools/microbeworld
2. https://www.microbes.info/
3. https://www.asmscience.org/VisualLibrary
4. https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404
5. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Examine various microbes employing the microscopic techniques learnt. Measure and compare the size of microbes.
CO2	Differentiate and appreciate the anatomy of various microbes. Plan the growth of microbes for different environmental conditions.
CO3	Identify and cultivate the algae understanding their habitat. Analyze the morphology, classify and propagate depending on its economic importance.
CO4	Create aseptic conditions by following good laboratory practices.
CO5	Categorize and cultivate a variety of extremophiles following standard protocols for industrial applications.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	M	H	H	M	H	M
CO2	M	M	H	H	M	M	M	H	H	M
CO3	H	M	H	M	M	H	M	H	M	M
CO4	M	M	M	M	M	M	M	M	M	M
CO5	M	M	H	H	H	M	M	H	H	H
H – High; M- Medium; L - Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM102	DSC II: IMMUNOLOGY	SEMESTER I

Course Objectives:

The course aims

- To learn functions of immune system and their immune complexes.
- To understand the mechanisms of immune response and autoimmune disorders.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Historical perspective of Immunology:** Hematopoiesis – process and regulation, stromal cells, programmed cell death. Cells of the immune system – Organs of the immune system – primary and secondary lymphoid organs. Early theories and clonal selection theory. Innate immunity, acquired Immunity, humoral and cell mediated immunity.	10	CO1
II	**Antigens:** Factors influencing immunogenicity – epitopes, haptens and adjuvants. Immunoglobulins – basic structure and classes – Diversity. Monoclonal antibodies – production, formation and clinical uses. Antigen – Antibody reactions – agglutination, precipitation, complement fixation, immunofluorescence, ELISA and Radio Immunoassay.	10	CO2
III	**Antigen processing and Histocompatability complex:** Antigen processing cells, Processing of exogenous and endogenous antigens. Major Histocompatibility complex – structure and functions - Class I, Class II and Class III molecules. T – Cell receptor – structure, organization and maturation. Cytokines – Structure and functions.	10	CO3
IV	**Complement activation:** Classical, alternative and terminal complement pathways. Hypersensitive reactions – classification – IgE mediated (Type –I), antibody mediated cytotoxic (Type –II), immune complex mediated (Type III), TDTH - mediated (Type IV). Vaccines – active and passive immunization, Types of Vaccines – polysaccharide, toxoid and recombinant vaccines.	10	CO4
V	**Autoimmunity:** Organ specific autoimmune diseases – diseases mediated by direct cellular damage and stimulating or blocking antibodies- Hashimotus Thyrioditis, autoimmune anemia's, Grave's Disease, Myasthenia Gravis. Systemic	10	CO5

	autoimmune disease – Systemic lupus erythematosus. Transplantation immunology – Graft versus host reactions – Tumor immunology.		

Text Books:

1.	*Richard A Goldsby, Thomas J. Kindt, Barbara A Osborn and Janis Kuby.* 2022. **Immunology.** [Eighth Edition]. W. H. Freeman and Company, New York.
2.	*Tizard, K.* 2004.**Immunology–An Introduction**. Saunders College, Philadelphia.

Reference Books:

1.	*Ivan Roitt, Jonathan Brostolf and David Male.* 2017. **Immunology.** [13th Edition].Mosby Publications, Edinburg.
2.	*Abul Abbas.* 2021. **Cell and Molecular Immunology.** [Tenth Edition]. Saunders, USA.

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

CO1	Recall the basics concepts of immunology.
CO2	Analyze the knowledge of proteins for the detection and prevention of diseases.
CO3	Evaluate the regulatory mechanism of the body against foreign antigens.
CO4	Apply knowledge of immune system for vaccine production.
CO5	Formulate and develop anti-hypersensitivity drugs.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	M	H	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM103	DSC III: MICROBIAL GENETICS	SEMESTER I

Course Objectives:

The course aims

- To enable the students to understand the genetic organization of microbes.
- To impart the significant processes involving in microbial genetics.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Organization of prokaryotic and eukaryotic genome:** Nucleic acids- Structure of DNA, types of DNA, Chargaff rule and types of RNA. Transfer of genetic materials in prokaryotes: Transformation- competence and mechanism. Conjugation- the classical bacterial conjugation experiment - types of conjugation - conjugation in mapping the bacterial genome. Transduction – generalized and specialized transduction.	10	CO1
II	**DNA replication:** Semi-conservative mode of DNA replication- enzymology of DNA replication- Messelson and Stahl experiment- rolling circle replication- bidirectional replication. Transcription (Prokaryotes) - the basic mechanism of transcription- process of transcription- initiation- elongation and termination- Inhibitors of transcription- Post transcriptional modification of m-RNA- temporal control of transcription.	10	CO2
III	**Translation, expression and regulation:** Translation- the genetic code-mechanism of translation- initiation- elongaton- termination- inhibitors of translation. Post translational modifications. Gene regulation- General aspects of prokaryotic gene regulation –Operon concept- the *lac, trp, ara* and *Gal* operon. Eukaryotic gene regulation- regulatory strategies in Eukaryotes – gene alteration - regulation of synthesis of primary transcripts.	10	CO3
IV	**Mutation**: Types - somatic versus germ line mutation, morphological mutation, nutritional mutation, lethal mutations and conditional mutations. Molecular basis of mutation - Missense and nonsense mutations, spontaneous mutations, chemical mutagenesis, and radiation - induced mutations, silent mutations and reversions. Detection of mutants- replica plate	10	CO4

	and gradient plate method. Carcinogenicity test. DNA repair – Biological indication of repair - biochemical mechanisms for repair of thymine dimers- light and dark repair.		
V	**Recombination and plasmids**: General properties - types of plasmids and its derivatives. Transposable elements – definition - types of bacterial transposons - mechanism of transposition. Bacterial Artificial Chromosome and Yeast Artificial Chromosome. Genetic recombination- mechanism of general recombination -Holliday model, site specific recombination.	**10**	**CO5**
Text Books:			
1.	*David Freifelder* 2006. **Microbial Genetics.** CMC Press Pvt. Ltd., Kolkatta.		
2.	*Pradeep D Devkate* 2023**. A Text Book of Microbial Genetics.** Booksclinic publisher.		
Reference Books:			
1.	*Peter J Russel*. 2016. **IGenetics**. [Fifth edition]. Benjamin/Cummings., New York.		
2.	*Chaudhuri K* 2012. **Microbial Genetics**. [Sixth Edition]. The Energy and Resources Institute.		
3.	*Stanly R Maloy*. 2006 **Microbial Genetics.** [Second Edition]. Narosa publishing House, New Delhi.		

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

CO1	Recall the basics about prokaryotic and eukaryotic genome and DNA repair mechanisms.
CO2	Apply the genomic knowledge for the production of novel proteins.
CO3	Evaluate the regulation system of gene for various industrial products.
CO4	Explain about mutation and its types and apply for its detection.
CO5	Assess gene transfer mechanisms for production of novel products.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	H	H	H	M	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	H	H	H	H	M	H	H	H	H
CO4	M	H	M	M	M	M	H	M	M	M
CO5	M	H	H	H	H	M	H	H	H	H
H – High; M- Medium; L – Low										

Prepared By

(Course Coordinator)

Approved By

(BoS Chairman)

24PMBM104	DSC IV: MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY	SEMESTER I

Course Objectives:

The course aims

- To enable the students to aware about the role of biochemistry in microbial metabolism.
- To illustrate the various pathways involved in microbial metabolism.

Credits: 04 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Biomolecules:** Classification, structure and functions of carbohydrates-monosaccharides, disaccharides, polysaccharides (starch, cellulose, Pectin, hyaluronic acid). Protein - General structure, Properties, functions and classification. Lipids - General properties, functions, structure, classification (Simple, Derived and Complex).	10	CO1
II	**Enzymes:** Introduction, classification, properties and specificity of enzyme, recognition of enzymes- inhibiting agent. Coenzyme, isozyme, factors affecting enzyme activity- mechanism of enzyme action. Location of enzymes in the cell.	10	CO2
III	**Microbial growth:** Prokaryotic cell cycle (binary fusion). Growth curve– different phases of growth– kinetics of growth. Measurement of microbial growth– cell number, membrane filtration procedure and cell mass. Continuous culture– chemostat and turbidostat; Synchronous culture. Various factors affecting growth – physical and chemical.	10	CO3
IV	**Microbial metabolism:** Anabolism– photosynthesis– oxygenic and anoxygenic. Catabolic metabolism– The Embden-Meyerhof-Parnas pathway, The Enter- Doudoroff, Citric acid cycle, Electron transport chain. Anaerobic respiration and fermentation – lactic acid, propionic acid and alcohol.	10	CO4
V	**Protein and lipid metabolism:** protein metabolism- lysine pathway, serine pahway and arginine pathway. Lipid metabolism - ß oxidation of lipids. Integration of metabolic pathway.	10	CO5

Text Books:

1.	*Deb, A.C.* 2006. **Fundamentals of Biochemistry.** New Central Book Agencies Pvt.Ltd., Kolkatta.
2.	*Salle, A.J.* 2001.**Fundamental Principles of Bacteriology**. [Seventh Edition]. Tata Mc Graw-Hill, New Delhi.
Reference Books:	
1.	*Albert L. Lehninger., Michael M. Cox and David L. Nelson.* 2021. **Principles of Biochemistry**. [Fifth edition].W H Freeman & Co., New York.
2.	*Edward Alcamo.* 2013. **Fundamentals of Microbiology**. [Tenth Edition]. Jones &Bartlett Publishers, New York.
3.	*Hans G Schlegel.* 2003. **General Microbiology**. [Seventh Edition]. Cambridge University Press, UK.

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

CO1	Discuss the structure and importance of biomolecules.
CO2	Assess the role of mechanism and function of enzymes.
CO3	Apply the various parameters for microbial growth.
CO4	Design the important strategies for fermentation.
CO5	Evaluate the metabolism and biological role of proteins and lipids.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	H	H	H	M	M	H
CO2	M	M	M	H	H	H	M	M	H	H
CO3	M	H	H	H	M	M	H	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM105	DSC V: FORENSIC SCIENCE	SEMESTER I

Course Objectives:

The course aims

- To learn the tools and techniques in forensic science.
- To identify and examine body fluids for identification.
- To recognize medico legal post mortem procedures and their importance.

Credits: 03 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Forensic Science:** Definition, history and development of forensic science. Scope and need of forensic science in present scenario. Branches of forensic science. Tools and techniques of forensic science. Duties of a forensic scientist.	08	CO1
II	**Forensic Science Laboratories** : Organizational setup of a forensic science laboratory. Central and State level laboratories in India. Mobile forensic science laboratory and its functions. Forensic Microbiology - Types and identification of microbial organisms of forensic significance.	08	CO2
III	**Forensic Serology:** Definition, identification and examination of body fluids - blood, semen, saliva, sweat and urine. Forensic examination and identification of hair and fibre.	08	CO3
IV	**DNA Profiling:** Introduction, history of DNA typing. Extraction of DNA from blood samples - Organic and Inorganic extraction methods. DNA fingerprinting - RFLP, PCR, STR. DNA testing in disputed paternity.	08	CO4
V	**Forensic Toxicology :** Introduction and concept of forensic toxicology. Medico legal post mortem and their examination. Poisons - Types of poisons and their mode of action.	08	CO5

Text Books:

1.	Nanda B. B. and Tewari R. K. (2001) Forensic Science in India: A Vision for the Twenty First Century. Select Publishers, New Delhi. ISBN- 10:8190113526 / ISBN-13:9788190113526.
2.	James S. H. and Nordby, J. J. (2015) Forensic Science: An Introduction to Scientific and Investigative Techniques. (5th Edition). CRC Press. ISBN-10:9781439853832 / ISBN-13:978-1439853832.
3.	Li R. (2015) Forensic Biology. (2nd Edition). CRC Press, New York. ISBN-13:978-1-4398-8972-5.
Reference Books:	
1.	Nordby J. J. (2000). Dead Reckoning. The Art of Forensic Detection- CRC Press, New York. ISBN:0-8493-8122-3.
2.	Saferstein R. and Hall A. B. (2020). Forensic Science Hand book, Vol. I, (3rd Edition). CRC Press, New York. ISBN-10:1498720196.
3.	Lincoln, P.J. and Thomson, J. (1998). (2nd Edition). Forensic DNA Profiling Protocols. Vol. 98. Humana Press. ISBN: 978-0-89603-443-3.
4.	Val McDermid (2014). Forensics. (2nd Edition). ISBN 9780802125156.
5.	Vincent J. DiMaio., Dominick DiMaio. (2001). Forensic Pathology (2nd Edition). CRC Press.
Web resources	
1.	http://clsjournal.ascls.org/content/25/2/114
2.	https://www.ncbi.nlm.nih.gov/books/NBK234877/
3.	https://www.elsevier.com/books/microbial-forensics/budowle/978-0-12-382006-8
4.	https://www.researchgate.net/publication/289542469_Methods_in_microbial_forensics
5.	https://cisac.fsi.stanford.edu/events/microbial forensics

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Identify the scope and need of forensic science in the present scenario.
CO2	Plan for the organizational setup and functioning of forensic science laboratories.
CO3	Analyze the biological samples found at the crime scene.
CO4	Perform extraction and identification of DNA obtained from body fluids.
CO5	Discuss the concept of forensic toxicology.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	M	H	H	M	H	M
CO2	M	M	H	H	M	M	M	H	H	M
CO3	H	M	H	M	M	H	M	H	M	M
CO4	M	M	M	M	M	M	M	M	M	M
CO5	M	M	H	H	H	M	M	H	H	H
H – High; M- Medium; L – Low										

Prepared By

(Course Coordinator)

Approved By

(BoS Chairman)

24PMBMP101	**DSC PRACTICAL I**	**SEMESTER I**

Course Objectives

The course aims

- To learn the basic techniques of microbiology.
- To understand the morphological structures of bacteria.
- To perform DNA extraction and gene transfer mechanisms, analyze and identify by gel electrophoresis.

Credit: 04 **Total Hours: 60**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Measurement of bacterial cell size – Micrometry	**3**	**CO1**
2.	Pure culture techniques	**6**	**CO1**
3.	Motility – Hanging drop technique - Soft agar deeps	**3**	**CO1**
4.	Measurement of bacterial growth – Growth curve	**6**	**CO1**
5.	Simple staining, Capsular staining	**3**	**CO1**
6.	Gram staining, Endospore staining	**3**	**CO1**
7.	Acid-fast staining	**3**	**CO1**
8.	IMViC tests, Carbohydrate fermentation, Triple sugar iron (TSI) agar test.	**6**	**CO1**
9.	ABO Blood grouping, Agglutination tests – WIDAL.	**3**	**CO2**
10.	RA, ASO and CRP	**3**	**CO2**
11.	ODD and CIE, ELISA – tridot (demo)	**3**	**CO2**
12.	Isolation of genomic DNA from *E. coli*	**6**	**CO3**
13.	Isolation of Plasmid DNA from *E.coli*.	**6**	**CO3**
14.	Separation of proteins by polyacrylamide gel electrophoresis (SDS-PAGE)	**6**	**CO3**

Reference Books:

1.	*James G. Cappucino and Sherman Natalie* 2005. **Microbiology–A Laboratory Manual**. [Seventh edition].Pearson education India, New Delhi.

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

CO1	Handle microorganisms in aseptic laboratory conditions.
CO2	Apply serological analysis for the detection of various infections.
CO3	Perform the molecular techniques.

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM201	**DSC VI: MEDICAL BACTERIOLOGY AND MYCOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To acquire knowledge on collection, transportation and processing of various kinds of clinical specimens.
- To explain morphology, characteristics and pathogenesis of bacteria.
- To acquire knowledge on fungal disease diagnosis, antifungal agents and their importance.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Specimen Collection:** Normal flora of human body, Collection, transport, storage and processing of clinical specimens- Urine ,Pus, Sputum, Blood and Faeces.	**10**	**CO1**
II	**Gram Positive Bacteria:** Morphology, characteristics, pathogenesis, laboratory diagnosis, control and treatment - *Staphylococcus* sp., *Streptococcus* sp., *Neisseriae* sp., *Bacillus* sp., *Corynebacterium* sp., *Mycobacterium* sp., and *Clostridium* sp.	**10**	**CO2**
III	**Gram Positive Bacteria:** Morphology, characteristics, pathogenesis, laboratory diagnosis, control and treatment - Enterobacteriaceae members, *Pseudomonas, Vibrio, Mycoplasma, Helicobacter, Rickettsiae, Chlamydiae, Spirochaetes- Leptospira,* and*Treponema.* Nosocomial infections.	**10**	**CO3**
IV	**Medical Mycology:** Morphology, characteristics, pathogenesis, laboratory diagnosis, control and treatment **-** Superficial mycosis -Tinea, Piedra. Cutaneous mycosis - Dermatophytoses, Subcutaneous mycosis - Sporotrichosis, Systemic mycoses, *Histoplasma, Sporothrix, Blastomyces.* Fungi causing Eumycotic Mycetoma, Opportunistic mycosis – *Candida, Cryptococcus* and *Aspergillus*.	**12**	**CO4**
V	**Laboratory Diagnosis and Treatment:** Fungi causing secondary infections in immuno compromised patients. Immunodiagnostic methods in mycology- Recent advancements in diagnosis. Antifungal agents.	**08**	**CO5**

Text Books:	
1.	Kanunga R. (2022). Ananthanarayanan and Panicker's Text book of Microbiology. Orient Longman, Hyderabad.
2.	Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London.
3.	Alexopoulos C. J., Mims C. W. and Blackwell M. (2007). Introductory Mycology, (4th Edition). Wiley Publishers.
4.	Chander J. (2018). Textbook of Medical Mycology. (4th Edition). Jaypee brothers Medical Publishers.
Reference Books:	
1.	Salle A. J. (2007). Fundamental Principles of Bacteriology. (4th Edition). Tata McGraw-Hill Publications.
2.	Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston.
3.	Topley and Wilson's. (1998). Principles of Bacteriology. 9th edn. Edward Arnold, London.
4.	Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. Pfaller. 7thedn. Elsevier, Mosby Saunders.
Web Resources	
1.	http://textbookofbacteriology.net/nd
2.	https://microbiologysociety.org/members-outreach-resources/links.html
3.	https://www.pathelective.com/micro-resources
4.	http://mycology.cornell.edu/fteach.html
5.	https://www.adelaide.edu.au/mycology/

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Collect, transport and process of various kinds of clinical specimens.
CO2	Analyze various bacteria based on morphology and pathogenesis.
CO3	Discuss various treatment methods for bacterial disease.
CO4	Employ various methods detect fungi in clinical samples.
CO5	Apply various immunodiagnostic methods to detect and treat fungal infections.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	M	H	H	M	H	M
CO2	M	M	H	H	M	M	M	H	H	M
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM202	**DSC VII: MEDICAL VIROLOGY AND PARASITOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To describe the replication strategy and cultivation methods of viruses.
- To acquire knowledge about oncogenic virus and human viral
- To develop diagnostic skills, in the identification of viral and parasitic infections.

Credits: 04 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Viruses:** General properties - Structure and Classification - Viroids, Prions, Satellite RNAs and Virusoids. Cultivation of viruses - Embryonated eggs, Experimental animals and Cell cultures. Purification and Assay of viruses. Infectivity Assays (Plaque and End-point).	10	CO1
II	**DNA Viruses:** Virus Entry, Epidemiology, Pathogenesis, Laboratory Diagnosis, Control and Treatment - Pox, Herpes, Adeno , Papova and Hepadna.	10	CO2
III	**RNA Viruses**: Virus Entry, Epidemiology, Pathogenesis, Laboratory Diagnosis, Control and Treatment - Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota and HIV. Arbo– Dengue virus, Ebola virus, Emerging and reemerging viral infections. Antiviral drugs.	10	CO3
IV	**Introduction to Medical Parasitology**: Classification, Epidemiology, Life Cycle, Pathogenesis, Laboratory Diagnosis and Treatment for *Entamoeba,* Aerobic and Anaerobic amoebae, *Giardia, Trichomonas, Leishmania, Trypanasoma* and *Plasmodium.*	10	CO4
V	**Introduction to Helminthes and Protozoans:** Classification, Life Cycle, Pathogenesis, Laboratory Diagnosis And Treatment for parasites – Helminthes - Cestodes – *Taenia solium, T. saginata*. Trematodes – *Fasciola hepatica.* Nematodes - *Ascaris, Ankylostoma* and *Wuchereria*. Anti-protozoan drugs.	10	CO5

Text Books:

1.	Kanunga R. (2022). Ananthanarayanan and Panicker's Text book of Microbiology. (12th Edition). Universities Press (India) Pvt. Ltd.
2.	Dubey, R.C. and Maheshwari D.K. (2010). A Text Book of Microbiology. S. Chand & Co.
3.	Rajan S. (2007). Medical Microbiology. MJP publisher.
4.	Paniker J. (2006). Text Book of Parasitology. Jay Pee Brothers, New Delhi.
5.	Arora, D. R. and Arora B. B. (2020). Medical Parasitology. (5th Edition). CBS Publishers & Distributors Pvt. Ltd. New Delhi.
Reference Books:	
1.	Carter J. (2001). Virology: Principles and Applications (1st Edition). Wiley Publications.
2.	Willey J., Sandman K. and Wood D. Prescott's Microbiology. (11th Edition). McGraw Hill Book.
3.	Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A.
4.	Levanthal R. and Cheadle R. S. (2012). Medical Parasitology. (6th Edition). S.A. Davies Co. Philadelphia.
Web Resources	
1.	https://en.wikipedia.org/wiki/Virology
2.	https://academic.oup.com/femsre/article/30/3/321/546048
3.	https://www.sciencedirect.com/science/article/pii/S0042682215000859
4.	https://nptel.ac.in/courses/102/103/102103039/
5.	https://www.healthline.com/health/viral-diseases#contagiousness

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Cultivate viruses by different methods and aid in diagnosis.
CO2	Investigate the symptoms of viral infections and presumptively identify the viral disease.
CO3	Diagnose various viral diseases by different methods
CO4	Educate public about the spread, control and prevention of parasitic diseases.
CO5	Identify the protozoans and helminthes present in stool and blood specimens.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	M	H	H	M	H	M
CO2	M	M	H	H	M	M	M	H	H	M
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	M	M	H	H	H	M	M	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBEL201	**DSE I: BIOREMEDIATION**	**SEMESTER II**

Course Objectives:

The course aims

- To describe the nature and importance of bioremediation and its applications in water treatment.
- To explain the fundamentals of treatment technologies and implementation in treatment plants.
- To explain the potential of microbes with methods of reducing health risks caused by xenobiotics.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Bioremediation**: Process and organisms involved. Bioaugmentation - *Ex-situ* and *in-Situ* processes; Intrinsic and engineered bioremediation. Major pollutants and associated risks; Organic pollutant degradation. Factors affecting the process.	08	CO1
II	**Microbes involved in aerobic and anaerobic processes in nature**: Water treatment - BOD, COD, dissolved gases, removal of heavy metals. Secondary waste water treatments - use of membrane bioreactor. Aerobic sludge and landfill leachate process. Aerobic digestion.	08	CO2
III	**Composting of solid wastes**: Anaerobic digestion - methane production and important factors involved, Pros and cons of anaerobic process. Bioremediation of dyes, bioremediation in paper and pulp industries. Aerobic and anaerobic digesters – design.	08	CO3
IV	**Microbial leaching of ores**: Process, microorganisms involved and metal recovery with special reference to copper and iron. Biotransformation of heavy metals and xenobiotics. Petroleum biodegradation - reductive and oxidative. Dechlorination. Biodegradation of plastics and super bug.	08	CO4
V	**Phytoremediation of heavy metals in soil** : Basic principles of phytoremediation - Uptake and transport, Accumulation and sequestration. Phytoextraction. Phytodegradation. Phytovolatilization. Rhizodegradation. Phytostabilization - Role of Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria in phytoremediation.	08	CO5

Text Books:	
1.	Bhatia H.S. (2018). A Text book on Environmental Pollution and Control. (2nd Edition). Galgotia Publications.
2.	Chatterjee A. K. (2011). Introduction to Environmental Biotechnology. (3rd Edition). Printice-Hall, India.
3.	Pichtel, J. (2014). Waste Management Practices: Municipal, Hazardous, and Industrial , 2nd edition, CRC Press.
4.	Liu,D.H. F and Liptak, B.G (2005). Hazardous Wastes and Solid Wastes, Lewis Publishers.
5.	Rajendran, P. & Gunasekaran, P. (2006). Microbial Bioremediation. 1st edition. MJP Publishers
Reference Books:	
1.	Sangeetha J., Thangadurai D., David M. and Abdullah M.A. (2016). Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development. (1st Edition). Apple Academic Press.
2.	Singh A. and Ward O. P. (2004). Biodegradation and Bioremediation. Soil Biology. Springer.
3.	Singh A., Kuhad R. C., and Ward O. P. (2009). Advances in Applied Bioremediation (1st Edition). Springer-Verlag Berlin Heidelberg, Germany.
4.	Rathoure, A.K. (Ed.). (2017). Bioremediation: Current Research and Applications. 1st edition. I.K. International Publishing House Pvt. Lt
Web Resources	
1.	Bioremediation- Objective, Principle, Categories, Types, Methods, Applications (microbenotes.com)
2.	https://agris.fao.org › agris-search
3.	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/bioremediation
4.	https://www.intechopen.com/chapters/70661
5.	https://microbiologysociety.org/blog/bioremediation-the-pollution-solution.html

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Assess the roles of organisms in bioremediation and to differentiate *Ex-situ* bioremediation and *in-situ* bioremediation.
CO2	Distinguish microbial processes necessary for the design and optimization of biological processing unit operations.
CO3	Identify, formulate and design engineered solutions to environmental problems.
CO4	Explore microbes in degradation of toxic wastes and playing role on biological mechanisms.
CO5	Establish the mechanisms of Arbuscular mycorrhizal fungi and Plant growth promoting *Rhizobacteria* in phytoremediation.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	M	M	H	H	M	M	M	H	H	M
CO3	H	M	H	M	M	H	M	H	M	M
CO4	M	M	M	M	M	M	M	M	M	M
CO5	M	M	H	H	H	M	M	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBEL202	**DSE I: BIOINFORMATICS**	**SEMESTER II**

Course Objectives:

The course aims

- To discuss about various biological data mining concepts, tools.
- To elucidate the principles and applications of sequence alignment methods and tools
- To demonstrate different phylogenetic tree construction methods and inpredicting 3D and 2D structure of proteins.
- To describe various tools and techniques used in molecular docking, immunoinformatics and subtractive genomics

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Biological Data Mining**: Exploration of Data Mining Tools. Cluster Analysis Methods. Data Visualization. Biological Data Management. Biological Algorithms – Biological Primary and Derived Databases. Concept of Alignment, Pairwise Sequence Alignment (PSA), Multiple Sequence Alignment (MSA), BLAST, CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).	08	CO1
II	**Phylogenetic Tree Construction:** Concept of Dendrograms. Evolutionary Trees - Distance Based Tree Reconstruction - Ultrametric trees and Ultrametric distances – Reconstructing Trees from Additive Matrices - Evolutionary Trees and Hierarchical Clustering - Character Based Tree Reconstruction - Maximum Parsimony Method, Maximum likelihood method - Reliability of Trees – Substitution matrices – Evolutionary models.	08	CO2
III	**Computational Protein Structure prediction:** Secondary structure – Homology modelling- Fold recognition and abinitio 3D structure prediction – Structure comparison and alignment – Prediction of function from structure. Geometrical parameters – Potential energy surfaces – Hardware and Software requirements-Molecular graphics – Molecular file formats- Molecular visualization tools.	08	CO3
IV	**Prediction of Properties of Ligand Compounds:** 3D Autocorrelation -3D Morse Code-Conformation Dependent	08	CO4

	and Independent Chirality Codes –Comparative Molecular Field Analysis – 4 D QSAR –HYBOT Descriptors – Structure Descriptors – Applications – Linear Free Energy Relationships – Quantity Structure - Property Relationships –Prediction of the Toxicity of Compounds		
V	**Molecular Docking:** Flexible - Rigid docking- Target-Ligand preparation- Solvent accessibility- Surface volume calculation, Active site prediction- Docking algorithms- Genetic, Lamarckian - Docking analyses- Molecular interactions, bonded and nonbonded - Molecular Docking Software and Working Methods. Genome to drug discovery – Subtractive Genomics – Principles of Immunoinformatics and Vaccine Development.	**08**	**CO5**

Text Books:

1. Lesk A. M. (2002). Introduction to Bioinformatics. (4th Edition). Oxford University Press.
2. Lengauer T. (2008). Bioinformatics- from Genomes to Therapies (Vol-1).Wiley-VCH.
3. Rastogi S. C., Mendiratta N. and Rastogi P. (2014). Bioinformatics - Methods and Applications (Genomics, Proteomics and Drug Discovery) (4th Edition).
4. Prentice-Hall of India Pvt.Ltd.
5. Attwood, T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Addision Wesley Longman Limited, England.

Mount D.W., (2013).Bioinformatics sequence and genome analysis, 2ndedn.CBS Publishers, New Delhi.

Reference Books:

1. **Baxevanis A. D. and Ouellette F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. (2nd Edition).** John Wiley and Sons.
2. Bosu O. and Kaur S. (2007). Bioinformatics - Database, Tools, and Algorithms. Oxford University Press.
3. David W. M. (2001). Bioinformatics Sequence and Genome Analysis (2nd Edition). CBS Publishers and Distributors(Pvt.)Ltd.
4. Xiong J, (2011). Essential bioinformatics, First south Indian Edition, Cambridge University Press.

Web Resources

1. https://www.hsls.pitt.edu/obrc/

2.	https://www.hsls.pitt.edu/obrc/index.php?page=dna
3.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1669712/
4.	https://www.ebi.ac.uk/
5.	https://www.kegg.jp/kegg/kegg2.html

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Access to databases that provides information on nucleic acids and proteins.
CO2	Invent algorithms for sequence alignment.
CO3	Construct phylogenetic tree.
CO4	Predict the structure of proteins.
CO5	Design drugs by predicting drug ligand interactions and molecular docking.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	M	M	H	H	M	M	M	H	H	M
CO3	H	M	H	M	M	H	M	H	M	M
CO4	M	M	M	M	M	M	M	M	M	M
CO5	M	M	H	H	H	M	M	H	H	H
H – High; M- Medium; L - Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBEL203	DSE I: CELL BIOLOGY	SEMESTER II

Course Objectives:

The course aims

- To ascertain the cellular level organization and its functions
- To understand about the activation, regulation of cellular metabolism.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	Structure and organization of cytoskeleton - microfilaments, microtubules and intermediate filament. Structure and functions of nucleus, mitochondria, chloroplasts, endoplasmic reticulum and golgi apparatus- protein trafficking.	**08**	**CO1**
II	Cell cycle - Events and regulation in cell cycle. Microtubules and mitosis. Cell movements. Intracellular transport and the role of kinesin and dynein.	**08**	**CO2**
III	Ca++ dependent and independent cell-cell adhesion. Cell junctions and adhesion molecules, mitosis, meiosis, role of cyclins and cyclin dependent kinases, regulation of Cdk – cyclin activity.	**08**	**CO3**
IV	Signal transduction- G Protein couple receptors (GPCR), second messenger, role of cAMP and cGMP, steroid/peptide hormone regulation, tissue specific regulation - protein folding- molecular chaperones.	**08**	**CO4**
V	Cell division regulation and cancer. Role of protein kinases, Programmed cell death (PCD) - Autophagy and apoptosis. Geno toxicity assays.	**08**	**CO5**

Text Book:

1. *Ajoy Paul.* 2011. **Text Book of Cell and Molecular Biology**, Books and Allied Ltd., New Delhi.

Reference Books:	
1.	*Lodish, H., Berk A., Kaiser C. A., Krieger M., Scott M.P., Bretscher A., Ploegh H., and Matsudaira P.* 2008. **Molecular Cell Biology**, [Sixth Edition]. Freeman, W. H. and Co.
2.	*Geoffrey, M. Cooper and Hausman, R.E. 2007.* The cell **– A Molecular Approach.** [Fourth Edition]. ASM Press, Washington, D.C.
3.	*Sadava, D.E.* 2004. **Cell Biology: Organelle Structure and Function**. Reprint, [First Edition]. Panima Publishing Corp., India.

COURSE OUTCOMES (CO)

After completion of the course, the students' will be able to

CO1	Recall about structural components and internal organelles.
CO2	Assess cell cycle and its regulations.
CO3	Analyze cell cycle mechanisms.
CO4	Apply cell signal transduction for design drugs.
CO5	Develop drugs for cancer therapy.

MAPPING

PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	M	M	M	M	M	M	M	M	M	M
CO3	M	H	H	H	M	M	H	H	H	M
CO4	M	M	H	H	H	M	M	H	H	H
CO5	M	M	H	H	H	M	M	H	H	H

H – High; M- Medium; Low - Low

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBMP201	**DSC PRACTICAL II**	**SEMESTER II**

Course Objectives:

The course aims

- To understand and identify unknown pathogens.
- To estimate the environmental pollutants.
- To study plant growth promoting microorganisms.

Credits: 04 **Total Hours: 50**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Isolation and Identification of bacteria causing urinary tract infection.	**5**	**CO1**
2.	Identification of unknown pathogen from pus from infected wound.	**5**	**CO1**
3.	Identification of unknown pathogen from diarrhoeic stool.	**5**	**CO1**
4.	Minimal Inhibitory Concentration for selected antibiotics against clinical pathogens.	**3**	**CO1**
5.	Examination of fungi by Lactophenol Cotton Blue Mount.	**2**	**CO1**
6.	Examination of cysts, ova by concentration, Flotation and sedimentation method.	**3**	**CO1**
7.	Biological Oxygen Demand (BOD).	**2**	**CO2**
8.	MPN technique.	**5**	**CO2**
9.	Isolation of phage from sewage sample.	**3**	**CO2**
10.	Chemical Oxygen Demand (COD).	**2**	**CO2**
11.	Isolation of amylase from soil sample.	**5**	**CO3**
12.	Isolation of antibiotic producers by crowded plate technique.	**5**	**CO3**
13.	Observation of VAM fungi from roots.	**3**	**CO3**
14.	Enzyme immobilization technique.	**2**	**CO3**

Reference Book:

1. *James G. Cappucino and Sherman Natalie* 2005. **Microbiology–A Laboratory Manual**. [Seventh edition].Pearson education India, New Delhi.

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

CO1	Apply the diagnosis knowledge to detect the unknown pathogens from clinical samples.
CO2	Evaluate the purity of the water and analyze the pollutants present in water bodies.
CO3	Handle the agriculturally important microorganisms.

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PLS201	**AEC I: CAREER COMPETENCY SKILLS - I**	**SEMESTER – II**

Course Objectives:

The course aims

- To enhance employability skills and to develop career competency.

Credit 1 **Total Hours: 15**

UNIT	CONTENTS	Hrs	CO
I	Interview Skills 1.1Interview Skills: Opening & Closing expressions-Dress code-Dos and Don'ts In Interview 1.2Resume Preparation: Cover letters-Types of resume. Practice: Mock Interview with basic and advanced Interview questions Practice: Draft updated version of resume & cover letter.	3	CO1
II	Soft Skills: Interpersonal Skills - Swocanalysis -Problem Solving Skills. Practice: Speaking on interpersonal skills. Activity on problem solving skills.	3	CO2
III	Professional Skills: Public Speaking-Group Discussion- Creative Thinking. Practice: Non-technical presentation & Group Discussion Assessment can be based on presentation in the class	3	CO3
IV	Professional Writing Skills: Report writing: Progress report-Feasibility Memos and Circulars.	3	CO4
V	Self-improvement –CALL-Language Techniques and Concepts, E-learning	3	CO5

Text Book:

1	*Know Yourself & Know the World*

Reference Book :

1	*Alex, K. Soft Skills New Delhi, S. Chand & Company Ltd, 2012.*

COURSE OUTCOMES (CO)

On completion of this course, students will be able to

CO1	Understand the types of Interviews, interview skills
CO2	Developing Resume content and structures.
CO3	Improving soft skills & group discussion
CO4	Types of skills, Attain the different level of Learning Skills.
CO5	Self-improvements and learning techniques

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PBCMBI201 /24PBCBTI201	**MDC I : DIAGNOSTIC BIOCHEMISTRY**	**SEMESTER–II**

Course Objectives:

The Course aims

- To enable the students to develop practical and interpretative skills to contribute effectively in diagnostic haematology and clinical biochemistry.

Credits: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Clinical Laboratory:** Introduction, types and set-up. Basic laboratory safety, hazards in the clinical laboratory, safety with chemical/reagents, first aid in laboratory accidents. Fundamental chemistry - Indicators, solutes, solvents and solutions.	06	CO1
II	**Clinical Haematology:** Ways of obtaining blood, Separation of serum and plasma, Anticoagulants, Blood collection system, Complete blood cell count (CBC), Erythrocyte sedimentation rate. Automation in haematology, bleeding time, clotting time	06	CO2
III	**Urine analysis and Stool examination:** Physicochemical characteristics of urine, preservation of specimen, gross examination of urine and chemical examination of urine-tests for glucose, proteins, aminoacids, ketone bodies, bile salts, bile pigments. Stool examination – Specimen collection, test for occult blood, microscopic examination of stool	06	CO3
IV	**Clinical Chemistry and Enzymology:** Diabetes Mellitus - Introduction, types, diagnostic tests – Glucose, glycosylated haemoglobin. Estimation and interpretation of cholesterol, urea, creatinine and protein in blood samples. Enzymology – Role of AST and ALT in diagnosis of diseases.	06	CO4
V	**Organ function tests:** Liver function test: Functions of the Liver, Tests based on abnormalities of bile pigments (Jaundice). Renal Function Test: Renal clearance test (Creatinine and urea), dilution test, phenol red test, principles of precise tests of renal function – Glomerular filtration rate, renal plasma flow and maximal tubular capacity.	06	CO5

Text Books:

1.	*Ramnik Sood.* 2006. **Medical Laboratory Technology.** [First Edition].Jaypee Brother's Medical Publishers Ltd., New Delhi
2.	*Kanai L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi

COURSE OUTCOMES (CO)

On completion of this course the students will be able to

CO1	Practice the safe laboratory processes
CO2	Explain the general concepts of specimen collection methods and analysis of blood cells in clinical labs
CO3	Recite the handling and analytical procedures of urine and stool samples
CO4	Describe the general concepts and methods in diagnosis of clinical disorders
CO5	Perform various laboratory procedures to assess the functional status of the Organs

MAPPING

PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	H	H	H	M	H	M
CO2	H	H	M	H	H	H	H	M	H	M
CO3	H	H	M	H	H	H	H	M	H	M
CO4	H	H	M	H	H	H	H	M	H	M
CO5	H	H	M	H	H	H	H	M	H	M

H – High; M- Medium; L - Low

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PBCMBIP201	**MDC PRACTICAL I: DIAGNOSTIC BIOCHEMISTRY**		**SEMESTER II**
Course Objectives: The course aims • To enable the students to develop practical knowledge in handling and testing the biological samples			
Credits: 02			**Total Hours: 24**
S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Clinical haematology			
1.	Enumeration of WBC and RBC	3	CO1
2.	Estimation of haemoglobin (Sahli's method)	3	CO1
3.	Erythrocyte sedimentation rate (Westergren's method)	3	CO1
II. Blood analysis			
4.	Estimation of glucose in blood (Nelson Somogyi's method).	3	CO2
5.	Estimation of urea in blood (DAM method).	3	CO2
6.	Estimation of creatinine in blood (Jaffe's method).	3	CO2
III. Urine analysis			
7.	Estimation of creatinine in urine (Jaffe's method).	3	CO2
8.	Qualitative analysis of normal and abnormal constituents in urine	3	CO3
Reference Books:			
1.	*Harold Varley*. 1980. **Practical Biochemistry. Volume I & II.** [Fifth Edition]. CBS Publishers, New Delhi		

COURSE OUTCOMES (CO)

On completion of this course the students will be able to

CO1	Perform blood cell analysis procedures
CO2	Estimate the presence of metabolites in blood and urine
CO3	Use the tests to identify normal and abnormal constituents in urine by qualitative analysis

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(Course Coordinator) **(BoS Chairman)**

24PBTMBI201	**MDC I: PLANT TISSUE CULTURE TECHNOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To understand the basic techniques in plant tissue culture.

Credits: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Introduction to Plant cells:** Types of plant cells, Principles of plant tissue culture, Tissue culture media, Growth regulators and Sterilization techniques.	06	CO1
II	Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.	06	CO2
III	Agrobacterium mediated gene transfer, Agrobacterium - based vectors, direct gene transfer methods-electroporation, microinjection, particle bombardment.	06	CO3
IV	Genetic engineering for quality improvement-Protein, lipids, carbohydrates, and vitamins, Production of resistant plants - Herbicide resistance, Insect resistance (Bt approach), Abiotic stress tolerance plant production-Drought, temperature and salt.	06	CO4
V	**Secondary metabolites from plants**: Alkaloids, flavonoids and phenolic compounds, Germplasm conservation.	06	CO5

Text Books:

1. *Bhojwani,S.S., and Razdan,M.K.*2008. **Plant Tissue Culture –Theory And Practice.** Elsevier Publishers, New Delhi.

Reference Books:

1. *Chawla, H.S.* 1998. **Biotechnology in Crop Improvement.** International Book Distribution Co., New Delhi.
Hopkins, W.G.and Hiiner,N.P.A. 2004. **Introduction to Plant Physiology.**

2.	[Third Edition]. John W i l e y and Sons, NewJersey, USA.
	Jain, V.K .2013. **Fundamentals of Plant Physiology**. [Fifth Edition]. S.Chandand Company, NewYork.
3.	*Trivedi, P.C.* 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International Publications Pvt Ltd., New Delhi.
4.	

COURSE OUTCOMES (CO)

On completion of this course the students will be able to

CO1	Simplify the types of plant cells and will able to utilize various sterilization techniques
CO2	Utilize the micro propagation and isolation of plant tissue
CO3	Analyze the techniques for Transfer gene by biological and physical method
CO4	Contrast the benefits and develop the genetically modified crops
CO5	Demonstrate the Extraction and identification of secondary metabolites

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	H	H	M	H	H	M	H	M
CO2	M	M	H	H	M	H	H	M	H	M
CO3	M	M	H	H	M	H	H	M	H	M
CO4	M	M	H	H	M	H	H	M	H	M
CO5	M	M	H	H	M	H	H	M	H	M
H – High; M- Medium; L - Low										

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(Course Coordinator) **(BoS Chairman)**

24PMBBTIP201	**MDC PRACTICAL I: PLANT TISSUE CULTURE TECHNOLOGY**		**SEMESTER II**
Course Objectives: The course aims • To get hands on experience on Plant tissue culture			
Credits: 02		**Total Hours: 30**	
Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Media preparation.	**3**	**CO1**
2.	Hormone stock solution preparation	**2**	**CO1**
3.	Callus induction.	**5**	**CO1**
4.	Micropropagation.	**5**	**CO2**
5.	Protoplast isolation.	**5**	**CO2**
6.	Synthetic seed preparation	**5**	**CO2**
Reference Books:			
1.	Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.		
2.	*Bhojwani, S.S. and Razdan, M.K*. 2008. **Plant Tissue Culture – Theory and Practice**. Elsevier Publishers, New Delhi.		

COURSE OUTCOMES (CO)

On completion of this course the students will be able to

CO1	Prepare media for plant tissue culture.
CO2	Cultivate the plant tissues/cells.
CO3	Synthesis seeds and hybridoma cells.

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(Course Coordinator) **(BoS Chairman)**

24PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER- II

Course Objectives

The Course aims

- To make the students to understand the concepts of human rights.

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**Human Rights:** Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights - Fundamental Rights - Directive Principles of the State Policy - Indian Constitution.	5	CO1
II	**Civil and Political Rights:** Right to Work - Right to Personal Freedom - Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality-Right to Religion - Right to Form Associations and Unions - Right toMovement - Right to Family - Right to Contract - Right to Constitutional Remedies-Right to Vote and Contest in Elections - Right to Hold Public Offices-Right to Petition-Right to Information - Right to Criticize the Government- Right to Democratic Governance.	5	CO2
III	**Economic Rights:** Right to Work - Right to Adequate Wages - Right to Reasonable Hours of Work - Right to Fair Working Conditions - Right to Self Government in Industry - Customer Rights - Social and Cultural Rights - Right to Life - Right to Clean Environment.	5	CO3
IV	**Women's Rights:** Right to Inheritance - Right to Marriage – Divorce and Remarry -Right to Adoption - Right to Education - Right to Employment and Career. Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care – Right to Education - Issues Related with Infanticide - Street Children – Child Labour-Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights-Tribal Rights- Nomads Rights.	5	CO4
	Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights - UNO - National Commission for Human Rights - State Commissions - Non Governmental Organizations and Human Rights - Amnesty		

V	Terrorism and Human Rights - Emergency and Human Rights - Judiciary and Human Rights - Media and Human Rights - Police and Human Rights.	**5**	**CO5**
Reference Books			
1.	*Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.		
Web References			
1	https://idwfed.org/en/about-us-1/idwf-constitution		
2	https://www.womenlawsindia.com/legal-awareness/women-rights-in-india/		
3	https://projectworldimpact.com/cause/Human-Trafficking		

COURSE OUTCOMES (CO)

On completion of this course the students will be able to

CO1	Understand the core principles of human rights philosophy
CO2	Know the importance and functions of human rights commission
CO3	Apply their rights for democracy, human rights and gender equality
CO4	Know the rights from the Governance, economic and social development through various Acts
CO5	Understand the right to information Act, rights for women, children, Nomads, refugees and various sector of people in our country

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(Course Coordinator) **(BoS Chairman)**

24PMBM301	DSC VIII: SOIL AND ENVIRONMENTAL MICROBIOLOGY	SEMESTER III

Course Objectives:

The course aims

- To explain the role of microorganisms in soil fertility.
- To learn the benefits of interactions among soil microbes.
- To acquire in depth knowledge about degradation of organic matter.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Soil Microbiology** – Introduction, Classification, and types of soil. Soil profile and properties, Soil formation, Diversity, and distribution of major group of microorganisms in soil. Mineralization of Organic & Inorganic Matter in Soil. Biological Nitrogen fixation- Chemistry and Genetics of BNF.	08	CO1
II	**Phytopathology and Disease Cycle of Plant Pathogens**: Tikka, rust, smut, Rot, Mosaic, Citrus canker - symptoms and their control measures. Structural and Inducible biochemical defenses. Systemic Acquired Resistance (SAR), pathogenesis related (PR) - proteins, Plantibodies, Phenolics, Phytoalexins.	08	CO2
III	**Microbial Interactions** - Mutualism, Commensalism, Amensalism, Synergism, Competition, Parasitism and predation. Mycorrhizae – Types, Endophytes, PGPR- Plant growth promoting bacteria– symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non-symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers and Biocontrol agents – Types, benefits and application. Advantages, social and environmental aspects - Bt crops, golden rice.	08	CO3
IV	**Components of Environment:** Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples. Energy flow in the ecosystem- Carbon, Nitrogen, Sulfur and Phosphorous cycles. Treatment and safety of drinking (potable) water, methods to detect potability of water samples. BOD, COD. Space microbiology - Microbiological research in space environment.	08	CO4

V	**Degradation of Organic Matter**: Lignin, cellulose, hemicellulose, pectin, common pesticides and heavy metals. Biodegradation of Xenobiotics - Recalcitrant Halocarbons, Recalcitrant TNTs, PCBs and Synthetic polymers. Biodegradation of Hydrocarbons. Pollution Control Bodies and Environmental laws in India. Environmental impact assessment, EIA guidelines, US Environment protection Agency norms.	**08**	**CO5**

Text Books:

1.	Subba Rao. N. S. (2017). Soil Microbiology. (5th Edition). MedTech Publishers.
2.	Daniel. C. J. (2006). Environmental Aspects of Microbiology. (2nd Edition). Bright Sun Publications.
3.	Rangaswami. G. and Mahadevan. A. (2006). Diseases of Crop Plants in India. (4thEdition). Prentice–Hall of India Pvt. Ltd.
4.	Sharma P. D. (2010). Microbiology and Plant pathology. (2nd Edition). Rastogi Publications.
5.	Subba Rao. N.S. (2005). Soil microorganisms and Plant Growth. (4th Edition). Oxfordand IBH Publishing Pvt. Ltd.

Reference Books:

1.	Pepper I. L., Gerba C. P. and Gentry T. J. (2014). Environmental Microbiology (1stEdition). Academic Press, Elsevier.
2.	Bitton, G. (2011). Wastewater Microbiology. (4th Edition). Wiley-Blackwell.
3.	Bridgewater L. (2012). Standard Methods for the Examination of Water andWastewater. American Public Health Association.
4.	Shrivastava A.K. (2003). Environment Auditing. A. P. H. Publishing Corporation.
5.	Tinsley, S. and Pillai, I. (2012). Environmental Management Systems –U

Web Resources

1.	https://academic.oup.com/femsec/article/93/5/fix044/3098413
2.	http://www.fao.org/3/t0551e/t0551e05.htm
3.	www.environmentshumail.blogspot.in/
4.	https://www.frontiersin.org/articles/10.3389/fpls.2017.01617/full
5.	https://serc.carleton.edu/microbelife/index.html

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Infer the significance of soil microbes and predict the role of microbes in biological nitrogen fixation.
CO2	Gain knowledge about plant pathogens, disease control aspects.
CO3	Identify plant microbial interaction and its significance.
CO4	Know about environmental components and the role of microbes.
CO5	Acquire knowledge about environmental issues and protection.

MAPPING

PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	H	H	H	M	M	H
CO2	M	M	M	H	H	H	M	M	H	H
CO3	M	H	H	H	M	M	H	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H

H – High; M- Medium; L - Low

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM302	DSC IX: RESEARCH METHODOLOGY, BIOETHICS AND IPR	SEMESTER III

Course objectives

- To achieve competence and proficiency in the theory and practice of research.
- To offer basic knowledge of ethical issues in medicine, health and the life sciences.
- To introduce fundamental aspects of Intellectual property rights.

Credit: 3 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Research–** Meaning and objectives of research. Types of research – Basic and applied research. Essential steps in research. Experimental designs- Hypothesis and Null-hypothesis, Basic principle of experiment. Experimental unit and sampling unit, Experimental error, Replication, Generalization, Controls, Randomization, Measurements. Few common experimental designs.	08	CO1
II	**Research Problem Identification & Formulation:** Defining and formulating the research problem, Selecting the problem. Literature collection – Need of literature review, Review and bibliography.	08	CO2
III	**Literature citation –** Formulation of research objectives and their importance, Computer and its role in research. Report writing and scholarly publishing. Research report – components of research report, Research report – Tables and Figures. Research report – Formatting and typing. Format of thesis.	08	CO3
IV	**Bioethics in Research:** Ethics-ethical issues, ethical committees (Human & Animal). Ethical issues in clinical research. Ethical issues related to Publishing, Authorship, Plagiarism and Self-Plagiarism. Contemporary issues in research ethics.	08	CO4
V	**Intellectual Property Rights (IPR):** Introduction to IPR, Patentable life science process and products, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design. Process of filling the patent: IPR regulation bodies (National and International), Procedure for	08	CO5

	IPR registration, the effect of registration and term of protection. Govt. of India's National IPR Policy and Career opportunities in IPR.		

Reference/Text Books

1) Kumar, R. (2011). **Research Methodology: a step-by-step guide for beginners (3rd edition)**. London, UK: TJ International Ltd, Padstow, Corwall.
2) Gurumani, N. (2017). **Research methodology for biological sciences**. MJP Publishers, Chennai.
3) Kothari, C.R. (2019).**Research Methodology: Methods and Techniques**. 4th Edition, New Age International Publishers, New Delhi.
4) Fink, A., 2009. **Conducting Research Literature Reviews: From the Internet to Paper**. Sage Publications
5) Satheesh, M. K. 2011. **Bioethics and Biosafety**. I.K. International, New Delhi.
6) Nithyananda, K V. (2019). **Intellectual Property Rights: Protection and Management**. India, IN: Cengage Learning India Private Limited.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Learn the fundamental details of research and will have knowledge on how to design a research work
CO2	Understand to select research problem, to identify the research gap and to formulate a hypothesis and objectives of the research.
CO3	Gain knowledge to interpret the research data, to write a research report and to publish a research paper
CO4	Acquire fundamental knowledge about bioethics in research.
CO5	Understand the intellectual property rights and their by-laws.

MAPPING

PO,PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H	M	M	M	H	H
CO2	H	H	H	H	H	M	M	M	H	H
CO3	H	H	H	H	H	M	M	M	H	H
CO4	H	H	H	H	H	M	M	M	H	H
CO5	H	H	H	H	H	M	M	M	H	H

H-High; M-Medium; L- Low

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM303	**DSC X: BIOSTATISTICS**	**SEMESTER–III**

Course Objectives:

- To familiarize the application of biostatistics in biology.
- To know about the research concepts.
- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research

Credits: 03 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Statistics:** Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics. **Collection of data**: Primary and Secondary data – Methods of collecting primary data – Sources of secondary data. **Classification and Tabulation of data**: Types of classification – Tabulation of data – Parts of a table - Types of tables. **Diagrammatic and Graphical Representation:** Types of diagrams – Graphs – Graphs of frequency distributions.	08	CO1
II	**Measures of Central Tendency:** Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits – Geometric mean - Harmonic Mean.	08	CO2
III	**Measures of Dispersion:** Range – Quartile deviation – Standard deviation – Coefficient of variation.	08	CO3
IV	**Correlation Analysis:** Types of correlation – Methods of Correlation - Karl Pearson's Coefficient – Rank correlation coefficient. **Regression Analysis:** Regression lines (except graphing) – Regression equations.	08	CO4
V	**Test of Hypothesis:** Population – Sample – Procedure of testing hypothesis – Types of errors – Standard error - t test – Chi-square test of independence of attributes. **Analysis of Variance:** One way classification – Two way classification.	08	CO5

TEXT BOOK:

1.	**S.P.Gupta**, 2008. **STATISTICAL METHODS**, [Thirty Seventh Edition]

	S. Chand and Company Ltd., New Delhi.
REFERENCE BOOK:	
1.	**Sancheti,D,C and Kapoor V.K** 2005. **STATISTICS**. [Seventh Editions]. S, Chand And Company limited, New Delhi.

Course Outcomes (CO)

After completion of the course, the students will be able to

CO 1	Learn the importance of statistics
CO 2	Understand the concepts of measures of central tendency
CO 3	Know the concepts of measures of dispersion
CO 4	Gain knowledge on correlation and regression analyses
CO 5	Test the samples using testing of hypothesis

MAPPING										
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	M	H	H	M	H	M	L	L	H	H
CO 2	M	H	H	M	H	M	L	L	H	H
CO 3	L	H	H	M	H	M	L	L	H	H
CO 4	M	H	H	M	H	M	L	L	H	H
CO 5	M	H	H	M	H	M	L	L	H	H
H-High; M-Medium; L-Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBEL301	DSE II: RECOMBINANT DNA TECHNOLOGY	SEMESTER III

Course Objectives:

The course aims

- To provide knowledge about artificial gene transfer mechanism and selection of recombinants.
- To understand gain knowledge on various molecular techniques and their role in biotechnology.
- To implement the knowledge of genetic engineering in various fields.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Tools and Methods in Gene Cloning**. Restriction endonucleases –Types, nomenclature, and characteristics – DNA Modifying enzymes and manipulating enzymes. Artificial gene transfer techniques -electroporation, microinjection, protoplast fusion and microparticle bombardment. Radiolabelling and its methods.	08	CO1
II	**Gene Cloning Vectors for Prokaryotes and Eukaryotes** - cloning properties and types of plasmids vectors (pBR322 and derivatives, pUC vectors and pGEM3Z) - Phage Vectors(M13 and Lambda), Hybrid vectors- Eukaryotic vectors - Yeast vectors (YIp, YEp ,YRp, YAC) – Animal (Retro virus) and plant vectors (CaMV) –Expression vectors. Expression of eukaryotic foreign genes in bacteria – merits and demerits. Screening for recombinants.	08	CO2
III	**Modern Techniques:** Construction of Genomic DNA and cDNA Library. Blotting- Southern, Northern, Western and Dot blot. Restriction mapping -Restriction Fragment Length Polymorphism (RFLP). Polymerase Chain Reaction (PCR) – Principles, types and their applications.	08	CO3
IV	**DNA Sequencing and Protein Engineering** - Primer walking, Chemical, Sanger's method and Next Generation sequencing. Pyrosequencing – DNA chips and micro array. Site directed mutagenesis, Protein engineering methods and its applications.	08	CO4

V	**Applications of Genetic Engineering** : Transgenic Plants – Ti Plasmid, Ti plasmid mediated vectors and its applications. Transgenic animals - mice and cattle. Human Gene Therapy - Germline and Somatic Cell Therapy - *Ex-vivo* Gene Therapy. *In-vivo* Gene Therapy.	**08**	**CO5**

Text Books:	
1.	*Brown, T.A.* 1995.**Gene Cloning–An Introduction**. [Third Edition]. Chapmanand Hall, UK.
2.	*Old, R.M. and Primrose, S.B.* 2006. **Principles of Gene Manipulation**. [Seventh Edition]. Blackwell Scientific Publication, London.

References Books	
1.	*Glick, B.K.* and *Pasternik, J.J.* 2003. **Molecular Biotechnology**. **Principles and applications of recombinant DNA**. [Third Edition]. ASM Press, Washington DC, USA.
2.	*Winnacker, E.L.* 1987. **From Genes to Clones**. **Introduction to Gene technology**. [First Edition]. Panima Publishing Corporation, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the basics and importance of enzymes in molecular research.
CO2	Apply cloning for developing novel recombinant products.
CO3	Develop transformants for production of various pharmacologically important products.
CO4	Apply gene transfer technology for protein engineering.
CO5	Apply genetic engineering for gene therapy and transgenic organisms.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBEL302	**DSE II: NANOTECHNOLOGY**	**SEMESTER III**

Course Objectives:

The course aims

- To enable the learners to construct a good foundation in nanotechnology.
- To understand the role of microbes in the synthesis of nanoparticles.
- To know about the modern applications of nanobiology.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Nanobiology:** Concepts, definitions, prospects. Nano-scale systems. Biological Nano objects– proteins, lipids and DNA. Bio-nano particles- Nanostarch, Nanocomposites- Dendrimers.	08	CO1
II	**Methods of Nanobiology:** Analysis of bimolecular Nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microcopy and FTIR. Nano-fabrication- Lithography- hot olithography, Electron beam lithography. Characterization of Nanomaterials - XRD and Zeta Potential.	08	CO2
III	**Methods for Susceptibility Testing of Nanoparticles:** Growth inhibition assay by spectrophotometer, Broth dilution method, standard agar well diffusion method, Estimation of colony forming units (CFU).	08	CO3
IV	**Antimicrobial Properties of Metal Nanoparticles:** Ag, Cu, Au nano particles- antibiofilm properties of nanoparticles. Biogenesis of bacterial silver nanoparticles, platinum nanoparticles.	08	CO4
V	**Nano Applications:** Drug and gene delivery **–** protein mediated and nanoparticle mediated. Toxicology in nanoparticles – Dosimetry. Nanomedicines. Health risk Associated with Nanoparticles.	08	CO5

Text Books:

1. *Balaji Subbaih.* 2010. **Nanobiotechnology**. MJP Publishers, India.

Reference Books:	
1.	*Pradeep,T.* 2008. **Nano: The Essentials: Understanding Nanoscience and Nanotechnology.** Tata Mc Graw-Hill Publishing Company Limited,New Delhi.
2.	*Mahendra Roiand Nelson Dura.*2011.**Metal nanoparticles in Microbiology**. Springer.
3.	*Christ of M. Niemayer, ChadA. Mirkin*. 2004. **Nanobiotechnology: Concepts, applications and perspectives.** Wiley VCH publishers.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the basic concepts of bionanoparticles.
CO2	Compute the bimolecular nano structures by AFM, Scanning Probe Electron Microcopy and FTIR.
CO3	Assess the various methods for susceptibility testing of nanoparticles.
CO4	Analyze antimicrobial properties of metal nanoparticles.
CO5	Prepare effective nano based drug delivery systems for infectious disease.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBEL303	DSE II : MARINE MICROBIOLOGY	SEMESTER III

Course Objectives:

- This subject aims to introduce the students to understand microbial diversity, significance and dynamics of Marine environment, Marine food borne pathogens, and Marine products.

Credits: 04 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Marine Environment**: properties of sea water, chemical and physical factors of Marine environment-ecology of costal, shallow and deep-sea microorganisms-significance of marine microflora. Diversity of microorganisms, archaea, bacteria, actinobacteria, cyanobacteria, algae, fungi, viruses and protozoa in the mangroves and coral environments.	08	CO1
II	**Cultivation of Marine Microbes**: methods of studying marine microorganisms- sample collection-isolation and identification: Cultural, morphological, physiological, biochemical and Molecular characteristics- preservation methods of marine microbes.	08	CO2
III	**Marine Extremophiles**: survival at extreme environments-starvation – adaptive mechanisms in thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms- hyperthermophiles, halophiles and their importance.	08	CO3
IV	**Microbial Biodegradation**: Natural and synthetic material in the marine environment pesticide, cellulose degradation, hydrocarbon production. Bioremediation of pollutants in Marine environment.	08	CO4
V	**Marine Microbial Products:** Carrageenan, agar-agar, sea weed fertilizers, Astaxanthin, β carotene – enzyme – antibiotics – antitumour agents – bio surfactants – pigments. Preservation of sea foods.	08	CO5

TEXT BOOKS

1. *Belkin, S* and *Colwell, R, R*. 2005. **Ocean and health: Pathogens in the Marine Environment.** Springer.

2. *Bhakuni, D.S* and *Rawat, D.S*. **Bioactive marine natural products.** Anamaya Publishers, New Delhi. 2005.

3. *Atlas, R.M.* 1988. **Microbiology, Fundamentals and applications**.Maxwell McMilla

REFERENCE BOOKS

1. *Hunter-Cevera, J., Karl, D* and *Buckley, M*. 2005. **Marine Microbial Diversity: the key to Earth's habitability.** American Academy of Microbiology.

2. *Jamesh W. Nybakker* . 2001. **Marine Biology**. Benjamin Cummings.

3. *Krichman D.L*. **Microbial ecology of the oceans.** Wiley liss, New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Discuss Marine Environment and its diversity
CO2	Be aware of marine microbes isolation, preservation and biogeochemical cycle
CO3	Demonstrate marine extremophiles and their importance
CO4	Apply the marine microbes for biodegradations of various pollutant
CO5	Create and develop the employable and entrepreneur opportunity in marine microbiology.

MAPPING

PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	H	H	M	M	H	H
CO2	H	H	M	H	H	H	H	M	H	H
CO3	H	M	M	M	H	H	M	M	M	H
CO4	H	H	M	H	H	H	H	M	H	H
CO5	H	H	M	H	H	H	H	M	H	H

H – High; M- Medium; L - Low

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBMP301	**DSC PRACTICAL III**	**SEMESTER III**

Course Objectives:

The course aims

- To understand molecular techniques.
- To know the preparative work for soil fertility.
- To study the quality of the food by standard protocols.

Credits: 04 **Total Hours: 50**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Isolation of Plasmid DNA	5	CO1
2.	Protein profiling – SDS -PAGE	5	CO1
3.	Paper Chromatography	2	CO1
4.	Thin Layer Chromatography	3	CO1
5.	Column Chromatography	5	CO1
6.	Effect of temperature, pH, sugar and salt conc. on growth of microbes.	5	CO2
7.	Isolation of antibiotic producing microorganism from soil.	5	CO2
8.	Isolation and enumeration of phosphate-solubilizing bacteria from soil.	5	CO2
9.	Thermal Death Point and Thermal Death Time	5	CO2
10.	Isolation and identification of fungi from spoiled food.	3	CO2
11.	Enumeration of microbes from milk by Breeds count method.	2	CO2
12.	Methylene blue reduction Test (MBRT)	5	CO5

Reference Book:

1. James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Apply the molecular techniques for strain improvement for product recovery.
CO2	Demonstrate the economically important microbial products.

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBMP302	**DSC PRACTICAL IV: STATISTICAL SOFTWARE**	**SEMESTER III**

Course Objectives:

The course aims

- To give a good grip on concepts in analyzing the data using statistical software.

Credits: 02 **Total Hours: 24**

PROGRAM	CONTENTS	Hrs	CO
1	Diagrams and graphs	**03**	**CO 1**
2	Measures of Central Tendency	**03**	**CO 2**
3	Measures of Dispersion	**03**	**CO 2**
4	Correlation Coefficient (Karl Pearson and Spearman Rank Method)	**03**	**CO 3**
5	Regression lines	**03**	**CO 3**
6	Small Sample Test (t and F)	**03**	**CO 4**
7	Chi-square Test for Independence of Attributes.	**03**	**CO 4**
8	ANOVA (one way and two way classification)	**03**	**CO 4**

Reference Books:

1.	*Shentan J. Coakes, Lyndall Steed and Peta Dzidic.* **SPSS 13.0 version for Windows analysis without Anguish.** John Wiley & Sons, Australia.
2.	*Andy Field.* 2006. **Discovering Statistics using SPSS.** [Second Edition]. SAGE Publications.

COURSE OUTCOMES (CO)

On completion of this course, the students will be able to

CO 1	Demonstrate the data in diagrammatic and graphical representation
CO 2	Find the averages and measures dispersion
CO 3	Calculate correlation and regression for huge amount data
CO 4	Gain knowledge about test of significance

24PLS301	AEC II: CAREER COMPETENCY SKILLS II	SEMESTER – III

Course Objectives

The course aim

- To impart knowledge on the Aptitude.
- To enhance employability skills and to develop career competency.

Credits: 1 **Total Hours: 15**

UNIT	CONTENTS	Hrs.	CO
I	Solving Simultaneous Equations Faster – Number System - HCF, LCM – Square roots and Cube roots – Averages	3	CO 1
II	Problems on Numbers –Problems on Ages	3	CO 2
III	Calendar – Clocks – Pipes and Cisterns	3	CO 3
IV	Time and Work – Time and Distance	3	CO 4
V	Ratio and Proportion – Partnership – Chain Rule	3	CO 5

Text Books

1. *Aggarwal R.S.* 2022. **Quantitative Aptitude.** [Seventh Revised Edition]. S. Chand& Co., New Delhi.

Reference Books

1. *AbhijithGuha,* 2015. **Quantitative Aptitude for Competitive Examinations**, [5th Edition], Tata McGraw Hill, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the student will be able to

CO 1	Understand the basic mathematical functions.
CO 2	Calculate Problems on Ages with shortcuts.
CO 3	Understand the core concepts of Pipes & Cisterns, Calendar & Clocks.
CO 4	Obtain knowledge on shortcuts to Time & Work and Time & Distance.
CO 5	Calculate Ratio & Proportion, Partnership with shortcuts.

Course Prepared by
Mr. A. SILAMBARASAN
Assistant Professor

Course Approved by
Mr. T. RAJENDRAKUMAR
BOS Chairman

24PBCMBI301	MDC II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER–III

Course Objectives:

The Course aims

- To enable the students to learn about Pharmacodynamics and pharmacokinetics of drugs.
- To make the students aware of Plant therapeutics

Credits: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Drugs**: Drug –Definition, Nomenclature, Structural feature and pharmacology activity, prodrug concept. Classification of drugs based on their source and – Plant, animal, mineral and synthetic, based on action. Routes of drug administration, Drug absorption- mechanism. Factors influencing drug absorption	**06**	**CO1**
II	Distribution and elimination of drugs. Metabolism- Phase I, II reactions. Factors influencing drug distribution and elimination. Mechanism of drug action- Physical, Chemical, Enzymes, Receptors. Drug-Receptor interactions: Receptor – Definition. Agonists, partial aganoists, inverse agonists and antagonists. Drug action not mediated through receptor.	**06**	**CO2**
III	Adverse drug reactions- Definition, Classification and drug induced side effects, biological effects of drug abuse and drug dependence, tachyphylaxis, idiosyneracy, drug allergy, drug tolerance and intolerance. Drug discovery- Animal toxicity studies and clinical evaluation Phase I-IV (Elementary details)	**06**	**CO3**
IV	Phytomedicine: Definition and Scope of Phytomedicine. Indian Medicinal systems– Ayurveda, Siddha and Unani. Medicinal properties and active principles of plant parts (leaves, flowers, roots, seeds, rhizome, bark etc). Role of medicinal and aromatic plants in national economy.	**06**	**CO4**
V	Secondary metabolites of plants - Alkaloids, flavonoids and terpenoids, phenols – occurrence, distribution and functions. (Synthesis not required). Extraction of Phytopharmaceuticals or crude drugs –	**06**	**CO5**

	(Aqueous, Methonol and Chloroform extracts) maceration, percolation (soxhlet) extraction. Pharmacological Screening of Plant Extracts (In vitro, In vivo and Toxicological Screening).		
Text Books:			
1.	*Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **(UNIT - I, II & III).**		
2.	*Tripathi, K. D*. 1999. **Essentials of MedicalPharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **(UNIT - I, II & III).**		
Reference Books:			
1.	*Satoskar, R. S., Nirmala N. Rege*and*Bhandarkar S.D,* 2011. **Pharmacology and Pharmacotherapeutics**[Twenty-Second edition]. PopularPrakashanPvt Ltd, Mumbai		
2.	*Roseline, A*. 2011**. Pharmacognosy.** M.J.P Publishers, Chennai		

COURSE OUTCOMES (CO)

After completion of the course, the student will be able to

CO1	Describe the drug sources, classification and its pharmacodynamics
CO2	Explain the mechanisms of action and fate of drugs inside living organisms
CO3	Analyze the effects of adverse drug reactions
CO4	Appreciate the various medical systems that utilize phytoconstituents as medicines
CO5	Explore the new strategies in the development of efficient drugs to combat diseases from plants

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	M	H	H	M	H	M	H
CO2	H	M	H	M	H	H	M	H	M	H
CO3	H	M	H	M	H	H	M	H	M	H
CO4	H	M	H	M	H	H	M	H	M	H
CO5	H	M	H	M	H	H	M	H	M	H
H – High; M- Medium; L - Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

<table>
<tr><td>24PBCMBIP301</td><td colspan="2">MDC PRACTICAL II:
PHARMACEUTICAL BIOCHEMISTRY</td><td>SEMESTER – III</td></tr>
<tr><td colspan="4">Course Objectives:
The Course aims
• To enable the students to understand the basic concepts in extraction, screening, quantification process of secondary metabolites</td></tr>
<tr><td colspan="2">Credits: 2</td><td colspan="2">Total Hours: 24</td></tr>
<tr><td>S.No.</td><td>EXPERIMENT</td><td>Hrs</td><td>CO</td></tr>
<tr><td>1.</td><td>Extraction of phytoconstituents of neem leaves using water and methanol as solvents- Maceration and Soxhlet extraction</td><td>6</td><td>1</td></tr>
<tr><td>2.</td><td>Preliminary phytochemical screening for the presence of following constituents
(i) Carbohydrates
(ii) Lipids
(iii) Proteins and Amino acids
(iv) Phenols
(v) Flavonoids
(vi) Anthraquinones
(vii) Alkaloids
(viii) Terpenoids
(xi) Glycosides
(x) Saponins</td><td>3</td><td>1</td></tr>
<tr><td>3.</td><td>Quantitative estimation of proteins (Lowry’s method).</td><td>3</td><td>2</td></tr>
<tr><td>4.</td><td>Quantitative estimation of carbohydrates (Anthrone method).</td><td>3</td><td>2</td></tr>
<tr><td>5.</td><td>Quantitative estimation of phenols (Singleton and Rossi’s method).</td><td>3</td><td>2</td></tr>
<tr><td>6.</td><td>Isolation and partial purification of phytoconstituents (Phenol and Flavonoids) using Chromatographic techniques (TLC)</td><td>6</td><td>2</td></tr>
<tr><td colspan="4">Reference Books:</td></tr>
<tr><td>1.</td><td colspan="3">Kokate, C.K., Purohit, A.P. andGokhsale, S.B. 2008. Phytochemical Methods.NiraliPrakasham, Pune</td></tr>
</table>

COURSE OUTCOMES (CO)

After completion of the course the student will be able to:

CO1	Extract and screen the presence of various plant metabolites
CO2	Quantify the presence of biomolecules and secondary metabolites in samples

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PBTMBI301	MDC II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER III

Course Objectives

The course aims

To understand the basic techniques in Animal cell culture.

Credits: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	Introduction to Animal cell culture, Applications of cell culture, Designing the cell culture laboratory – washing and sterilization area, Storage area and cell culture room, Equipments in tissue culture laboratory – Inverted Microscope, Centrifuge, Laminar flow benches, CO2 incubator.	06	CO1
II	Glass ware and other plastic ware in tissue culture Substrate materials for growing cells, cell culture vessels, culture media – Properties and special requirements, Complete media, Conditioned media.	06	CO2
III	Type of cell culture - Isolation of primary explants culture, Isolation of cells and disaggregation method cell culture, organ culture.	06	CO3
IV	Cell culture-Transformation, Differentiation and Dedifferentiation, Growth curve of cells, Types of microbial contamination, Stem cell culture.	06	CO4
V	Applications of Animal cell culture technology– Somatic cell fusion, Transgenic fish and sheep.	06	CO5

Reference Books:

1. *Sudha Gangal*, 2010. **Principles and Practice of Animal Tissue Culture**. [Second Edition]. University Press (India) Pvt. Ltd.
2. *Freshney, R.I.* 2005. **Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After the completion of the course the student will be able to

CO1	Handle animal cells and familiar with instruments
CO2	Prepare animal tissue culture media for culturing animal cells
CO3	Disaggregate the animal tissues
CO4	Differentiate cells and stem cells
CO5	Apply the animal cell culture technology in day to day life

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	H	H	M	H	M	H
CO2	H	M	M	H	H	H	M	H	M	H
CO3	H	M	M	H	H	H	M	H	M	H
CO4	H	M	M	H	H	H	M	H	M	H
CO5	H	M	M	H	H	H	M	H	M	H
H – High; M- Medium; L - Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PBTMBIP301	MDC PRACTICAL II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER III

Course objectives:

The Course aims

- To get hands on experience on Animal cell culture.

Credits: 02 **Total Hours: 20**

Experiment	CONTENTS	Hrs	CO
1.	Sterilization techniques in Animal cell culture	**06**	**CO1**
2.	Media preparation for Animal cell culture	**06**	
3.	Primary culture of Chick embryo fibroblast	**03**	**CO2**
4.	Trypsinization and subculturing	**06**	
5.	Determination of viability of cells using Trypan blue stain.	**03**	**CO3**

Reference Books:

1. *Freshney, R.I.*2005. **Culture of Animal cells: A manual of basic technique**. [Fifth edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Sterilize the media and utensils for Animal cell culture.
CO2	Cultivate the animal cells and maintain it for further studies.
CO3	Analyze viable cells.

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM401	DSC XI : INDUSTRIAL MICROBIOLOGY	SEMESTER IV

Course Objectives:

The course aims

- To acquire an overview about the industrial processes.
- To understand the design of fermenters and its components.

Credits: 05 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Fermentation Process:** Introduction and economic importance of fermentation process. Screening of potential microorganisms– Primary Screening – Secondary Screening. Preservation of microorganisms.	10	CO1
II	**UpStream Processing:** Strain Improvement: Mutation – ionizing and non-ionizing radiation: rDNA technology. Strain development technique – bacteria, fungi and yeast. Medium formulation and optimization. Sterilization – Batch and Continuous. Del factor. Types of fermentation – Submerged – Solid State fermentation.	10	CO2
III	**Fermentor:** Body construction – aeration and agitation. Maintenance of aseptic conditions – sterilization of fermentor, sterile air supply, mass and heat transfer. Types of fermentor. Measurement and control - Temperature, pH, foam and pressure.	10	CO3
IV	**Production and Purification of Microbial Products**: Antibiotics: (Penicillin and Streptomycin), Organic acids : (Citric acid and Lactic acid), Enzymes: (Amylase and Protease), Beverages: (Beer and Wine). Aminoacids: (Tryptophan and Aspartic acid). Vitamins – $B_{12.}$	10	CO4
V	**Downstream Processing and Product Recovery:** Intracellular products: Cell disruption methods – Mechanical, Physical Chemical. **Extracellular products:** Solid to Liquid Separation: Flotation, Flocculation, Filtration and Centrifugation – Concentration: Evaporation - Liquid – Liquid Extraction: Membrane filtration, Precipitation-Purification - Chromatography, Formulation: Drying, Freeze drying and Crystallization.	10	CO5

Text Books:

1.	*Stanbury, P.F., Whittaker, A. and Hall, S.J.* 1997. **Principles of Fermentation Technology.** [Second Edition]. Reed Elsevier India Pvt. Ltd., New Delhi.
2.	*Patel, A.H., 2005*. **An Introduction to Industrial Microbiology.** Macmillan India Ltd., Chennai.
Reference Books:	
1.	*Michael J Waites, John S Roackey, Neil L. Morgan and Garry Highton.* 2006. **Industrial Microbiology – An Introduction**. Blackwell Science Ltd., USA.
2.	*Cruegar, W and Cruegar, A.* 1989. **Biotechnology**: **A Textbook of Industrial Microbiology**. Panima Publishing Corporation, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand and screen the industrially important microorganisms.
CO2	Develop strain improvement and media formulation.
CO3	Demonstrate the design and maintenance of the fermenter.
CO4	Optimize production and purification of microbial products.
CO5	Apply the recovery process for purification of intra and extra cellular products

MAPPING

PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	M	H	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M
CO4	M	H	H	H	H	M	H	H	H	H
CO5	M	M	H	H	H	M	M	H	H	H

H – High; M- Medium; L - Low

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBM402	DSC XII : FOOD AND DAIRY MICROBIOLOGY	SEMESTER IV

Course Objectives:

The course aims

- To understand the basic concepts of contamination, spoilage and preservation of food.
- To acquire an overview about food borne infections and intoxications.
- To learn about the fermented food products.

Credits: 04 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Introduction to Food Microbiology:** Importance of food and dairy Microbiology– Types of microorganisms in food – Source of contamination (primary sources) – Factors influencing microbial growth in foods (extrinsic and intrinsic).	10	CO1
II	**Spoilage and Preservation of Different Kinds of Foods:** Cereals and cereal products– Milk and milk products – Vegetable and fruits– Meat and meat products– Fish and eggs.	10	CO2
III	**Food Borne Infections and Intoxications:** Bacterial, non-bacterial (*Staphylococcus*, *Clostridium*, *Escherichia coli* and *Salmonella* infections) Hepatitis, Amoebiosis and Mycotoxins – Food borne disease outbreaks– Laboratory testing– preventive measures.	10	CO3
IV	**Food Preservation and Fermented Food Products:** Principles of food preservation–methods of preservation. Biopreservation of foods. Physical methods and Chemical preservatives. Production of fermented food products - Bread, Sauerkraut, cheese, Yoghurt, Buttermilk, Kefir, Dahi, Wine and Tempeh.	10	CO4
V	**Food Quality Indicators:** Food standards, Food Safety, Security and Agencies (India and Foreign countries). HACCP, SOP, ISO, FDA and FSSAI methods in food quality assessment – Microbial quality, toxin detection and Adulterant detection. Food sanitation and its control. AIML applications in food industry.	10	CO5

Text Book:	
1.	*Frazier, W.C. and Westhoff, D.C.* 2024. **Food Microbiology**. [Sixth Edition]. Tata Mc Graw-Hill Publishing Company Limited, New Delhi.

Reference Books:	
1.	*Banwart, G.J.*2020. **Basic Food Microbiology.** Chapman and Hall New York.
2.	*Jay,J. M.* 2021. **Modern Food Microbiology**. CBS Publishers and distributors, New Delhi
3.	*Adams, M.R. and Moss, M.O.* 2025. **Food Microbiology.** The Royal Society of Chemistry, Cambridge.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Discuss importance of food and dairy microbiology.
CO2	Understand the spoilage and preservation of food products.
CO3	Analyze food borne infections and intoxications.
CO4	Demonstrate different kinds of food preservation methods for product safety.
CO5	Evaluate the food quality standards.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	M	H	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	M	H	M	H	H	M	H	M	H
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H – High; M- Medium; L - Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project Viva-voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

A). THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each theory paper with a passing minimum of 38 marks in External out of 75.

Internal Marks Distribution [CA- Total Marks: 25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

(B) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

(C) PROJECT WORK

- The project work shall be carried out by each student in the IV semester and has to complete the work at the end of the Semester.

- Upon completion of the project work the candidate will be required to appear for a Viva-Voce conducted by an external examiner.
- The Student has to attend 2 reviews before completing his/her Project.
- Two reviews will be reviewed by internal members
- Final project Viva-Voce examination conducted by an external examiner.
- A candidate failing to secure the prescribed passing minimum in the dissertation shall be required to resubmit the dissertation with the necessary modifications.

MARK DISTRIBUTION PATTERN

Continuous Assessment (CA) : 40 Marks
Comprehensive Examination (CE) : 60 Marks

- The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in Project with a passing minimum of 30 marks in External out of 60.

Mark Distribution Pattern

Internal Mark Distribution

Continuous Assessment (CA) Total Marks: 40

1.	Attendance	:	10 Marks
2.	Review (2)	:	20 Marks
3.	Presentation	:	10 Marks
Total		**:**	**40 Marks**

External Mark Distribution

Comprehensive Examination (CE) Total Marks: 60

1.	Research work done	:	20 Marks
2.	Project report	:	20 Marks
3.	Presentation	:	10 Marks
4.	Viva-Voce	:	10 Marks
Total		**:**	**60 Marks**

Question paper pattern for DSC practical

(Maximum marks: 60) Time: 6 Hours

Experiment–I (Major)	- 30 Marks
Experiment–II (Minor)	- 15 Marks
Spotters (5 x3)	- 15 Marks
Total	**- 60 Marks**

MDC PRACTICALS

Comprehensive Examination (CE): 60 Marks
Continuous Assessment (CA): 40 Marks

Question paper pattern for MDC practical

(Maximum marks: 60)	**Time: 3 Hours**
One experiment (1x30)	: 30 Marks
Spotters (10x2)	: 20 Marks
Viva Voce	: 10 Marks
Total	**: 60 Marks**

QUESTION PAPER PATTERN AND MARK DISTRIBUTION

THEORY

Question Paper Pattern and Mark Distribution **(For 75 marks)**

1. PART – A (10 x 1 = 10 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

2. PART – B (5 x 5 = 25 Marks)

Either or type questions

One question from each UNIT with Internal Choice

2. PART – C (5 x 8 = 40 Marks)

Either or type questions

One question from each UNIT with Internal Choice

AEC: CCS (100 % Internal Evaluation)

CCS Internal Marks Distribution [CA – Total Marks: 100]

Attendance	:	10 marks
Assignment / Listening / Speaking	:	50 Marks (5 Assignments Compulsory)
Class Test	:	40 Marks (2 Test Compulsory)
Total	**:**	**100 Marks**

The candidate shall be declared to have passed the examination if he / she secured at least 40 marks for PG programme, out of a total of 100 marks.

MDC COURSES OFFERED

S.NO.	SUBJECT CODE	SEMESTER	SUBJECT	OFFERED TO THE STUDENTS OF
1.	24PMBBCI201/ 24PMBBTI201	II	MDC I: Clinical Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology
2.	24PMBBCIP201/ 24PMBBTIP201		MDC Practical I: Clinical Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology
3.	24PMBBCI301/ 24PMBBTI301	III	MDC II: Industrial Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology
4.	24PMBBCIP301/ 24PMBBTIP301		MDC Practical II: Industrial Microbiology	M.Sc. Biochemistry/ M.Sc. Biotechnology

24PMBBCI201/ 24PMBBTI201	**MDC I: CLINICAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

- To enable the learners to know basics in clinical Microbiology.
- To learn the diagnosis of infectious diseases.
- To know about the modern approaches in clinical microbiology.

Credits: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Infection: S**ources of infection - transmission of infection - types of infection. Classification of microbes based on hazard – Types of diseases - disease carriers.	06	CO1
II	**Collection and transport of clinical specimens**: urine, pus, faeces, sputum and blood.	06	CO2
III	**Microbiological examination of samples:** sputum, pus, faeces and urine. Diagnosis of anaerobic infections.	06	CO3
IV	**Serological diagnosis of microbial diseases:** Antigen tests- Agglutination test for pregnancy, Elek's gel precipitation test, ELISA. Antibody tests - WIDAL, ASO. Monoclonal antibodies in clinical microbiology.	06	CO4
V	**Molecular diagnosis of infectious diseases:** tuberculosis, malaria, AIDS. RFLP as a molecular marker in disease diagnosis.	06	CO5

Text Books:

1. *Ananthanarayan, R. and Jayaram Paniker, C.K*. 2022. **Text book of Microbiology**. [Twelfth edition]. University Press (India) Private Limited, Hyderabad.
2. *Monica Cheesbrough* 2006. **Medical Laboratory Manual for Tropical countries**. Volume II: Microbiology. ELBS Publishers.
3. *Sathyanarayana, U*. 2020. **Biotechnology**. Books and Allied (P) Ltd, Kolkatta.

Reference Books:	
1.	*Jawetz,E, Melnic,J.K. and Adelberg, E.A.* 1998. Review of Medical Microbiology, Lange Medical Publications, U.S.A.

COURSE OUTCOMES (CO)

On completion of this course the students will be able to

CO1	Evaluate the infectious disease caused by microorganisms.
CO2	Apply the methods of collection and processing of clinical samples.
CO3	Apply the preliminary detection of pathogens for disease diagnosis.
CO4	Assess the serological detection of pathogens.
CO5	Develop diagnose the disease based on molecular methods.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	H	M	H	H	M	H	H	H
CO2	M	H	H	M	H	H	M	H	H	H
CO3	M	H	H	M	H	H	M	H	H	H
CO4	M	H	H	M	H	H	M	H	H	H
CO5	M	H	H	M	H	H	M	H	H	H
H – High; M- Medium; L – Low										

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBBCIP201/ 24PMBBTIP201	**MDC PRACTICAL I: CLINICAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To learn the basic techniques in clinical microbiology.
- To acquire knowledge on identification of clinical pathogens.

Credits: 02 **Total Hours: 24**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Colony morphology of pathogenic bacteria on selective media.	**3**	**CO1**
2.	Morphological characterization of pathogenic bacteria by differential staining.	**6**	**CO1**
3.	Identification of pathogenic bacteria by preliminary test, biochemical test and special test. a)*Staphylococcus aureus* b) *Pseudomonas aeruginosa*	**6**	**CO1**
4.	Culture methods of fungi i. Media usage–PDA, SDA, Corn meal agar	**3**	**CO2**
5.	Examination of fungi by Lactophenol cotton blue stain.	**3**	**CO2**
6.	Examination of *Candida albicans* - Gram's stain, Germ tube test.	**3**	**CO2**

Reference Books:

1.	*Gerald Collee, J. Barie P. Marmion, Andrew, G. Fraser and Anthony Simmons*. 1996. **Mackie and MacCartney Practical Medical Microbiology.** Fourteenth edition. Churchill Livingstone Publishers.
2.	*Sundararaj, T.* **Microbiology Laboratory Manual.** Dr.A.L.Mudaliyar Post Graduate Institute of Basic Medical Sciences, Chennai.

COURSE OUTCOMES (CO)
On completion of this course the students will be able to

CO1	Identify and detect the pathogenic bacteria based on the morphological and physiological studies.
CO2	Evaluate the mycological diseases.

Prepared By **Approved By**

(Course Coordinator) **(BoS Chairman)**

24PMBBCI301/ 24PMBBTI301	MDC II: INDUSTRIAL MICROBIOLOGY	SEMESTER III

Course Objectives:

The course aims

1. To learn the basics of bioprocess techniques.
2. To know about fermentor design and production of various fermented products.

Credits: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**An Introduction to Fermentation Process:** Historical development of industrial microbiology– Component parts of a fermentation process – Screening of industrial microorganisms– primary screening – Crowded plate method, auxanography, indicator dye and enrichment. Secondary screening. Preservation of microorganisms - lyophilization, cryogenic storage.	06	CO1
II	**Strain Improvement and Media Formulation:** rDNA technology. Medium formulation and sterilization – batch, continuous. Types of fermentation –submerged – solid state fermentation.	06	CO2
III	**Fermentor:** Components and parts of fermentor – Body construction - stirring and mixing – scale up window – control of pH, temperature, foam and pressure – types of bioreactors – Air lift and cylindro conical bioreactors.	06	CO3
IV	**Microbial Production of Fermented Products**: Antibiotics – Penicillin. Organic acid – Citric acid. Vitamin – Vitamin B12. Enzyme – α-amylase. Wine.	06	CO4
V	**Downstream Processing:** Intracellular products: Cell disruption methods – Mechanical, Physical Chemical. **Extracellular products:** Solid to Liquid Separation: Flotation, Flocculation, Filtration and Centrifugation – Concentration: Evaporation - Liquid –Liquid Extraction: Membrane filtration, Precipitation- Purification - Chromatography, Formulation: Drying, Freeze drying and Crystallization.	06	CO5

Text Books:	
1.	*Stanbury, P.F., Whitaker, A., and Hall, S.J.,* 2012. **Principles of Fermentation technology.** Reed Elsevier India Ltd., New Delhi.
2.	*Patel, A.H.,* 2022. **An Introduction to Industrial Microbiology.** MacMillan India Ltd., Chennai.

Reference Books:	
1.	*Michael J Waites, John S Roackey, Neil L. Morgan and Garry Highton.* 2006. **Industrial Microbiology – An Introduction**. Blackwell Science Ltd., USA.
2.	*Hugo, W.B. and Russell, A.D.* 2023. **Pharmaceutical Microbiology.** [Ninth Edition]. Blackwell Scientific Company Ltd., USA.

COURSE OUTCOMES (CO)

After the completion of the course the student will be able to

CO1	Recall the basics and importance of industrially important microbes.
CO2	Apply the techniques for the formulation of media for microbial products.
CO3	Develop the suitable conditions for maximum product yield.
CO4	Apply fermentation technology for production of microbial products.
CO5	Demonstrate chemotherapeutic drugs production under *in vitro* conditions.

MAPPING										
PO &PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	M	H	H	M	H	H	H
CO2	M	H	M	M	H	H	M	H	H	H
CO3	M	H	M	M	H	H	M	H	H	H
CO4	M	H	M	M	H	H	M	H	H	H
CO5	M	H	M	M	H	H	M	H	H	H
H – High; M- Medium; L - Low										

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(Course Coordinator) **(BoS Chairman)**

24PMBBCIP301/ 24PMBBTIP301	**MDC PRACTICAL II: INDUSTRIAL MICROBIOLOGY**	**SEMESTER II**

Course Objectives:

The course aims

- To learn the basic techniques in industrial microbiology.
- To acquire knowledge on antibiotics and its susceptibility.

Credits: 02 **Total Hours: 24**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Screening of antibiotic producing organisms from soil.	**3**	**CO1**
2.	Screening of amylase enzyme producing organisms from soil.	**3**	**CO1**
3.	Antibiotic sensitivity disc preparation.	**3**	**CO1**
4.	MIC determination by filter paper disc assay.	**3**	**CO2**
5.	Antibiotic susceptibility method - Kirby Bauer method.	**3**	**CO2**
6.	Evaluation of disinfectant - Phenol Coefficient method.	**3**	**CO2**
7.	Wine production and Estimation	**6**	**CO2**

Reference Books:

1. *Gerald Collee, J. Barie P. Marmion, Andrew, G. Fraser and Anthony Simmons*. 1996. **Mackie and MacCartney Practical Medical Microbiology.** Fourteenth edition. Churchill Livingstone Publishers.
2. *Sundararaj, T.* **Microbiology Laboratory Manual.** Dr.A.L.Mudaliyar Post Graduate Institute of Basic Medical Sciences, Chennai.

COURSE OUTCOMES (CO)

After completion of the course, the students' will be able to

CO1	Assess antibiotic and enzyme production and produce industrially important products.
CO2	Evaluate the susceptibility of antibiotics and disinfectants.

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(Course Coordinator) **(BoS Chairman)**