M. Sc. Microbiology

Syllabus

AFFILIATED COLLEGES

Program Code: 32L

2021 – 2022 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000,Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Programme Educational Objectives (PEOs)	
The **M. Sc. Microbiology** program describe accomplishments that graduates areexpected to attain the following:	
PEO1	To provide an excellence in their microbiology subject along with research
PEO2	To expertise in the fields of clinical microbiology and also quality controller in industries
PEO3	The students shall become an industrialist and also an entrepreneur commercializing his own microbial product
PEO4	To provide the students with subject proficiency, environmental awareness, ethical codes and guidelines, along with life education for a successful professional career.

Programme Specific Objectives (PSOs)	
After the successful completion of **M. Sc. Microbiology degree course, the students are able to**	
PSO1	Recollect the fundamental aspects in the various branches of Microbiology, which enable them to be familiar with emerging and advanced scientific concepts in life sciences
PSO2	Implement the obtained conceptual knowledge through connecting interdisciplinary areas of Microbiology
PSO3	Evaluate the necessity and its effectiveness of scientific application towards the development of society
PSO4	Analyze the advancement in Microbiology in research aspects which lead to new inventions
PSO5	Create innovative ideas in technical areas of Microbiology, to become an industrialist, entrepreneur and a good citizen to the nation

Programme Outcomes (POs)	
On successful completion of **M. Sc. Microbiology degree course, the students are able to**	
PO1	Acquire knowledge on microorganisms and its significance in various fields of microbiology
PO2	Focus on innovation and entrepreneurial thinking to be successful in a rapidly changing world.
PO3	Develop knowledge in qualitative, quantitative, analytical skills and Fulfill the necessity of Life Sciences stream through clearing NET/ SLET and other competitive exams.
PO4	Conquer the novel and recent techniques to compete with the societal needs.
PO5	Impart knowledge on progressing issues and its significance on ethical thinking.
PO6	Manipulate the microbes using various molecular biology techniques for the benefit of living organisms.
PO7	Scale up production of microbial metabolites using industrially important microorganism adopting bioprocess technology
PO8	Apply bioinformatics tools for analyzing molecular biology data of Microbes
PO9	Understand the Synthesize of Nano-materials and the impact on microbiological applications.
PO10	Understand the importance of artificial intelligence and machine learning in microbiology and allied applications.

Template for Scheme of Examination

BHARATHIAR UNIVERSITY, COIMBTORE: 641 046

M.Sc. MICROBIOLOGY SCHEME OF EXAMINATION (CBCS PATTERN)

(Affiliated Colleges)

(For the students admitted during the academic year 2021-2022 Batch onwards) To Adopt OBE Only

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
	Fundamentals of Microbiology	4	5		50	50	100
	Microbial Physiology and Biochemistry	4	5		50	50	100
	Applied Biotechniques	4	5		50	50	100
	Environmental and Agricultural Microbiology	4	5		50	50	100
	Practical I	-	-	5	-	-	-
	Elective - Paper I	4	5		50	50	**100**
	Total	20	25	5	250	250	**500**
SECOND SEMESTER							
	Molecular Genetics	4	5		50	50	100
	Microbial Food Technology	4	5		50	50	100
	Bioprocess Technology	4	5		50	50	100
	Gene Manipulation and Bioinformatics	4	5		50	50	100
	Practical I	4	-	-	50	50	100
	Practical II	4	-	5	50	50	**100**
	Elective - Paper II	4	5		50	50	100
	Total	**28**	25	5	**350**	**350**	**700**
THIRD SEMESTER							
	Immunology and Immuno technology	4	5		50	50	100
	Medical Microbiology	4	5		50	50	100
	Biotechnology and IPR	4	5		50	50	100
	Bionanotechnology	4	5		50	50	100
	Biostatistics and Research Methodology	4	5		50	50	100
	Practical III	-	-	5	-	-	-
	Total	**20**	25	5	**250**	**250**	500

FOURTH SEMESTER							
	Elective - Paper III	4	4		50	50	100
	Practical III	4		5	50	50	100
	Project and viva- voce	8		16	100	100	200
	Industrial training /Internship and viva- voce @	2		-		-	50
	Elective - Paper IV –Practical	4		5	50	50	100
Total		22	**4**	26	250	250	**550**
Grand Total		**90**					**2250**
ONLINE COURSES							
	SWAYAM – MOOC – Online Course*	2					50
		Non-scholastic with Credits					

List of Group Elective papers (Colleges can choose any one of the Group papers as electives)

	GROUP A	**GROUP B**	**GROUP C**
Paper I/Sem I 1EA/1EB/1EC	Artificial Intelligence For Biological Sciences	Artificial Intelligence ForBiological Sciences	Artificial Intelligence ForBiological Sciences
Paper II/Sem II 2EA/2EB/2EC	Principles of Quality Assurance and Total QualityManagement (TQM)	Communicable and Non communicable diseases	Biophysics and Biochemistry
Paper III/Sem IV 4EA/4EB/4EC	Quality Assessment in Pharmaceuticals	Health care of thecommunity	Molecular Cytology and Tissue Engineering
Paper IV/Sem IV 4EPA/4EPB/4EPC	Quality Assurance and Assessment	Water Analysis and Health Care	Techniques in Cytology

List of Value Added Courses offered (Colleges/Departments can choose anyone of the papers in each/respective semester as Valued Added Course)

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
Odd Semester (I)	20PMBVAC1	Organic Farming	2	3	50	2
	20PMBVAC2	HACCP – Level 1 and 2	2	3	50	2
	20PMBVAC3	Human Anatomy and Medical Transcription	2	3	50	2
	20PMBVAC4	Introduction to Clinical research & Pharmaceutical medicine	2	3	50	2

Odd Semester (III)	20PMBVAC5	Basics in Bioinformatics	2	3	50	2
	20PMBVAC6	HACCP – Level 3	2	3	50	2
	20PMBVAC7	Medical Coding & Clinical data management	2	3	50	2
	20PMBVAC8	Entrepreneurial Microbiology	2	3	50	2

First Semester

Course code	13A	M. Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER I – FUNDAMENTALS OFMICROBIOLOGY	4	1	-	4
Pre-requisite		Basic Knowledge about Microbes	Syllabus Version		2021 - 2022	

Course Objective:

To provide the students with the foundation of the microbiology including bacteriology, phycology, mycology and virology.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire basics and importance of Microbiology	K1
2	Perform Microscopy, staining, and characterization of microbes	K3
3	Describe the classification of Bactria	K2
4	Know in detail the characteristic features of algal and fungal classification	K2
5	Gain insights into the important characters for classification of animal viruses	K2

K1 - Remember; **K2** - Understands; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	HISTORY AND DEVELOPMENT	13 hours

Spontaneous generation, Conflict - Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Winogradsky, Paul Ehrlich, Lederberg &Zinder, Lwoff, Arber & Smith, Temin & Baltimore, Montaigner and Galo.

Unit:2	MICROSCOPY AND STAINING	15 hours

Microscopy: Principle and working of Bright field, Dark field, Phase Contrast, Fluorescence, Confocal scanning microscope and Electron (TEM, SEM) microscopes.**Staining:** Simple, Gram, Negative, Capsule, Spore staining, Flagellar, Nuclear staining, Acid fast and Fungal staining.

Unit:3	BACTERIAL TAXONOMY	15 hours

Domains and kingdoms of life - Bacterial Nomenclature – Classification of bacteria by physiological, metabolic, serological and molecular methods - Bergey's manual of systematic bacteriology with general characteristics of each division - Numerical taxonomy - 16S rRNA based classification.

Unit:4	CLASSIFICATION OF ALGAE AND FUNGI	15 hours

General characteristics and classification of algae (Fritsch). Structure and reproduction of *Chalmydomonas* sp. General characteristics and classification (Alexopolus) of fungi. Structure and reproduction of *Aspergillus niger* and *Saccharomyces cerevisiae*. General characteristics and classification of Protozoa. Structure and reproduction of Paramecium sp.

Unit:5	TAXONOMY OF VIRUSES	15 hours

General properties and Classification of Viruses. Cultivation of plant and animal viruses – Characterization and Enumeration of viruses – Quantitative assay. General properties, structure, genome replication, protein synthesis and assembly of: DNA containing plant viruses – CaMV and Gemini Virus - RNA containing plant viruses - TMV, Cowpea mosaic viruses.

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Atlas, R.M., 1997. Principles of Microbiology 2nd Ed. WCB McGraw Hill Publications, New Delhi.
2	Black, J.G., 1999. Microbiology: Principles and Explorations 4th Ed.., Prentice Hall International, Inc.
3	Presscott, L.M., Harley, J.P. and Klein, D.A., 2005. Microbiology. 6th Ed.., TATA McGraw Hill, New Delhi.
4	Alcamo E. 2001. Fundamentals of Microbiology. 6th Ed., Jones and Bartlett Publishers, New Delhi.
5	Salle A J. 2001. Fundamentals and Principles of Bacteriology. 7th Ed., Tata MC Graw Hill, New Delhi.
Reference Books	
1	Madigan M.T, Martinko J M, Dunlap P V and Clark. D P. 2008. Brock Biology of Microorganisms. 12th Ed. Pearson/ Prentice Hall.
2	Hayes. W. 1968. The Genetics of Bacteria and their Viruses.
3	Lee, R. E. 2008. Phycology. Cambridge University Press
4	DM Knipe, PM Howley. 2007. Fields Virology. 5th Edition. ippincott Williams & Wilkins Health
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://ecoursesonline.iasri.res.in/course/view.php?id=108
2	https://microbenotes.com/classification-of-fungi/
3	https://www.onlinebiologynotes.com/classification-of-bacteria/
Course Designed By: **Dr. R. Vijayaraghavan**	

Mapping with Programme outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	L	L	L	L	M	L	M	L	M
CO2	M	S	M	M	M	M	L	M	L	M
CO3	M	M	M	L	M	L	M	L	M	L
CO4	M	M	M	L	M	M	L	M	M	L
CO5	M	M	M	L	M	L	M	L	M	M

*S-Strong; M-Medium; L-Low

Course code	13B	M.Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER II - MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY	4	1	-	4
Pre-requisite		Fundamentals of cell organelles	Syllabus Version		2021 - 2022	

Course Objectives:

1. Introduce conceptual idea on physiology of the microorganism
2. Develop knowledge on the role of enzymes and its mechanism
3. Impart knowledge on the biosynthetic pathways to understand microbial role in beneficial and harmful effects

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the ultrastructure of prokaryotic and eukaryotic cells and apply the same in laboratory and research	K1& K3
2	Comprehend the role of nutrients in microbial growth and their uptake mechanism, understand growth kinetics and growth influencing factors	K2
3	Understand carbohydrate metabolism, respiration and fermentation	K3
4	To categorize on the types of enzymes and their mechanism	K4
5	To prioritize the importance of biosynthesis of macromolecules	K5

K1 - Remember; **K2** - Understands; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	CELL STRUCTURE AND ORGANIZATION	13 hours

Microbial cell – Ultra structure of Prokaryotic and Eukaryotic cell – Differences between prokaryotic and eukaryotic cells – Slime layer, Capsules, Pili, Flagella - Sub-cellular organelles – structure and function - cell envelope, cytoplasm, nucleus, nuclear envelope, mitochondria, endoplasmic reticulum, Golgi Complex, ribosomes, lysosomes - Endospores, Cell membrane – Liposomes –Extremophiles - Archaebacteria – Adaptations to extreme environments.

Unit:2	MICROBIAL NUTRITION AND GROWTH	15 hours

Nutritional grouping of Microorganisms - Phototrophs, Chemotrophs, Autotrophs, Heterotrophs, Lithotrophs and Organotrophs. – Uptake of nutrients by the cell – Facilitated diffusion – Active transport – Group translocation, Iron uptake - Pinocytosis and Phagocytosis - Photosynthesis - Oxygenic and Anoxygenic. – Assimilation of CO_2 - Calvin cycle - Common nutrient requirements, Growth factors – Microbial growth – Growth curve – Measurement of microbial growth. Growth kinetics – Batch, Continuous and Synchronous cultures. Factors influencing the growth of microorganisms.

Unit:3	RESPIRATION AND FERMENTATION	15 hours

Carbohydrate metabolism – EMP, HMP and ED pathway – Kreb"s Cycle – Glyoxylate cycle – Aerobic respiration – Substrate level and Oxidative phosphorylation – ATP generation. Lipid catabolism – β-oxidation. Anaerobic respiration – Sulphur compounds – Nitrate and Carbon -di - oxide as electron acceptors. Fermentation.

Unit:4	ENZYMES CLASSIFICATION AND KINETICS	15 hours

Enzymes and co–enzymes: IUBMB classification and nomenclature of enzymes, active site, Lock and key Mechanism and induced fir hypothesis, Enzyme kinetics - enzyme inhibition: Reversible – Competitive, Noncompetitive, uncompetitive, Irreversible inhibition.

Unit:5	BIOSYNTHESIS OF MACROMOLECULES	15 hours
Protein structures, Biosynthesis – Aminoacids: Aspartic and serine families. Fatty acid synthesis, Nucleotide biosynthesis- Bioluminescence.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Microbiology. 7th edition, 2008. Prescott LM, Harley JP and Klein DA. McGraw Hill, Newyork.
2	Caldwell. D.R. 1995. Microbial Physiology and metabolism, Wm C. Brown Publishers.
3	Moat. A.G. and Foster. J.W. 1988. Microbial Physiology, John Wily sons. White J.D. Motteshead. D.W. Harrison S.J. Enivronmental system 2ed. 1992.
4	Stainier R.Y. Ingraham,J.L. Wheolis, H.H. and Painter. P,R. 1986. Microbiology.
5	Principles of Biochemistry – Lehninger, Nelson, Cox, CBS publishers.

Reference Books

1	Brock Biology of Microorganisms, 15th edition, 2017. Michael M. Madigan, Kelly S. Bender, Daniel H. Buckley, W Matthew Sattley, David A. Stahl, Published by Pearson
2	The Physiology and Biochemistry of Prokaryotes, 4th Edition, 2011. David White, James Drummond, and Clay Fuqua, Oxford University Press.
3	Protein Structure, Stability and Folding by Kenneth P. Murphy. Published by Humana Press Inc. 2001

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
2	http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	M	M	M	S	S	L	M
CO2	S	S	M	M	M	L	M	M	M	L
CO3	S	M	M	S	M	M	S	L	M	L
CO4	M	M	S	M	S	L	M	S	M	L
CO5	S	S	L	S	S	L	S	L	M	M

*S-Strong; M-Medium; L-Low

Course code	13C	M.Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER III - APPLIED BIOTECHNIQUES	4	1	-	4
Pre-requisite		Aware on Bioinstrumentation	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. Make the students know about the principle behind the instruments and to acquaint them with the fundamentals of research methods.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To help the students to identify the physical and chemical characters of macromolecules	K1
2	To facilitate the students with the principles and applications of the various techniques	K3
3	To apply their knowledge in principles and instrumentation of centrifugation	K3
4	To implement the instrumentation of chromatography	K3
5	To determine the principle and instrumentation of electrophoresis.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	FUNDAMENTALS OF MACROMOLECULES	15 hours

Fundamental building blocks – Atoms – Bonds and molecules. Macromolecules – Chemical nature and functions of Carbohydrate, Lipids, Proteins and Nucleic acids. Radioisotopes – Measurement, uses and safety aspects. Autoradiography, GM counters, Scintillation – Instrumentation and applications.

Unit:2	COLORIMETRY	15 hours

Principles, Instrumentation and Applications– Beer Lambert"s law and deviation – Analysis – Qualitative and Quantitative. Basic principles of spectrophotometry: The laws of absorption, principles and instrumentation for UV- visible and IR spectroscopy. Principles, theory and applications of spectrofluorometry, and Flame photometry, NMR, 3D structure by x- ray diffraction, ESR - Principles, Instrumentation and Applications. Analysis – Qualitative and Quantitative.

Unit:3	CENTRIFUGATION	15 hours

Principles – Instrumentation – Types – Methods and Factors affecting sedimentation co-efficient – Applications

Unit:4	CHROMATOGRAPHY	15 hours

Principles, Instrumentation, Types and Detection methods – Paper, TLC, HPLC, GC (CGMS/ LCMS), Ion-exchange, Column, Gel permeation, Chiral, Hydroxyapatite, Immuno adsorption and Affinity Chromatography – Applications.

Unit:5	ELECTROPHORESIS	15 hours

Principles, Instrumentation, Types. Staining and Detection methods – Isoelectrophoresis – isoelectric focusing – Applications. Mass spectrometry based methods for protein identification, MALDI-TOF, 2D gel electrophoresis.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	75 hours

Text Book(s)	
1	Physical Biochemistry: David Freifelder.
2	Practical Biochemistry, Boyer
Reference Books	
1	Practical Biochemistry, Keith Wilson and John Walker, 4ed . 1994
2	Foundation in Microbiology, Kathleen Talaro and Arthur Talaro, WCB Publishers. 1993.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.biopharmainstitute.com/course/GLP06
2	https://study.com/academy/topic/equipment-instrumentation-for-microbiology-labs.html
Course Designed By: **Ms. N.Gunasheela**	

Mapping with Programme outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	M	M	M	L	M
CO2	S	S	M	S	M	M	S	L	M	L
CO3	S	M	S	M	S	S	S	M	M	M
CO4	S	S	M	S	S	S	S	M	L	L
CO5	S	S	S	M	S	S	M	L	M	L

*S-Strong; M-Medium; L-Low

Course code	13D	M.Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER IV- ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	4	1	-	4
Pre-requisite		Basic knowledge about the importance of microbes in Agriculture	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:
1. To give hands-on experience on isolation and characterization on environmental microbiology.
2. This paper is designed with the objective to impart hand-on experience and laboratory skills to students in the area of soil microbiology.
3. The practical structure is designed so that solid waste treatment.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To make the students understand the contemporary issues associated with environmental microbiology	K2
2	To understand the significance of soil microorganisms and their impact in environment	K2
3	To make the students capable of applying fundamental principle of microbiology to waste water treatment	K3
4	To facilitate the students understand microbial ecology and community development	K2
5	To facilitate understanding about analysis and treatment of hazardous and non hazardous solid wastes and treatment	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	AEROBIOLOGY	15 hours

Microbial contamination of air-Sources of contamination-Biological indicators of air pollution. Enumeration of bacteria from air, Air sampling devices. Significance of air Microflora, Outline of Airborne diseases (Bacterial - Whooping cough, Diphtheria, Pneumonia; Fungal - Aspergillosis, Cryptococcosis; Viral – Chickenpox, Influenza, Measles), Air sanitation. Effect of Air pollution on plants and Humans.

Unit:2	SOIL MICROBIOLOGY	15 hours

Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration)-Weathering and Humus formation, Soil pollution-Sources. Biogeochemical cycling-Nitrogen, Carbon, Phosphorous, Sulphur, Iron cycles and its importance.

Unit:3	AQUATIC MICROBIOLOGY	15 hours

Microbiology of water (Aquatic environment-Fresh and Marine)- Water Pollution and Waterborne Pathogens. Assessment of water quality (Chemical and Microbial) Bacteriological examination of water-Indicator organisms. Waste water treatment – BOD and COD.

Unit:4	MICROBIAL INTERACTIONS	15 hours

Microbial interaction-among microbes, with plants, Phyllosphere, Rhizosphere, Mycorhizzae, Symbiotic and free-living nitrogen fixers (Rhizobium, Azotobacter, Azospirillum, Frankia, BGA and Azolla - Phosphate solubilizers (Phosphobacterium and Aspergillus) - PhytopathogensBacterial, Fungal, Viral diseases (Wilt, Blight, Canker, Mosaic) - Control measures.

Unit:5	BIODEGRADATION OF SOLID WASTE	15 hours
Recycling of Solid wastes-Composting-Biogas, Mushroom and SCP production from Waste. Biodegradation of Complex Polymers (Cellulose, Hemicellulose, Lignin, Chitin and Pectin), Bioremediation (In-situ, Ex-situ, Intrinsic, Engineered, Solid phase, Slurry phase, Mobilization and Immobilization systems) Bioaugmentation and Biostimulation, Bioleaching (Copper and Uranium) - Degradation of recalcitrant polymers and xenobiotics eg., cellulose, lignin and lignocellulose. GMOS and Environment. Applications of GIS and RS techniques in Environmental monitoring		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	R. M. Atlas and R. Bartha - 1998 - Microbial Ecology - Fundamentals and Applications. Campbell. R. 1983. Microbial Ecology, 2ed
2	Subbha Rao, M.S. 1995. Soil microorganisms and plant growth
3	Martin Alexander, 1997. Introduction to Soil Microbiology
4	Reiheimer. G. 1991. Aquatic Microbiology, 4ed
Reference Books	
1	Mitchell. R. 1974. Introduction to environmental microbiology
2	Dart. R.K. and Shettron R.J. 1980. Microbiological aspects of pollution control. 2ed
3	Brock Biology of microorganisms12ed, Madigan,Martinko,Dunlap,Clara,Pearson
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_ce17/preview
2	https://www.wur.nl/en/Education-Programmes/online-education/MOOCs.htm

Course Designed By: **Ms. N.Gunasheela**

Mapping with Programme outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	M	S	M	M	L
CO2	S	S	M	S	M	M	S	M	M	M
CO3	S	M	S	M	S	S	S	L	L	M
CO4	S	S	M	S	S	L	M	M	M	L
CO5	S	S	S	M	S	M	M	M	M	M

*S-Strong; M-Medium; L-Low

Second Semester

Course code	23A	M.Sc., MICROBIOLGY	L	T	P	C
Core		PAPER V - MOLECULAR GENETICS	4	1	-	4
Pre-requisite		Basic knowledge about Molecular Biology	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:
1. Provide knowledge on the genetic material of microorganisms and its replication process
2. Impart conceptual idea about the central dogma and gene regulation
3. Enrich with molecular biology concepts to suit industrial needs

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of genetic material and its replication process	K2
2	Understand and apply the knowledge of the genetics of microorganisms and their molecular setup in gene regulation	K3
3	Understand the central dogma of the prokaryotic and eukaryotic cells, the gene regulation and operon concept	K2
4	Evaluate the role of genetic recombination in development of new microbial strains naturally and conceptual knowledge on genetic mapping	K4
5	Analyze the molecular mechanism behind mutation, DNA damage and repair and apply molecular biology aspects	K5 & K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	ORGANIZATION AND REPLICATION OF DNA	15 hours

DNA and Replication: Mendelian principles – Discovery of DNA as genetic material - DNA structure & alternative forms of DNA. Organization of genetic material: Viruses and Bacteria- Eukaryotes: Nucleus and nucleosomes, Lamp brush chromosomes, Giant chromosomes - satellite DNA. C-value paradox. DNA replication – prokaryotes and eukaryotes - theta and Plasmid DNA replication- rolling circle models of replication - Inhibitors of replication

Unit:2	TRANSCRIPTION	15 hours

Transcription: Transcription in prokaryotes and eukaryotes – structures of rRNA, tRNA and mRNA, post transcriptional processes. Inhibitors of transcription. Reverse Transcription. Antisense RNA and its significance

Unit:3	TRANSLATION AND GENE REGULATION	15 hours

Translation: Genetic code - Deciphering of genetic code and important properties of genetic code. Translation in prokaryotes and eukaryotes - post translational processing. Inhibitors of translation. Gene Regulation - Operon models - lactose, tryptophan and arabinose operon.

Unit:4	GENETIC RECOMBINATION AND MAPPING	15 hours

Genetic Recombination in Bacteria: Conjugation. F+ v/s F-, Hfr+ v/s F-, F' v/s F-, Transformation, Transduction: generalized and specialized. Mobile elements in prokaryotes and eukaryotes – Insertion sequences, transposons - properties. : Linkage and genetic maps. Genetics of T4 and λ phages – Genetic mapping of T4 phage.

Unit:5	MUTATION AND MOLECULAR MARKERS	13 hours
Mutagenesis and DNA Repair: Mutation – spontaneous and induced mutation – Types of Mutation. Mutagenesis – Physical and Chemical - DNA damage and repair mechanism. Molecular Markers, RFLP, RAPD, AFLP and Isozyme Loci. CRISPR gene editing.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Principles of Genetics, 7th Edition, 2010. Robert H. Tamarin, McGraw Hill Education
2	Molecular Genetics of Bacteria, 5th Edition, 2010. Jeremy W. Dale, Simon F. Park. Wiley-Blackwell Publishers
3	Microbial Genetics, 2nd edition, 2009, John Cronan, David Freifelder, Stanly R. Maloy, Narosa Publishing House
4	Principles of Genetics, 3rd Edition, 2003. Gardner, Simmons, Snustad, John Wiley & Sons.
5	Essentials of Genetics, 1996. Klug, W.S. and Cummings, M.R., Prentice Hall, New Jersey
6	Microbial Genetics, 2nd edition, 1994. Stanley R. Maloy, John E. Cronan, David Freifelder. Jones and Bartlett Publishers.
Reference Books	
1	Genes XII, 12th Edition, 2018. Benjamin Lewin; Jocelyn E Krebs; Elliott S Goldstein; Stephen T Kilpatrick. Burlington, Massachusetts : Jones & Bartlett Learning, 2018
2	Concepts of Genetics,12th Edition, William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Darrell Killian, 2018
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.swayam2.ac.in/cec20_ma13/preview

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	M	M	S	M	L	M	M
CO2	S	S	M	M	M	S	M	M	L	M
CO3	S	M	M	S	M	S	M	M	M	M
CO4	M	M	S	M	S	S	L	M	M	M
CO5	S	S	L	S	S	S	M	L	M	M

*S-Strong; M-Medium; L-Low

Course code	23B	M.Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER VI - MICROBIAL FOOD TECHNOLOGY	4	1	-	4
Pre-requisite		Fundamentals about food safety and role of microorganism in food processing	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. The course will enable students to understand the preservation techniques in food.
2. The course will teach the strategies to develop fermented and non-fermented milk products.
3. The student can knowledge on National and International Food Laws and Regulation

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To identify appropriate processing , preservation and packaging methods	K2
2	To understand the various causes of food deteriorations and food poisoning	K2
3	To analyze the food related hazards and HACCP method	K4
4	To evaluate the product quality and effect of processing technique	K5
5	Awareness of food laws and regulations	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	MICROBIAL FOOD SPOILAGE AND PRESERVATION	15 hours

Food as a substrate – Incidence and types of microorganisms in food – Contamination and Spoilage of Meat, Poultry, Sea foods, Vegetables, Fruits.
Principles of food preservations: Asepsis, Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives.

Unit:2	FERMENTED FOOD AND FOOD BORNE DISEASES	15 hours

Food poisoning – Food borne diseases- Bacterial and Non- Bacterial. Fermented foods - Meat and fishery products – Country cured hams, Dry sausages, Idly batter and Sauerkraut. Fermented milk products – Butter, Butter milk, Sour cream, Yoghurt and Cheese.

Unit:3	ANALYSIS OF FOOD HAZARDS	15 hours

In house Committee for quality assurance, Persons involved, Internal Microbial Quality control Policy, Quality Check at every step from collection of raw materials till it reaches the customer , Implementation of ISO standards, definitions, principles and use of HACCP in Food Industry .

Unit:4	FOOD QUALITY AND PROCESSING TECHNIQUE	15 hours

Indicator organisms – Direct examination – culture techniques – enumeration methods – plate – Viable & Total Count; Alternative methods – Dye reduction tests , electrical methods , ATP determination: Rapid methods, immunological methods – DNA / RNA methodology – Laboratory accreditation.

Unit:5	FOOD LAWS AND REGULATION	15 hours

Food laws and regulations A. National – PFA Essential Commodités Act (FPO, MPO etc.) B. International – Codex Alimentarius, ISO – 9000 series , ISO 22000 & BS 5750.C. Regulatory Agencies – WTO Consumer Protection Act - Relevance of Microbiological standards & criteria for food safety – Sampling plans – Microbiological guidelines Hygiene and sanitation in food

sector General Principles of Food Hygiene, GHP for commodities, equipment, work area and personnel, cleaning and disinfect ion (Methods and agents commonly used in the hospitality industry).		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**
Text Book(s)		
1	James. M. Jay, 1992, Modern food microbiology 4ed	
2	Frazier, W. C. and Westhoff D.C. 1989. Food Microbiology 8 ed	
Reference Books		
1	Dubey. R.C. and Maheswari. D.K. A Textbook of Microbiology, 1999. 1ed	
2	Food Microbiology. 2nd Edition – M.R.Adams & M.O.Moss – Panima Publishers	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.swayam2.ac.in/cec20_ag13/preview	
2	https://onlinecourses.swayam2.ac.in/cec20_ag09/preview	
3	https://onlinecourses.swayam2.ac.in/cec19_ag03/preview	
4	https://www.coursera.org/courses?query=food	
Course Designed By: **Ms. N.Gunasheela**		

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	M	M	M	L	M
CO2	S	S	M	S	M	M	L	M	M	L
CO3	S	M	S	S	S	M	M	L	L	M
CO4	S	S	M	S	S	M	L	M	M	M
CO5	S	S	S	M	S	L	M	M	L	M

*S-Strong; M-Medium; L-Low

Course code	23C	M.Sc MICROBIOLOGY	L	T	P	C
Core		PAPER VII - BIOPROCESS TECHNOLOGY	4	1	-	4
Pre-requisite		Aware of industrially important microbes and its products	Syllabus Version		2021 - 2022	

Course Objectives:

1. Make the learner competent on exploring industrially important microbes for commercially important products
2. Provide adequate knowledge on fermenters, its types, operation and other parameters that govern the fermentation process
3. Attain conceptual knowledge on different fermentation processes and provide strategies for downstream processing of microbial industrial products

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire knowledge in industrial microbiology, understand the process of fermentation and its types	K2
2	Attain knowledge about the design and components of bioreactors and factors affecting the process of fermentation	K2
3	Isolate, analyze and assess industrially important microorganisms from different sources to develop new industrial microbial products	K4
4	Apply the downstream process techniques and can design suitable strategy for recovery of an product in an industry process	K3 & K6
5	Develop in to an entrepreneur with the acquired knowledge in the production of microbial products that are commercially important	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	FERMENTATION AND ITS TYPES	13 hours

Industrial microbiology - Types of fermentation- Solid, Submerged - Batch, Continuous, Fed batch - Component parts of fermentation process - Fermentation economics

Unit:2	FERMENTERS	13 hours

Fermenter design and construction, Fermenter types - Productivity, Yield coefficients, Heat production, Stirring and mixing, Gas exchange and mass transfer, Computer Applications in fermentation technology.

Unit:3	SCREENING AND UPSTREAM PROCESSING	17 hours

Industrially important microorganisms. Isolation - Primary and Secondary screening – Screening for - Enzymes - probiotic function – Flavour – Organic acids - use of MALDI-TOF/TOF and LC-MALDI for high throughput screening of metabolites. Preservation and improvement of industrially important strains. Upstream processing – Development of inoculums for fermentation process - Media for industrial fermentation - Formulation, Optimization - Sterilization. Stages of upstream- Growth of inoculums, Fermenter preculture and Production fermentation.

Unit:4	DOWNSTREAM PROCESSING	15 hours

Downstream Processing- Recovery and purification of intracellular and extracellular products- Flocculation, Floatation, Filter systems, Centrifugation, Disintegration, Chromatography, Extraction, Crystallization, Precipitation and Drying.

Unit:5	MICROBIAL PRODUCTS	15 hours
Microbial production of commercially important products - Organic acids (citric acid, acetic acid) - Enzymes (Amylase and Protease) - Amino acids (Lysine and Glutamic acid) - Antibiotics (Penicillin) - Vitamins (Riboflavin, cyanocobalamine and ascorbic acid). Biosynthesis of Ergot alkaloids. Microbial transformation - steroids and sterols. Non steroid compounds		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Industrial Microbiology, 2nd Edition, 2019. L.E.J.R. Casida. New Age International Publishers
2	Cruegers Biotechnology: A Textbook of Industrial Microbiology, 3rd Edition, 2017. Wulf Crueger and Anneliese Crueger. MedTech Publishers.
3	Microbial Biotechnology, Principles and Applications, 3rd Edition, 2013. Lee Yuan Kun, World Scientific Publishing Co. Pte. Ltd
4	Principles of Fermentation Technology, 2nd edition, 1999. Stanbury P F, Whitaker A, Hall SJ. Butterworth Heinemann
5	Biotechnology: A Textbook of Industrial Microbiology, 1990. Wulf Crueger and Anneliese Crueger.

Reference Books

1	Prescott and Dunns' Industrial Microbiology, 4th Edition, 2004. Edited by Reed, CBS Publishers and Distributors, New Delhi
2	Creuger and Creuger (2001). Biotechnology- A textbook of Industrial Microbiology, Sinauer Associates, Inc.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc20_bt21/preview
2	https://onlinecourses.nptel.ac.in/noc20_bt25/preview
3	https://onlinecourses.nptel.ac.in/noc20_bt26/preview

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	M	M	L	S	M	M	L
CO2	S	S	M	M	M	M	S	L	M	M
CO3	S	M	M	S	M	M	S	M	L	M
CO4	M	M	S	M	S	M	S	M	M	L
CO5	S	S	L	S	S	L	S	M	M	M

*S-Strong; M-Medium; L-Low

Course code	23D	M.Sc MICROBIOLGY	L	T	P	C
Core		PAPER VIII – GENE MANIPULATION AND BIOINFORMATICS	5	-	-	4
Pre-requisite		Basics about Bioinformatics tools and Genetic Engineering	Syllabus Version		2021 - 2022	

Course Objectives:

1. To familiarize the students with the basic perceptions in genetic engineering; to explain the students to multipurpose tools and techniques employed in genetic engineering and recombinant DNA technology.
2. To provide knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the basics of gene manipulation techniques	K1
2	Understand the enzyme involved in cloning, various techniques involved in gene transformation	K2
3	Acquire knowledge on vectors and gene expressions in prokaryotes and eukaryotes	K2
4	Analyze the cloned DNA with different characterization techniques	K4
5	Impart knowledge on gene sequence using bioinformatic tools	K3

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	BASIC TECHNIQUES	15 hours

Isolation and purification of nucleic acids (chromosomal DNA, RNA & Plasmids) – Methods of handling and quantification of DNA and RNA. Blotting: Types of blotting – Southern, Northern and Western Blotting. Chromosome walking. Dot and Colony Blotting.

Unit:2	RESTRICTION ENDONUCLEASES, SCREENING AND TRANSFORMATION TECHNIQUES	15 hours

Restriction endonucleases: Types and characteristics, DNA methylases, Ligases, Adapters, Linkers and Homopolymer tailing, Genomic DNA libraries - cDNA libraries. **Transformation techniques:**Electroporation, microinjection, protoplast fusion and microparticle bombardment.**Screening:** Direct methods -Insertional inactivation, plaque phenotype,Indirect methods - Immunochemical detection, nucleic acid hybridization,

Unit:3	VECTORS	15 hours

Vectors: Properties, types of vectors – plasmids– host range and incompatibility, Vectors constructed based on bacteriophages (M13 & Lambda), cosmids, phasmids, phagemids and BACs, Eukaryotic vectors - Yeast vectors (YAC) – animal (retroviruses, adenoviruses) and plant vectors (Ti plasmid based vectors and caulimoviral vector), expression vectors, shuttle vectors, Expression of genes in bacteria, animal, plant, algae & fungi.

Unit:4	CHARACTERIZATION OF CLONED DNA	15 hours

Restriction mapping:Restriction fragment length polymorphism (RFLP), Polymerase chain reaction (PCR) - Types of PCR and their applications. DNA sequencing: Primer walking, Maxam and Gilbert method, dideoxy method, automated sequencing and micro array. Site directed mutagenesis.

Unit:5	**BIOINFORMATICS**	**13hours**
Introduction to Bioinformatics, Data bases and sequence alignment – DNA data bases: Genbank, EMBL – cDNA database – ESTs, NCBI: Pubmed, Entrez, BLAST – Protein data base:SWISSPROT. Similarly search tool: BLAST and FASTA.		
Unit:6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**50 hours**

Text Book(s)	
1	Old. R. W. and Primrose S.B. 1995. Principles of Gene Manipulations – An Introduction toGenetic Engineering, 5Ed .
2	Winnacker E.L, 1987, From Genes to Clones. – Introduction to Gene Technology. Nicholl.D.S.T, 1994. An Introduction to Genetic Engineering.
3	Brown. T.A. 1995. Gene Cloning.
4	Pinler. A. 1993. Genetic engineering of microorganisms
5	Lesk, A M.2002. Introduction to Bioinformatics. Indian Ed. Oxford University Press.
Reference Books	
1	Protein Structure, Stability and Folding by Kenneth P. Murphy. Published by Humana PressInc. 2001
2	Protein Engineering Principles and Practice by Jeffrey L. Cleland and Charles S. Craik. Published by Wiley-Liss Inc., 1996.
3	Protein Engineering and Design by Paul R. Carey. Published by Academic Press Inc., 1996.
4	Andreas D B. and Francis Outlette B F. 2001. Bioinformatics – a practical guide to the analysis of genes and proteins. 2nd Ed. Wiley Interscience, John wiley and Sons, Inc. Publication, New York.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.my-mooc.com/en/categorie/bioinformatics
2	https://www.coursera.org/specializations/bioinformatics
3	https://nptel.ac.in/courses/102/103/102103013/
Course Designed By: **Dr. R. Vijayaraghavan**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	L	S	M	S	M	L
CO2	M	L	M	L	M	S	M	S	M	L
CO3	S	M	M	S	M	S	M	S	L	L
CO4	M	S	S	M	M	S	L	S	M	M
CO5	S	S	S	M	S	S	M	S	L	L

*S-Strong; M-Medium; L-Low

Course code	23P	M.Sc., MICROBIOLGY	L	T	P	C
Core		PRACTICAL I		-	5	4
Pre-requisite		Basic knowledge about microbial culture Techniques	Syllabus Version		2021 - 2022	

Course Objectives:

1. Enhance the learner on practical approaches of microbiological techniques
2. Provide skillful training in microbial identification through microscopic observation and biochemical test

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To impart the awareness of elemental principles and techniques in Microbiology	K1
2	To acquire knowledge on culturing of microorganisms.	K2
3	To study the isolation process and quantification of microorganisms.	K2
4	To enable the students to identify microorganisms and characterise them biochemically.	K4
5	To assess the growth kinetics and the study basis of anaerobic culture techniques.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

1. Sterility control test
2. Media preparation – Liquid and Solid media, Agar deep, slant and plate.
3. Pure culture techniques – Streak plate, pour plate, spread plate, decimal dilution.
4. Micrometry – measurement of microorganisms.
5. Motility determination- Hanging drop and soft agar inoculation.
6. Enumeration of microorganisms from soil: Bacteria, Fungi and Actinomycetes.
7. Direct Microscopic observation of fungal spores, mycelium and and yeast
8. Staining: Smear fixation, simple, Gram, acid fast, spore, capsule and negative.
9. Growth curve: Direct microscopic (Haemocytometer, Viable count)
10. Effect of various intrinsic factors on the growth of bacterium and fungi – pH, Temperature, Osmotic pressure.
11. Anaerobic culture techniques; RCM, Mc Intosh Fildes anaerobic jar, Wright's tube method.
12. Phenol Co-efficient test.
13. IMViC test
14. Hydrogen sulphide test
15. Oxidase test
16. Calalase test
17. Urease test
18. Nitrate reduction test
19. Polymer degradation – Starch, Gelatin, Casein.
20. Carbohydrate fermentation.
21. Morphology of Algae

	Total Practical hours	**75 hours**

Text Book(s)	
1	Microbiology: A Laboratory Manual, 11th Edition, 2017. James G. Cappuccino and Chad T. Welsh , Pearson
2	Laboratory Exercises in Microbiology, Fifth Edition, 2002. Harley−Prescott. The McGraw−Hill Companies.
Reference Books	
1	Microbiology A Laboratory Manual, 10th Edition, 2014. James G. Cappuccino and Natalie Sherman, Pearson
2	Microbiological Methods,8th Edition, 2004. Collins and Lyne. Arnold Publishers.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://microbenotes.com/category/biochemical-test-of-bacteria/
2	https://www.uwyo.edu/molb2210_lab/info/biochemical_tests.htm
3	https://www.biologydiscussion.com/micrometry/micrometry-meaning-and-types-with-diagram-biology/56994
Course Designed By: **Dr. A. Vijaya Chitra**	

Mapping with Programme outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	M	S	L	M	M	M
CO2	S	S	M	M	M	S	M	L	M	L
CO3	S	M	S	S	M	M	S	L	L	M
CO4	M	S	S	M	S	S	M	M	M	M
CO5	S	S	M	S	S	M	M	M	L	M

*S-Strong; M-Medium; L-Low

Course code	23Q	M.Sc MICROBIOLOGY	L	T	P	C
Core		PRACTICAL II	-	-	5	4
Pre-requisite		Fundamentals of Microbial Techniques	Syllabus Version		2021 - 2022	

Course Objectives:

1. Impart knowledge on microbial analysis of environmental samples and bioremediation
2. Provide expertise training in development of industrially important microbial products
3. Enhance the learner skill in agricultural microbiology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To expertise in the production of commercially important microbial products	K1
2	To isolate and identify the microorganisms having agricultural importance	K3
3	To assess the quality of drinking water from sewage contamination	K4
4	To acquire knowledge on selection of microorganism for bioremediation	K5
5	To expertise in molecular techniques	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

1.Wine production – sugar estimation

2. Organic acid production – Citric acid – Solid state and submerged fermentation.
3.Isolation of antibiotic producing organisms and determination of antimicrobial spectrum of isolates

4. Production of Extra cellular enzymes – Protease by submerged fermentation – Cellulase by solid state fermentation.

5.Isolation of nitrogen fixers – free living, symbiotic, ammonification, nitrification, denitrification.
6. Isolation of Phosphate solubilizers.

7. Isolation of Coliphage.

8. Microbial decolourisation of textile dyes.

9. Isolation of mutants: Auxotrophic and Antibiotic resistant mutants.

10. Isolation of Plasmids and chromosomal DNA from microbes.

11. Size determination and fractionation of nucleic acids and proteins – Agarose gel electrophoresis, SDS – PAGE.

Total Lecture hours **75 hours**

Text Book(s)

1	Microbiology: A Laboratory Manual, 11th Edition, 2017. James G. Cappuccino and Chad T. Welsh , Pearson
2	Laboratory Exercises in Microbiology, Fifth Edition, 2002. Harley−Prescott. The McGraw−Hill Companies.

Reference Books

1	Microbiology A Laboratory Manual, 10th Edition, 2014. James G. Cappuccino and Natalie Sherman, Pearson
2	Microbiological Methods,8th Edition, 2004. Collins and Lyne. Arnold Publishers.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.mdpi.com/2076-3417/10/8/2958/htm
2	https://www.biotechnologynotes.com/microbial-biotechnology/isolation-of-coliphages-from-sewage-microbial-biotechnology/1324
3	https://www.frontiersin.org/articles/10.3389/fpls.2015.01225/full
Course Designed By: **Dr. A. Vijaya Chitra**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	M	M	S	S	M	L	M
CO2	S	S	M	M	M	S	S	M	M	M
CO3	S	M	M	S	M	S	S	M	L	L
CO4	M	M	S	M	S	S	S	L	M	L
CO5	S	S	L	S	S	S	S	M	L	M

*S-Strong; M-Medium; L-Low

Third Semester

Course code	33A	M.Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER IX- IMMUNOLOGY & IMMUNOTECHNOLOGY	5	-	-	4
Pre-requisite		Basic Knowledge about immune system	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. Provide the basic concepts of immunology and organization of the immune system
2. Impart knowledge on antigen and antibody interactions and immunological techniques
3. To make the learner understand the concepts of hypersensitivity, transplantation of organs and autoimmune disorders

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recall the history and the development of immunology.	K1
2	To understand the structure, properties and functions of antigen and antibody.	K2
3	Apply the immunological techniques to understand the antigen antibody interactions and for diagnosis	K4
4	To explain the role of MHC and hypersensitivity in immune system and discuss about the immunity against various pathogens.	K3
5	To understand the role of HLA in transplantation, immunodeficiency disorders and role of vaccines in immune system.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO IMMUNOLOGY	15 hours

Historical background and scope of immunology, Immunohaematology -ABO and Rh factor. Cells and organs of immune system. Defence mechanisms of human body: Primary, Secondary and tertiary line. Types of immunity - HI and CMI

Unit:2	ANTIGENS AND ANTIBODIES	13 hours

Antigens - properties, Epitopes, haptens, adjuvant, cross reactivity. Antibodies - properties, structure and isotypes. Diversity and specificity

Unit:3	ANTIGEN AND ANTIBODY INTERACTIONS	15 hours

Serology - Introduction and classification of antigens and antibody reactions - Agglutination and precipitation reaction. Strength of antigen and antibody bindings - affinity & avidity. Monoclonal antibodies and their applications. Complement pathway and complement fixation reaction. Immunofluorscence RIA, RAST, ELISA and Flowcytometry.

Unit:4	MAJOR HISTOCOMPATIBILITY COMPLEX AND HYPERSENSTIVITY	15 hours

MHC antigens - types and functions. Response of B Cell to antigens. T cell products. Immunity to infectious diseases - Viral, bacterial and protozoan. Hyper sensitivity reactions.

Unit:5	TRANSPLANTATION IMMUNOLOGY AND VACCINES	15 hours

Transplantation immunology - Tissue transplantation and grafting . Mechanism of graft acceptance and rejection. HLA typing Tumor immunology. Immunodeficiency diseases: Primary immunodeficiency disorders: severe combined immunodeficiency (SCID disorders) and

Secondary immunodeficiency disorders: AIDS, cancers of the immune system, leukemia, viral hepatitis - auto immunity: mechanism, types: Rheumatoid arthritis, Systemic lupus erythematosus, Multiple sclerosis and myasthenia gravis. Vaccines - Types and vaccination methods.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Coleman, R.M. , Lourbard, M.F and Sicard, R.E., 1992. Fundamental immunology, 2nd edition
2	Kuby, J. 1997. Immunology, W.H Freeman and co., New York.
3	Roitt, I.M. 1988. Essential of Immunology, Black Well Scientific Publishers.
4	Tizard, R.I. 1983. Immunology - An introduction , Saunder's College publishers Philadelphia.
5	Roitt's Essential Immunology. Wiley-Blackwell. 12th Edition
Reference Books	
1	Black S., Symour, Disinfection, Sterilization and Preservation,Philadelphia, London
2	Gennaro, Alfonso R., Remington: The Science and Practice of Pharmacy, Vol-I & II, Lippincott Williams & Wilkins, New York, 2001.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_bt43/preview
Course Designed By: **Dr. A. Vijaya Chitra**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	M	M	M	M	M	L	M
CO2	S	S	M	M	M	M	M	M	M	M
CO3	S	M	M	S	M	M	L	M	L	L
CO4	M	M	S	M	S	L	M	M	M	L
CO5	S	S	L	S	S	M	M	M	L	M

*S-Strong; M-Medium; L-Low

Course code	33B	M.Sc., MICROBIOLOGY	L	T	P	C
Core		PAPER X - MEDICAL MICROBIOLOGY	4	1	-	4
Pre-requisite		Basic Knowledge on microbial pathogens and its diagnosis	Syllabus Version		2021 - 2022	

Course Objectives: The main objectives of this course are to:

1. To introduce basic principles and application relevance of clinical disease for students who are in preparation for physicians.
2. The course will provide the conceptual basis for understanding pathogenic microorganisms and particularly address the fundamental mechanisms of their pathogenicity.
3. It will also provide opportunities for a student to develop diagnostic skills in microbiology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To acquire knowledge on the basis of infectious diseases, diagnosis, examination of the clinical sample	K1
2	To understand the morphology, pathogenesis and lab diagnosis of pathogenic bacteria	K2
3	To apply the new approaches in lab diagnosis of mycosis infections.	K3
4	To analyse the life cycle, pathogenicity and lab diagnosis of parasitic infections	K4
5	To understand the general properties, pathogenesis and lab diagnosis of viral infections	K2

K1 - Remember; **K2** - Understands; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	BASICS OF INFECTIOUS DISEASE	15 hours

Milestones in medical microbiology - Infectious Diseases process – Diagnosis – Process of sample collection, transport, examinations and discarding of clinical specimens. Antibiogram and serological test. Virulence factors of bacteria – Host parasite relationship.

Unit:2	MEDICAL BACTERIOLOGY	15 hours

Gram positive organisms - Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of *Staphylococcus aureus, Streptococccus pyogenes, Pneumococcus, Bacillus anthracis, Corynebacterium diphteriae, Mycobacterium tuberculosis, Mycobacterium leprae. Spirochaetes – Treponema pallidum.*

Gram negative organisms:- Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of *E. coli, Klebsiella pneumoniae, Salmonella typhi, Shigella dysentriae, Pseudomonas aeruginosa, Vibrio cholerae, Bordetella pertusis, Neiserria gonorrhoeae,* and *Neiserria meningitidis*.

Unit:3	MEDICAL MYCOLOGY	15 hours

Mycology: General properties and approaches to laboratory diagnosis. Mycosis – Superficial, Subcutaneous and Systemic infections – Cryptococcosis, Madura mycosis, Histoplasmosis, *Candida allbicans,* Aspergillosis and Blastomycosis.

Unit:4	MEDICAL PARASITOLOGY	15 hours

Parasitology: Life cycle, Pathogenicity and laboratory diagnosis of *Entamoeba histolytica, Trichomonas vaginalis, Plasmodium vivax, Leishmania donovani, Taenia solium, Ascaris lumbricoides, Enterobious vermicularis* and *Wucheraria bancrofti.*

Unit:5	MEDICAL VIROLOGY	15 hours
Virology: General properties, structure, genome replication, protein synthesis and assembly, pathogenesis and laboratory diagnosis of: DNA containing animal viruses- Adeno viruses, Herpes viruses-type-I and type-II, Pox viruses – Variola virus. RNA containing animal viruses: Picorna virus, Rhabdo virus, Hepatitis viruses -A, B and C, Orthomyxo virus – Influenza H1N1, Paramyxovirus, Retroviruses - HIV and Rubella virus. Arbo virus – Dengue virus, Ebola virus, Prions.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Essentials of Diagnostic Microbiology – Lisa Anne Shimeld, Anne T. Rodgers
2	Textbook of Microbiology – Ananthanarayanan and Jayaram Panicker
3	Textbook of Medical Parasitology – Subash. C. Parija
4	Medical Mycology – Jagadesh Chander
5	Luria. S.E. Darnall. J.E. Baltimore. D. and Compare. A. 1978. General Virology, 3ed.
Reference Books	
1	Laboratory Manual in Microbiology-T. Sundararaj
2	Freidfelder ,D. 1995. Microbial genetics
3	Medical Microbiology - Geo. F. Brooks. S
4	Hayes. W. 1968. The Genetics of Bacteria and their Viruses
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/courses?query=microbiology
2	https://www.classcentral.com/course/canvas-network-intro-to-medical-microbiology-1-bacteriology- 12514
3	https://www.classcentral.com/tag/microbiology
Course Designed By: **Ms. N.Gunasheela**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	M	M	M	L	L
CO2	S	S	M	S	M	M	L	L	M	L
CO3	S	M	S	M	S	M	M	M	L	M
CO4	S	S	S	S	M	L	M	L	M	L
CO5	S	S	S	S	M	M	M	L	M	L

*S-Strong; M-Medium; L-Low

Course code	33C	M.Sc MICROBIOLOGY	L	T	P	C
Core		PAPER XI - BIOTECHNOLOGY & IPR	5	-	-	4
Pre-requisite		Basic knowledge about the intellectual Property rights in Biotechnology	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. To develop the knowledge of gene expression and microbial production of recombinant molecules
2. To describe the new developments in plant & Animal biotechnology
3. To provide basic understanding on Intellectual Property Rights (IPR)

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recollect the basic concepts in gene manipulation techniques	K1
2	To understand the basics of microbial production of therapeutic agents and various types of modern vaccines.	K2
3	To acquire the knowledge of microbial products which are commercially important	K3
4	To ascertain the methodologies in Plant and Animal Biotechnology process	K3
5	To popularize the basic concepts of patents and the importance of related components	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Microbial Production of Recombinant Therapeutic Products	15 hours

Microbial Production of Therapeutic Agents and Vaccines: Emergence of molecular biotechnology – Commercialization – concerns and consequences - Pharmaceuticals - interferon's and growth hormones, enzymes: DNase I and alginate lyase, Monoclonal antibodies - HIV therapeutic agents. Subunit vaccines: Herpes simplex virus, Foot and mouth disease virus, TB, Peptide vaccines – genetic immunisation – attenuation through recombinant DNA technology, vector vaccines

Unit:2	Microbial Production of Recombinant Products	13 hours

Synthesis of Commercial Products by Recombinant Microorganisms: Restriction endonucleases: PstI, Small biological molecules: Indigo, Antibiotics: Synthesis of Novel antibiotics. Biopolymers: Xanthan gum, Melanin, byssal adhesive, rubber and PHA.

Unit:3	Plant biotechnology	17 hours

Plant Biotechnology: Plant growth promoting bacteria (PGPR) – genetic engineering of nitrogenase gene cluster, hydrogenase and Nodulation. Biocontrol of pathogens: Siderophores, antibiotics and enzymes. Plant transformation with Ti plasmid, Ti plasmid derived vector systems, physical method of gene transfer, developing plant strains by genetic engineering - insect, virus and herbicide resistant plants. Plant as bioreactors. Microbial insecticides: Insecticidal toxin of BT - genetic engineering of BT toxin genes – Baculovirus.

Unit:4	Animal Biotechnology	15 hours
Animal Biotechnology: Transgenic mice methodology – Retroviral vector, DNA microinjection, Engineered embryonic stem cell method. Applications – transgenic disease models – Alzheimer disease. Transgenic cattle and sheep. Human gene therapy – in vivo and ex vivo gene therapy – gene delivery system. Molecular diagnostics for genetic diseases.		
Unit:5	**Intellectual Property Rights (IPR)**	**13 hours**
Intellectual Property Rights (IPR): Patents - copy right and neighboring rights, patents for invention, trademarks, trade names - Conditions for patentability - Drafting and filing a patent application, infringement, copyright and development, exploitation of patented invention. Indian patent laws**.** Regulating the use of biotechnology: recombinant DNA Technology, food and agricultural ingredients, - patenting biotechnology inventions - Bio safety and Bioethics.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	GIick, B. R and Pasternak, J.J. 2003. Molecular Biotechnology – Principles and Applications of Recombinant DNA. ASM Press, Washington D.C.
2	Chawla, H.S. Introduction to Intellectual Property Rights. 2020 edition. Oxford & IBH Publications.
3	U. Satyanarayana. Biotechnology. 2010.Books and Allied (P) Ltd, 8/1 Chintomoni Das Lane, Kolkata 700009. India
Reference Books	
1	Old, R.W. and Primrose, S.B. 1995. Principles of Gene Manipulation - An Introduction to Genetic Engineering 5th Ed. Blackwell Scientific Publications, London.
2	Brown T A., 2001. Gene cloning and DNA analysis introduction. 4th Ed. Blackwell Science Ltd., London.
3	Winnacker E.L., 2003. From Genes to Clones – Introduction to Gene Technology. First Indian reprint, PANIAMA publishing Co-operation, New Delhi.
4	Watson, J. D., Gillman, M., Iknowski, J and Zollar, M 2001. Recombinant DNA. 2nd Ed. Scientific American Books, WH freeman and Company, New York.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayamprabha.gov.in/index.php/program/archive/9
2	https://onlinecourses.nptel.ac.in/noc20_bt21/preview
4	https://onlinecourses.nptel.ac.in/noc20_bt32/preview
Course Designed By**: Dr.T.Savitha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	L	M	S	S	S	S	L	M	L
CO2	S	M	L	L	M	S	S	M	M	M
CO3	L	M	S	L	S	S	S	L	M	L
CO4	M	S	M	S	L	S	S	M	M	L
CO5	S	L	L	M	M	S	S	M	M	L

Course code	33D	M. Sc. MICROBIOLOGY	L	T	P	C
Core		PAPER XII – BIONANOTECHNOLOGY	4	1	-	4
Pre-requisite		Basic knowledge about Nano-materials	Syllabus Version		2021 - 2022	

Course Objectives:

1. To make the students acquire an understanding the Bio-nanoscience and Applications.
2. To help them understand in broad outline of Bio-nanoscience and Nanotechnology.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	List out and study nanostructures and bio inspired nanomaterials.	K1
2	Discuss various methods in the process of nanoparticle synthesis.	K2
3	Demonstrate physiochemical properties of materials at nano scale level.	K3
4	Integrate various instruments involved in characterizing nanomaterials.	K4
5	Prioritize the range of biological applications of nanoparticles.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION	13 hours

Definition: Nanotechnology - Nanobiotechnology - Nanomaterial - Nanocomposites - Classification of nanostructures – Top down and Bottom Up approach - Quantum dots - Bio-inspired nanomaterials.

Unit:2	SYNTHESIS METHODS OF NANOMATERIALS	15 hours

Physical synthesis - Ball Milling - Thermal evaporation - Chemical synthesis - Solgel Process - Hydro thermal Synthesis - Biological Synthesis – Plant, Microbial compound based synthesis.

Unit:3	PROPERTIES OF NANOMATERIALS	15 hours

Physical properties - Optical, Magnetic, Surface Plasmon resonance - Electrochemical Properties of Nanoscale Materials, Intra-molecular bonding, Inter-molecular bonding, Nanocatalysis, Self-assembly – DNA, Protein.

Unit:4	CHARACTERIZATION METHODS	15 hours

X-ray diffraction (XRD) - Dynamic Light Scattering (DLS). Electron microscopes: Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) -UV - Visible Spectrophotometer - Fourier Transform InfraRed Spectrometer (FTIR).

Unit:5	APPLICATIONS OF NANOPARTICLES	15 hours

Drug delivery – Nanoparticles in cancer therapy, Biosensors - DNA Microarrays - Cell Biochips - Nanoparticles for Bioimaging - Military applications of Nanotechnology - Nanomaterials for food Applications - Toxicity of Nanoparticles - Future Perspectives.

Unit:6	CONTEMPORARY ISSUES	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	75 hours

Text Book(s)

1	Pradeep .T. 2008. Nano: The Essentials: Understanding Nanoscience and Nanotecnology. Tata McGraw-Hill Publishing Company Limited, New Delhi.
2	Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan. 2005. Nanoscale Science and Technology. John Wiley & Sons, Ltd., UK.

3	GuozhongGao. 2004. Nanostructures &Nanomaterials: Synthesis, Properties & Applications. Imperial College Press.
4	Richard C Brundle, Charles A. Evans Jr., Shaun Wilson. 1992. Encyclopedia of Materials Characterization. Butterworth-Heinemann Publishers.
Reference Books	
1	Mick Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons, BurkhardRaguse. 2005. Nanotechnology: Basic Science and Emerging Technologies. Overseas Press.
2	Vladimir P Torchilin. 2006. Nanoparticles as Drug carriers. Imperial College Press, USA.
3	Christ M.Niemeyer, Chad A.Mirkin. 2004. Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH, Weinheim.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/118/104/118104008/
2	https://www.my-mooc.com/en/categorie/nanotechnology
3	https://www.coursera.org/courses?query=nanotechnology
Course Designed By: **Dr. R. Vijayaraghavan**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	L	M	L	S	S	L
CO2	M	L	M	L	M	M	M	S	S	M
CO3	S	M	M	S	M	M	L	S	S	M
CO4	M	S	S	M	M	M	M	S	S	L
CO5	S	S	S	M	S	M	M	S	S	L

*S-Strong; M-Medium; L-Low

Course code	33E	M.Sc MICROBIOLOGY	L	T	P	C
Core		PAPER XIII – BIOSTATISTICS AND RESEARCH METHODOLOGY	5	-	-	4
Pre-requisite		Basic knowledge about Statistics & Research	Syllabus Version		2021 - 2022	

Course Objectives:

1. Make the learner competent on biostatistics analysis
2. Provide adequate knowledge on measures of central tendency, correlation,T-test and ANOVA
3. Provide awareness on research ethics and to inculcate research insight in the minds of the learner

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recall the scope of biostatistics.	K2
2	To apply their knowledge in measure of central tendency.	K3
3	To understand the correlation of different statistical methods.	K4
4	To analyse the basic ideas of various significance test.	K4
5	To explore the different aspects of research ethics.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION TO BIOSTATISTICS	15 hours

Definition – Scope of Biostatistics, Probability analysis, Variables in Biology, Collection, Classification and Tabulation of data. Graphical and diagrammatical representation –Scale diagram - Histogram- frequency curve.

Unit:2	MEASURES OF CENTRAL TENDENCY	15 hours

Measures of central tendency - Arithmetic mean, Median, Mode. Calculation of Mean, median, Mode in series of individual observations, discrete series, continuous, open end classes, measure of dispersion, standard deviation, standard error. Variance, Range and Percentile

Unit:3	CORRELATION	13 hours

Simple correlation coefficient, correlation regression- simple and linear.Skewness

Unit:4	T –TEST and ANOVA	15 hours

Basic ideas of significant test-Hypothesis testing, Level of significant test, test based on studies-t-test- chi square, Goodness of fit. ANOVA

Unit:5	RESEARCH METHODOLOGY	15 hours

Plagiarism and research ethics. Selection of research problem – Formulation of research objectives - project design - review of literature writing - Sources of data collection for biosciences research - processing of data - presentation of data – editing – preparation of master's thesis. Presenting the research findings in open defense.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	75 hours

Text Book(s)

1	S.P. Guptha-Statistical Methods
2	Palanisamy and Manoharan-Statistical methods of Biology

3	Khan and Khan- Fundamentals of Biostatistics
4	Kothari-Research Methodology
Reference Books	
1	Practical Statistics: R S N Pillai and Bhagavathi
2	Fundamentals of Statistics: D. N. Elhance, Veena Elhance and B. M. Aggarwal
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_bt28/preview
2	https://onlinecourses.swayam2.ac.in/cec20_mg13/preview
3	https://onlinecourses.swayam2.ac.in/cec20_bt23/preview
Course Designed By: **Dr. T. Viswanathan**	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	M	L	M	M	L	M
CO2	L	L	L	L	L	M	L	S	M	L
CO3	M	S	M	L	M	L	M	S	L	M
CO4	M	L	M	M	S	M	L	S	M	L
CO5	L	L	M	L	M	L	M	M	L	L

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code	43P	M.Sc MICROBIOLOGY	L	T	P	C
Core		PRACTICAL III	-	-	5	4
Pre-requisite		Aware of clinically important microbes and its diagnosis techniques	Syllabus Version		2021 - 2022	

Course Objectives:

To impart knowledge on the sample collection, diagnosis and processing of clinical pathogen.

To evaluate the serological process in clinical pathogens

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recall the isolation and identification of pathogen from various clinical specimens.	K1
2	To understand the diagnostics of clinically important fungi.	K3
3	To apply serology in the diagnosis of diseases.	K4
4	To impart knowledge on performing serological experiments for the diagnosis of parasitic infections.	K3
5	To understand viral cultivation procedures.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

1.Diagnostic Microbiology: Isolation and identification of pathogens from clinical specimens like urine, pus, faeces, sputum, CSF, blood and discharges.

2.Isolation and identification of clinically important fungi - *Candida albicans*, *Aspergillus* sp, *Cryptococcus neoformans*

3.Antibiotic susceptibility test. - Kirby Bauer technique

4.Identification and enumeration of Lymphocytes.

5.Examination of blood smear study for Plasmodium sp

6.Agglutination reaction - Blood grouping & Rh Typing – Cross matching demonstration.

7.Precipitation reaction – ODD Test.

8.Serological Tests – WIDAL (Slide & Tube Test), RA, ASO, CRP, RPR.

9.Pregnancy Test – β-hCG.

10.Immunoelectrophoresis – Counter Current & Rocket Immunoelectrophoresis.

11.ELISA – HIV, HBV & HCV.

12.Separation techniques: Chromatography - Paper, TLC and Column.

13.Virus cultivation – Egg inoculation techniques.

	Total Lecture hours	**75 hours**

Text Book(s)

1	Microbiology: A Laboratory Manual, 11th Edition, 2017. James G. Cappuccino and Chad T. Welsh , Pearson
2	Laboratory Exercises in Microbiology, Fifth Edition, 2002. Harley−Prescott. The McGraw−Hill Companies.

Reference Books

1	Microbiology A Laboratory Manual, 10th Edition, 2014. James G. Cappuccino and Natalie Sherman, Pearson
2	Microbiological Methods,8th Edition, 2004. Collins and Lyne. Arnold Publishers.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	
Course Designed By: **Ms. N.Gunasheela**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	L	M	M	L
CO2	S	S	S	S	M	L	M	M	M	M
CO3	S	M	S	S	S	M	L	M	L	L
CO4	S	S	S	S	S	M	M	M	M	L
CO5	S	S	S	M	S	L	L	M	M	L

*S-Strong; M-Medium; L-Low

Elective Courses

Course code	1EA	M.Sc., MICROBIOLOGY	L	T	P	C
Elective		GROUP A - ELECTIVE PAPER I - ARTIFICIAL INTELLIGENCE FOR BIOLOGICAL SCIENCES	5	-	-	4
Pre-requisite		Fundamentals about Machine learning	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. Introduce Artificial Intelligence & machine learning for biology students
2. Facilitate students to learn & apply AI tools for solving research issues in biology
3. Understand the basics of automation
4. Develop automated solutions for research problems in biology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of Artificial Intelligence	K2
2	Apply the knowledge of Machine learning and Deep learning techniques to solve real time problems	K3
3	Understand the application of Artificial Intelligence in microbe analysis and prediction of host – microbiome relationship	K2
4	Apply and validate Artificial Intelligence in clinical diagnosis of infectious disease	K4
5	Evaluate the role of Artificial Intelligence in the molecular mechanism behind drug discovery, sequencing and auto immune diseases	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	ARTIFICIAL INTELLIGENCE (AI)	15 hours

Introduction to AI – Fundamentals – Need for AI – Foundations of AI – AI environment – Application domains of AI – AI tools – Challenges and Future of AI.

Unit:2	MACHINE LEARNING (ML) AND DEEP LEARNING (DL)	15 hours

Fundamentals of ML and DL – ML algorithms to find associations across biological data, cellular image classification and identification of genetic variations.

Unit:3	ARTIFICIAL INTELLIGENCE IN CLASSIFICATION AND PREDICTION IN MICROBIOLOGY	15 hours

AI in bacterial counting - Prediction of Microbial Species - Prediction of Environmental and Host Phenotypes - Interaction Between Microorganisms – Microbiome - Disease Association - Using Microbial Communities to Predict Disease – pest management - Prediction of the Antimicrobial Activity

Unit:4	ARTIFICIAL INTELLIGENCE IN CLINICAL MICROBIOLOGY	15 hours

Artificial Intelligence Diagnostic Testing - AI and Gram Stain - AI and Parasitology - AI and Bacterial Culture Plate Images - AI and MALDI-TOF MS - AI and Whole Genome Sequencing

Unit:5	**ARTIFICIAL INTELLIGENCE IN MOLECULAR BIOLOGY**	**13 hours**
Artificial Intelligence and Machine learning in autoimmune disease – AI in drug discovery -- AI in Phylogeny – AI and Whole Genome Sequencing - AI in next generation sequencing – AI in protein structure prediction – AI in protein folding analysis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Paul P. Bourbeau, Nathan A. Ledeboer; Automation in Clinical Microbiology, Journal of Clinical Microbiology May 2013, 51 (6) 1658-1665; DOI: 10.1128/JCM.00301-13
2	LeCun, Y., Bengio, Y. & Hinton, G. Deep learning. *Nature* **521,** 436–444 (2015). https://doi.org/10.1038/nature14539
3	Kenneth P. Smith, Anthony D. Kang, James E. Kirby, Automated Interpretation of Blood Culture Gram Stains by Use of a Deep Convolutional Neural Network, Journal of Clinical Microbiology Feb 2018, 56 (3) e01521-17; DOI: 10.1128/JCM.01521-17
4	Mahdieh Poostchia, Kamolrat Silamut, Richard J.Maude, Stefan Jaegera, George Thomaa, Image analysis and machine learning for detecting malaria, Translational Research, Volume 194, April 2018, Pages 36-55, https://doi.org/10.1016/j.trsl.2017.12.004.
5	Cui W, Aouidate A, Wang S, Yu Q, Li Y, Yuan S. Discovering Anti-Cancer Drugs *via* Computational Methods. *Front Pharmacol*. 2020;11:733. Published 2020 May 20. doi:10.3389/fphar.2020.00733
6	Clark RD. Putting deep learning in perspective for pest management scientists. *Pest Manag Sci*. 2020;76(7):2267-2275. doi:10.1002/ps.5820
Reference Books	
1	Qu K, Guo F, Liu X, Lin Y and Zou Q (2019) Application of Machine Learning in Microbiology. Front. Microbiol. 10:827. doi: 10.3389/fmicb.2019.00827
2	Park HS, Rinehart MT, Walzer KA, Chi J-TA, Wax A (2016) Automated Detection of *P. falciparum* Using Machine Learning Algorithms with Quantitative Phase Images of Unstained Cells. PLoS ONE 11(9): e0163045. https://doi.org/10.1371/journal.pone.0163045
3	Yang X, Wang Y, Byrne R, Schneider G, Yang S. Concepts of Artificial Intelligence for Computer-Assisted Drug Discovery. *Chem Rev*. 2019;119(18):10520-10594. doi:10.1021/acs.chemrev.8b00728
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_me88/preview
2	https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3	https://www.weforum.org/agenda/2019/05/how-artificial-intelligence-can-help-us-decode-human-immunity/

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	L	M	M	M	M	S
CO2	S	M	S	M	M	L	M	L	M	S
CO3	M	S	M	S	M	M	L	L	L	S
CO4	M	M	S	M	S	M	L	M	L	S
CO5	S	M	M	S	M	L	M	L	L	S

*S-Strong; M-Medium; L-Low

Course code	2EA	MSC MICROBIOLOGY	L	T	P	C
Elective		GROUP A - ELECTIVE PAPER II - PRINCIPLES OF QUALITY ASSURANCEAND TOTAL QUALITY MANAGEMENT	5	-	-	4
Pre-requisite		Aware of Management Skills	Syllabus Version	2021 - 2022		

Course Objectives:

The main objectives of this course are to:

1. To understand the basics of quality assurance, aware of the good practices and regulations involved in management of hazardous substances
2. Comprehend quality assessment and management of quality assurance in laboratories
3. Make the learner competent on the concepts of Total Quality Management
4. Provide adequate knowledge on representation of datas in graphical form

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To understand design and applications of microbiology lab and to outline good lab practices and first aid procedures	K2
2	To describe the maintenance of lab equipments and quality control records, facilitate the quality control of culture preparation and their maintenance	K1
3	To acquire the knowledge of effluent disposal with respect to biological reference and standard	K2
4	To provide information about the tools and techniques of total quality management.	K2
5	To impart knowledge about data analysis and data representation.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	OVERVIEW OF QUALITY ASSURANCE AND MANAGEMENT	15 hours

Quality assurance – Introduction and overview – Definition. Designing of microbiology laboratory – Control of quality – Applications. Good laboratory practices – Management of laboratory hazards and knowledge in First aid procedures.

Unit:2	QUALITY ASSESSMENT AND ASSURANCE	15 hours

Quality assessment of Equipments, chemicals, glass wares and laboratory environments – Variance – Quality control calculations – Quality management – Maintenance of records and reports. Quality assurance in sterilization and disinfection - Preservation of stock cultures, media and diagnostic kits – Quality control of media and stains

Unit:3	QUALITY ASSESSMENT OF DISPOSAL	15 hours

Quality assessment of disposal – decontaminated matters and other biological effluents – Quality management in transportations of cultures. National control of biological – Biological references and standards.

Unit:4	TOTAL QUALITY MANAGEMENT	15 hours

Concepts in TQM- Tools & techniques of TQM – Requirements for implementing TQM – Steps for implementing TQM – Questionnaire, Assessment through questionnaire – Mission statement – Benefits of TQM – Check list for implementing TQM – Case study.

Unit:5	DATA AND GRAPHCAL REPRESENTATION	15 hours
Types of Data, tabular and Graphical summarization of numeric data: - Histograms & Stem and Leaf displays : Graphs for categorical data – Bar, Pie charts & Pareto diagrams. Graphs for time ordered data – Run charts, Cause effect diagrams – Check Sheets		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Rajesh Bhatia and Rattan lal Ichhpujani. 1995. Ied. "Quality assurance in Microbiology
2	Hugo B. S., Rusell, Pharmaceutical Microbiology, Blackwell Science
3	Twelve Management skills for success – Ram Narain , Viva books private limited – Chennai.
Reference Books	
1	Black S., Symour, Disinfection, Sterilization and Preservation,Philadelphia, London
2	Gennaro, Alfonso R., Remington: The Science and Practice of Pharmacy, Vol-I & II, Lippincott Williams & Wilkins, New York, 2001.
3	A cross functional perspective Total Quality Management – Rao, Carr, Dambolena and Kopp-John Wiley & Sons, New York .
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.openlearningworld.com/books/Quality%20Management%20System/Quality%20Control/Qu ality%20Assurance.html
Course Designed By: N.GUNASHEELA	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	L	M	L	L	M
CO2	S	S	M	S	M	M	M	M	L	M
CO3	S	M	S	M	S	L	M	L	L	M
CO4	S	S	M	S	S	M	L	M	L	L
CO5	S	S	S	M	S	M	M	L	L	L

*S-Strong; M-Medium; L-Low

Course code	4EA	M. Sc. MICROBIOLOGY	L	T	P	C
Elective		GROUP A - ELECTIVE PAPER III - QUALITY ASSESSMENT IN PHARMACEUTICALS	5	-	-	4
Pre-requisite		Aware of Quality systems in Pharmaceuticals	Syllabus Version		2021 - 2022	

Course Objectives:

1. To develop knowledge of quality assurance guidance GMP, GLP and ICH in all areas that impact drug quality.
2. To accomplish GMP and quality related issues as well as various regulatory requirements

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explain the role of drugs and antibiotics in pharmaceuticals.	K1
2	State the significance of sterility in pharmaceutical industry	K2
3	Impart knowledge on regulatory guidelines on production of natural, nutraceutical and vetenary antimicrobial products	K3
4	Impart knowledge on quality assurance in pharmaceutical manufacturing	K3
5	Validate the regulatory requirements for biotherapeutics and role of microbiologist in HACCP	K4

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**ANTIMICROBIAL DRUGS**	**13 hours**

An introduction to pharmaceutical microbiology. Chemical growth control. Chemical antimicrobial agents for external use, synthetic antimicrobial drugs, naturally occurring antimicrobial drugs: Antibiotics. Antibiotics from prokaryotes,antiviral drugs, antifungal drugs, antimicrobial drug resistance, the search for new antimicrobial drugs.

Unit:2	**SPOILAGE AND STERILIZATION**	**15 hours**

Types of spoilage, Factors affecting microbial spoilage – assessment of microbial spoilage – preservation. Ecology of microorganisms as it affects the pharmaceutical industry – Sterile pharmaceutical products – injections, Non injectable sterile fluids, Ophthalmic preparations, dressings & implants.

Unit:3	**CONTROL MEASURES**	**15 hours**

Sterilization control - methods of sterility testing- sterilization monitors and Quality assurance of products. The microbiological quality and regulatory requirements for natural and nutraceutical products, The regulatory control and quality assurance of immunological products, Containment system integrity – sterile products, Regulatory guidelines (microbiology) for veterinary antimicrobial products.

Unit:4	**QUALITY ANALYSIS**	**15 hours**

The role of the Qualified Person in microbiological quality assurance, Safety in microbiology, Rapid enumeration and identification methods, Selection and use of cleaning and disinfection agents in pharmaceutical manufacturing, Prevention and elimination of microbial biofilms in the manufacturing environment using Clean-in- Place, Cleanroom design, operation and regulatory standards.

Unit:5	QUALITY ASSURANCE	15 hours
Microbiological quality assurance. Validation of aseptic processing and media fills, International disinfectant testing protocols, Measurement of biocide effectiveness, Microbiological quality and regulatory requirements for biotherapeutics and manufactured products, The role of the microbiologist in HACCP, Auditing the pharmaceutical microbiology department.		
Unit:6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Hugo W.B. and A.D.Russel. 2004. Pharmaceutical Microbiology. 4 th Ed, Blackwell Scientific Publications.
2	Dr Norman Hodges and Professor Geoff Hanlon (University of Brighton). Industrial Pharmaceutical Microbiology – Vol&Vol II: Standards & Controls Editors, (REF; www.euromed.uk.com).
Reference Books	
1	Brock. Biology of Microorganisms. 2006. Madigan M.T. 11th Edition, PearsonPrentice Hall, USA.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.openlearning.com/courses/pharmaceutical-quality-assurance/
2	https://www.mooc-list.com/tags/pharmaceutical
3	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ge14/

Course Designed By: **Dr. R. Vijayaraghavan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	L	M	M	M	L	M	M	M	L
CO2	M	S	M	S	M	L	L	M	L	M
CO3	M	M	M	S	S	M	M	M	L	L
CO4	M	S	S	M	S	M	M	M	M	L
CO5	S	S	S	S	S	L	L	M	M	L

*S-Strong; M-Medium; L-Low

Course code	4EPA	M.Sc., MICROBIOLOGY	L	T	P	C
Elective		GROUP A - ELECTIVE PAPER IV QUALITY ASSURANCE AND ASSESSMENT	-	-	5	4
Pre-requisite		Basic Knowledge in handling of Microbial cultures	Syllabus Version		2021 - 2022	

Course Objectives:

1. Enhance the knowledge of microbiological techniques in analysis of food samples and water quality
2. Make the learner to understand the concepts behind sterility in hospitals and industries and provide expertise training in sterility testing of pharmaceutical products
3. Broaden the knowledge in analysis of samples of manufactured products

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Enhance the knowledge in the field of testing of food products and be skillful as a quality supervisor in Food industry	K3
2	To understand and apply asepsis in pharmaceutical industry	K3
3	Analyze the chemical and biological quality of water	K4
4	To evaluate the microbial load in the environment.	K5
5	To analyse the impact of temperature on microbial death.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

1. Staining Techniques (Grams and LPCB)–Food samples- vegetables and packed foods.
2. Sterility tests for Instruments – Autoclave & Hot Air Oven
3. Sterility of Air and its relationship to Laboratory & Hospital sepsis.
4. Sterility testing of Pharmaceutical products –Antibiotics, Vaccines & fluids
5. Quantitative analysis of water – Membrane filter method
6. Enumeration of microbes from industrial effluents.
7. Evaluation of Drug potency by MIC.
8. Isolation & characterization of Bacteria from wood and Paints.
9. Water quality analysis – MPN.
10. Estimation of BOD and COD.
11. Isolation of microorganisms from spoiled foods – Meat, milk and Bread.
12. Milk quality – Dye reduction test.
13. Thermal death point and thermal death time.

	Total Lecture hours	**75 hours**

Text Book(s)

1	Microbiology: A Laboratory Manual, 11th Edition, 2017. James G. Cappuccino and Chad T. Welsh , Pearson
2	Laboratory Exercises in Microbiology, Fifth Edition, 2002. Harley−Prescott. The McGraw−Hill Companies.
3	Hugo and Russell's Pharmaceutical Microbiology, 7th Edition, 2004. Blackwell Publishers

Reference Books	
1	Microbiology A Laboratory Manual, 10th Edition, 2014. James G. Cappuccino and Natalie Sherman, Pearson
2	Microbiological Methods,8th Edition, 2004. Collins and Lyne. Arnold Publishers.
3	Manual of Diagnostic Microbiology, Dr.B.J.Wadher & Dr. G. L.Bhoosreddy, First .Ed., Himalaya publishing house, Nagpur.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://milnepublishing.geneseo.edu/suny-microbiology-lab/chapter/differential-staining-techniques/
2	https://www.cliffsnotes.com/study-guides/biology/microbiology/microscopy/staining-techniques
3	https://www.pharmaguideline.com/2013/06/determination-of-biological-oxygen.html
4	https://gibraltarlabsinc.com/services/microbiology/sterility-testing/
Course Designed By: **Dr. A. Vijaya Chitra**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	M	M	L	M
CO2	S	S	S	S	S	L	M	S	M	M
CO3	S	S	M	S	S	L	L	L	L	M
CO4	S	S	L	S	S	M	M	S	M	L
CO5	S	S	S	S	S	M	L	S	L	L

*S-Strong; M-Medium; L-Low

Course code	1EB	M.Sc., MICROBIOLOGY	L	T	P	C
Elective		GROUP B - ELECTIVE PAPER I - ARTIFICIAL INTELLIGENCE FORBIOLOGICAL SCIENCES	5	-	-	4
Pre-requisite		Fundamentals about Machine learning	Syllabus Version	2021 - 2022		

Course Objectives:

The main objectives of this course are to:

1. Introduce Artificial Intelligence & machine learning for biology students
2. Facilitate students to learn & apply AI tools for solving research issues in biology
3. Understand the basics of automation
4. Develop automated solutions for research problems in biology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of Artificial Intelligence	K2
2	Apply the knowledge of Machine learning and Deep learning techniques to solve real time problems	K3
3	Understand the application of Artificial Intelligence in microbe analysis and prediction of host – microbiome relationship	K2
4	Apply and validate Artificial Intelligence in clinical diagnosis of infectious disease	K4
5	Evaluate the role of Artificial Intelligence in the molecular mechanism behind drug discovery, sequencing and auto immune diseases	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	ARTIFICIAL INTELLIGENCE (AI)	15 hours

Introduction to AI – Fundamentals – Need for AI – Foundations of AI – AI environment – Application domains of AI – AI tools – Challenges and Future of AI.

Unit:2	MACHINE LEARNING (ML) AND DEEP LEARNING (DL)	15 hours

Fundamentals of ML and DL – ML algorithms to find associations across biological data, cellular image classification and identification of genetic variations.

Unit:3	ARTIFICIAL INTELLIGENCE IN CLASSIFICATION AND PREDICTION IN MICROBIOLOGY	15 hours

AI in bacterial counting - Prediction of Microbial Species - Prediction of Environmental and Host Phenotypes - Interaction Between Microorganisms – Microbiome-Disease Association - Using Microbial Communities to Predict Disease – pest management - Prediction of the Antimicrobial Activity

Unit:4	ARTIFICIAL INTELLIGENCE IN CLINICAL MICROBIOLOGY	15 hours

Artificial Intelligence Diagnostic Testing - AI and Gram Stain - AI and Parasitology - AI and Bacterial Culture Plate Images - AI and MALDI-TOF MS - AI and Whole Genome Sequencing

Unit:5	**ARTIFICIAL INTELLIGENCE IN MOLECULAR BIOLOGY**	**13 hours**
Artificial Intelligence and Machine learning in autoimmune disease – AI in drug discovery -- AI in Phylogeny – AI and Whole Genome Sequencing - AI in next generation sequencing – AI in protein structure prediction – AI in protein folding analysis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

1	Paul P. Bourbeau, Nathan A. Ledeboer; Automation in Clinical Microbiology, Journal of Clinical Microbiology May 2013, 51 (6) 1658-1665; DOI: 10.1128/JCM.00301-13
2	LeCun, Y., Bengio, Y. & Hinton, G. Deep learning. *Nature* **521,** 436–444 (2015). https://doi.org/10.1038/nature14539
3	Kenneth P. Smith, Anthony D. Kang, James E. Kirby, Automated Interpretation of Blood Culture Gram Stains by Use of a Deep Convolutional Neural Network, Journal of Clinical Microbiology Feb 2018, 56 (3) e01521-17; DOI: 10.1128/JCM.01521-17
4	Mahdieh Poostchia, Kamolrat Silamut, Richard J.Maude, Stefan Jaegera, George Thomaa, Image analysis and machine learning for detecting malaria, Translational Research, Volume 194, April 2018, Pages 36-55, https://doi.org/10.1016/j.trsl.2017.12.004.
5	Cui W, Aouidate A, Wang S, Yu Q, Li Y, Yuan S. Discovering Anti-Cancer Drugs *via* Computational Methods. *Front Pharmacol*. 2020;11:733. Published 2020 May 20. doi:10.3389/fphar.2020.00733
6	Clark RD. Putting deep learning in perspective for pest management scientists. *Pest Manag Sci*. 2020;76(7):2267-2275. doi:10.1002/ps.5820
Reference Books	
1	Qu K, Guo F, Liu X, Lin Y and Zou Q (2019) Application of Machine Learning in Microbiology. Front. Microbiol. 10:827. doi: 10.3389/fmicb.2019.00827
2	Park HS, Rinehart MT, Walzer KA, Chi J-TA, Wax A (2016) Automated Detection of *P. falciparum* Using Machine Learning Algorithms with Quantitative Phase Images of Unstained Cells. PLoS ONE 11(9): e0163045. https://doi.org/10.1371/journal.pone.0163045
3	Yang X, Wang Y, Byrne R, Schneider G, Yang S. Concepts of Artificial Intelligence for Computer-Assisted Drug Discovery. *Chem Rev*. 2019;119(18):10520-10594. doi:10.1021/acs.chemrev.8b00728
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc20_me88/preview
2	https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3	https://www.weforum.org/agenda/2019/05/how-artificial-intelligence-can-help-us-decode-human-immunity/

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	L	M	M	L	M	S
CO2	S	M	S	M	M	M	M	M	M	S
CO3	M	S	M	S	M	M	L	M	L	S
CO4	M	M	S	M	S	L	L	M	L	S
CO5	S	M	M	S	M	L	M	M	M	S

*S-Strong; M-Medium; L-Low

Course code	2EB	M. Sc. MICROBIOLOGY	L	T	P	C
Elective		GROUP B - ELECTIVE PAPER II -COMMUNICABLE AND NON- COMMUNICABLE DISEASES	5	-	-	4
Pre-requisite		Aware of microbial pathogens and its diagnosis	Syllabus Version		2021 - 2022	

Course Objectives:

1. Develop knowledge and choose epidemiological methods to investigate and manage outbreaks.
2. Apply knowledge of communicable and non-communicable disease epidemiology to strategies for prevention and control leading to improvements in public health.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Describe about various respiratory infections.	K1
2	Elaborate on the various intestinal infections.	K2
3	Discuss about different types of vector borne infections	K2
4	Acquire information about superficial mycosis and their diagnosis and treatment	K3
5	Know various non-communicable diseases and their preventive measures	K3

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**RESPIRATORY INFECTIONS**	**13 hours**

Influenza, Mumps, Measles, Rubella, Acute respiratory infections and TB.

Unit:2	**INTESTINAL INFECTIONS**	**15 hours**

Polio, Cholera, Acute diarrhea diseases, Food poisoning, Typhoid, Amoebiasis,Ascariasis, Hook worm, Tapeworm, Pinworm infections.

Unit:3	**VECTOR BORNE INFECTIONS**	**15 hours**

Leprosy, STD – AIDS – Diagnostic Techniques and Treatment.

Unit:4	**SUPERFICIAL MYCOSES**	**15 hours**

Dermatophytoses – Opportunistic fungal infections – Candidiasis – Diagnostics Techniques and Treatment.

Unit:5	**NON-COMMUNICABLE DISEASES**	**15 hours**

Hyper Tension – Diabetes – Coronary Heart diseases – Cancer, Obesity, Blindness, Accidents – Preventive measures.

Unit:6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**75 hours**

Text Book(s)

1	Dr. JahanEverttPark. 2015.Park's Text book of Preventive and social medicine.
2	K C Sawant. 1993. Medical Microbiology. Dominant Publishers.
3	K C Sawant. 2005. Virology. Dominant Publishers.
4	SubrataBhattacharjee. 2005. Bacteriology. Dominant Publishers.
5	Dr Reba Kanungo. 2017. Ananthanarayan and Paniker's Textbook of Microbiology. 10th Edition.

Reference Books	
1	Samuel Baron. 1996. Medical Microbiology. 4th Edition
2	R. C. Dubey, D. K. Maheshwari. 2010. A Textbook of Microbiology. S. Chand Publication.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.mooc-list.com/course/non-communicable-diseases-humanitarian-settings-coursera
2	https://www.who.int/health-topics/noncommunicable-diseases#tab=tab_1
3	https://www.mooc-list.com/course/global-disease-masterclass-communicable-diseases-epidemiology-intervention-and-prevention
Course Designed By: Dr. R. Vijayaraghavan	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	L	M	M	M	M	L	M	M	L
CO2	M	S	M	M	M	M	M	L	M	L
CO3	M	L	M	M	S	L	M	M	L	L
CO4	M	M	S	L	M	M	M	M	M	L
CO5	M	M	M	S	S	L	M	M	M	L

*S-Strong; M-Medium; L-Low

Course code	4EB	MSC MICROBIOLOGY	L	T	P	C
Elective		GROUP B - ELECTIVE PAPER III - HEALTH CARE OF THE COMMUNITY	5	-	-	4
Pre-requisite		Aware of Human Health Care Practices	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. Improve and expand the availability of comprehensive health service
2. Expand access to health care services in underserved and rural areas.
3. Foster and encourage the use of health care delivery models that utilize team-based approaches where each member practices at the full scope of their training.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To gain information about nutrition, health, food adulteration and preventive measures.	K2
2	To understand the importance of physical and mental health.	K2
3	To emphasize the need of health programs and health education.	K3
4	Top apply the social culture to find the solutions for mental illness and drug addiction.	K3
5	To insist the need of family planning and reproductive health education.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Nutrition and Health**	**15 hours**

Balanced Diet, food surveillance, food fortifications- addition of vitamins and minerals - Adulteration andpreventive steps.

Unit:2	**Physical health**	**15 hours**

Care of skin, hair, teeth, eyes. ears, hands and feet-physical exercises and their importance - Walking and jogging – Yoga and meditation – stress Relief.

Unit:3	**Health Education**	**15 hours**

Health Programmes and health education-Malaria control – TB control – AIDS control programmes and Immunization programmes.

Unit:4	**Mental Health**	**13 hours**

Social sciences and mental health – Sociology; Social structure, culture and customs – social problems-Mental health – cases of mental illness Alcoholism and drug dependence – prevention Rahabilitation.

Unit:5	**Health programme**	**15 hours**

Family planning, Maternal and child health – Antenatal and Postnatal care – Reproductive and child Health programme (RCH).

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**75 hours**

Text Book(s)	
1	Park's Text books of preventive and social medicine
2	Immune – biotechnology by Naha & Narain
3	Immunology by Dulsy Fatima & N.Arumugam
Reference Books	
1	Food and Nutrition by L.Swaminathan
2	Dietics by Srilakshmi 6.Practice of fertility control & Comprehensive manual 6th edition by S.K.Choudhary
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.classcentral.com/subject/public-health
2	https://onlinecourses.nptel.ac.in/noc19_mg50/preview
3	https://www.edx.org/learn/healthcare
Course Designed By:**N.Gunasheela,**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	M	M	M	L
CO2	S	S	S	S	M	M	M	L	L	L
CO3	S	M	S	S	S	L	M	M	M	L
CO4	S	S	S	S	S	S	L	S	M	L
CO5	S	S	S	M	S	S	M	L	M	L

*S-Strong; M-Medium; L-Low

Course code	4EPB	M.Sc MICROBIOLOGY	L	T	P	C
Elective Practical		GROUP B - ELECTIVE PRACTICAL IV WATER ANALYSIS AND HEALTH CARE	-	-	5	4
Pre-requisite		Basic knowledge about Biochemical Techniques	Syllabus Version		2021 - 2022	

Course Objectives:

1. To train the learner in quality analysis of physico-chemical parameters of water
2. Provide expertise training in immunological testing procedures
3. Enhance the learner skill in microscopic observation of parasites

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Enhance the knowledge in the field of testing of food products and can be skillful as a quality supervisor in Food and Dairy industries	K5
2	Perform immunological assays and diagnosis of medical samples	K3
3	Perform analysis of environmental samples such as water.	K4
4	Understand the concepts of food adulteration	K3
5	Investigate samples for Protozoa and helminthic parasites.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

1. Water Analysis: Physicochemical parameters -pH, Turbidity, TDS, TSS, BOD, COD and DO
2. Pasteurization of milk & Methylene Blue Dye Reduction test.
3. Diagnostic test: Diabetic test, Hypertension test, Widal test, VDRL test
4. Food Adulteration Any four Food Stuffs
5. Radial Immuno diffusion test
6. ELISA test
7. Microscopic examination of Infectious Agents- Entamoeba, Ascaris, Hook worm, pinworm, Tape worm, Malarial parasite and Filarial parasite.
8. Water Quality analysis- MPN

Total Lecture hours **75 hours**

Text Book(s)

1	Microbiology: A Laboratory Manual, 11th Edition, 2017. James G. Cappuccino and Chad T. Welsh , Pearson
2	Laboratory Exercises in Microbiology, Fifth Edition, 2002. Harley−Prescott. The McGraw−Hill Companies.

Reference Books

1	Microbiology A Laboratory Manual, 10th Edition, 2014. James G. Cappuccino and Natalie Sherman, Pearson
2	Microbiological Methods,8th Edition, 2004. Collins and Lyne. Arnold Publishers.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	M	M	M	L
CO2	S	M	S	S	S	S	M	M	L	L
CO3	S	S	M	S	S	M	M	M	L	L
CO4	S	S	L	S	S	L	L	M	L	L
CO5	S	S	L	S	S	M	L	L	M	L

*S-Strong; M-Medium; L-Low

Course code	1EC	M.Sc MICROBIOLOGY	L	T	P	C
Elective		GROUP C - ELECTIVE PAPER I - ARTIFICIAL INTELLIGENCE FORBIOLOGICAL SCIENCES	5	-	-	4
Pre-requisite		Fundamentals about Machine learning	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

1. Introduce Artificial Intelligence & machine learning for biology students
2. Facilitate students to learn & apply AI tools for solving research issues in biology
3. Understand the basics of automation
4. Develop automated solutions for research problems in biology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of Artificial Intelligence	K2
2	Apply the knowledge of Machine learning and Deep learning techniques to solve real time problems	K3
3	Understand the application of Artificial Intelligence in microbe analysis and prediction of host – microbiome relationship	K2
4	Apply and validate Artificial Intelligence in clinical diagnosis of infectious disease	K4
5	Evaluate the role of Artificial Intelligence in the molecular mechanism behind drug discovery, sequencing and auto immune diseases	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	ARTIFICIAL INTELLIGENCE (AI)	15 hours

Introduction to AI – Fundamentals – Need for AI – Foundations of AI – AI environment – Application domains of AI – AI tools – Challenges and Future of AI.

Unit:2	MACHINE LEARNING (ML) AND DEEP LEARNING (DL)	15 hours

Fundamentals of ML and DL – ML algorithms to find associations across biological data, cellular image classification and identification of genetic variations.

Unit:3	ARTIFICIAL INTELLIGENCE IN CLASSIFICATION AND PREDICTION IN MICROBIOLOGY	15 hours

AI in bacterial counting - Prediction of Microbial Species - Prediction of Environmental and Host Phenotypes - Interaction Between Microorganisms – Microbiome - Disease Association - Using Microbial Communities to Predict Disease – pest management - Prediction of the Antimicrobial Activity

Unit:4	ARTIFICIAL INTELLIGENCE IN CLINICAL MICROBIOLOGY	15 hours

Artificial Intelligence Diagnostic Testing - AI and Gram Stain - AI and Parasitology - AI and Bacterial Culture Plate Images - AI and MALDI-TOF MS - AI and Whole Genome Sequencing

Unit:5	ARTIFICIAL INTELLIGENCE IN MOLECULAR BIOLOGY	13 hours
Artificial Intelligence and Machine learning in autoimmune disease – AI in drug discovery -- AI in Phylogeny – AI and Whole Genome Sequencing - AI in next generation sequencing – AI in protein structure prediction – AI in protein folding analysis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Paul P. Bourbeau, Nathan A. Ledeboer; Automation in Clinical Microbiology, Journal of Clinical Microbiology May 2013, 51 (6) 1658-1665; DOI: 10.1128/JCM.00301-13
2	LeCun, Y., Bengio, Y. & Hinton, G. Deep learning. *Nature* **521,** 436–444 (2015). https://doi.org/10.1038/nature14539
3	Kenneth P. Smith, Anthony D. Kang, James E. Kirby, Automated Interpretation of Blood Culture Gram Stains by Use of a Deep Convolutional Neural Network, Journal of Clinical Microbiology Feb 2018, 56 (3) e01521-17; DOI: 10.1128/JCM.01521-17
4	Mahdieh Poostchia, Kamolrat Silamut, Richard J.Maude, Stefan Jaegera, George Thomaa, Image analysis and machine learning for detecting malaria, Translational Research, Volume 194, April 2018, Pages 36-55, https://doi.org/10.1016/j.trsl.2017.12.004.
5	Cui W, Aouidate A, Wang S, Yu Q, Li Y, Yuan S. Discovering Anti-Cancer Drugs *via* Computational Methods. *Front Pharmacol*. 2020;11:733. Published 2020 May 20. doi:10.3389/fphar.2020.00733
6	Clark RD. Putting deep learning in perspective for pest management scientists. *Pest Manag Sci*. 2020;76(7):2267-2275. doi:10.1002/ps.5820

Reference Books

1	Qu K, Guo F, Liu X, Lin Y and Zou Q (2019) Application of Machine Learning in Microbiology. Front. Microbiol. 10:827. doi: 10.3389/fmicb.2019.00827
2	Park HS, Rinehart MT, Walzer KA, Chi J-TA, Wax A (2016) Automated Detection of *P. falciparum* Using Machine Learning Algorithms with Quantitative Phase Images of Unstained Cells. PLoS ONE 11(9): e0163045. https://doi.org/10.1371/journal.pone.0163045
3	Yang X, Wang Y, Byrne R, Schneider G, Yang S. Concepts of Artificial Intelligence for Computer-Assisted Drug Discovery. *Chem Rev*. 2019;119(18):10520-10594. doi:10.1021/acs.chemrev.8b00728

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc20_me88/preview
2	https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3	https://www.weforum.org/agenda/2019/05/how-artificial-intelligence-can-help-us-decode-human-immunity/

Course Designed By: **Dr. A. Vijaya Chitra**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	L	M	L	M	L	S
CO2	S	M	S	M	M	L	L	M	M	S
CO3	M	S	M	S	M	M	M	L	M	S
CO4	M	M	S	M	S	M	M	M	M	S
CO5	S	M	M	S	M	L	M	L	L	S

*S-Strong; M-Medium; L-Low

Course code	2EC	M. Sc. MICROBIOLOGY	L	T	P	C
Elective		GROUP C - ELECTIVE PAPER II - BIOPHYSICS AND BIOCHEMISTRY (2EA)	5	-	-	4
Pre-requisite		Fundamentals about structural information of Biologically active molecules	Syllabus Version		2021 - 2022	

Course Objectives:

CO1: To develop the knowledge of biophysical methods in the analysis of biopolymers
CO2: To describe technological aspects of biological molecules
CO3: To provide basic understanding on biochemistry principles of biomolecules

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To impart knowledge about biophysical methods used for analysis of biopolymers	K1
2	To provide information on nucleic acid polymorphism	K2
3	To educate about radio-physics with respect to tracer techniques in biology	K2
4	To provide basic information on conversion and synthesis of macromolecules and their rolein metabolism	K4
5	To understand various metabolic disorders and their molecular biology	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	BIOPHYSICAL METHODS	15 hours

Principles of biophysical methods used for analysis of biopolymer structure, X-ray diffraction, Hydrodynamic methods; plasma emission spectroscopy.

Unit:2	NUCLEIC ACID HYBRIDIZATION TECHNIQUES	15 hours

Principles and techniques of nucleic acid hybridization and Cot curves; Sequencing of Proteins and nucleic acids; Methods for measuring nucleic acid and protein interactions. Structural polymorphism of DNA, RNA and three dimensional structure of tRNA.

Unit:3	TRACER BIOLOGY	13 hours

Principles and applications of tracer techniques in biology; Radiation dosimetry; Radioactive isotopes and half life of isotopes; Effect of radiation on biological system.

Unit:4	BIOCHEMISTRY	15 hours

Interconversion of hexoses and pentoses; Amino acid metabolism; Coordinated control of metabolism; Oxidation of lipids; Biosynthesis of fatty acids; Triglycerides; Phospholipids; Sterols, Group transfer and Coupled reactions.

Unit:5	CANCER BIOLOGY	15 hours

Biochemistry and molecular biology of cancer; Oncogenes; Chemical carcinogenesis;Genetic and metabolic disorders; Hormonal imbalances; Drug metabolism and detoxification.

Unit:6	CONTEMPORARY ISSUES	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	75 hours

Text Book(s)	
1	Gauri Misra. Introduction to biomolecular structure and biophysics, basics of biophysics. 2017. Springer
2	Peter Jomo Walla. Modern biophysical chemistry: detection and analysis of biomoleules. 2014. Second, updated and expanded edition. Wiley publications.
3	Thomas Jue. Hand book of modern biophysics. Biomedical applications of biophysics.2010.Volume 3. Humana Press.
Reference Books	
1	Keith Wilson and John Walker. Principles and Techniques of biochemistry and Molecular biology. 2010. Seventh edition. Cambridge University Press.
2	Roger L. Lundblad, Fiona Macdonald. Hand book of biochemistry and molecular biology. 2018. CRC Press.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.swayam2.ac.in/cec20_bt12/preview
2	https://onlinecourses.swayam2.ac.in/cec20_bt19/preview
3	https://www.edx.org/course/medicinal-chemistry-the-molecular-basis-of-drug-di
Course Designed by: Dr.T.Savitha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	L	M	S	S	S	M	L	L	L
CO2	S	M	L	L	M	S	L	M	M	L
CO3	L	M	S	L	S	S	M	L	M	L
CO4	M	S	L	S	L	S	L	M	L	L
CO5	S	L	M	M	M	S	M	M	L	L

*S-Strong; M-Medium; L-Low

Course code	4EC	M. Sc. MICROBIOLGY	L	T	P	C
Elective		GROUP C - ELECTIVE PAPER III - MOLECULAR CYTOLOGY AND TISSUEENGINEERING	5	-	-	4
Pre-requisite		Basic knowledge about Molecular Genetics	Syllabus Version		2021 - 2022	

Course Objectives:

CO1: To impart knowledge on molecular basis of signal transduction in life
CO2: To provide technological aspects in cell and tissue culture
CO3: To develop understanding of histological techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire the techniques in molecular cytology	K1
2	To understand the molecular background linked to signal transduction pathways and sexlinked inheritance.	K2
3	To gain knowledge about DNA constancy and mutagenesis	K2
4	To Analyze the different cell and tissue culture techniques.	K4
5	To acquire the knowledge about the basics of mammalian systems.	K3

Unit:1	BASIC TECHNIQUES	15 hours

Molecular basis of signal transduction in bacteria, plants and animals; Model membranes; protein sorting, secretory and endocytic pathways, cell cycle; Dosage compensation and sex determination andsex-linked inheritance

Unit:2	DNA MUTAION AND EXPRESSION STUDIES	15 hours

The law of DNA constancy and C-value paradox; Numerical, and structural changes in chromosomes; Molecular basis of spontaneous and induced mutations and their role in evolution; polypoidy;
Environmental mutagenesis and toxicity testing; Population genetics. Environmental regulation of gene expression

Unit:3	TECHNIQUES OF CELL AND TISSUE CULTURE	13 hours

Cell and tissue culture in plants and animals; Primary culture; Cell line; Cell clones; Callus cultures; Somaclonal variation; Micropropagation; Somatic embryogenesis; Haploidy; Protoplast fusion and somatic hybridization; Cybrides;

Unit:4	GENE TRANSFER AND APPLICATIONS	15 hours

Gene transfer methods in plants and in animals; Transgenic biology; Allopheny; Artificial seeds; Gene targeting. Applications of genetic engineering in agriculture, health and industry.

Unit:5	HISTOLOGY, PHYSIOLOGY AND HAEMATOLOGY	15 hours

Histology – Basics of mammalian systems, nutrition, digestion and absorption; Circulation (open and closed circular, lymphatic systems, blood composition and function); Excretion and osmoregulation: Homeostatis (neural and hormonal); Bioluminiscence.

Unit:6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Bailey & Scotts Diagnostic Microbiology. 12th edition. 2007.
2	Histology: A text and Atlas: with coorelated cell and Molecular biology. 2015.
Reference Books	
1	Leopoid G.Koss & Myron R.Melamed (eds). Koss' Diagnostic cytology and its histopathologic bases. Volume2. 2005.
2	Jean Brachet. Molecular cytology. Volume 1: Cell cycle. 1985.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://study.com/articles/List_of_Free_Online_Pathology_Courses_and_Classes.html
2	https://www.futurelearn.com/courses/histology
Course Designed by: Dr.T.Savitha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**M**	**L**	**M**	**S**	**L**	M	M	L	L	L
CO2	**M**	**S**	**L**	**M**	**M**	M	L	M	M	L
CO3	**L**	**M**	**S**	**L**	**S**	M	M	M	L	L
CO4	**S**	**L**	**M**	**L**	**M**	L	L	M	L	L
CO5	**M**	**L**	**L**	**M**	**S**	L	M	L	L	L

*S-Strong; M-Medium; L-Low

Course code	4EPC	M.Sc MICROBIOLOGY	L	T	P	C
Elective Practical		GROUP C – ELECTIVE PRACTICAL IV TECHNIQUES IN CYTOLOGY	-	-	5	4
Pre-requisite		Basic Knowledge about cytogenetic Methods andplant tissue culture techniques	Syllabus Version		2021 - 2022	

Course Objectives:

1.To provide the knowledge on cell divisions

2.To enhance technical skill on electrophoresis techniques

3.To impart the basics of callus and auxin production

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To learn the various stages of cell divisions.	K5
2	To estimate the total carbohydrate and proteins in the sample	K3
3	To induce mutation by UV radiations	K4
4	To visualize agglutination, precipitation patterns and agarose gel electrophoresis	K3
5	To understand the phenomenon of callus, auxin production and bioluminescence	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

1. Stages of cell division-mitosis and meiosis
2. Estimation of total carbohydrates and proteins
3. CS of dicot and monocot root and stem
4. Physical mutation with UV
5. Antagonistic activity of any one biocontrol agent
6. Agarose gel electrophoresis
7. Agglutination-Blood grouping, Precipitation-ODD
8. Callus induction
9. Auxin production
10. Phenomenon of Bioluminescence

	Total Lecture hours	**75 hours**

Text Book(s)

1	Microbiology: A Laboratory Manual, 11th Edition, 2017. James G. Cappuccino and Chad T. Welsh , Pearson
2	Laboratory Exercises in Microbiology, Fifth Edition, 2002. Harley−Prescott. The McGraw−Hill Companies.

Reference Books

1	Microbiology A Laboratory Manual, 10th Edition, 2014. James G. Cappuccino and Natalie Sherman, Pearson
2	Microbiological Methods, 8th Edition, 2004. Collins and Lyne. Arnold Publishers.

Course Designed by: Dr.T.Savitha

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	M	M	L	L
CO2	S	M	S	S	S	S	M	M	M	L
CO3	S	S	M	S	S	S	M	M	L	L
CO4	S	S	L	S	S	L	M	M	L	L
CO5	S	S	L	S	S	S	L	L	M	L

*S-Strong; M-Medium; L-Low

Annexure

BHARATHIAR UNIVERSITY,
COIMBATORE – 46M.Sc.,
MICROBIOLOGY
(EFFECTIVE FROM THE ACADEMIC YEAR 2021 – 2022 ONWARDS)

VISION

Impart quality education with ethical values besides making the young minds to explore the world with great enthusiasm. Improve the academic qualities and capabilities, through building intellectual and imaginative minds with sophisticated education consequently making them a responsible citizen who can work for the advancement of the society.

MISSION

To nurture knowledge, skills, values and confidence in the students to grow, thrive and prosper. Inculcating optimistic thinking and positive spirit will establish global competence among students community. Promote the science of Microbiology through integrated application-oriented courses, with a view to pursue their goals and to produce all-round development of individuals in areas such as teaching-learning, research, entrepreneur and consultancy in the field of microbiology

- Project Report – 160 Marks, Viva voce- 40 Marks * Students should undergo an institutional/industrial training/ Internship relevant to any one of theory paper for a continuous period of 15 days before semester IV and submit report along with attendance certificate.
- 16 hrs should be allotted for project guidance to the respective guides as per the Universitynorms. 16 hrs of project guidance should be considered equivalent to 8 hrs of teaching while calculating work load of respective guides.
- Training Report – 40 Marks, Viva voce- 10 Marks. @ No University Examinations.Only Continuous Internal Assessment (CIA).

List of Group Elective papers (Colleges can choose any one of the Group papers as electives)

	GROUP A	GROUP B	GROUP C
Paper I/Sem I 1EA/1EB/1EC	Artificial Intelligence ForBiological Sciences	Artificial Intelligence ForBiological Sciences	Artificial Intelligence ForBiological Sciences
Paper II/Sem II 2EA/2EB/2EC	Principles of Quality Assurance and Total QualityManagement (TQM)	Communicable and Non communicable diseases	Biophysics and Biochemistry
Paper III/Sem IV 4EA/4EB/4EC	Quality Assessment in Pharmaceuticals	Health care of thecommunity	Molecular Cytology and Tissue Engineering
Paper IV/Sem IV 4EPA/4EPB/4EPC	Quality Assurance and Assessment	Water Analysis and Health Care	Techniques in Cytology

List of Value Added Courses offered (Colleges/Departments can choose any one of the papers in each/respective semester as Valued Added Course)

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
Odd Semester (I)	20PMBVAC1	Organic Farming	2	3	50	2
	20PMBVAC2	HACCP – Level 1 and 2	2	3	50	2
	20PMBVAC3	Human Anatomy and Medical Transcription	2	3	50	2
	20PMBVAC4	Introduction to Clinical research & Pharmaceutical medicine	2	3	50	2

Odd Semester(III)	20PMBVAC5	Basics in Bioinformatics	2	3	50	2
	20PMBVAC6	HACCP – Level 3	2	3	50	2
	20PMBVAC7	Medical Coding & Clinical data management	2	3	50	2
	20PMBVAC8	Entrepreneurial Microbiology	2	3	50	2

A. Conditions for award of degree:

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed course of study in a college affiliated to the university for a period of not less than two academic years, passed the examination of all the four semesters prescribed with earning credits and fulfilled such conditions.

1. **Duration of the course**
   The duration of the course is for two academic years consisting of four semesters.
2. **Credits**
   The phrase credit denotes that the quantum of syllabus for various programmes in terms of study. It mainly focused on differential weightage given the contents and duration of the courses in the curriculum design. The total number of credits for this programme is 90.
3. **Core and elective courses**
   Candidate admitted to PG Microbiology course should undertake 22 courses, of which 13 courses are of core theory papers, 3 courses of elective papers, 1 course of project and 4 practical courses along with 1 industrial training/ internship course.
4. **Examinations**
   There will be four semester examinations: first semester examinations at the middle of the first academic year (November/ December) and the second semester examinations at the end of the first academic year (April/May). Similarly, the third and fourth semester examinations will be held at the middle and end of the second academic year respectively.

a. Theory examinations
The external evaluation will be based on the examinations to be conducted by the university at the end of each semester.

b. Practical examinations
Practical examinations will be conducted at the end of every semester.

5. Scheme of examinations

The scheme of examinations for different semesters will be as follows:

a. Theory paper

External	: 75 marks
Internal	: 25 marks
Total	: 100 marks
Time	: 3hours

The following procedure will be followed for internal marks:Theory papers Internal Best two tests out of 3 : 15MarksSeminar : 5 Marks
Assignment : 5 Marks Total : 25 Marks

b. Practical : 40 Internal MarksExperimental performance : 25 Marks Pra
Record : 5 Marks

c. Project*

Internal	: 30 Marks
Dissertation Project report	: 100 MarksPresentation : 30 Marks
Viva-voce	: 40 Marks

Passing Minimum

i. There will be no passing minimum for internal
ii. For external examinations, passing minimum will be of 50% of maximum marks allottedfor the paper.
iii. In the aggregate (external + internal), the passing minimum will be of 50% for eachpaper/practical/ project and viva-voce.
iv. Grading will be based on overall marks obtained (external + internal).

Note: * to elaborate the following regarding to project:

i. Students should carry out INDIVIDUAL PROJECT only
ii. Project will be allotted at the beginning of IVth semester only
iii. In-house projects are encouraged
iv. Students may be allowed to undertake their project work in other research institutes
v. Faculty members of the respective colleges must serve as their guides
vi. Co-guide from other institutions maybe allowed only with the concern from guide.
vii. Project report evaluation will be done and viva-voce will be conducted by both externalexaminer and the guide at the end of fourth semester itself.
viii. Dissertation in THREE copies has to be submitted 15 days before the actual schedule ofthe exam.

d. Grading system

The performance of the students are indicated by the SEVEN POINT SCALE GRADINGSYSTEM as per the UGC norms given below

GRADE	GRADE POINT	PERCENTAGE OF PERFORMANCE MARKS	
O	9.5 and above	95-100	Outstanding
E	9.5 and above	85-94	Excellent
D	8.5 and above	+75-84	Distinction
A	7.5 and above	70-74	Very Good
B	7.0 and above	60-69	Good
C	6.0 and above	50-59	Average
RA	5.0 and above	Upto 49	Re-Appear

The overall performance level of the candidates will be assessed by the following formulae:Cumulative weighted average of marks = Σ(marks + credits) / Σ credits Cumulative weighted average grade points =Σ (Grade points x Credits) / Σ Credits.

e. Industrial visit

Academic industrial visits to institutions and industries correlated to the courses during the semesters of study will outline part of the curriculum to reinforce the understanding of concepts and applications educated theoretically and practically. This kind of visits will be a boon to collect specimens and samples, to understand the scope and avenues of different subjects studied by students and the expectations of the organisation, who are employing them after the finishing point of their degree. Based on the desires, students could develop the required skills. Staff accompanying the students should be given non-remunerative OD for such visits.

6. The question paper pattern for all theory papers should be as follows:

Section	Type of questions	Marks
Part – A questions	Multiple choice (2 questions from each unit)	1x10= 10 Marks 5x5= 25 Marks
Part – B questions	Internal choice (One question from each unit)	8x5= 40 Marks
Part – C questions	Internal choice (One question from each unit)	

Total 75 Marks

7. The question paper pattern for all practical papers should be as follows:

Duration of practical time: 9 hours
Max.marks: 60

S.No	Components	Marks
1	Major experiment	25 Marks
2	Minor experiment	15 Marks
3	Identification of spotters (5x2	10 Marks
4	Record	5 Marks
5	Viva-voce	5 Marks

Scheme of examinations

The scheme of examinations for different semesters will be as follows:

a. Theory paper

External : 75 marks
Internal : 25 marks
Total : 100 marks
Time : 3hours

The following procedure will be followed for internal marks:Theory papers Internal

Best two tests out of 3 : 15MarksSeminar : 5 Marks
Assignment : 5 Marks Total : 25 Marks

b. Practical : 40

Internal MarksExperimental performance : 25 Marks
Practical test (Best 2 out of 3) : 10 Marks
Record : 5 Marks

c. Project*

Internal : 30 Marks
Dissertation Project report : 100 MarksPresentation : 30 Marks
Viva-voce : 40 Marks

Passing Minimum

v. There will be no passing minimum for internal

vi. For external examinations, passing minimum will be of 50% of maximum marks allottedfor the paper.

vii. In the aggregate (external + internal), the passing minimum will be of 50% for eachpaper/practical/ project and viva-voce.

viii. Grading will be based on overall marks obtained (external + internal).

Note: * to elaborate the following regarding to project:

ix. Students should carry out INDIVIDUAL PROJECT only

x. Project will be allotted at the beginning of IVth semester only

xi. In-house projects are encouraged

xii. Students may be allowed to undertake their project work in other research institutes

xiii. Faculty members of the respective colleges must serve as their guides

xiv. Co-guide from other institutions maybe allowed only with the concern from guide.

xv. Project report evaluation will be done and viva-voce will be conducted by both externalexaminer and the guide at the end of fourth semester itself.

xvi. Dissertation in THREE copies has to be submitted 15 days before the actual schedule ofthe exam.

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C	6.0 and above	50-59	Average
RA	5.0 and above	Upto 49	Re-Appear

The overall performance level of the candidates will be assessed by the following formulae:
Cumulative weighted average of marks = Σ(marks + credits) / Σ credits
Cumulative weighted average grade points =Σ (Grade points x Credits) / Σ Credits.

e. Industrial visit

Academic industrial visits to institutions and industries correlated to the courses during the semesters of study will outline part of the curriculum to reinforce the understanding of concepts and applications educated theoretically and practically. This kind of visits will be a boon to collect specimens and samples, to understand the scope and avenues of different subjects studied by students and the expectations of the organisation, who are employing them after the finishing point of their degree. Based on the desires, students could develop the required skills. Staff accompanying the students should be given non-remunerative OD for such visits.

8. The question paper pattern for all theory papers should be as follows:

Section	Type of questions	Marks
Part – A	Multiple choice questions	1x10= 10 Marks
	(2 questions from each unit)	5x5= 25 Marks
Part – B	Internal choice questions	8x5= 40 Marks
	(One question from each unit)	
Part – C	Internal choice questions	
	(One question from each unit)	

Total 75 Marks

9. The question paper pattern for all practical papers should be as follows:

Duration of practical time: 9 hours

Max.marks: 60

S.No	Components	Marks
6	Major experiment	25 Marks
7	Minor experiment	15 Marks
8	Identification of spotters (5x2	10 Marks
9	Record	5 Marks
10	Viva-voce	5 Marks