B.Sc. Microbiology

Syllabus

AFFILIATED COLLEGES

Program Code: 22L

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
The B.Sc., Microbiology program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Active and Principal investigator
PEO2	Resourceful educator
PEO3	Administrative / Executive official
PEO4	Leadership excellence
PEO5	Intellectual adeptness in various perceptions
PEO6	Entrepreneur
PEO7	Chief microbiologist in clinical diagnostic and quality control sector

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
After the successful completion of B.Sc., Microbiology, the students are expected to	
PSO1	isolate and identify the microorganisms including bacteria, fungi and algae.
PSO2	to get acquainted knowledge about the taxonomical classification of microorganisms.
PSO3	acquire knowledge about modern microbiological techniques and bioinstrumentation which make them competent to be placed in various Microbiological / Biotechnological industries.
PSO4	attain practical exposure during the institutional training.
PSO5	gain the knowledge of clinical investigation and diagnosis of various infectious diseases.
PSO6	acquire knowledge on health care, prevention and control of various pathogenic microbes which cause seasonal outbreaks, epidemics and pandemics etc.
PSO7	understand theoretical and practical knowledge in the allied subjects Biostatistics andComputer Applications, Biochemistry in addition to the core subjects in Microbiology.

PROGRAMME OUTCOMES (POs)	
On successful completion of the B.Sc., Microbiology programme	
PO1	Acquire eligibility for higher studies / technical and administrative placement in government and private sectors.
PO2	Attain competency to be placed in various Microbiological / Biotechnological industries.
PO3	Obtain technical experience to become an entrepreneur by institutional training / internship.
PO4	Understand the integral role of science in life.
PO5	Acquaint and establish equilibrium of nature and in fact create a fit biosphere with the knowledge of Microbiology.
PO6	Acquire skills necessary to fulfill the personal, civil and social responsibilities.
PO7	Develop knowledge in ethical thinking, quantitative analytical skills and its application to the issues in society.
PO8	Acquire knowledge on harmful and beneficial role played by microbes in human health.
PO9	Understand the impact of gene technology in microbiology for human welfare.
PO10	Comprehend the role of recent technologies in microbiological applications & research data management.

BHARATHIAR UNIVERSITY, COIMBATORE – 641 046

B.Sc., MICROBIOLOGY

(For the students admitted from the Academic Year 2021 – 2022 onwards)

Eligibility:

Pass in higher secondary (academic stream) examination conducted by the Government of Tamil Nadu with Biology / Botany / Zoology/ Microbiology / Nursing / Biochemistry as subjects or DMLT or Diploma in Pharmacy / Pharmacology or other examinations accepted as equivalent there to by the Syndicate, subject to such other conditions as may be prescribed therefor.

Medium of Instruction and examinations:

The medium of instruction and examinations for the papers of Part I and II shall be the language concerned. For part III subjects and part IV subjects other than Foundation, Value education and Non – Major Elective – II, the medium of instruction as well as the medium of examinations shall be English. For Foundation course, Value education and Non – Major Elective – II the medium of instruction shall be English and the medium of examinations is in English / Tamil irrespective of the medium of instructions. For modern languages, the medium ofinstruction and examination will be in the languages concerned.

Passing Minimum:

A candidate shall be declared to have passed in a paper if he / she should obtain not less than 40% of marks in the external examination. A candidate failing to secure the minimummarks prescribed shall be required to reappear for the examination in that paper.

Qualification of the Faculty:

M.Sc. degree in Microbiology or equivalent recognized by Bharathiar University / TamilNadu State Council for Higher Education (TANSHE) along with qualifications prescribed by University / University Grants Commission (UGC) time to time.

Conferment of the Degree:

No candidate shall be eligible for conferment of the Degree unless he / she,

- has undergone the prescribed course of study for a period of not less than six semesters in an institution approved by / affiliated to the University or has been exempted from in the manner prescribed and has passed the examinations as have been prescribed therefor.
- has successfully completed the prescribed Institutional Training / internship as evidenced by certificate issued by the Principal of the College.

The successful candidates will be conferred with Bachelor Degree in Microbiology.

BHARATHIAR UNIVERSITY, COIMBATORE – 641 046
B.Sc., MICROBIOLOGY DEGREE COURSE
CBCS - OBE PATTERN : (AFFILIATED COLLEGES)
(For the students admitted from the academic year 2021 – 2022 onwards)
Scheme of Examination

Part	Study Components	Course Title	Course / Subject Code	Ins. hrs / Week	Examinations				Credits
					Dur.	CIA	Marks	Total Marks	
	SEMESTER – I								
I	Language – I		11T/M/H/F	6	3	50	50	100	4
II	English – I		12E	6	3	50	50	100	4
III	Core Paper – I : Fundamentals of Microbiology		13A	6	3	50	50	100	4
III	Core Practical – I		23P	4	-	-	-	-	-
III	Allied – A : Paper – I: Biostatistics and Computer Applications I		1AB	4	3	30	45	75	3
III	Allied Practical – I		2PB	2	-	-	-	-	-
IV	Environmental Studies #		1FA	2	3	-	50	50	2
	SEMESTER – II								
I	Language – II		21T/M/H/F	6	3	50	50	100	4
II	English – II		22E	6	3	50	50	100	4
III	Core Paper – II : Analytical Microbiology		23A	4	3	50	50	100	4
III	Core Paper – III : General Biology		23B	3	3	50	50	100	4
III	Core Practical – I		23P	3	6	30	45	75	3
III	Allied – A : Paper – II: Biostatistics and ComputerApplications – II		2AB	4	3	30	45	75	3
III	Allied Practical – I (Biostatistics and Computer Applications)		2PB	2	3	25	25	50	2
IV	Value Education – Human Rights #		2FB	2	3	-	50	50	2
	Swatch Bharath Summer Internship								
	SEMESTER – III								
I	Language – III		31T/M/H/F	6	3	50	50	100	4
II	English – III		32E	6	3	50	50	100	4
III	Core Paper – IV : Microbial Diversity		33A	4	3	50	50	100	4
III	Core Practical – II		43P	3	-	-	-	-	-
III	Allied – B : Paper – I: Biochemistry – I / Zoology – I		3AC	4	3	30	45	75	3
III	Allied Practical – II		43Q	2	-	-	-	-	-
IV	Skill based Subject – I: Diagnostic Microbiology – I		3ZA	3	3	30	45	75	3
IV	Tamil @ / Advanced Tamil # (OR) Non – MajorElective – I (Yoga for Human Excellence # / Women's Rights #)		3FD	2	3	-	50	50	2

	SEMESTER – IV							
I	Language – IV	41T/M/H/F	6	3	50	50	100	4
II	English – IV	42E	6	3	50	50	100	4
III	Core Paper – V : Microbial Physiology	43A	4	3	50	50	100	4
III	Core Practical – II	43P	3	6	30	45	75	3
III	Allied – B : Paper – II: Biochemistry – II / Zoology –II	4AC	4	3	30	45	75	3
III	Allied Practical – II	43Q	2	3	25	25	50	2
IV	Skill based Subject – II: Diagnostic Microbiology – II	4ZB	3	3	30	45	75	3
I V	Tamil @ / Advanced Tamil # (OR) Non – Major Elective – II (General Awareness #)	4FA	2	3	-	50	50	2
	SEMESTER – V							
III	Core Paper – VI : Microbial Genetics	53A	5	3	50	50	100	4
III	Core Paper – VII : Principles of Immunology	53B	5	3	50	50	100	4
III	Core Paper – VIII : Food Microbiology	53C	4	3	50	50	100	4
III	Core Paper – IX : Medical Microbiology	53D	4	3	50	50	100	4
III	Elective – I	5EA	4	3	50	50	100	4
III	Core Practical – III	63P	5	-	-	-	-	-
IV	Skill based Subject – III: Infectious diseases and their management	5ZC	3	3	30	45	75	3
	SEMESTER – VI							
III	Core Paper – X: Industrial Microbiology	63A	5	3	50	50	100	4
III	Core Paper – XI : Environmental and Agricultural Microbiology	63B	5	3	50	50	100	4
III	Core Paper – XII : Virology	63C	4	3	50	50	100	4
III	Elective – II	6EA	4	3	50	50	100	4
III	Elective – III	6ED	4	3	50	50	100	4
III	Core Practical – III	63P	5	9	50	50	100	4
IV	Skill based Subject – Practical	6ZP	3	6	30	45	75	3
IV	Extension activities @	67A	-	-	-		50	2

Institutional training / Internship: Students should undergo an institutional training / Internship for a continuous period of 15days before semester VI. It is evidenced by certificate issued by the Principal of the College.

@ No University Examinations. Only Continuous Internal Assessment (CIA).

No Continuous Internal Assessment (CIA). Only University Examinations.

* **Swatch Bharath Summer Internship is mandatory – Extra 2 credit points would be given.**

List of Elective papers (Colleges can choose any ONE GROUP of the paper as electives)			
S. No.	**Group**	**Title of the subject**	**Sub. Code**
Elective – I	**A**	Recombinant DNA Technology - I	**5EA**
	B	Plant Therapeutics	**5EB**
	C	Medical coding	**5EC**
Elective – II	**A**	Recombinant DNA Technology – II	**6EA**
	B	Entrepreneurial Microbiology	**6EB**
	C	Medical Biochemistry	**6EC**
Elective - III	**A**	Dairy Microbiology	**6ED**
	B	Bionanotechnology	**6EE**
	C	Bioinformatics	**6EF**

First Semester

Course code	13A	FUNDAMENTALS OF MICROBIOLOGY	L	T	P	C
Core-I			4	2	-	4
Pre- requisite	Basic knowledge on Microbiology gained during H. Sc.,		Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- gain knowledge of discovery, development and scope of Microbiology.
- internalize the techniques used to observe microorganisms.
- understand the concept of asepsis and techniques used for the cultivation of microorganisms.

Expected Course Outcomes:

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

1	Get acquainted with contributions of various scientists.	**K 1**
2	Gain knowledge about microscopy.	**K 2**
3	be trained with staining techniques to observe microorganisms.	**K 3**
4	be familiar with principles and methods of sterilization.	**K 4**
5	Identify and cultivate microbes in the laboratory.	**K 5**

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

Unit – I **18 Hours**

History and Scope of Microbiology – Spontaneous generation theory – Conflict – Contribution of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, Waksman, John Tyndall, Paul Ehrlich, Watson & Crick and Miescher.

Unit –II **18 Hours**

Microscopy – Principles and applications – Bright field, Dark field, Phase contrast, Fluorescence, Confocal, SEM & TEM – Specimen preparation for Electron microscopy.

Unit – III **18 Hours**

Structure and organization of bacterial cell wall: Gram positive and Gram Negative bacterial cell wall. Staining – Principles – Types of staining – Simple, Differential (Gram, Spore, AFB), Capsule staining (Negative), Giemsa Staining, LPCB, KOH Mount.

Unit – IV **18 Hours**

Sterilization and Disinfection – Principles – Methods of Sterilization – Physical methods – Dry heat, Moist heat, Filtration (Membrane & HEPA), Radiation – Chemical Sterilization – Chemical agents and their Mode of action – Phenol coefficient test – Sterility testing.

Unit–V **18 Hours**

Culture and Media preparation – Solid and Liquid – Types of Media – Synthetic and Complex, Enriched, Enrichment, Selective, Differential media and Special Purpose Media (one example for each type). Anaerobic culture techniques – Wright's tube, Roll tube, Mclntosh filde's jar method. Pure culture techniques – Serial dilution, Pour plate, Spread plate and Streak plate.

Total Lecture Hours **90 Hours**

Text Books

1	Ananthanarayanan R and CK Jayaram Panicker, (2017). Textbook of microbiology, 10th Ed. Orient Longman.
2	Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.

References

1	Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020).Prescott's Microbiology 11th Ed. Mc Graw Hill Book.
2	Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg, (1993). Microbiology 5th Ed. Mc GrawHill Book Company.

3	Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R, (1986). The Microbial world, 5th Ed. Eagle Works Cliffs N.J. Prentica Hall.
4	Tauro P., Kapoor, K.K. Yadav, K.S. An introduction to Microbiology 1st Ed., New Age InternationalPublishers.
5	Gerard J. Tortora, Berdell R. Funke & Christine L. Case,(2013). Microbiology – An Introduction 11th Ed. Pearson
Related Online Contents	
1	https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Kaiser)/Unit_1%3A_Introduction_to_Microbiology_and_Prokaryotic_Cell_Anatomy/1%3A_Fundamentals_of_Microbiology
2	http://www.wales.nhs.uk/sitesplus/888/agordogfen/149787
3	http://ecoursesonline.iasri.res.in/course/view.php?id=108
4	https://www.cliffsnotes.com/study-guides/biology/microbiology/microbial-cultivation-and-growth/microbial-cultivation
5	https://www.swayam.gov.in

Course designed by: Mrs. C.L. Shathiyaa Priyaa, Assistant Professor of Microbiology
TiruppurKumaran College For Women, Tiruppur

Verified by: Dr.Gandhimathi.R., Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Second Semester

Course code 23A	ANALYTICAL MICROBIOLOGY	L	T	P	C
Core-II		3	1	-	4
Pre- requisite	Basic knowledge on Microbiology gained in Semester I of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- gain insights on the concepts in chemistry for the preparation of solutions.
- get acquainted with the different instruments used in microbiology laboratory.
- impart knowledge to identify the physical and chemical properties of biomolecules.
- facilitate the students with the concept of property of light absorption to study biomolecules.

Expected Course Outcomes:

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

1	Get acquainted with properties of bio molecules.	**K 2**
2	Gain knowledge about different instruments in microbiological laboratory	**K 2**
3	Understand the harvesting and preserving microbes.	**K 3**
4	Estimate the biomolecules and microbial growth.	**K 4**
5	Separate and identify the bio molecules using chromatographic techniques.	**K 5**

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

Unit – I **12 Hours**

Buffers, Molar and Normal solutions, pH meter, pH electrodes – Colomel and glass electrode

Unit –II **12 Hours**

Principles and Applications of Autoclave, Hot air oven, Incubator, Laminar air flow chamber / Biosafety cabinets, BOD incubator, Metabolic shaker, Incinerator

Unit – III **12 Hours**

Centrifugation: Principle – Types of Centrifuges – Low speed, High speed, Ultra centrifuge. Applications of Centrifuge. Lyophilization.

Unit – IV **12 Hours**

Colorimetry, Turbidometry, Spectrometry – UV and Visible Spectrophotometer. Flame Photometry, AAS.

Unit – V **12 Hours**

Chromatography – Paper, Thin layer, Column, Ion-exchange, Gas and HPLC. Electrophoresis – SDS – PAGE and Agarose gel electrophoresis, PFG.

Total Lecture Hours **60 Hours**

Text Books

1. Upadhyay & Upadhyay. Biophysical Chemistry, (2010). Himalaya Publishing House.
2. Dubey R.C. and Maheshwari, (2010). Text book of Microbiology, S.Chand Publications.

References

1. Gedder, A. and L. E. Balser, John Wiley and Sons, Principles of applied Biomedical instrumentation.
2. Dean, Willard and Merrit, Instrumental Methods of analysis Asian Ed.
3. Fritschen, L. J and L. W. Gay, Springer, Verlag, Environmental Instrumentation, (1979). New York.
4. Boyer, Rodney, F. Benjamin and Cummins, Modern Experimental Biochemistry. 2nd Ed.
5. E.Padmini., Biochemical Calculations and Biostatistics, (2007). 1st Ed. Books and Allied (P) Ltd.

Related Online Contents	
1	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Acids_and_Bases/Buffers/Introduction_to_Buffers
2	https://www.fishersci.se/se/en/scientific-products/centrifuge-guide/centrifugation- theory. html
3	https://en.m.wikipedia.org/wiki/Chromatography
4	https://en.m.wikipedia.org/wiki/Spectrometry
5	https://microbenotes.com/instruments-used-in-microbiology-lab/
6	https://www.swayam.gov.in

Course designed by: Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology
Tiruppur Kumaran College For Women, Tiruppur

Verified by: Dr.Gandhimathi.R., Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	23B	GENERAL BIOLOGY	L	T	P	C
Core – III			3	-	-	4
Pre- requisite		Basic knowledge on biology gained during HSc.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- study about the ultra structure of prokaryotic and eukaryotic cells.
- learn about cell divisions.
- know about the basics of plant kingdom.
- understand few important systems of human physiology.

Expected Course Outcomes:

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

1	Provide knowledge about the structure and function of Prokaryotic cells.	**K 2**
2	Acquire knowledge about the structure and function or Eukaryotes.	**K 2**
3	Impart knowledge on cell division in Prokaryotes and Eukaryotes.	**K 3**
4	Understand basis of plant kingdom	**K 4**
5	Acquire knowledge about human physiology.	**K 4**

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

Unit – I **9 Hours**

Ultra structure of Eubacteria – Cell membrane – Extra mural layer – Slime – Capsule – Cytoplasmic inclusions – Mesosomes – Nuclear material – Reserve materials – Pigments – Cell appendages – Flagella – Pili.

Unit –II **9 Hours**

Ultra structure and functions of Eukaryotic cell organelles – Cell wall – Cell membrane – Mitochondria – Chloroplast – Endoplasmic reticulum – Golgi complex – Nucleus – Ribosomes – Other cell inclusions and Flagella.

Unit – III **9 Hours**

Cell division in Bacteria – Binary fission – Cell division in Eukaryotes – Mitosis and Meiosis.

Unit – IV **9 Hours**

Botany: Ultra structure of plant cell. General characters of Thallophyta – Spirogyra, Bryophyta– Liverwort, Pteridophyta – Fern, Angiosperms – Tulips and Gymnosperms – Pinus.

Unit – V **9 Hours**

Human physiology – Structure and functions of Digestive system and excretion, Respiratory system and Cordiovascular system.

Total Lecture Hours **45 Hours**

Text Books

1. Dubey R.C. and Maheshwari,(2010). Text book of Microbiology, S.Chand Publications.

References

1. Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott‟s Microbiology 11th Ed. Mc Graw Hill Book.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg, (1993). Microbiology 5th Ed.Mc Graw Hill Book Company.
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R, (1986). The Microbial world, 5th Ed. Eagle Works Cliffs N.J. PrenticeHall.
4. Reddy, S.M, (2010). University Botany – 2. Gymnosperms, Plant Anatomy, Genetics, Ecology. New Age International Publishers, New Delhi.
5. Sarada Subramaniam and K. MadhavanKutty, Human Physiology. S. Chand and Co, New Delhi.
6. Ross and Wilson, Anatomy and Physiology, 8th Ed, Churchill Livingston.

	Related Online Contents
1	https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology
2	https://courses.lumenlearning.com/boundless-biology/chapter/eukaryotic-cells/
3	https://en.m.wikipedia.org/wiki/Cell_division
4	www.swayam.gov.in
5	https://m.jagranjosh.com/general-knowledge/amp/classification-of-plant-kingdom-1453445359-1
6	https://www.visiblebody.com/anatomy-and-physiology-apps/anatomy-and-physiology
7	https://www.registerednursing.org/teas/general-anatomy-physiology-human/
8	https://www.innerbody.com/htm/body.html

Course designed by: Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology
Tiruppur Kumaran College For Women, Tiruppur

Verified by: Dr.Gandhimathi.R., Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Third Semester

Course code	33A	MICROBIAL DIVERSITY	L	T	P	C
Core -IV			4	-	-	4
Pre-requisite		Basic knowledge on taxonomy gained during HSc. and basics of microorganisms during the first year of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- impart knowledge about the taxonomical classification of microorganisms with representative types.

Expected Course Outcomes:

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

1	Know about basics of microbial classification, taxonomy and their modern approaches.	**K 2**
2	Gain knowledge about major divisions of Bergey's Manual of Systematic Bacteriology.	**K 4**
3	Explore the taxonomy, characters, life cycle and economic importance of Fungi.	**K 3**
4	Know about the morphology, characters, reproduction and economic importance of Algae.	**K 3**
5	Understand the basic structural characterization of Protozoa and its classification	**K 3**

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

Unit–I **12 Hours**

Taxonomy – Principles – Modern approaches – Numerical, Molecular, Serotaxonomy and Chemotaxonomy. Introduction to Microbial Classification and Taxonomy – Taxonomic Ranks.

Unit–II **12 Hours**

II Edition of Bergey's Manual of Systematic Bacteriology (Volume I – V) – Concise account of Phylum level classification – General characteristics – Vol. I: The Archaea, and the Deeply Branching and Phototropic Bacteria – Vol. II: The Proteobacteria – Vol. III: The Low G + C Gram-positive Bacteria – Vol. IV: The High G + C Gram-positive Bacteria –Vol. V: Planctomycetes. Spirochetes, Fibrobacteres, Bacteriodetes and Fusobacteria.

Unit–III **12 Hours**

Fungi –Taxonomy and General Characteristics – Life cycle of *Aspergillus, Mucor, Rhizopus* and *Penicillium* – Modes of reproduction – Economic importance (Brief note with an example on the role of fungi in industrial production of antibiotics, enzymes , alcohol and cheese).

Unit–IV **12 Hours**

Algae – Outline classification (Class level) by F. E. Fritsch – Morphology and General Characteristics – Representative form – *Chlamydomonas sp., Volvox* – Economic importance (Food, Fodder and Fertilizers).

Unit–V **12 Hours**

Protozoa – General characteristics – **Classification (proposed by International Society of Protistologists)** – Subphyla : I. Sarcomastigophora – II. Sporozoa – III. Cnidospora – IV. Ciliophora.

Total Lecture Hours **60 Hours**

Text books

1 Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott's Microbiology 11th Ed. Mc Graw Hill Book.

References

1 Madigan, Michael T., Martinko, John M., Dunlap, Paul V., Clark, David P, (2015). Brock's Biology of Microorganisms Global Ed. Pearson Publications.

2 Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg, (1993). Microbiology 5th Ed. Mc Graw Hill Book Company.

3	Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R, (1986). The Microbial world, 5th Ed. Eagle Works Cliffs N.J. Prentice Hall.
4	Atlas & Atlas. Microbiology. 4th Ed. Pearson Publications.
5	Whitman, W.B., Goodfellow, M., Kämpfer, P., Busse, H.-J., Trujillo, M.E., Ludwig, W. and Suzuki, K, (2012). Bergey's Manual of Systematic Bacteriology, 2nd Ed., Vol. 5, Parts A and B, Springer-Verlag, New York, NY.
Related Online Contents	
1	http://www.science direct.com
2	https://microbenotes.com
3	http://www.onlinelibrary.wiley.com
4	https://swayam.gov.in
5	http://www.inflibnet.ac.in
6	https://openaccessebooks.com/current-research-in-microbiology.html
7	https://microbiologyinfo.com/top-and-best-microbiology-books/
8	http://www.freebookcentre.net/medical_text_books_journals/microbiology_ebooks_online_texts_download.html

Course Designed By: Dr. Gandhimathi.R., Assistant Professor of Microbiology
L.R.G. Government Arts College For Women, Tiruppur
Mrs. C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology
Tiruppur Kumaran College For Women, Tiruppur

Verified By: Dr. Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Fourth Semester

Course code	43A	MICROBIAL PHYSIOLOGY	L	T	P	C
Core -V			4	-	-	4
Pre- requisite		Basic knowledge of microorganisms during the first year of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- understand the nutritional requirements of microorganisms and their uptake.
- elucidate the growth and growth factors of microorganisms.
- provide knowledge about the metabolism, aerobic and anaerobic respiration of microorganisms.
- facilitate the understanding on photosynthesis, anabolism and bioluminescence.

Expected Course Outcomes:

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

1	Distinguish the Microorganisms based on their nutritional requirements and transport mechanisms of nutrients uptake.	**K 2**
2	Gain knowledge about growth and key factors influencing the growth ofmicroorganisms	**K 3**
3	Understand about key metabolic and biosynthetic pathways carried out in microorganisms.	**K 2**
4	Acquire the knowledge about aerobic and anaerobic respiration of microorganisms.	**K 4**
5	Be acquainted with anabolism and bioluminescence.	**K 4**

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

Unit–I **12 Hours**

Nutrition: Nutritional requirements of Microorganisms – Autotrophs, Heterotrophs, Photoautorophs, Chemoautotrophs, Copiotrophs, Oligotrophs. Transport Mechanisms Diffusion – Facilitated Diffusion, Active Transport – Group Translocation. Nutrition in Protozoa –Phagocytosis and Pinocytosis.

Unit–II **12 Hours**

Different phases of growth – Growth curve – Generation time – Factors influencing microbial growth – Temperature, pH, Pressure , Salt concentration , Nutrients – Synchronous growth and continuous cultivation. Diauxic growth. Sporulation – Endospore formation in bacteria.

Unit–III **12 Hours**

Metabolism – EMP – HMP – ED pathways – TCA cycle- Electron transport chain – Oxidative and Substrate level phosphorylation.

Unit–IV **12 Hours**

Anaerobic respiration – Sulphur , nitrogenous compounds and CO_2 as final electron Acceptor – Fermentation – alcoholic, propionic and mixed acid fermentation. Lactic acid fermentation.

Unit–V **12 Hours**

Photosynthesis – Oxygenic and Anoxygenic, Carbon dioxide fixation, Biosynthesis – Bacterial cell wall – Amino acids (Glutamic acid family) – Bioluminescence.

Total Lecture Hours **60 Hours**

Text books

1. Dubey R.C. and Maheshwari, (2010). Text book of Microbiology, S.Chand Publications.

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1 Doelle. H.W,(1975). Bacterial Metabolism. 2nd Ed. Academic Press.
2 Moat. A.G. J.W.Foster, (1988). Microbial physiology. 2nd Ed. Springer – Verlag.
3 David White, (2011). The Physiology and Biochemistry of Prokaryotes, 4th Ed.Oxford University Press.
4 Atlas & Atlas. Microbiology. Pearson Publications. 4th Ed.

5	Gerard J. Tortora, Berdell R. Funke & Christine L. Case, (2013). Microbiology - An Introduction 11thEd. Pearson
6	Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott's Microbiology 11thEd. Wm, C. Brown publishers.
7	Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg, (1993). Microbiology 5thEd. Mc Graw Hill Book Company.
8	Caldwell. D.R.1995, Microbial physiology and Metabolism. WmC Brown Publishers, England.

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8	https://www.youtube.com/watch?v=653U2JW2TRw
9	https://www.youtube.com/watch?v=kfy92hdaAH0

Course Designed By: Dr.Gandhimathi.R., Assistant Professor of Microbiology, L.R.G. Government Arts College For Women, Tiruppur
Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology Tiruppur Kumaran College For Women,Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Fifth Semester

Course code 53A	MICROBIAL GENETICS	L	T	P	C
Core -VI		5	-	-	4
Pre- requisite	Basic knowledge on Genetics gained during HSc. and this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- gain knowledge on the structure and characters of Genetic materials.
- understand replication, transcription and translation process in prokaryotes and eukaryotes.
- perceive genetic alterations and their repair mechanisms.
- understand the methods of genetic exchange.

Expected Course Outcomes:

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

1	Know about basics structure of DNA and RNA, and Organization of genes in prokaryotes & Eukaryotes.	**K 2**
2	Gain knowledge about replication in Prokaryotes & Eukaryotes and role of enzymes in replication.	**K 4**
3	Understand the gene expression by Translation and Transcription process and regulation of gene expression.	**K 4**
4	Know about the Mutation, their types and repair mechanism	**K2 & K3**
5	Understand the Genetics exchanges in microbes	**K2**

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

Unit–I **15 Hours**

DNA as genetic material – Characters of a genetic material – Chemistry and Molecular structure of DNA – Topology of DNA – Bacterial chromosome – Organization of genes in prokaryotes and eukaryotes – RNA as genetic material – Structure and types of RNA.

Unit–II **15 Hours**

Replication of DNA – Replication in prokaryotes and eukaryotes – Mechanism and enzymology of replication – Theta replication and Rolling circle replication.

Unit–III **15 Hours**

Transcription in prokaryotes and eukaryotes – Enzymology and molecular mechanism – Genetic code – Translation of proteins – Enzymology and molecular mechanism – Regulation of gene expression in prokaryotes – Operon concept – lac and trp operon.

Unit– IV **15 Hours**

Mutation –Spontaneous and induced – Mutagen and Mutagenesis – DNA repair mechanisms – Light repair (Photoreactivation) – Dark repair – Mismatch, Excision, Recombination and SOS repair .

Unit–V **15 Hours**

Genetic exchange – Transduction (specialized and generalized), Transformation, Conjugation – Hfr mapping.

Total Lecture Hours **75 Hours**

Text books

1. Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.
2. Ajoy Paul (2018). Text Book of Genetics (From Gene to Genome), 2nd Ed. Books & Allied Pvt. Ltd.

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1. Gardner, E. J, Simmons, M J& D P Snustard, (1991). Principles of Genetics, 8th Ed. John Wiley & Sons. NY.
2. David Freifelder.S, (1994). Microbial Genetics, 2nd Ed. Jones & Bartlett, Boston.
3. Robert H .Tamarin. Principles of Genetics, 5th Ed, WmC Brown Publishers.

4	Jocelyn E. Krebs (Author), Stephen T. Kilpatrick (Author), Elliott S. Goldstein, (2013) Lewins Genes XI, Oxford University Press.
5	Klug.W.S. & Cummings, MR, (2020). Essentials of Genetics, 10th Ed. Pearson.
6	Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott's Microbiology 11th Ed. Mc Graw Hill Book.

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3	https://www.zmescience.com/medicine/genetic/dna-replication-steps-43264/#
4	https://www.youtube.com/watch?v=NGLuO-NYRug
5	https://www.youtube.com/watch?v=a48GfC0ygpg
6	https://www.youtube.com/watch?v=QcBYTA7uVXk
7	https://www.youtube.com/watch?v=EMDuf_kBJcs
8	https://www.youtube.com/watch?v=EjRXz1xAdow
9	https://www.youtube.com/watch?v=CaCq4gglw0g
10	https://www.youtube.com/watch?v=S_3C7R6UbAI
11	https://www.youtube.com/watch?v=sX6LncNjTFU&vl=en
12	https://www.youtube.com/watch?v=TfBnfxm0Xyc
13	https://www.youtube.com/watch?v=sSjKh2fgDIQ

Course Designed By: Mr.P.Nallasamy, Asst. Professor in Microbiology
Bharathidasan College of Arts and Science, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	53B	PRINCIPLES OF IMMUNOLOGY	L	T	P	C
Core - VII			5	-	-	4
Pre- requisite		Basic knowledge on Immunology gained during HSc. and basics learned during the first year of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- recall the developments in immunology and learn immunity types, structure and functions of immunoglobulins.
- categorize mechanism of antigen antibody reactions.
- gain knowledge on autoimmune diseases, blood transfusion and tissue transplantation.

Expected Course Outcomes:

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

1	Understand the basics of Immunology and defense mechanisms.	**K 2**
2	Gain knowledge about immunity types and function of immunoglobulins.	**K 2**
3	Create awareness about hypersensitivity and immunodeficiency disease.	**K 3 & K 4**
4	Know about the autoimmune diseases and monoclonal antibodies.	**K 2 & K3**
5	Gain knowledge about application of Immunohaematology.	**K 3 & K4**

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

Unit – I **15 Hours**

History and Scope of Immunology – The basis of defence mechanisms – Cell and Organs involved in immune system – Phagocytosis.

Unit – II **15 Hours**

Types of immunity – Antigen – Antibody – types – Complement pathways – Classical and Alternate – Immunoglobins – structure and functions.

Unit – III **15 Hours**

Allergy and Hypersensitivity – Classification types and Mechanisms – Immunodeficiency diseases.

Unit – IV **15 Hours**

Autoimmunity mechanisms and autoimmune response diseases: RA, SLE and Myasthenia Gravis. Monoclonal antibodies and its applications (Hybridoma technology)

Unit – V **15 Hours**

Immunohaematology – Blood transfusion – ABO grouping – Rh factor – Tissue transplantation – HLA typing – Mechanism of acceptance and rejection.

Total Lecture Hours **75 Hours**

Text books

1	Ajoy Paul (2018). Text Book of Immunology, Books & Allied Pvt. Ltd.
2	Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.

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1	Jenni Punt; Judith A Owen; Sharon A Stranford; Patricia P Jones; Janis Kuby; (2019). Immunology, 8th Ed..W.H.Freeman, NY
2	Tizard, I R (2017). Immunology An Introduction,10th Ed. W.B. Saunders, Philadelphia.
3	Roitt, I M (2017). Essentials of Immunology, 13th Ed. Blackwell Publications.
4	Nandhini Shetti (1993). Immunology – Introductory Text Book. New Age Int. Ltd.
5	Abul K. Abbas and Andrew H. Lichtman, Saunders (2001). Basic Immunology
6	Charles Janeway, Jr. and Paul Travers. Immunobiology – The immune system in health and disease.
7	Joanne Willey and Kathleen Sandman and Dorothy Wood (2020). Prescott‟s Microbiology 11th Ed. Mc Graw Hill Book.

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3	https://www.youtube.com/watch?v=mB5nFSVysmw
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5	https://www.youtube.com/watch?v=vxWf-66lymg
6	https://www.youtube.com/watch?v=2tmw9x2Ot_Q
7	https://www.youtube.com/watch?v=6wOiDrObk_A&vl=en
8	https://www.youtube.com/watch?v=NKnAXcM5Ly0
9	https://primaryimmune.org/video/introduction-primary-immunodeficiency-diseases
10	https://www.youtube.com/watch?v=KB980_rt8GI
11	https://www.youtube.com/watch?v=ki-3AOfmAZE
12	https://www.youtube.com/watch?v=0CK1it7Qltg
13	https://www.youtube.com/watch?v=ZuHdnTKBBKg
14	https://www.webmd.com/a-to-z-guides/blood-transfusion-what-to-know#1
15	https://www.google.co.in/intl/en/about/products?tab=wh
16	https://www.youtube.com/watch?v=H6w-BRSgfMg
17	https://www.youtube.com/watch?v=1dpw8yoggYY
18	https://www.youtube.com/watch?v=oFshHjk1Hp0

Course Designed By: Mr.P.Nallasamy, Asst. Professor in Microbiology
Bharathidasan College of Arts and Science, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	53C	FOOD MICROBOLOGY	L	T	P	C
Core – VIII			4	-	-	4
Pre- requisite		Basic knowledge on Microbiology during the previous years of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- learn the basic relationship between food and microorganisms.
- understand the principles of food preservation.
- analyze the mechanism food spoilage.
- acquire knowledge on fermented foods.
- understand food borne diseases and food quality control measures.

Expected Course Outcomes:

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

1	Understand the role of Microbes in food.	**K 2**
2	Familiarize the preservation techniques in food.	**K 2 & K3**
3	Create awareness about spoilage of food by microbes.	**K 3 & K 4**
4	Gain acquaintance about fermented foods.	**K 3 & K 4**
5	Get the knowledge about food borne diseases and their outbreaks.	**K 4**

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

Unit – I **2 Hours**

Food and Microorganisms – Important microorganisms in food (Bacteria, Mold and yeasts); Factors affecting the growth of microorganisms in food – pH, moisture, oxidation – Reduction potential, Nutrient content and Inhibitory substances and biological structure.

Unit –II **2 Hours**

Principles of food preservation – General principles and application methods – Asepsis – Techniques of removal – use of temperature (low & high). Drying, radiation and chemical preservatives.

Unit – III **2 Hours**

Spoilage of food – Cereals, vegetables, fruits, egg and milk – Canned foods and sea foods.

Unit – IV **2 Hours**

Fermented food – pickled cucumber, sauerkraut – soy sauce, Bread, Idli – Fermented dairy products – Yoghurt and cheese.

Unit – V **2 Hours**

Food borne diseases & Food Quality control Measures – Food poisoning and Food borne infections – Bacterial and Mycotoxins – Investigation of food poisoning outbreaks – food standards, quality control. HACCP, FDA, WHO.

Total Lecture Hours **60 Hours**

Text books

1. Frazier. W.C and D.C Westhoff, (2017). Food Microbiology . 5th Ed. Tata Mc Graw Hill publishing Co.

References

1. Jay,J.M, (2005). Modern Food Microbiology 4th Ed. , Van Nostra and Rainhokdd Co.
2. Adams. M. R and M. D Moss, (1995). Food Microbiology. New Age International limited.
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3	https://www.med.navy.mil/sites/nmcphc/Documents/nepmu-6/Epidemiology/FDA- Food-Borne-Pathogens/Natural-Toxins/Factors-affecting-Microorganisms-Growth-in-Foods.pdf
4	https://www.youtube.com/watch?v=AMJYn3hgv3o
5	https://www.youtube.com/watch?v=ZXYXZwEokEE
6	https://www.youtube.com/watch?v=fr1nzF9AMXs
7	https://slideplayer.com/slide/4164539/
8	https://www.youtube.com/watch?v=WWGRTSbvef0
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17	https://www.cdc.gov/foodsafety/food-poisoning.html
18	https://www.youtube.com/watch?v=mjm5mjBVceo
19	https://www.youtube.com/watch?v=7nbjd_TnU8o

Course Designed By: Mr.P.Nallasamy, Asst. Professor in Microbiology
Bharathidasan College of Arts and Science, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

***S – Strong; M – Medium; L – Low**

Course code	53D	MEDICAL MICROBIOLOGY	L	T	P	C
Core – IX			4	-	-	4
Pre- requisite		Basic knowledge on Microbiology during the previous years of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- learn basics of infection and the epidemiology of infectious diseases.
- understand the morphology, pathogenecity and laboratory diagnosis of gram positive, gram negative and acid fast bacteria,
- acquire basic knowledge about the pathogenecity and laboratory diagnosis of fungal and protozoan pathogens.

Expected Course Outcomes:

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

1	Gain the basic knowledge about infections, outbreaks and control measures.	**K 2 & K3**
2	Understand the pathogenicity of Gram positive bacterial pathogens.	**K 2 & K3**
3	Understand the pathogenicity of Gram negative bacterial pathogens.	**K 2 & K3**
4	Understand the pathogenicity of Acid Fast and miscellaneous bacteria.	**K 2 & K3**
5	Gain the basic knowledge about fungal and parasitic infections.	**K 2 & K3**

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

Unit–I **12 Hours**

Infections – Sources of infections – Types of infections – Methods of infections – Definitions : Epidemic, Pandemic, Endemic diseases, Nosocomial infections – Epidemiology of Infectious diseases, Infectious diseases cycle – Investigation of epidemics – Control of epidemics

Unit–II **12 Hours**

Morphology, Pathogenicity and Laboratory diagnosis – Gram positive organisms – *Staphylococcus aureus, Streptococcus pyogenes, Pneumococcus sp. Bacillus anthracis, Corynebacterium diptheriae, Clostridium botulinum* and *Clostridium tetani*

Unit–III **12Hours**

Morphology, Pathogenicity and Laboratory diagnosis – Gram negative organisms – *Escherichia coli, Klebsiella sp., Proteus sp., Salmonella typhimurium, Shigella dysenteriae, Pseudomonas sp., Vibrio cholera* and *Neisseria sp.*

Unit–IV **12 Hours**

Morphology, Pathogenicity and Laboratory diagnosis – *Mycobacterium tuberculosis, Mycobacterium leprae, Treponema pallidum, Leptospira, Chlamydias, Rickettsiae* and *Mycoplasma*.

Unit–V **12 Hours**

Morphology, Pathogenicity and Laboratory diagnosis – Fungi – *Candida albicans* and *Cryptococcus neoformans* – Parasites – *Entamoeba histolytica, Plasmodium vivax* and *Ascaris.*

Total Lecture Hours **60 Hours**

Text books

1	Ananthanarayanan R and CK Jayaram Panicker, (2017). Textbook of Microbiology 10th Ed. Orient Longman.
2	David Greenwood, Richard C B Slack, Michael R. Barer, Will L Irving, (2012), Medical Microbiology, 18th Ed.Elsevier Ltd.

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2	Bailey and Scotts, (1994). Diagnostic Microbiology, 9th Ed, Baron and Fine gold CV Mosby Publications.
3	Jawetz E Melnic JL and Adelberg EA, (1998). review of Medical Microbiology Lange Medical Publications, USA.
4	Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott‟s Microbiology

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5	Medical Microbiology 19th Ed., Michael Barer Will Irving.
6	Chakraborty P, (1995). A Text book of Microbiology, New Central Book Agency Pvt. Ltd.

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13	https://www.youtube.com/watch?v=uwFU_QZT-E0
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15	https://www.youtube.com/watch?v=DDELNhn7t1I
16	https://www.youtube.com/watch?v=y3PE7mLLBvM

Course Designed By: Mr.P.Nallasamy, Asst. Professor in Microbiology
Bharathidasan College of Arts and Science, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Sixth Semester

Course code	63A	INDUSTRIAL MICROBIOLOGY	L	T	P	C
Core – X			5	-	-	4
Pre- requisite		Basic knowledge on microorganisms gained during the first and second year of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- impart knowledge on industrial production of economically important products using microorganisms.
- acquire knowledge on the production of health care products using microorganisms.
- analyze the methods for effective recovery and purification of fermented products.

Expected Course Outcomes:

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

1	Understand fermentation and fermentors.	**K 2**
2	Screen, isolate and improve the beneficial microorganisms from the environment for improved yield.	**K 3**
3	Gain knowledge on production of commercially important microbial products.	**K2**
4	Acquire theoretical and technical knowledge on microbial production of health care products.	**K 3 &4**
5	Develop as an entrepreneur.	**K 3 &4**

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

Unit – I **15 Hours**

Fermentation – Definition & types – Submerged and Solid state. Fermentors & its types (CSTFTower, cylindro – conical & airlift) – Batch fermentation – Continuous fermentation.

Unit –II **15 Hours**

Industrially important strains – Screening methods – Strain development for Improved yield – Mutation, Recombination and protoplast fusion.

Unit – III **15 Hours**

Production of beverages – beer and wine – vitamin B12 and Riboflavin – Antibiotics – penicillin – production of enzymes – Amylases and Proteases – methods of immobilization

Unit – IV **15 Hours**

Single cell protein – Baker‟s yeast, *Spirulina* – Details of mushroom development – Oyster (*Pleurotus*) and Button (*Agaricus*) mushroom.

Unit – V **15 Hours**

Downstream process Biochemistry – Intercellular and extracellular – Centrifugation, filtration, Floatation – solvent extraction, precipitation – Breakage of cells – Physical and Chemical methods.

Total Lecture Hours **75 Hours**

Text books

1	A.H. Patel. Industrial Microbiology, (2016). 2nd Ed. Laxmi Publications, New Delhi
2	Casida, L E JR., (2019). Industrial Microbiology. New Age International Publishers

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1	Stanbury P T and Whitaker, (2016). Principles of Fermentation Technology, 3rdEd. Pergamon Press. NY
2	Prescott SC and C G Dunn. Industrial Microbiology, (2011). Jodhpur: Agrobios
3	Nduka Okafor. Modern Industrial Microbiology and Biotechnology. (2007). CRC Press
4	Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. Industrial Microbiology: An Introduction, (2013). Wiley Blackwell Publishers.
5	Crueger W and Crueger A. Biotechnology: A Textbook of Industrial Microbiology.2ndEd. (1991). Sinauer Associates Inc.,U.S.
6	Sathyanarayana. U, Biotechnology, (2005). 1stEd. Books and Allied (P) Ltd.

7	Dubey R C. A Textbook of Biotechnology, (2014). S Chand & Co.
Related Online Contents	
1	http://www.simbhq.org/
2	https://www.rapidmicrobiology.com/
3	http://rapidmicromethods.com/
4	swayam.gov.in › nd1_noc20_bt21
5	sites.google.com>site>microbiology-courses-in-swayam
6	onlinecourses.nptel.ac.in>courses
7	www.classcentral.com>Subjects>Sciences>Biology

Course Designed By: Dr.A.K.Lakkumi Venmal, Assistant Professor & HOD of Microbiology, L.R.G. Government Arts College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	63B	ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	L	T	P	C
CORE – XI			5	-	-	4
Pre- requisite		Basic knowledge on Microbiology gained from the previous subjects in this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- understand the distribution of microorganisms in nature and microbial associations.
- acquire knowledge about the key role of microbes in degradation of organic matter.
- learn the microbial ecology, analysis and treatment of water.
- provide basic information on air microbiology.

Expected Course Outcomes:

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

1	Able to know about basics of microorganisms in nature	**K 2**
2	Gain knowledge about principles and applications of microbial decomposition,.	**K 2**
3	Understand decomposition of organic matter.	**K 3**
4	Acquire knowledge on water microbiology.	**K 4**
5	Help to learn techniques in microbiological analysis of air.	**K 4**

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

Unit– I **15 Hours**

Distribution of microorganisms in nature – Microbial communities in soil – Factors Influencing the microbial density in soil – zymogenous and autochthonous flora in Soil – Microbial associations – symbiotic proto cooperation, Ammensalism, Commensalism, Syntropism, Parasitism and Predation with suitable examples.

Unit–II **15 Hours**

Microbial decomposition; Cellulose, Hemicellulose, Lignin, Pectin and Chitin – Factors influencing degradation – Acetate utilization – bioconversion of organic wastes – sugarcane wastes – coir pith composition – composting, principles and Applications- conversion process.

Unit– III **15 Hours**

Microorganisms in the Decomposition of organic matter- Carbon cycle – Nitrogen Cycle – Nitrogen fixing microorganisms – Root nodule bacteria – non symbiotic Nitrogen fixers – biofertilizers in agriculture – Rhizobium and phosphate Solubilizers – Mycorrhizial association – Phosphorous cycle.

Unit– IV **15 Hours**

Water microbiology, algae, phytoplankton – eutrophication – Water Pollution (Microbiological) water treatment – Primary, secondary and tertiary. Drinking water – Potability – MPN technique.

Unit– IV **15 Hours**

Aero microbiology – aerosol, droplet nuclei, air pollution – sources (Microbiological) – air quality analysis – air sampling devices.

Total Lecture Hours **75 Hours**

Text books

1	Atlas R. M. and Bartha. R, (1992). Microbial Ecology. Fundamental and application. 3rd Ed. Bengamin and Cummings.
2	Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.

References

1	Alexander A M, (1987). Introduction to Soil Microbiology, 5th Ed. John Wiley and sons.
2	Alexander, A M (1974). Microbiology Ecology, John Willy & Sons.
3	Rangasamy, G and D J Bagyaraj, Agricultural microbiology, Asia Publishing House.
4	Rheinheimer, G. (1986). Aquatic Microbiology, John Wiley and Sons, NY.
5	Grant. W. D. P. E. Long, (1981). Environmental Microbiology, Thomson Litho Ltd.

Related Online Contents	
1	https://en.wikipedia.org/wiki/Soil_organic_matter
2	https://aem.asm.org/content/85/14/e00324-19
3	https://en.wikipedia.org/wiki/Bacteriological_water_analysis
4	https://www.researchgate.net/publication/286217260_Aero-microbiology
5	https://aosts.com/role-microbes-microorganisms-used-wastewater-sewage-treatment/

Course designed by: Mrs. M.Meenakshi, Assistant Professor of Microbiology
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	63C	VIROLOGY	L	T	P	C
Core – XII			4	-	-	4
Pre-requisite		Basic knowledge gained during HSc. and this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- Recall the historical development and basic information on viruses.
- Learn the viral lifecycle.
- Acquire knowledge about oncogenic virus and human viral infections.

Expected Course Outcomes:

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

1	Able to know about basics of virology & assay of viruses.	**K 2**
2	Gain knowledge about lytic cycle of DNA phages.	**K 2**
3	Gain knowledge about lysogenic cycle of DNA phages and Multiplication of RNA phages.	**K 3**
4	be familiar with important plant and animal viruses.	**K 4**
5	Understand and diagnose various viral diseases.	**K 4**

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

Unit – I **12 Hours**

Early development of virology – General Structure – Properties and Classification (Baltimore classification) – Cultivation of viruses – virus purification and assays.

Unit –II **12 Hours**

Multiplication of DNA phages – Lytic cycle of T4 phage – Adsorption to the host cell and penetration - synthesis of Phage nucleic acids and protein assembly of phage particles – release of phage particles.

Unit – III **12 Hours**

Multiplication of DNA phages – Lysogeny – Temperate bacteriophages – lambda phage – Induction of lysogens – Generation of defectivephages and their uses. Multiplication of RNA phages.

Unit – IV **12 Hours**

Viruses of Eukaryotes – Reproduction of animal (Pox and Adeno) and plant viruses (TMV and CMV) – Viruses of Algae, fungi and viruses – viruses and cancer.

Unit – V **12 Hours**

Human viral infections – Pathogenicity and diagnosis of Hepatitis (A, B & C). Mumps, Measles, Rubella, Polio, Rabies, Influenza, AIDS, SARS, Ebola virus and Covid - 19.

Total Lecture Hours **60 Hours**

Text books

1. Ananthanarayanan R and CK Jayaram Panicker, (2017). Textbook of Microbiology 10th Ed. Orient Longman.
2. Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.

References

1. Luria S.E. Darnel, J.E Jr. Baltimore. D and Campbell A, (1978). General Virology 3rd Ed. Wiley and sons.
2. Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott‟s Microbiology 11th Ed. Mc Graw Hill Book.
3. Alan J. Cann, (2011). Principles of Molecular Virology. 5th Ed..Academic Press.
4. John Carter, (2001). Virology: Principles and Applications, 1st Ed. Wiley Publications.
5. Nicholas H. Acheson, (2011). Fundamentals of Molecular Virology. Wiley Publications.

Related Online Contents

1. https://en.wikipedia.org/wiki/Virology
2. https://academic.oup.com/femsre/article/30/3/321/546048
3. https://www.sciencedirect.com/science/article/pii/S0042682215000859

4	https://nptel.ac.in/courses/102/103/102103039/
5	https://www.healthline.com/health/viral-diseases#contagiousness

Course designed by: Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Practical

Course code	23P	CORE PRACTICAL – I	L	T	P	C
Core			-	1	3	3
Pre- requisite		Basic acquaintance gained during Semester I and II.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- get acquainted to the laboratory precautions and techniques to be followed in general microbiology laboratory.
- identify microorganisms microscopically.
- train the students in culturing techniques.
- acquire skills to isolate and quantify microorganisms.
- analyze biomolecules by separation techniques.

Experiments

1. Laboratory precautions.
2. Preparation of cleaning solutions.
3. Culture media preparation – Liquid and Solid medium.
4. Selective and differential media: MacConkey and Blood agar.
5. Methods of sterilization.
6. Pure culture techniques – Pour plate, Spread plate and Streak plate methods (Simple, Quadrant and Continuous).
7. Enumeration of Bacteria, Fungi and Actinobacteria from soil.
8. Determination of Motility – Hanging drop & SIM agar.
9. Cultural characteristics of Microorganisms - Colony morphology on Nutrient agar.
10. Maintenance and preservation of cultures.
11. Staining of Bacteria - Simple, Negative, Gram, Spore, Fungal wet mount –LCB - Slide culture method.
12. Biomolecule Separation Techniques - Paper chromatography & Thin layer chromatography

References

1	James Cappuccino. Microbiology: A Laboratory Manual 10th Ed.
2	William Claus. G.W. (1989). Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
3	Wilson. K and Goulding. K.H. (1986). A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
4	Dubey, R.C. & D.K. Maheshwari. Practical Microbiology. S. Chand & Co
5	Kannan. N (1996), Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.

Scheme of Practical Examination			
Duration :6 Hours			**Max. Marks:45**
Sl. No.	**Experiment***		**Marks**
1	**I. Major experiment (1 × 15 = 15 marks)**		15
	i. Procedure ii. Performance iii. Result and Discussion	5 marks each	
2	**II. Minor experiment (1× 10 =10 marks)**		10
	i. Procedure and Performance ii. Result and Discussion	5 marks each	
3	**III. Spotters (5× 3 =15 marks)**		15
	i. Identification ii. Description	1 mark 2 marks	
4.	**IV. Record**		5
	Total Marks		**45**

*** Students to be divided into batches (5 students / batch) in order to perform all experiments. Question setting to be done by internal and external examiners and separately for each batch.**

Course designed by: Dr.Gandhimathi.R., Assistant Professor of Microbiology,
L.R.G. Government Arts College For Women, Tiruppur
Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Course code	43P	CORE PRACTICAL – II	L	T	P	C
Core			-	1	3	3
Pre- requisite		Basic knowledge on microbiology gained during Semester I and II.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- expertise in estimation of various biomolecules.
- measure morphological and population size of microbes.
- acquire knowledge about the physiological characteristics of microorganisms.
- screen the enzymatic potential of microorganisms.
- understand the morphological characters of Algae, Fungi and Parasites.

Experiments

1. Protein estimation (Lowry *et. al.* method)
2. Estimation of Carbohydrates (DNSA method)
3. Micrometry
4. Measurement of Microbial growth –Turbidity methods – Determination of Generation time, Neubaur Counting chamber.
5. Influence of pH and Temperature on bacterial growth.
6. Cultivation of anaerobic Microorganisms – Wrights tube – Mclntosh filde's jar
7. Indole, MR, VP, Citrate utilization tests
8. Carbohydrate fermentation tests – TSI – H2S production tests
9. Catalase – Oxidase – Urease – Nitrate production tests
10. Starch hydrolysis, Gelatin and Casein hydrolysis tests
11. Observation of representative forms of Algae – Diatoms – Chlamydomonas – Volvox – Cyanobacteria – Oscillatoria – Nostoc –Anabaena
12. Observation of representative forms of Fungi – Aspergillus – Pencillium – Rhizopus – Yeast
13. Observation of representative forms of Parasites – *Entamoeba* , *Plasmodium*, *Ascaris*, *Taenia*.

References

1	James Cappuccino. Microbiology: A Laboratory Manual 10thEd.
2	William Claus. G.W. (1989). Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
3	Wilson. K and Goulding. K.H, (1986). A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
4	Dubey, R.C. & D.K. Maheshwari. Practical Microbiology. S. Chand & Co
5	Kannan. N (1996). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
6	Tiwari, G. S. Hoondal, (2005). Laboratory Techniques In Microbiology & Biotechnology. Swastik publishers.
7	K. R. Aneja, (2018). Laboratory Manual of Microbiology and Biotechnology, ED-TECH.

Scheme of Practical Examination			
Duration :6 Hours			**Max. Marks:45**
Sl.No.	**Experiment***		**Marks**
1	**I. Major experiment (1 × 15 = 15 Marks)**		15
	i. Procedure ii. Performance iii. Result and Discussion	5 marks each	
2	**II. Minor experiment (1× 10 =10 Marks)**		10
	i. Procedure and Performance ii. Result and Discussion	5 marks each	
3	**III. Spotters (5× 3 =15 Marks)**		
	i. Identification ii. Description	1 mark 2 marks	15
4.	**IV. Record**		5
		Total Marks	**45**

*** Students to be divided into batches (5 students / batch) in order to perform all experiments. Question setting to be done by internal and external examiners and separately for each batch.**

Course designed by: Dr.Gandhimathi.R., Assistant Professor of Microbiology, L.R.G. Government Arts College For Women, Tiruppur
Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology, Tiruppur Kumaran College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Course code	63P	CORE PRACTICAL – III	L	T	P	C
Core			-	1	4	4
Pre- requisite		Knowledge in practical and theory gained from previous years of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- Acquire knowledge about isolation and identification of DNA.
- Evaluate the microorganisms involved in food spoilage.
- Expose the screening and production mechanism of commercially important fermented products.
- Apply the new approach in laboratory diagnosis of mycotic infections.
- Assess the quality of drinking water from various sources.

Experiments

1. Isolation of total DNA from *E.coli.*
2. Isolation of *E. coli* plasmid DNA and detection by agarose gel electrophoresis.
3. Isolation of drug resistant mutants using UV and Chemical agents.
4. Phenol Coefficient method.
5. Methylene blue reduction test.
6. Microbial analysis of spoiled food –Bread and Vegetables.
7. Identification of fungal food spoilers –*Aspergillus, Mucor, Penicillium, Rhizopus*
8. Direct microscopic examination of curd – observation of lactobacilli.
9. Screening and assay of Enzymes – protease and amylase.
10. Wine production – Sugar Estimation.
11. Immobilization-Demonstration.
12. Isolation of free living nitrogen fixers –*Azotobacter, Azospirillum*– Phosphate solubilizers – *Rhizobium* from root nodule.
13. Isolation of coliphages.
14. Microscopic identification of clinically important fungi – *Candida albicans, Cryptococcus neoformans* and *Aspergillus.*
15. MPN Technique – Detection of potability of water.

References

1	James Cappuccino. Microbiology: A Laboratory Manual 10thEd.
2	William Claus. G.W. 1989. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
3	Wilson. K and Goulding. K.H. 1986. A Biologist‟s Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
4	Dubey, R.C. & D.K. Maheshwari. Practical Microbiology. S. Chand & Co
5	Kannan. N (1996), Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
6	Tiwari, G. S. Hoondal, Laboratory Techniques In Microbiology & Biotechnology. Swastik publishers. 2005.
7	K. R. Aneja; Laboratory Manual of Microbiology and Biotechnology, 2018. ED-TECH.

Scheme of Practical Examination			
Duration :9Hours			**Max. Marks: 50**
Sl.No.	**Experiment***		**Marks**
1	**I. Major experiment (1 × 15 = 15 Marks)**		15
	i. Procedure ii. Performance iii. Result and Discussion	5 marks each	
2	**II. Minor experiment - A (1× 10 =10 Marks)**		10
	i. Procedure and Performance ii. Result and Discussion	5 marks each	
3	**III. Minor experiment - B (1× 10 =10 Marks)**		10
	iii. Procedure and Performance iv. Result and Discussion	5 marks each	
4	**III. Spotters (5× 2 =10 Marks)**		10
	iii. Identification iv. Description	1 mark each	
5.	**IV. Record**		5
		Total Marks	**50**

*** Students to be divided into batches (5 students / batch) in order to perform all experiments. Question setting to be done by internal and external examiners and separately for each batch.**

Course designed by: Dr. Gandhimathi.R., Assistant Professor of Microbiology
L.R.G. Government Arts College For Women, Tiruppur
Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology
Tiruppur Kumaran College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Elective Courses

Course code	5EA	RECOMBINANT DNA TECHNOLOGY – I	L	T	P	C
Elective – I (Group – A)			4	-	-	4
Pre-requisite	Basic knowledge on DNA gained during HSc. and during the previous years of this programme.		Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- understand the role of Enzymes in Gene manipulation.
- learn tools and techniques of R – DNA technology.
- understand the role of vectors in R – DNA technology.

Expected Course Outcomes:

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

1	Gain the basic knowledge about role of enzymes in Gene manipulation.	**K 2 & K3**
2	Understand the Gene isolation techniques.	**K 2 & K4**
3	Understand the uses of Vectors in rDNA technology	**K 2 & K3**
4	Gain knowledge about Gene transfer techniques.	**K 2 & K3**
5	Understand the Blotting techniques.	**K 3 & K4**

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

Unit – I **12 Hours**

Gene manipulation – Definition and Application, Restriction Enzymes, Discovery, Types and Mode of Action – Ligases and Methylases, Modifying enzymes – Alkaline Phosphatase, Phosphonucleokinase.

Unit –II **12 Hours**

Isolation – Purification of DNA (Chromosomal and Plasmid) – Isolation and Purification of RNA – Chemical Synthesis of DNA – Genomic Library and cDNA Library.

Unit – III **12 Hours**

Vectors – Plasmid based Vectors – pBR322 and pUC8, Phage based Vectors – λ (Lamda) phage Vectors –Insertion and Replacement vectors – Hybrid Vectors – Phagemid (pEMBL8) – Phasmid – Cosmid, Artificial Chromosomes – BAC and YAC.

Unit – IV **12 Hours**

Gene Transfer Techniques: Physical – Biolistic Method, Chemical – Calcium chloride and DEAE Methods, Biological in vitro package method – Screening and Selection of recombinants – Direct Method – Selection by Complementation – Indirect Methods – Immunological and Genetic Methods.

Unit – V **12 Hours**

PCR – DNA Sequencing (Sanger's Method) – Blotting (Southern, Western, Northern) Techniques – RFLP and Applications – RAPD and Applications – Microarray.

Total Lecture Hours **60 Hours**

Text books

1	Sathyanarayana. U, Biotechnology, (2005). 1st Ed. Books and Allied (P) Ltd.
2	Desmond S. T. Nicholl, (2008). An Introduction to Genetic Engineering. Cambridge University Press.

References

1	Brown T.A, (2012), An Introduction to gene cloning 6th Ed. Chapman and hall
2	Old. RW and Primrose, (2003). Principles of Gene Manipulation, 7th Ed. Blackwell Scientific Publication, Boston.

3	Winnecker, E.D, (2003). From genes to clones, Introduction to Gene Technology, 4thEd. Panima Publishing Corporation.
4	Bernard. R Glick and Jack J Pasternak, (2004). Molecular biotechnology, 4thEd. Panima Publishing Corporation.
Related Online Contents	
1	http://www.bio.miami.edu/dana/dox/restrictionenzymes.html#:~:text=A%20restriction%20enzyme%20is%20a,the%20bacteria%20that%20manufacture%20them.
2	https://www.youtube.com/watch?v=YSFqEZ6jvOk
3	https://www.youtube.com/watch?v=npb06rF6Qww
4	https://www.youtube.com/watch?v=2JKDu8kijrs
5	https://www.youtube.com/watch?v=fmMp6avlB6I
6	https://www.youtube.com/watch?v=ISqM-u3in2Y
7	https://www.youtube.com/watch?v=FA-gI5CjAR0
8	https://www.youtube.com/watch?v=11OK_i9E9xk
9	https://www.youtube.com/watch?v=matsiHSuoOw
10	https://www.youtube.com/watch?v=ONGdehkB8jU
11	https://www.youtube.com/watch?v=OUlfbGfwdIk
12	https://www.youtube.com/watch?v=Vfm57MqqQaQ
13	https://www.youtube.com/watch?v=JVM4LpCuT7g
14	https://www.youtube.com/watch?v=0ATUjAxNf6U
15	https://www.youtube.com/watch?v=PV73-V7bxU8

Course Designed By: Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	5EB	PLANT THERAPEUTICS	L	T	P	C
Elective – I (Group – B)			4	-	-	4
Pre- requisite		Basic knowledge on botany gained during HSc. and during the previous years of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- learn the historical and cultural aspects of plants and medicine.
- understand the contribution of medicinal plants to alternative therapeutics .
- have a complete understanding of phytochemicals and production of pharmaceutical compounds.

Expected Course Outcomes:

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

1	Learn the history of medicinal plants and methods of extraction of various therapeutics from medicinal plants.	**K 2 & K3**
2	be trained in skills associated with screening of active principle of biologically important plants.	**K 3 & K4**
3	Comprehend the mechanism of free radicals damage in living cells and antioxidant defense system from phytochemical sources.	**K 2 & K3**
4	Analyse the primary metabolites distribution in therapeutic plants and applying the knowledge in maintaining health and lifestyle.	**K 3 & K4**
5	Develop novel pharmaceutical products and understand the tissue culture techniques	**K 5**

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

Unit– I **12 Hours**

Medicinal plants-bioactive principles in medicinal plants: methods of extraction, isolation, separation and screening, pharmacologically active plants – CNS, CVS, Hypoglycemic.

Unit–II **12 Hours**

Hepatoprotective, nephroprotective, anti allergic, anticancer, antibacterial, antiviral and antimalarial, anti-inflammatory, immunoactive properties of the medicinal plants, plants protecting against oxidative stress, chemotherapeutic products.

Unit– III **12 Hours**

Free radicals – types, sources, importance, production, free radicals induced damages, lipid peroxidation, measurement of free radicals, disease caused by radicals, reactive oxygen species, antioxidant defence system, enzymic and non-enzymic antioxidants, role of antioxidants in prevention of diseases, phytochemicals as antioxidants.

Unit– IV **12 Hours**

Primary metabolites, Alkaloids, flavanoids, terpenoids, phenolics, steroids, Vitamins, minerals – Occurrence, distribution & functions.

Unit– V **12 Hours**

Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques, elicitation, biotransformation- production of pharmaceutical compounds

Total Lecture Hours **60 Hours**

Text books

1.	Purohit.S.S, (2005). Agricultural Biotechnology, Dr.Updesh Purohit Publishers, Jodhpur
2.	Khan,I.A and Khanum.A, (2004). Role of Biotechnology in medicinal and aromatic plants, Vol. 1 and Vol. 10, Ukkaz Publications, Hyderabad.

References	
1	Slater.A. Scott.N.W and Fowler.M.R, (2004). Plant Biotechnology -The genetic manipulation of plants, Oxford University Press, Oxford.
2	Singh.M.P and Panda .H, (2005). Medicinal Herbs with their formulations, Daya Publishing House, Delhi
Related Online Contents	
1	https://www.berkeleyherbalcenter.org/herbal-foundations-therapeutics-certification/
2	https://www.youtube.com/watch?v=_7RHYEZ5x9c
3	https://www.youtube.com/watch?v=DWZJEQv7kqY
4	https://www.youtube.com/watch?v=EvZZxDb7VpE
5	https://www.youtube.com/watch?v=hOHyIuO20-4

Course designed by: Dr.R.Parimala, Assistant Professor of Biochemistry,
L.R.G. Government Arts College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	5EC	MEDICAL CODING	L	T	P	C
Elective – I (Group – C)			2	1	-	3
Pre-requisite		Basic knowledge on Human Physiology gained during HSc. and Semester – II of this programme	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- gain insights on concepts of terminologies in medical coding.
- understand &Identify ICD guidelines.
- impart knowledge on to impart knowledge on assigning diagnosis and procedure codes.
- provide practical application of coding operative reports and evaluation and management services.

Expected Course Outcomes:

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

1	Able to know about basics of Medical coding.	**K 1**
2	Gain knowledge about different types of Coding.	**K 2**
3	Explore ICT & CPC coding.	**K 3**
4	Insist different types of procedure codes.	**K 4**
5	Help to predict codes based on anatomy &its ICD guidelines.	**K 5 & K6**

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

Unit – I **9 Hours**

Industry History and the Codes – The Coder – ICD Coding – CPT Coding – Specialty Coding – Liability and Legal Issues.

Unit –II **9 Hours**

The World of Health Care – Introduction to Medical Terminology – Medical Terminology: Dividing and Combining Terms – Medical Terminology: Abbreviations, Symbols and Special Terms – Documenting Medical Records – Medical Ethics.

Unit – III **9 Hours**

Diagnostic Coding – ICD-10-CM Coding Manual Introduction – ICD-10-CM Diagnosis Coding: Guidelines and Rules – Infections to Blood Diseases – Mental Disorders to the Respiratory System – the Digestive System to Pregnancy – Skin – Perinatal Period.

Unit – IV **9 Hours**

CPT Coding – Integumentary System – Reproductive Systems – Radiology, Pathology, Medicine and Anesthesia – Evaluation and Management Services – Comprehensive Surgery Coding – Comprehensive Musculoskeletal coding – Comprehensive Digestive System Coding – Comprehensive Urology and Reproductive system coding – Comprehensive Pulmonology and Cardiovascular coding.

Unit – V **9 Hours**

History of HCPCS Coding – Levels of HCPCS – **Medical Coding – Medical Billing – Auditing – Medical Documentation – Compliance – Medical coding tools.**

Total Lecture Hours **45 Hours**

References

1	Alok Gha, Priyanka Arora- Medical Transcription Made easy.
2	Terry Tropin M Shai, RHIA, CCS-P, AHIMAICD-10-CM- Coding guidelines made easy-2017.
3	Besty J Shiland- Medical terminology and anatomy for ICD-10.
4	Karen Smiley- Medical Billing and coding for dummies, 2nd edition.

5	ICD-10-CM Official Guidelines for Coding & Reporting.
Related Online Contents	
1	https://www.aapc.com/medical-coding/medical-coding.aspx#WhyIsMedicalCodingNeeded
2	https://www.medicalbillingandcoding.org/coding-training/
3	https://www.rasmussen.edu/degrees/health-sciences/blog/what-is-medical-coder/
4	https://revcycleintelligence.com/features/exploring-the-fundamentals-of-medical-billing-and-coding
5	https://www.ultimatemedical.edu/blog/what-is-a-medical-coding-and-billing-specialist/

Course Designed By: Mrs. M.Meenakshi, Assistant Professor of Microbiology,

Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10
CO1	S	S	S	S	S	S	S	L	M	S
CO2	S	S	S	S	S	S	S	L	M	S
CO3	S	S	S	S	S	S	S	M	M	S
CO4	S	S	S	S	S	S	S	L	M	S
CO5	S	S	S	S	S	S	S	L	M	S

*S – Strong; M – Medium; L – Low

Course code	6EA	RECOMBINANT DNA TECHNOLOGY – II	L	T	P	C
Elective – II (Group – A)			4	-	-	4
Pre- requisite		Basic knowledge about DNA gained in theprevious years of the programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- Learn about commercial production of Recombinant products.
- Know about emerging techniques in Recombinant DNA Technology.
- Understand about Vaccines, Transgenic plants & Animals, DNA finger printing analysis and Human Genome Project (HGP).

Expected Course Outcomes:

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

1	Understand the microbial synthesis of commercial products .	**K 1**
2	Gain knowledge about modern vaccines and gene therapy.	**K 2**
3	Be acquainted with Transgenic plants and Microbial insecticides .	**K 3**
4	Be familiar with the methodology and applications of Transgenic animals.	**K 4**
5	Comprehend the DNA finger printing and HGP.	**K5**

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

Unit – I **12 Hours**

Microbial synthesis of commercial products – Pharmaceuticals – Recombinant insulin – Human growth hormone – Interferons – Monoclonal antibodies for drug delivery – Antibiotics (Streptomycin) – Biopolymers (Xanthan gum).

Unit –II **12 Hours**

Vaccines – Subunit vaccines (HSV and FMDV) – Edible vaccine – Live Recombinant vaccines (Cholera and Vector vaccines) – Genetherapy (Germline and Somatic cell gene therapy).

Unit – III **12 Hours**

Transgenic plants –Ti plasmid – Ti plasmid based cloning vectors (Binary and Cointegrate) – insect, virus, herbicide resistant plants – Microbial insecticides –bacteria, fungi and viruses.

Unit – IV **12 Hours**

Transgenic animals – Transgenic mice methodology – Retroviral method – DNA Microinjection method – Engineered Embryonic stem cell method – Applications of Transgenic sheep and Transgenic fish.

Unit – V **12 Hours**

DNA finger printing and its Application – Human Genome Project (HGP)– History and its Applications.

Total Lecture Hours **60 Hours**

Text books

1	U.Sathyanarayana., Biotechnology, (2005). Books and Allied (P) Ltd.
2	Dubey R C. A Textbook of Biotechnology, (2014). S Chand & Co.

References

1	Brown T.A; An Introduction to gene cloning 6thEd. (2010). Chapman and hall
2	Bernard. R Glick and Jack J Pasternak. Molecular biotechnology, 4thEd. (2004). Panima Publishing Corporation.

Related Online Contents

1	https://nptel.ac.in/courses/102/103/102103045/
2	https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/recombinant -dna-technology
3	https://knowgenetics.org/recombinant-dna-technology/
4	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/

5	https://www.researchgate.net/publication/309381953_Fundamentals_of_Recombinant_DNA_Technology
6	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3854212/
7	https://www.britannica.com/science/recombinant-DNA-technology/Gene-therapy
8	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/
9	https://people.ucalgary.ca/~browder/transgenic.html

Course designed by: Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	6EB	ENTREPRENEURIAL MICROBIOLOGY	L	T	P	C
Elective – II(Group – B)			3	1	-	4
Pre- requisite		Basic knowledge on microorganisms gainedfrom courses learned in this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- develop as an entrepreneur by imparting knowledge on industrial production of economically important products using microorganisms.
- learn about fermentation, brewing and their types.
- acquire knowledge on the commercial production of health care products using microorganisms.
- familiarize about national and international patent / patenting processes.

Expected Course Outcomes:

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

1	Understand the basics of entrepreneur development	**K 2**
2	Comprehend that microorganisms play a vital role to all forms of life on earth.	**K 3**
3	Acquire theoretical and technical knowledge on production of mushrooms and biofertilizers.	**K 4,5 & 6**
4	Attain acquaintance about national and international patent / patenting processes.	**K 2 & 3**
5	Acquire technical understanding of brewing process.	**K 5 &K6**

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

Unit–I **12 Hours**

Entrepreneur development activity – Institutes involved, Government contributions toentrepreneurs, risk assessment. Industrial Microbiology– Definition, scope and historical development.

Unit–II **12 Hours**

Microbial cells as fermentation products – Bakers yeast, food and feed yeasts, Bacterial Insecticides, Legume Inoculants, Mushrooms, Algae. Enzymes as fermentation products – Bacterial and Fungal Amylases, Proteases, Pectinases, Invertases and other enzymes.

Unit–III **12 Hours**

Mushroom cultivation and Composting – Cultivation of *Agaricus campestris*, *Agaricus bisporus*, and *Volvariella volvaciae;* Preparation of compost, filling tray beds, spawning, maintaing optimal temperature, casing, watering, harvesting and storage. Biofertilizers – Historical background – Chemical fertilizers versus biofertilizers – Organic farming – *Rhizobium sp*, *Azospirillum sp*, *Azotobacter sp*, as Biofertilizers.

Unit–IV **12 Hours**

Patents and secret processes – History of patenting, composition, subject matter and characteristics of a patent, Inventor, Infringement, cost of patent – Patents in India and other countries. Fermentation Economics.

Unit–V **12 Hours**

Brewing – Media components, preparation of medium, Microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination, by products. Production of Industrial alcohol.

Total Lecture Hours **60 Hours**

Text books	
1.	Entrepreneurial Development in India- By Arora.
2.	Sathyanarayana. U, Biotechnology. (2005) 1st Ed. Books and Allied (P) Ltd.
References	
1	Stanbury P T and Whitaker, (1984). Principles of Fermentation Technology, Pergamon Press. NY
2	Casida, L E JR, (2019). Industrial Microbiology. New Age International Publishers
3	K.R.Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology, 6th Ed.S Chand Publication.
4	Nduka Okafor. Modern Industrial Microbiology and Biotechnology. 2007. CRC Press
5	Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. Industrial Microbiology: An Introduction. 2013. Wiley Blackwell Publishers.
6	A.H. Patel. Industrial Microbiology.2016. 2nd Ed. Laxmi Publications, New Delhi.
7	Dubey R C. A Textbook of Biotechnology. (2014). S Chand Publishers.
8.	Robert D. Hisrich, Michael P. Peters, "Entrepreneurship Development", Tata McGraw Hill
Related Online Contents	
1	http://www.simbhq.org/
2	https://www.rapidmicrobiology.com/
3	http://rapidmicromethods.com/
4	swayam.gov.in › nd1_noc20_bt21
5	sites.google.com>site>microbiology-courses-in-swayam
6	www.classcentral.com>Subjects>Sciences>Biology

Course Designed By: Dr.A.K.Lakkumi Venmal, Assistant Professor & HOD of Microbiology, L.R.G. Government Arts College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	6EC	MEDICAL BIOCHEMISTRY	L	T	P	C
Elective – II (Group – C)			4	-	-	4
Pre- requisite		Basic knowledge on biochemistry gained in the second year allied subject of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- understand the knowledge about various metabolic diseases.
- facilitate the understanding on blood sugar level and diabetes mellitus.
- understand the metabolic processes, molecular, biochemical and cellular mechanisms.
- elucidate the nitrogen balance of living cells.

Expected Course Outcomes:

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

1	Receive a fundamental grounding in the principles of carbohydrate metabolism, and its disorders namely diabetes mellitus and glycogen storage diseases.	**K 2**
2	Reveal the knowledge in abnormalities of lipid metabolism and theirrelationship to various diseases.	**K 2**
3	Understand about the functions of liver and kidney and their abnormalities.	**K 3**
4	Emphasize the role of amino acid and protein intermediates of their metabolism and monitoring the deficiency disorders.	**K 4**
5	Comprehend that hemoglobin is a key molecule in blood and recognize the important role of blood clotting mechanism.	**K4**

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

Unit – I **12 Hours**

Disorders of carbohydrate metabolism – Diabetes mellitus, Glucose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

Unit –II **12 Hours**

Disorders of lipids – Plasma lipo proteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher‟s disease, Tay-Sach‟s, ketone bodies, ß- lipoproteinemia.

Unit – III **12 Hours**

Disorders of liver and kidney- Jaundice, fatty liver, normal and abnormal functions of liver and kidney, insulin and urea clearance.

Unit – IV **12 Hours**

Abnormalities in nitrogen metabolism- Uremia, hyperurecemia, porphyria and factors affecting nitrogen balance.

Unit– V **12 Hours**

Blood – composition and functions, properties and functions of haemoglobin. Blood clotting – disturbances in blood clotting mechanisms – haemorrhagic disorders, haemophilia, purpura, thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants.

Total Lecture Hours **60 Hours**

Text books

1.	Textbook with clinical correlations. Thomas M Devlin. 7th Ed. (2010). A John Wiley and of biochemistry sons, Inc., publications., New York.

References

1	Fundamentals of biochemistry. A. C. Deb. 9th Ed. (2008). New central book agency Pvt. ltd.India.
2	Biochemistry. U. Sathyanarayana. 4th Ed. (2013). Books and Allied Pvt. ltd.

3	Fundamental of Biochemistry for medical students. Ambika Shanmugam. Revised 8th Ed. (2016). Published by the Author, Chennai
Related Online Contents	
1	https://www.sciencedirect.com/topics/biochemistry
2	https://www.youtube.com/watch?v=NoyM9zQamE0
3	https://www.youtube.com/watch?v=8F7wKGNAlpg
4	https://www.researchgate.net/publication
5	https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-biochemistry/

Course designed by: Dr.R.Parimala, Assistant Professor of Biochemistry,
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Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	6ED	DAIRY MICROBIOLOGY	L	T	P	C
Elective – III (Group – A)			3	1	-	4
Pre- requisite		Basic knowledge on Microbiology and Food Microbiology gained from this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- learn the basics of dairy processing units.
- impart knowledge on fermented milk products.
- be acquainted with food quality standards.

Expected Course Outcomes:

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

1	Understand the dairy processing unit operations.	**K 2**
2	be acquainted with various types of dairy products.	**K 2 & K3**
3	Emphasize the role microorganisms on fermented milk products and milk borne diseases.	**K 3 & K 4**
4	Gain information about hygienic manufacturing of dairy products.	**K 3 & K 4**
5	Get the knowledge about Government regulatory practices and policies for quality assurance of dairy products.	**K 4 & K 5**

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

Unit–I **12 Hours**

Milk - Introduction, composition, Microorganisms in Milk – Bacteria, Yeasts, Moulds. Starter Cultures – Starter cultures their biochemical activities. (*Streptococcus thermophillus, Lactobacillus bulgaricus*) Dairy processing unit operations: Pasteurization, UHT treatment, homogenization, Membrane processing, storage, transportation and distribution of milk. Judging and grading of milk and its products.

Unit–II **12 Hours**

Dairy Products Production : Overview and Fluid Milk Products, Concentrated and Dried Milk Products, condensed milk, evaporated milk, whole and skimmed milk powder, cultured Dairy Products: Whipped Cream, Ice Cream, Butter, Whey Products.

Unit–III **12 Hours**

Microbiology of fermented milk products – Acid fermented milks (acidophilus milk, yoghurt). Slightly acid fermented milks (Cultured butter milk), Acid-alcoholic fermented milk (Kefir). Fermented milk production with extended self-life (labneh)). Milk borne diseases, antimicrobial systems in milk, sources for contamination of milk – bacterial with examples of infective and toxic types – Clostridium, *Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria*. Mycotoxins in milk with reference to *Aspergillussp*.

Unit–IV **12 Hours**

Hygiene in Manufacturing Milk Products: Cleaning of Dairy Equipment – Instantization of milk and milk products. In-plant cleaning system. Dairy Processing Plant Sanitation. Probiotic utilization and disposal of dairy by product – whey.

Unit–V **12 Hours**

Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, WHO, EPA, HACCP, ISI. HACCP – Food safety, safety of dairy products, control of hazards.

Total Lecture Hours **60 Hours**

Text books

1	Milk & Milk Products – Clarence Henry Eckles, Tata McGraw Hill publishing company Ltd, New Delhi.
2	Jay,J.M , (2005). Modern Food Microbiology 4thEd. , Van Nostra and Rainhokdd Co.

References	
1	Dairy Microbiology by Robinson R.K, (1990). Volume I and II. Elsevier Applied Science, London.
2	Roday. S, (1998). Food Hygeine and Sanitation. Tata Mcgraw Hill Publications.
3	Fundamentals of Dairy Microbiology by Prajapati.
4	Dey, S, (1994). Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.
5	Rosenthal, I, (1991). Milk and Milk Products. VCH, New York.
6	Warner, J.M, (1976). Principles of Dairy Processing. Wiley Eastern Ltd. New Delhi.
7	Yarpar, WJ. and Hall, C.W, (1975). Dairy Technology and Engineering AVI, Westport.
Related Online Contents	
1	https://www.agrifarming.in/dairy-processing-plant-project-report-setup
2	https://www.youtube.com/watch?v=6Tkx3PTz9Pc
3	https://www.youtube.com/watch?v=_2z8iXU8dO0
4	https://www.cdc.gov/foodsafety/food-poisoning.html

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Erode Arts and Science College, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	6EE	BIONANOTECHNOLOGY	L	T	P	C
Elective – III(Group – B)			4	-	-	4
Pre- requisite		Basic knowledge gained in the previousyears of the programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- understand bionano machines.
- impart knowledge about structural principles of bionanotechnology.
- know various tools, techniques and applications of bionanotechnology.

Expected Course Outcomes:

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

1	Know about basics of bionanomachines and history of bionanotechnology.	K 1
2	Gain knowledge about structural principles of bionanomachines.	K 2
3	Acquire understanding of functional principles of bionanotechnology.	K 2
4	Familiarize with various tools and techniques being used in bionanotechnology.	K 2
5	Learn the applications of bionanotechnology	K3

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

Unit–I **12 Hours**

Introduction- Definition, about Bionanomachines, Molecular Bionanotechnology. History of Bionanotechnology; Richard Feynman and his contributions. Biotechnology versus Bionantechnology. Natural Bionanomachines.

Unit–II **12 Hours**

Structural Principles of Bionanaotechnology – Environment in which the Bionanomachines Functions. Principles behind design of Natural Bionanaomachines – Covalent bonding, Dispersions and repulsion forces. Hydrogen bonding, Electrostatic Interaction, Hydrophobic effect. Hierarchical strategy in construction of Bionanomachines – Self assembly, Self-organization. Concept of Molecular recognition.

Unit–III **12Hours**

Functional Principles of Bionanotechnology – Information storage – Nucliec acid, Ribosomes as assembler to construct proteins. Energetics – Energy from Light, electron transport pathways, electrochemical gradient. Biocatalysts – Enzymes and its regulation. Biomaterials. Biomolecular motors. Molecular sensing- Biosensors.

Unit–IV **12 Hours**

Tools and technique required for Bionanaotechnology – Recombinant DNA technology; site directed mutagenesis, Fusion proteins. X-Ray Crystallography, NMR, Electron Microscopy, Atomic force Microscopy. Bioinformatics – Molecular Modeling, Docking, Computer assisted Molecular design.

Unit–V **12 Hours**

Applications of Bionanotechnology – Nanomedicines; Immunotoxins, Liposomes as drug carriers, Gene therapy, Personalised Medicines; Lab on chip concept. DNA Computers, Artificial Life, Hybrid materials, Biosensors.

Total Lecture Hours **60 Hours**

Text books

1	Goodsell - Bionanotechnology 1st Ed. (2004). Wiley-Blackwell Publishers

References

1	Parag Diwan and Asish Bharadwaj, Nanomedicines, (2006). Pentagan Press,.
2	Vladimir P Torchilin, Nanoparticles as Drug Carriers, (2006). Imperial College Press, North Eastern University, USA.

Related Online Contents	
1	https://www.youtube.com/watch?v=ebO38bbq0_4
2	https://nanohub.org/resources/101
3	https://www.youtube.com/watch?v=TJRxXpKSKEY
4	https://aj.cqc-expert.ru/34

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Erode Arts and Science College, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

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

Course code	6EF	BIOINFORMATICS	L	T	P	C
Elective – III(Group – C)			3	1	-	4
Pre- requisite		Basic knowledge on database, proteomics and genomics gained from Recombinant DNA Technology learned in the previous semester of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- understand the basics of bioinformatics and its role in biosciences.
- gain knowledge about biological database and its types.
- familiarize with the nucleotide sequence databases.
- know about proteomics and genomics.
- understand gene finding, protein prediction, phylogenetic analysis and drug designing.

Expected Course Outcomes:

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

1	know about basics of bioinformatics and information technology and their relationship with biology.	**K 1**
2	gain knowledge about nucleotide sequence database.	**K 2**
3	explore proteomics and genomics.	**K 3**
4	know and explore biological databases.	**K 4**
5	predict gene, protein, bio-molecular visualization, phylogenetic analysis anddrug designing.	**K 5**

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

Unit–I **12 Hours**

Introduction to Bioinformatics, Sequences used in Bioinformatics – DNA, RNA and Protein Sequences, Scope and application of Bioinformatics.

Unit–II **12 Hours**

Biological databases and its significance – objectives, properties and classification of Biological databases, Hard – link relationships between databases, Symbols used in databases.

Unit–III **12 Hours**

Biological database NCBI – GenBank, EMBL, DDBJ. Sequence Alignment Pairwise (BLAST and FASTA) and Multiple sequence alignment (ClustalW).

Unit–IV **12 Hours**

Proteomics – Structure of Protein; Nomenclature of Protein Sequences ; Protein Database Swiss-PROT, SCOP, CATH. Protein visualization tools – RASMOL, Swiss PDB viewer.

Unit–V **12 Hours**

Gene finding, protein prediction, phylogenetic analysis & Drug designing.

Total Lecture Hours **60 Hours**

Text books	
1	Bioinformatics for beginners (2002) K.Mani and Vijayaraj.
2	Introduction to Bioinformatics S.SundaraRajan
References	
1	A.D.Baxevanis and B.J.Francis(Eds) "Bio-informatics"- A practical guide to the analyzing of gene protein", (1998). John Wiley and Sons.
2	Bioinformatics – Sequence and Genome analysis, (2001). David W.Mount.
3	Bioinformatics – R. Sundaralingam, V. Kumaresan.
4	Introduction to Bioinformatics Arthor M.Lesle.
5	Bioinformatics–A biologists guide to bio-computing and the internet, (2000). Stuart M.Brown.
6	Ruchi Singh and Richa Sarma, Bioinformatics: Basics, Algorithms and Applications, (2010). Universities Press, (India) Pvt. Ltd, Hydrabad, India.
Related Online Contents	
1	http://www.ncbi.nlm.nih.gov
2	https://www.ndl.iitkgp.ac.in
3	https://academic.oup.com/nar/article/33/suppl_2/W3/2505760
4	https://www.bioinformatics.org/
5	http://bioinfbook.com/bioinformatics/bioinf14_mainbioinf.htm
6	https://www.ebi.ac.uk/
7	https://www.classcentral.com/course/swayam-bio-informatics-algorithms-and-applications-12890
8	http://www.dypatil.edu/schools/biotech-and-bioinformatics/swayam-nptel-local-chapter/

Course designed by: Dr.Gandhimathi.R., Assistant Professor of Microbiology,
L.R.G. Government Arts College For Women, Tiruppur
Mr.M.Vasudevan, Asst. Professor and HOD of Microbiology
Erode Arts and Science College, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

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

Allied Subjects

Course code	1AB	BIOSTATISTICS AND COMPUTER APPLICATIONS – I	L	T	P	C
Allied A – I			3	1	-	3
Pre- requisite		Basic knowledge on statistics gained during school education and on computer.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- enable the students to learn the statistical methods and measures.
- understand the concept of probability.
- learn the fundamentals of computers.
- expose the students to basics of MS Office Excel.

Expected Course Outcomes:

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

1	Know the basics of Data Collections and Diagrams	**K2**
2	Learn the basics of Measures of Location and Dispersion	**K3**
3	Understand the basics of Probability and Various Distribution methods	**K4**
4	Acquire knowledge about the Basics of Computer Software and Hardware	**K2**
5	Explore the MS Office Excel for the use of Biological data analysis	**K5 & K6**

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

Unit– I **12 Hours**

Nature and Scope of Statistical methods and their limitations – Data collection – Classification and Tabulation – Primary and Secondary data and their applications in life sciences – Diagrams – Line diagram, Bar diagram and Pie diagram – Graphical presentation – Histogram and Ogives

Unit–II **12 Hours**

Measures of Location and Dispersion – Stem and Leaf plots – Box and Whisker Plots – Co-efficient of variation – Skewness and its measures.

Unit– III **12 Hours**

Probability – Concept and Definition – Addition and Multiplication theorems of Probability (statement only) – simple problems – Binomial, Poisson and Normal distributions (without proof) – simple problems.

Unit– IV **12 Hours**

Introduction to Computers – Software and Hardware – Operating Systems – Compilers and Interpreters – Personal, Mini, Main frame and Super computers – their characteristics and application, BIT, BYTE, WORD computer memory and types; data representation and storage, binary codes, binary system

Unit– V **12 Hours**

Microsoft Excel – Data entry – Graphs – Aggregate functions- formulae and functions (students are expected to be familiar with all operations) – different number systems and conversions, input and output devices, secondary storage media – Numerical problems based on Units I to III may be worked using Microsoft Excel.

Total Lecture Hours	**60 Hours**

Text books	
1	P.Ramakrishnan (2017). Biostatistics. Saras Publication.
References	
1	Daniel W.W, (1995). Biostatistics: A foundation for Analysis in health sciences, 6thEd., John Wiley.
2	CamphellR.C,(1989) Statistics for Biologists, Cambridge University Press.
3	Snedecor G.W. and Cochran W.G, (1967). Statistical Methods, Oxford Press.
4	Gupta S.P, (2017). Statistical Methods 45thEd. Sultan Chand & Sons.
5	Arora P.N, Sumeet Arora and Arora .S: Comprehensive Statistical Methods.
6	R.K. Taxali: PC Hardware and Software, Galgotia Publication.
Related Online Contents	
1	https://microbenotes.com/primary-data-and-secondary-data
2	https://www.youtube.com/watch?v=TyYg375pUu8
3	http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=4748
4	https://www.youtube.com/watch?v=z3KnlfATUek
5	https://trumpexcel.com/learn-excel/
6	https://books.google.com/books/about/A_Textbook_Of_Biostatistics.html?id=RzpFKbU62u4C

Course Designed By: Mr.M.Vasudevan, Asst. Professor and HOD of Microbiology, Erode Arts and Science College, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10
CO1	M	M	S	S	M	S	M	L	L	S
CO2	M	M	S	M	M	M	M	L	L	S
CO3	M	M	S	S	M	S	M	L	L	S
CO4	S	S	S	S	M	S	M	L	L	S
CO5	S	S	S	M	M	S	M	L	L	S

*S – Strong; M – Medium; L – Low

Course code	2AB	BIOSTATISTICS AND COMPUTER APPLICATIONS – II	L	T	P	C
Allied A – II			3	1	-	3
Pre- requisite		Basics of Bio-Statistics and Computer Applications – I learned during the previous semester.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- enrich students with computer knowledge for statistical analysis.
- enable the students to learn the Sampling methods.
- provide basic knowledge about Artificial Intelligence in Biological Sciences.
- make students familiar with the Big-Data Analysis.

Expected Course Outcomes:

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

1	Know the basics of Correlation and its various types.	**K2 & K3**
2	Understand the basics of Sampling and Distributions	**K2 & K3**
3	Understand and apply Non-Parametric tests	**K2 & K3**
4	Acquire knowledge about the Artificial Intelligence and its applications in Biology	**K2**
5	Understand the Big-Data Analysis and its applications	**K2**

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

Unit–I **12 Hours**

Correlation – Scatter diagram – Karl Pearson's co-efficient of Correlation – Co-efficient of determination – Spearman's Rank Correlation – Linear Regression. Curve fitting – Fitting of Linear curves.

Unit–II **12 Hours**

Need for Sampling – Methods of Sampling – Simple random, Stratified random, Systematic random and Cluster sampling – Sampling and Non-sampling errors. Concept of Sampling Distribution – Standard error – Tests of significance based on Normal, "t", "F" and Chi square distributions.

Unit–III **12Hours**

Non – parametric tests – Advantages and Disadvantages – Uses – Sign test, Mann – Whitney "U" test, Kruskal – Wallis test and Run test.

Unit–IV **12Hours**

Artificial Intelligence (AI): Introduction to AI – Fundamentals – Need for AI – Foundations of AI – AI environment – Application domains of AI – AI tools – Challenges and Future of AI. Artificial Intelligence in Biology research: AI in drug design – AI in Phylogeny – AI in next generation sequencing.

Unit–V **12Hours**

Big Data: Digital Data – an Imprint: Evolution of Big Data – What is Big Data – Sources of Big Data. Characteristics of Big Data 6Vs. Big Data Technology Potentials – AI – Machine Learning – Cloud Computing – Mobile Communication – IoT – Big Data in Industry 4.0 – Big Data Platforms – HADOOP – No SQL Databases – Types – Big Data Challenges.

Total Lecture Hours **60 Hours**

Text books	
1	P.Ramakrishnan (2017). Biostatistics. Saras Publication.
References	
1	Camphell R.C.(1989). Statistics for Biologists, Cambridge University Press.
2	Gupta S.P. (2017). Statistical Methods, 45thEd. Sultan Chand & Sons.
3	Arora P.N, Sumeet Arora and Arora .S: Comprehensive Statistical Methods.
4	V. Bhuvaneswari, T. Devi, (2018). "Big Data Analytics: Scitech Publisher.
5	Russell,S/Norvig, (2015).Artificial Intelligence: A Modern Approach, 3rdEd. Pearson Edu.
6	Patterson, (1997). Introduction to Artificial Intelligence & Expert Systems, Dan W. PHI
7	Nilsson, Nils, J. Harcourt, (2000). Artificial Intelligence: A New Synthesis, 2ndEd. AsiaPTE Ltd.
Related Online Contents	
1	https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression
2	https://www.scribbr.com/methodology/sampling-methods/
3	https://www.statisticshowto.com/parametric-and-non-parametric-data/
4	https://www.oreilly.com/library/view/getting-started-with/9781492027805/ch01.html
5	https://www.researchgate.net/publication/264888238_ARTIFICIAL_INTELLIGENCE_IN_BIOLOGY
6	https://www.sas.com/en_in/insights/big-data/what-is-big-data.html
7	https://www.guru99.com/what-is-big-data.html

Course Designed By: Mr.M.Vasudevan, Asst. Professor and HOD of Microbiology,Erode Arts and Science College, Erode

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	2PB	ALLIED PRACTICAL – I (BIO-STATISTICS AND COMPUTER APPLICATIONS)	L	T	P	C
Allied – A			-	-	2	2
Pre- requisite		Basic knowledge on Bio-Statistics and Computer Applications gained during Semester I and II.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- enrich students with computer knowledge to draw various diagrams and solving problems in microbiology using MS-Excel.
- provide basic knowledge about Artificial Intelligence in Biological Sciences.
- make students familiar with the Big-Data Analysis.

Programs:

The listed topics to be covered under practical in MS-Excel provided the students have prior exposure in the package.

1. Graphical Representation	a. Histogram b. Ogives c. Scatter diagram
2. Diagrams	a. Line diagram b. Bar diagram c. Pie diagram
3. Measures of Location	a. Mean (Arithmetic, Geometric and Harmonic) b. Median c. Mode
4. Measures of Dispersion	a. Range (max –min) b. Standard Deviation c. Variance d. Coefficient of variation e. Skewness
5. Correlation	a. Karl Pearson's coefficient b. Spearman's Rank c. Coefficient of determination
6. Curve Fitting	a. Linear Regression
7. Parametric tests	a. Normal(z) b. t (Equal Variance) c. F d. Chi square
8. (i) Implement the following file management tasks in Hadoop	a. Adding files and directories b. Retrieving files c. Deleting files
ii) Benchmark and stress test an Apache Hadoop cluster	

<table>
<tr><th colspan="4">Scheme of Practical Examination</th></tr>
<tr><td colspan="3">Duration : 3Hours</td><td>Max.Marks:25</td></tr>
<tr><th>Sl. No.</th><th colspan="2">Program*</th><th>Marks</th></tr>
<tr><td rowspan="2">1</td><td colspan="2">I. Program (1 × 10 = 10 marks)
From Programs 1 to 4 (Graphical Representation, Diagrams Measures of Location and Measures of Dispersion)</td><td rowspan="2">10</td></tr>
<tr><td>i. Algorithm
ii. Execution</td><td>5 marks each</td></tr>
<tr><td rowspan="2">2</td><td colspan="2">II. Program (1 × 10 = 10 marks)
(From Programs 5 to 8 (Correlation, Curve Fitting, Parametric tests, Implement the following file management tasks in Hadoop and Benchmark and stress test an Apache Hadoop cluster)</td><td rowspan="2">10</td></tr>
<tr><td>i. Algorithm
ii. Execution</td><td>5 marks each</td></tr>
<tr><td>3</td><td colspan="2">III. Record</td><td>5</td></tr>
<tr><td colspan="3">Total Marks</td><td>25</td></tr>
<tr><td colspan="4">* Students to be divided into batches (5 students / batch) in order to perform all experiments. Question setting to be done by internal and external examiners and separately for each batch.</td></tr>
<tr><td colspan="4">Course designed by: Dr.Gandhimathi.R., Assistant Professor of Microbiology,
L.R.G. Government Arts College For Women, Tiruppur
Mr.M.Vasudevan, Asst. Professor and HOD of
Microbiology, Erode Arts and Science College, Erode</td></tr>
<tr><td colspan="4">Verified By: Dr.Gandhimathi.R, Chairperson</td></tr>
</table>

Skill Based Subjects

Course code	3ZA	DIAGNOSTIC MICROBIOLOGY– I	L	T	P	C
Skill Based Subject – I			2	1	-	3
Pre- requisite		Basic knowledge gained in the previous semester of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- Impart knowledge about the collection and processing of clinical samples.
- Gain insight about the complete blood components and processing.
- Acquire skills to examine Urine, stool and sputum samples.

Expected Course Outcomes:

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

1	Enable to learn about the collection, transport, preservation and processing of clinical samples.	**K 3 & K4**
2	Gain insight about the complete blood components and processing of human tissue specimens.	**K 3 & K4**
3	Acquire skills to examine urine sample.	**K 3 & K4**
4	Learn laboratory techniques to examine stool samples.	**K 3 & K4**
5	Diagnose respiratory tract infections by examining sputum sample.	**K 3 & K4**

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

Unit–I **9 Hours**

Collection, Processing, transport and storage of specimens – Blood, Urine, Stool, Sputum, CSF & Pus.

Unit–II **9 Hours**

Blood smear preparations: Staining, blood smear examination and morphological abnormalities. Differential WBC count – Peripheral - Reticulocyte count- absolute eosinophil count – E.S.R, P.C.V, Blood indices - Platelet count: BT, CT, CRT- Prothrombin time, A.P.P.T, FDP estimation.

Unit–III **9 Hours**

Examination of urine: Physical and chemical tests, microscopic examination – crystals, casts,sediments, pregnancy tests – Diagnosis (Protocol Outline) of Urinary tract infection.

Unit–IV **9 Hours**

Examination of Stool – Physical, Chemical and Microscopic examination and its significance.

Unit–V **9 Hours**

Examination of Sputum: Microscopic examination – Diagnosis (Protocol Outline) of Respiratory tract infections (Upper and Lower).

Total Lecture Hours **45 Hours**

Text books

1	Ananthanarayanan R and CK Jayaram Panicker, Textbook of Microbiology, 10th Ed. (2017). OrientLongman.
2	Medical laboratory techniques, Abdul Khader, (2003). 1st Ed. Frontline Publications.

References	
1	Diagnostic Microbiology, Bailey and Scott‟s, (2013). 13th Ed. The Mosby Company.
2	Talib. V.H, (2008). Handbook of Medical Microbiology, 2nd Ed. CBS Publishers.
3	James Cappuccino. Microbiology: A Laboratory Manual 10th Ed.
4	Dubey, R.C. & D.K. Maheshwari. Practical Microbiology. S. Chand & Co.
Related Online Contents	
1	https://www.youtube.com/watch?v=uAmTgVvTUNk
2	https://www.youtube.com/watch?v=KrpooZv5juo
3	https://www.youtube.com/watch?v=Oy5uixdzJ_c
4	https://www.ndl.iitkgp.ac.in

Course Designed By: Mr.P.Nallasamy, Asst. Professor in Microbiology
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Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	4ZB	DIAGNOSTIC MICROBIOLOGY– II	L	T	P	C
Skill Based Subject –II			2	1	-	3
Pre- requisite		Basic knowledge gained from Diagnostic Microbiology – I studied in the previous semester of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- identify the bacterial pathogen by microscopic and physiological characterization.
- demonstrate the antibiotic susceptibility and resistance pattern of pathogens and result interpretation.
- impart the knowledge about the Immunological and rapid diagnostic tests.
- learn basic Laboratory techniques in mycology and diagnosis of parasitic infections.

Expected Course Outcomes:

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

1	Identify the bacterial pathogen by microscopic observation and biochemical tests from clinical samples.	**K 3 & K4**
2	Perform the antibiotic susceptibility testing and result interpretation.	**K 3 & K4**
3	Become experienced in Immunological and rapid diagnostic tests.	**K 3 & K4**
4	Learn basic diagnosis in mycology to identify fungal pathogens.	**K 3 & K4**
5	Diagnose parasitic infections.	**K 3 & K4**

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

Unit–I **9 Hours**

Identification of Bacterial pathogens – Microscopic examination of specimen – simple, differential staining and motility. Biochemical reaction – Sugar fermentation test.

Unit–II **9 Hours**

Antimicrobial susceptibility testing- Disc diffusion – Kirby Bauer method. MIC, E test –reporting of results and interpretation.

Unit–III **9 Hours**

Serology – Antigen – Antibody reactions – Agglutination (blood grouping, WIDAL) RPR and Hemaaglutination Precipitation (VDRL), Immunodiffusion – (Mono and Double), Immunoelectorophoresis (Rocket and Counter current). Advanced techniques – ELISA, RadioimmunoAssay (RIA) Quantitative study of Antigen – Antibody reactions. Immunosensors. CD4, CD8 cell counting, Western blot analysis for HIV, RT-PCR for Covid 19.

Unit–IV **9 Hours**

Laboratory methods in basic Mycology – Direct Microscopic examination of clinical specimens, culture media and incubation, Serological tests for fungi – Antifungal susceptibility testing. superficial infections – *Dermatophytes – Microsporum – Trichophyton, Epidermophyton – Madura mycosis* – Opportunistic fungal infections – *Aspergillus* and *Mucor*.

Unit–IV **9 Hours**

Laboratory methods for parasitic infections – Diagnostic techniques for faecal, gastrointestinal and urino–genital specimen. Identification of Protozoa – Amoebiasis and Malaria. Identification of Helminths – Filariasis and Ascariasis.

Total Lecture Hours **45 Hours**

Text books

1 P.B. Godkar, Text Book of Medical Laboratory Technology, 2nd Ed. (2003). Bhalani Publication.

References

1 Diagnostic Microbiology, Bailey and Scott's, (2013). 13th Ed. The Mosby Company.

2	Ananthanarayanan R and CK Jayaram Panicker, Textbook of Microbiology, 10th Ed., (2017). OrientLongman.
3	Medical laboratory techniques, Abdul Khader, (2003), 1stEd. Frontline Publications.
4	Medical Parasitology, Rajesh Karyakarte, Ajit Damla, 2004. Books and Allied publishers.
5	Textbook of Medical Parasitology, Subash O. Parija, (2013). 1stEd. All India Publishers and Distributors.
6	Rajesh Karyakarte and Ajith Damle, (2005). Medical Parasitology, Books and Allied Pvt.Ltd

Related Online Contents

1	https://www.youtube.com/watch?v=uAmTgVvTUNk
2	https://www.youtube.com/watch?v=KrpooZv5juo
3	https://www.youtube.com/watch?v=Oy5uixdzJ_c
4	https://sites.google.com/view/frejltsgqy/medical-mycology-lecture-notes-ppt
5	https://www.dailymotion.com/video/x3eoujz

Course Designed By: Mr.P.Nallasamy, Asst. Professor in Microbiology
Bharathidasan College of Arts and Science, Erode
Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	5ZC	INFECTIOUS DISEASES AND THEIR MANAGEMENT	L	T	P	C
Skill based Subject			3	-	-	3
Pre-requisite		Basic knowledge on Microbiology during the previous years of this programme.	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

- Develop knowledge about epidemiological methods to investigate and manage outbreaks.
- Apply knowledge of infectious disease epidemiology for the improvements in public health.
- Become skilled at the diagnosis of various infectious diseases.
- Acquire knowledge about Immunization and Health programmes.

Expected Course Outcomes:

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

1	Describe and diagnose respiratory infections.	**K3**
2	Become skilled at the diagnosis of intestinal infections.	**K3**
3	Carry out the diagnostic procedures of vector borne infections.	**K3**
4	Acquire information about Health Programmes in our country.	**K3**
5	Be acquainted with Immunization and Immunization programmes.	**K3**

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

Unit–I	**9 Hours**
Respiratory Infections – Bacterial pharyngitis – TB – Common cold – SARS – Covid-19 – Pathogenicity and diagnosis.	
Unit–I	**9 Hours**
Intestinal Infections – Acute diarrheal diseases – Cholera – ETEC – Typhoid – Dysentery – Pathogenicity and diagnosis.	
Unit–I	**9 Hours**
Vector Borne Infections – Malaria – Dengue – Chikungunya – Japanese Encephalitis Kala azar – Pathogenicity and diagnosis.	
Unit–I	**9 Hours**
Health Programmes in India – Programmes for Malaria control – TB control – AIDS control – Pandemic management programmes.	
Unit–I	**9 Hours**
Immunization – Brief note on vaccines and vaccination – Immunization programmes – Universal Immunization Program (UIP) – Immunization schedule in India.	
Total Lecture Hours	**45 Hours**

Text Books	
1	Ananthanarayanan R and CK Jayaram Panicker, (2017). Textbook of Microbiology 10th Ed. Orient Longman.
2	R. C. Dubey, D. K. Maheshwari. 2010. A Textbook of Microbiology. S. Chand Publication.
Reference Books	
1	K Park's Textbook of Preventive and Social Medicine 25th Ed. Banarasidas Bhanot Publishers.
2	David Greenwood, Richard C B Slack, Michael R. Barer, Will L Irving, (2012), Medical Microbiology, 18th Ed. Elsevier Ltd.
Related Online Contents	

1	www.who.int/topics/vaccines/en/.
2	https://www.mooc-list.com/course/global-disease-masterclass-communicable-diseases-epidemiology-intervention-and-prevention
3	http://nhp.gov.in/universal-immunisation-programme_pg
4	https://nhm.gov.in
5	https://nhp.gov.in
6	https://www.who.int/vaccines
7	https://main.mohfw.gov.in
8	https://ncdc.gov.in

Course designed by: Dr.Gandhimathi.R., Assistant Professor of Microbiology,
L.R.G. Government Arts College For Women, Tiruppur
Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology
Tiruppur Kumaran College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Mapping with Programme Outcomes

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

*S – Strong; M – Medium; L – Low

Course code	6ZP	SKILL BASED SUBJECT PRACTICAL	L	T	P	C
Skill Based Subject			-	-	3	3
Pre- requisite		Knowledge in practical and theory gained from previous years of this programme.	Syllabus Version		2021 - 2022	

Course Objectives:

The main objectives of this course are to:

- Acquire skill on collection and processing of clinical specimens.
- Gain knowledge on various serological techniques.
- Get accustomed to immunological techniques involved in diagnosis.
- Visualize different types of infectious fungi.

Experiments

1. Collection, transport, processing of specimen and Identification of bacteria from clinical specimens –Urine, Blood, Sputum, Pus and Faeces.
2. Slide agglutination – Blood grouping
3. Tube agglutination – WIDAL
4. Precipitation – RPR
5. Immunodiffusion – Radial and Ouchterlony's
6. Immunoelectrophoresis – Rocket and Counter current
7. ELISA
8. SDS–PAGE
9. Observation of fungi – LCB and KOH mount
10. Observation of representative forms of Parasites – *Entamoeba, Plasmodium, Ascaris.*

References

1	James Cappuccino. Microbiology: A Laboratory Manual 10thEd.
2	William Claus. G.W.(1989). Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
3	Wilson. K and Goulding. K.H, (1986). A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
4	Dubey, R.C. & D.K. Maheshwari. Practical Microbiology. S. Chand & Co
5	Kannan. N, (1996). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
6	Tiwari, G. S. Hoondal, (2005). Laboratory Techniques In Microbiology And Biotechnology. Swastik publishers.
7	K. R. Aneja, Laboratory Manual of Microbiology and Biotechnology, (2018).ED-TECH.

Scheme of Practical Examination			
Duration : 6 Hours			**Max. Marks: 45**
Sl. No.	**Experiment***		**Marks**
1	**I. Major experiment (1 × 15 = 15 Marks)**		15
	i. Procedure ii. Performance iii. Result and Discussion	5 marks each	
2	**II. Minor experiment (1× 10 =10 Marks)**		10
	i. Procedure and Performance ii. Result and Discussion	5 marks each	
3	**III. Spotters (5 × 3 =15 Marks)**		
	i. Identification ii. Description	1 mark 2 marks	15
4	**IV. Record**		5
	Total Marks		**45**

*** Students to be divided into batches (5 students / batch) in order to perform all experiments. Question setting to be done by internal and external examiners and separately for each batch.**

Course designed by: Mrs. M.Meenakshi, Assistant Professor of Microbiology,
Sri Ramakrishna College of Arts and Science For Women, Coimbatore
Mrs.C.L.Shathiyaa Priyaa, Assistant Professor of Microbiology
Tiruppur Kumaran College For Women, Tiruppur

Verified By: Dr.Gandhimathi.R, Chairperson

Annexure

BHARATHIAR UNIVERSITY, COIMBATORE – 641 046

UG - MICROBIOLOGY
MISSION

The mission of the programme is to;

- Create an awareness on " the wonderful microbial world"
- Impart knowledge on the integral role of microbiology in the science of life.
- Inculcate theoretical knowledge on the various applied fields of microbiology.
- Facilitate acquisition of technical skills through practical and institutional training.
- Develop the students to acquire suitable career opportunities.
- Encourage entrepreneurship.
- Develop confidence and leadership along with team spirit.
- Nurture them towards self, national and global development.