VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

ELAYAMPALAYAM, TIRUCHENGODE (Tk.), NAMAKKAL (Dt.).
(Affiliated to Periyar University, Approved by AICTE,
Re-Accredited with 'A' Grade by NAAC)
Recognized under section 2(f) &12(B) of UGC ACT 1956,
An ISO 9001:2015 (Certified institution)

AUTONOMOUS

DEPARTMENT OF MICROBIOLOGY

B.Sc MICROBIOLOGY

PROGRAMME CODE: UMB

SYLLABUS & REGULATIONS

FOR CANDIDATES ADMITTED FROM 2020 - 2021 ONWARDS

UNDER AUTONOMOUS & OBE PATTERN

VIVEKANANDHA EDUCATIONAL INSTITUTIONS
Angammal Educational Trust

B.Sc., Microbiology

1. SCOPE OF THE COURSE

The course of Microbiology is intended to prepare the students not only to be knowledgeable in the science of Microbiology, but also to be useful in the upliftment of the social and economic well being. Courses offered cover all areas of basic and applied microbiology and these prepare students for a Bachelor of Science degree in Microbiology.

The degree is a three-year full time programme. The programme is not only a specialist programme, but it is also designed to be relevant to the social and economic needs of the nation. In reflection to the specialized nature of the programme, emphasis is given to practical and acquisition of practical skills.

The Programme has been involved in teaching basic and applied microbiology as well as making findings on local problems of microbiology interest. The vision of the programme is therefore, to produce graduates who are not only knowledgeable in the science of microbiology, but who can make significant contributions to the development the human society.

The programme is aimed at training undergraduate graduate students who would have adequate background knowledge and practical skills for application in postgraduate research, teaching, industrial production, medicine, environmental management and biotechnology.

2. SALIENT FEATURES

- Course is specially designed for a higher level career placement.
- Special guest lecture from industries will be arranged.
- Enables students to gain a job oriented degree.
- Special industry orientations and training are parts of the degree course.

3. OBJECTIVES OF THE COURSE

The specific objectives of the programme are:

- To equip the undergraduate students with a sound knowledge of the fundamental principles involved in the study of microbiology.
- To produce graduates that would make impact in the diverse fields of human endeavor considering the ubiquitous nature of microorganism and the wide – ranging applications of the knowledge of microbiology.
- To provide focus for a career in various fields of applied science including medicine, pharmacy, bio-mining, biotechnology, industrial production, environmental management, agriculture and bioinformatics.

4. ELIGIBILITY FOR ADMISSION

Candidates seeking admission to the first-year degree course for **B.Sc., Microbiology** shall be required to have passed

a) Higher secondary examination with biology as major subjects conducted by the Government of Tamil Nadu (or)
b) These regulations shall take effect from the academic year 2017-2018 and 2020 - 2021 i.e. for the students who are to be admitted to the first year of the course during the academic year 2017-2018 and 2020 - 2021 thereafter
c) Any examination with biology as major subjects of any other University or Board accepted as equivalent there to by Periyar University.
d) Academic and vocational stream candidates are eligible.

5. DURATION OF THE COURSE

- The course shall extend over a period of three academic years consisting of six semesters. Each academic year will be divided into two semesters. The first semester will consist of the period from July to November and the second semester from December to March.
- The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Vivekanandha College of Arts and Sciences for Women (Autonomous) with the approval of Periyar University.
- Each subject will have six hours of lecture per week apart from practical at the end of even semester.

6. CONTINUOUS INTERNAL ASSESSMENT

The performance of the students will be assessed continuously and theInternal Assessment Marks will be as under:

Theory

1.	Average of two tests	-	15 Marks
2.	Assignment	-	5 Marks
3.	Attendance	-	5 Marks
	Total		**25 Marks**

Practical

1. Practical best average of two tests	-	25 Marks
2. Attendance	-	10 Marks
3. Observation note	-	5 Marks
Total		**40 Marks**

Break-up Details for Attendance

Below 75%	- No Marks
76 to 80%	- 1 Mark
81 to 85%	- 2 Marks
86 to 90%	- 3 Marks
91 to 95%	- 4 Marks
96 to 100%	- 5 Marks

PASSING MINIMUM

INTERNAL

There shall be no passing minimum for internal

EXTERNAL

In the end semester examinations, the passing minimum shall be 40 % out of 75 Marks (30 Marks)

7. ELIGIBILITY FOR EXAMINATION

A candidate will be permitted to appear for the end semester examination only on earning 75 % of attendance and only when his/her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the examination of language, core, allied, elective, skill based elective and non major elective courses and securing marks

a) 75% and above shall be declared to have passed the examination in first class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.
b) 60% and above but below 75% shall be declared to have passed the examinations in first class without distinction.
c) 50% and above but below 60% shall be declared to have passed the examinations in second class.

d) All the remaining successful candidates shall be declared to have passed the examinations in third class.

e) Candidates who pass all the examinations prescribed for the course at the first appearance itself and within a period of three consecutive academic years from the year of admission only will be eligible for University rank.

9. ELIGIBILITY FOR AWARD OF THE DEGREE

A candidate shall be eligible for the award of the degree only if she has undergone the above degree for a period of not less than three academic years comprising of six semestersand passed the examinations prescribed and fulfilled such conditions has have been prescribed therefore.

10. PATTERN OF QUESTION PAPER

PART- A (Objective)	Answer all Questions	20 x 1 = 20 Marks
PART- B (500 words)	Answer all 5 Questions (either or type)	5 x 5 = 25 Marks
PART - C (1000 words)	Answer any 3 Questions (three out of five)	3 x 10 = 30 Marks

11. PROCEDURE IN THE EVENT OF FAILURE

If a candidate fails in a particular subject, she may reappear for the university examination in the concerned subject in subsequent semesters and shall pass the examination.

12. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2021 - 2022 i.e. for the students who are to be admitted to the first year of the course during the academic year 2017 -2018 and thereafter.

13. TRANSITORY PROVISION

Candidates who were admitted to the UG course of Microbiology before 2017 – 2018 shall be permitted to appear for the examinations under those regulations for a period of three years *i.e.*, up to and inclusive of the examination of April/May 2020. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENES FOR WOMEN (AUTONOMOUS)

VISION

To evolve into a centre of excellence in higher education through creative andinnovative practices to secure social equity for women.

MISSION

1. To provide sufficient learning infrastructure to the students to pursue theirstudies
2. To provide good opportunity for higher education and conducive environmentto the students to acquire education
3. To provide high quality academic programme, training activities and researchfacilities
4. To facilitate industry-institute interface

DEPARTMENT OF MICROBIOLOGY

VISION

Aspires to be a microbiologist committed to progress the quality of human lives byexploring environment, fighting with disease and to utilize microbes for healthy food.

MISSION

- To educate the students to acquire the academic excellence with national and international recognition
- To train the students to recognize, investigate and to resolve the myriad of microbiologicalproblems affecting health and the environment through the programme designs
- To contribute to the cutting edge in Microbiology by pursuing high quality research andother scholarly activities
- To motivate the students to become a women entrepreneur by applying their knowledge inthe field of microbiology
- To establish as an expert resource within the geographical areas regarding all issues relatedto medical and environmental microbiology

B.Sc., MICROBIOLOGY

PROGRAMME OUTCOME:

POs	OUTCOME
PO-1	Develop the ability of understanding the basic concepts and inter relating lifescience domainsfor developing competitive skill metrics
PO-2	Revealing life science views and suggestions with the impartment andexplore in precisemanner with life science professionals and public
PO-3	Capability of crucial thoughts by forming experimental ideas and meet outspecificcompetences and expectations in different biological sectors
PO-4	Students shall able to explain by effectively observing the condition andchallengesexisting in different biological systems
PO-5	Evaluating various challenges, arguments and make accurate decision byintegratingclinical, immunological, pharmaceutical domains
PO-6	Define problems, formulate &test the hypotheses, analyse and interpret thedata related toplant, animal, microbial and biochemical systems
PO-7	Students shall map out the tasks of fellow mates, directing them to formulatethe vision of life science by improvising their managerial skill set
PO-8	Exploring the views and ideas with qualitative and quantitative biologicaldata fordeveloping logical and convincing arguments
PO-9	Knowledge values of multiple domains of life science with the capability ofeffectiveengagement in a multicultural society
PO-10	Students shall able to work effectively and access the utility of ICT withbiologicallydiversified teams with assistance
PO-11	Promote confidence level for executing, managing and completing abiological assignmentwith effective and reproducible solutions
PO-12	Students shall able to meet out their own learning needs by appreciatingenvironment and sustainability from a range of current research
PO-13	Students shall develop the habit of avoiding unethical misinterpretation ofresearch data derived, committing plagiarism, non-adherence of IPR
PO-14	Students shall apply the knowledge of basic life science and its specifictransferable skills for identifying the issues and solving problems
PO-15	Students shall able to acquire knowledge to meet outs the social, economic and cultural objectives which are relevant to life science related job trades

PROGRAMME SPECIFIC OUTCOME:

PSO 1 This program provides comprehensive knowledge and practical training in the spread of microorganisms, disease causation, diagnosis and treatment of pathogens significant to public health.

PSO 2 Students will acquire and demonstrate competency inlaboratory safety and in routine and specialized microbiologicallaboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

PSO 3 Students gain the knowledge of principles and practices in the main applications of microorganisms to the industrial production of foods, microbial metabolites, proteins and other useful products, including the use of genetically modified organisms

SCHEME OF CURRICULUM – B.Sc., IN MICROBIOLOGY

(For the candidates admitted during the academic year 2018 – 2019 and 2021 – 2022 onwards)

Sem	Subject code	Part	Course	Subjects	Hrs/ Week	Credits	Int. Marks	Ext. Marks	Tot. Marks
I	21U1LT01	I	Language – I	Foundation Tamil – I	5	3	25	75	100
	21U1LH01			Hindi – I					
	20U1LM01			Malayalam – I					
	21U1CE01	II		Communicative English - I	5	3	25	75	100
	21U1LSPE01			Professional English – I	4	4	25	75	100
	20U1MBC01	III	Core – I	Principles of Microbiology	4	5	25	75	100
	20U1MBCP01			Major Practical – I	4	3	40	60	100
	20U1BCA01	III	Allied – I	Biochemistry	3	4	25	75	100
	20U1BCAP01			Allied Practical – I	3	3	40	60	100
	18U1VE01	IV		Value education – (Yoga)	2	2	25	75	100
				Total	**30**	**27**	**230**	**570**	**800**
II	21U2LT02	I	Language – II	Foundation Tamil – II	5	3	25	75	100
	18U2LH02			Hindi – II					
	20U2LM02			Malayalam – II					
	21U2CE02	II		Communicative English - II	5	3	25	75	100
	21U2LSPE02			Professional English – II	4	4	25	75	100
	20U2MBC02	III	Core – II	Microbial Physiology and Metabolism	4	4	25	75	100
	20U2MBCP02	III		Major Practical – II	4	2	40	60	100
	20U2MBA01	III	Allied – II	Bioinstrumentation Techniques	3	4	25	75	100
	20U2MBAP01	III		Allied Practical – II	3	2	40	60	100
	20U2ES01	IV		Environmental studies	2	4	25	75	100
				Total	**30**	**26**	**230**	**570**	**800**
III	21U3LT03	I	Language – III	Foundation Tamil – III	6	3	25	75	100
	18U3LH03			Hindi – III					
	20U3LM03			Malayalam – III					
	21U3CE03	II		Communicative English - III	6	3	25	75	100
	20U3MBC03	III	Core – III	Molecular Biology and Microbial Genetics	4	4	25	75	100
	20U3MBCP03			Major Practical – III	3	2	40	60	100
	20U3MBA02	III	Allied – III	Cell Biology	4	4	25	75	100
	20U3MBAP02			Allied Practical – III	3	2	40	60	100
		IV	NMEC – I	Elected by students	2	2	25	75	100
	18U3MAAS01	IV	SBEC – I	Biostatistics	2	2	25	75	100
				Total	**30**	**22**	**230**	**570**	**800**
IV	21U4LT04	I	Language – IV	Foundation Tamil – IV	6	3	25	75	100
	18U4LH04			Hindi – IV					
	20U4LM04			Malayalam – IV					
	21U4CE04	II		Communicative English - IV	6	3	25	75	100
	20U4MBC04	III	Core – IV	Immunology and Immunotechnology	4	4	25	75	100
	20U4MBCP04			Major Practical – IV	3	2	40	60	100
	20U4BTA01	III	Allied – IV	Biotechnology	4	4	25	75	100
	20U4BTAP01			Allied Practical – IV	3	2	40	60	100
		IV	NMEC – II	Elected by Students	2	2	25	75	100
	20U4MBS02	IV	SBEC – II	Plant Diseases and Management	2	2	25	75	100

				Total	**30**	**22**	**230**	**570**	**800**
V	20U5MBC05	III	Core – V	Medical Bacteriology and Mycology	6	5	25	75	100
	20U5MBC06	III	Core – VI	Industrial and Pharmaceutical Microbiology	5	5	25	75	100
	20U5MBC07	III	Core – VII	Genetic Engineering	5	4	25	75	100
	20U5MBE01/02	III	Elective – I	Haematology and blood banking Entrepreneurship in microbiology	4	4	25	75	100
	20U5MBS03	IV	SBEC – III	Computer Applications in Biology	2	2	25	75	100
	20U5MBPR01			Mini Project	2	1	-	-	-
	20U5MBCP05	III		Practical – V	6	3	40	60	100
				Total	**30**	**24**	**165**	**435**	**600**
VI	20U6MBC08	III	Core – VIII	Medical Virology and Parasitology	6	4	25	75	100
	20U6MBC09	III	Core – IX	Soil and Environmental Microbiology	5	4	25	75	100
	20U6MBC10	III	Core – X	Food and Dairy Microbiology	5	4	25	75	100
	20U6MBE03/04	III	Elective – II	Microbial diagnosis / Quality control in food microbiology	4	3	25	75	100
	20U6MBS04	IV	SBEC – IV	Advances in Microbiology	2	2	25	75	100
	20U6MBCP06	III		Practical – VI	6	3	40	60	100
	20U6MBEX01	-	-	Extension activity	2	1	-		
				Total	**30**	**21**	**165**	**435**	**600**
Overall Total					**180**	**140**	**1250**	**3150**	**4400**

MAJOR ELECTIVE COURSES:

Semester – V

1. Hematology and Blood Banking (20U5MBE01)
2. Entrepreneurship in Microbiology (20U5MBE02)

Semester – VI

1. Microbial Diagnosis in Health Clinics (20U6MBE03)
2. Quality Control in Food Microbiology (20U6MBE04)

NON MAJOR ELECTIVE COURSES:

1.Public Health and Hygiene (20U3MBN01)

2.Bio-fertilizer Technology (20U4MBN02)

SEMESTER I

SEMESTER – I	**CORE - I**
20U1MBC01	**Total Number of Hours: 60**
Credits - 5	**4 Hours/ Week**

PRINCIPLES OF MICROBIOLOGY

Course Objectives:

- To study the history and scope of Microbiology
- To gain knowledge about techniques in Microbiology
- To understand the cultivation techniques of microbes
- To study the classification of bacteria, algae and fungi
- To gain knowledge on diverse group of bacteria

Course Outcome:

CO1	The students could understand the origin of Microbiology field and its discoveries in reference to the contributions of great scientists
CO2	The use of microscopy and the methods to visualize the microorganisms were could be Learnt
CO3	The art of cultivating the microorganisms, storing methods and removal of pathogenic organisms were taught
CO4	The students could learn the diverse groups of microorganisms
CO5	The microorganisms that grow at some extreme conditions were to be introduced

UNIT – I **No. of Hours: 12**

History and Development of Microbiology: Scope of microbiology, Spontaneous generation verses biogenesis Contributions of Anton van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming – Germ theory of disease and golden era of microbiology. Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky and Paul Ehrlich, Elie Metchnikoff and Edward Jenner.

UNIT – II **No. of Hours: 12**

Microbial Diversity: Introduction and General Characteristics of Bacteria, Algae and Fungi, protozoa, virus. Evolution, Phylogeny, Microbial Taxonomy and Classification – Haeckel, Whittaker and Carl Woese system. Bacterial diversity – classification – Bergeys' Manual of Systematic Bacteriology (up to order level) and Actinobacteria.

UNIT – III **No. of Hours: 12**

General characteristics of Chlamydia, Rickettsia and Mycoplasma. Microbial diversity in different ecosystems - psychrophiles, mesophiles, thermophiles, acidophiles, alkalophiles, barophiles, capnophilic, saccharophilic and other extremophiles (Halophiles, Methanogens).

Economic importance of bacteria.

UNIT – IV **No. of Hours: 12**

Microscopy: Bright field, Dark Field, Phase contrast, Fluorescence microscope and Electron microscope. **Staining Methods:** Staining and its types – Simple staining, Differential staining – Gram's, Acid fast and Special staining methods – Metachromatic granule, Endospore and Capsule staining. Hanging drop technique.

UNIT – V **No. of Hours: 12**

Cultivation of Microbes: Culture media – solid, liquid, semisolid and its types - Basal- Differential- Selective- Enrichment, Enriched and transport media. Cultivation of anaerobes – Pyrogallol and Gas Pack method. Pure culture isolation techniques – Spread. Pour and Streak plate methods. Preservation of cultures. **Sterilization:** Physical and Chemical methods of sterilization.

Text Books

1. Pelczar MJ, Chan ECS and Kreig NR (2008). **Microbiology**. 5th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Dubey RC and Maheswari DK (2013). **A Textbook of Microbiology.** 3rd Edition. S Chand and Company Limited, New Delhi.
3. Sullia S.B and Santhanam S (2017). **General Microbiology.** 2nd Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books

1. Wiley JM, Sherwood LM and Woolverton CJ. (2013) **Prescott's Microbiology**. 9th Edition. McGraw Hill International.
2. Jacquelyn G. Black (2015). **Microbiology: Principles and Explorations.** 9th Edition. John Wiley and Sons Australia Limited.
3. Kathleen Park Talaro (2014). **Foundations in Microbiology: Basic Principles,** 9th Edition. McGraw-Hill Higher Education.
4. Tortora GJ, Funke BR and Case CL. (2016). **Microbiology: An Introduction**. 11th Edition. Pearson Education Limited.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). **Brock Biology of Microorganisms**. 14th edition. Pearson International Edition
6. Atlas RM. (1997). **Principles of Microbiology**. 2nd edition. WM.T. Brown Publishers. Hill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (1999). **General Microbiology**. 5th edition. McMillan.

Web References

1. https://www.britannica.com/science/microbiology

2. https://nptel.ac.in/courses/102103015/pdf/mod8.pdf
3. https://www.atsu.edu/faculty/chamberlain/Website/Lects/Content1.html

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓
CO2	✓	✓	✓		✓
CO3	✓	✓	✓	✓	
CO4	✓		✓	✓	
CO5	✓	✓		✓	

SEMESTER – I	**CORE PRACTICAL - I**
20U1MBCP01	**Total Number of Hours: 45**
Credits - 3	**4 Hours/ Week**

PRINCIPLES OF MICROBIOLOGY (PRACTICALS)

Course Objectives

- To introduce the Good laboratory practices and biosafety
- To learn the SOP of basic instruments in microbiology lab
- To cultivate the microbes in laboratory
- To learn the basic techniques leading to characterization of microbes
- To evaluate the antibiotic sensitivity pattern of microbes

Course Outcome:

CO1	The knowledge on microbiology laboratory, working practices, basic instruments to be imparted
CO2	The handling of microscope for visualizing the morphology, size and movement of microbes could be learnt
CO3	The non pathogenic microbial cultivation may be practiced
CO4	The enumeration techniques from various samples may be experienced
CO5	The efficacy of the antibiotic sensitivity test might be learnt

1. Microbiology Good Laboratory Practices and Biosafety.
2. The principle and applications of instruments (Laminar air flow, autoclave, incubator, hot air oven, light microscope, pH meter), Centrifuge used in the microbiology laboratory.
3. Preparation of culture media for aerobic and anaerobic bacteria.
4. Pure culture technique- Serial dilution, pour plate, spread plate and streak plate.
5. Enumeration of bacteria from water and soil sample
6. Staining techniques- simple, differential, (Gram staining and Acid fast staining) Metachromatic, endospore, capsular staining.
7. Determination of bacterial motility by hanging drop technique.
8. Microscopic Examination of Mold and Yeast by LCB
9. Microscopic examination of Algae
10. Microscopic Examination of Protozoa by wet mount method.

Suggested Reading

1. Cappucino J and Sherman N (2010). **Microbiology: A Laboratory Manual**. 9th edition. Pearson Education Limited.

2. P. Gunasekaran (2005). **Laboratory Manual in Microbiology**. 1st Edition. New Age International Publishers.

3. Mette Praetorius Ibbe and Katherine Elasky (2017). **Basic and Practical Microbiology Laboratory Manual**. 1st Edition. Cognella. Incorporated.

4. Norbel A.Tabo (2004). **Laboratory Manual in Microbiology**. 1st Edition. Rex Book Store.

5. N.Kannan (2002). **Laboratory Manual in General Microbiology**. 1st Edition. Panima Publishing Corporation.

6. Sundara Rajan. S (2001). **Practical Manual of Microbiology**. 1st Edition. Anmol Publication Private.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓
CO2	✓	✓	✓	✓	
CO3			✓	✓	✓
CO4	✓	✓		✓	
CO5	✓	✓	✓		✓

SEMESTER II

SEMESTER – II	**CORE - II**
20U2MBC02	**Total Number of Hours: 45**
Credits – 4	**4 Hours/ Week**

MICROBIAL PHYSIOLOGY AND METABOLISM

Course Objectives:

- To study the Cellular structure of prokaryotes
- To gain knowledge about bacterial growth.
- To understand the transport mechanism of the bacteria.
- To study the metabolism and its types.
- To gain knowledge on mechanism of photosynthesis in bacteria.

Course Outcome:

CO1	The understand the Prokaryotic cellular organizations
CO2	The student got a clear idea of the bacterial growth and the factors influencing the Growth
CO3	The different methods involved in the transport of materials from outside environment into the bacterial cell were taught
CO4	The metabolism of microbes with reference to different cycles were learnt
CO5	The microbial respiration and its classification based on the respiration were studied

UNIT – I **No. of Hours: 12**

Cellular structures of prokaryotes and Eukaryotes: Prokaryotic and Eukaryotic cellular organization and functions - cell wall, Cytoplasmic membrane, Flagella, Pili, Slime layer, Capsule, inclusion bodies, Lysozymes.

UNIT – II **No. of Hours: 12**

Growth of bacteria: Nutritional requirements of bacteria. Classification of bacteria based on nutrients - Autotrophs, Phototrophs, Lithotrophs, Organotrophs and Chemotroph - factors influencing microbial growth – growth curve – Generation time - Specific Growth Rate - Mathematical determination of growth. Mechanism of sporulation.

UNIT – III **No. of Hours: 12**

Microbial growth culture and transport: Nutrients – Synchronous, Batch, continuous and diauxic growth culture. Structure and organization of membrane – Methods of nutrient transport in bacteria – Diffusion, active transport, passive transport and facilitated diffusion – group translocation.

UNIT – IV **No. of Hours: 12**

Aerobic Respiration and Fermentation: Glycolysis, Pentose Phosphate Pathways, EMP, TCA and Glyoxalate cycle. Alcoholic fermentation by yeasts and bacteria. Lactic acid fermentation – Homo and Hetero Lactic acid fermentation.

UNIT – V **No. of Hours: 12**

Photosynthesis and Anaerobic respiration: Photosynthesis – Photosynthetic pigments, Oxygenic and anoxygenic photosynthesis — photosynthesis in halobacteria. Anaerobic respiration (Nitrate reduction, Sulfidogenesis Methanogenesis and Acetogenesis). Physiology of Bio luminescence.

Text Books

1. Pelczar MJ, Chan ECS and Kreig NR (2008).**Microbiology**. 5th Edition, Tata McGraw Hill-Hill Education Pvt. Ltd., New Delhi.
2. Ram Reddy S and Reddy SM (2005). **Microbial Physiology.** 1st Edition. Scientific Publishers, India.
3. Meenakumari S (2006). **Microbial Physiology**. 1st Edition.MJP Publishers, A unit of Tamil Nadu Book House, Chennai.

Reference Books

1. Moat G, John W Foster and Michael P Spector (2002). **Microbial Physiology.** 4th Edition. Wiley-Lis, Inc., New York.
2. Daniel R. Caldwell (2000). **Microbial Physiology and Metabolism.** 2nd Edition. Star Publishing Company.
3. Willey, J.M., Sherwood, L and Wool Verton C.J. (2011). **Prescott's Microbiology.** 8th edition, McGraw Hill, New York.

Web sources

1. https://nptel.ac.in/courses/122103039/pdf/mod4.pdf
2. https://nptel.ac.in/courses/102103015/19
3. https://www.cliffsnotes.com/study-guides/biology/biology/the-biology-of cells/prokaryote-and-eukaryote-cell-structure

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓		✓
CO3	✓	✓	✓	✓	
CO4	✓		✓	✓	✓
CO5	✓	✓		✓	✓

SEMESTER – II	**CORE PRACTICAL – II**
20U2MBCP02	**Total Number of Hours: 30**
Credits – 2	**4 Hours/ Week**

MAJOR PRACTICAL – II - MICROBIAL PHYSIOLOGY AND METABOLISM

Course Objectives

- To study the bacterial growth
- To study the effect of temperature, pH, carbon, nitrogen and salt concentration, incubation time, inoculums size on bacterial growth
- To understand the characterization of unknown organisms

Course Outcome:

CO1	Different stages of bacterial growth could be studied
CO2	The impact of different physical parameters on bacterial growth are to be learnt
CO3	The impact of different chemical parameters on bacterial growth are to be learnt
CO4	The characterization of microorganisms based on IMViC tests are to be introduced
CO5	The characterization of microorganisms based on sugar assimilation are to be introduced

1. Bacterial growth curve by Direct and Indirect method
2. Determination of generation time.
3. Effect of temperature and pH on bacterial growth
4. Effect of carbon and nitrogen sources on bacterial growth
5. Effect of salt concentration on bacterial growth
6. Determination of microbial biomass: Wet and Dry
7. IMViC
8. Sugar fermentation test (glucose, lactose, maltose, mannitol and sucrose)
9. Catalase test
10. Oxidase test
11. Urease test
12. Triple Sugar Iron test
13. Nitrate reduction test
14. Sulphur reduction test
15. Screening of Lactate and Non lactate fermentation test
16. Winogradsky column

Reference Books

1. Cappucino J and Sherman N. (2010). **Microbiology: A Laboratory Manual**. 9th edition. Pearson Education Limited.
2. P.Gunasekaran. (2005). **Laboratory Manual in Microbiology**. 1st Edition. New Age International Publishers.
3. Mette Praetorius Ibbe and Katherine Elasky. (2017). **Basic and Practical Microbiology Laboratory Manual**. 1st Edition. Cognella. Incorporated.
4. Norbel A.Tabo. (2004). **Laboratory Manual in Microbiology**. 1st Edition. Rex Book Store.
5. N.Kannan. (2002). **Laboratory Manual in General Microbiology**. 1st Edition. Panima Publishing Corporation.
6. Sundara Rajan. S. (2001). **Practical Manual of Microbiology**. 1st Edition. Anmol Publication Private.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – II	**ALLIED – II**
20U2MBA01	**Total number of Hours: 45**
Credits: 4	**4 Hours/Week**

BIOINSTRUMENTATION TECHNIQUES

Course Objectives:

- To gain knowledge about laboratory requirement for microbiology laboratory
- To study the recent advancements in chromatography
- To impart knowledge on Electrophoretic techniques and its applications
- To study the different types of centrifuges
- To understand spectroscopic techniques

Course Outcome:

CO1	The course emphasizes on the basics of laboratory, its requirements and rules. It also gives an understanding about the recent advancements in microscopy, principle and the operation of the basic equipments used in the microbiology/clinical laboratory
CO2	Provides basic principles and separation of molecules by various chromatography techniques
CO3	Able to uptake introductory principle and background of electrophoresis and its common application in separation of genetic material and high throughput techniques for the separation of biomolecules
CO4	It is an opportunity to understand the working principles of analytical spectrophotometers and its applications
CO5	Ability to understand the most common and routine laboratory separation of molecules based on physical and chemical properties

UNIT – I **No. of Hours: 09**

Microbiological Instruments: SOP Guidelines for Microbiology Laboratory – Basic microbiological Instruments –Biosafety Cabinets – levels – 1 to 3, Neubaeur chamber, Transillumintor, Cyclo mixer, Homogenizer, Sonicator and fumigator. Incubators - Shaker incubator, BOD incubator, CO_2 Incubator – water and air jacketed. Weighing Balance – pH meter, microbalance Deep freezers – horizontal, verticle – Lyophilizer and rotary evaporator.

UNIT – II **No. of Hours: 09**

Centrifugation and filtration:

Centrifuge – Sedimentation principle, Relative centrifugal force, Sedimentation coefficient, factors affecting sedimentation velocity, Centrifuge rotors. Types of centrifuges – Low speed clinical bench top centrifuge, High speed refrigerated microcentrifuge. Ultracentrifugation – Preparative Types – Differential, Density gradient - Rate zonal, Isopycnic technique and analytical. Membrane, Syringe and Seitz filtration methods.

UNIT – III **No. of Hours: 09**

Spectrophotometry: Principle– Beer's and Lambert's Law. Principle and applications of Colorimeter, UV-Visible single and dual beam spectrophotometer, ELISA plate reader, Atomic Adsorption Spectrophotometer, Raman spectrophotometer. Spectroflourimeter and flow cytometer.

UNIT – IV **No. of Hours: 09**

Electrophoresis: Principle and applications of Agarose gel electrophoresis, Pulse Field Gel Electrophoresis, SDS – polyacrylamide gel electrophoresis, Zymography and 2D gel electrophoresis - Isoelectric focusing. Blotting Techniques – Southern, Western and Northern blotting.

UNIT – V **No. of Hours: 09**

Chromatography: Introduction, Principles and applications of paper chromatography. Thin layer chromatography, Column chromatography, Gel filtration chromatography, Gas chromatography coupled with mass spectrometry, Ion-exchange chromatography, affinity chromatography and HPLC.

Text Books

1. Praful K Godkarand and Darshan P Godkar (2006). **Text book of Medical Laboratory Technology.** Bhalani Publishing House, Mumbai.
2. Arora CK and Prakash M (1998). **Laboratory instrumentation.** Anmol Publications Pvt. Ltd., New Delhi.

Reference Books

1. Keith Wilson and John Walker (1994). **Principles and Techniques of Practical Biochemistry.** 5th Edition, Cambridge University Press, New York.
2. Rodney Boyer (2000). **Modern Experimental Biochemistry.** 3rd Edition**,** Addition Wesley Longman, San Francisco.
3. Webster JG (2004). **Bioinstrumentation**. University of Wisconsin, John Wiley & Sons, Inc. UK.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	
CO2	✓		✓	✓	✓
CO3		✓	✓		✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – II	**ALLIED PRACTICAL – II**
20U2MBAP01	**Total number of Hours: 30**
Credits – 2	**4 Hours/Week**

ALLIED PRACTICAL – II - BIOINSTRUMENTATION TECHNIQUES

Course Objectives:

- To know about the basics of solution preparation for various experiments
- To get trained in the estimation of biomolecules
- To understand the working principle and methods of analytical instruments
- To get skilled in basic molecular biology techniques
- To get trained in basics of chromatography

Course Outcome:

CO1	Become well-versed in preparation of reagents and buffers
CO2	It offers to participate with very advanced chromatographic methods for the separation of molecules
CO3	The student can learn most common methods to separate genetic material and proteins
CO4	Allows to capture detailed working principle of spectrophotometry and its application
CO5	A hands on approach to develop skill in estimation of biomolecules using spectrophotometry

1. Standard Operating procedure for Centrifuge, Colorimeter, Laminar air flow chamber and Autoclave
2. Standard calibration for Spectrophotometry
3. Standard calibration for Centrifuge
4. Calculation in preparation of reagents: Normality of solution, Molarity of solution
5. Paper Chromatography
6. Thin layer chromatography
7. Column Chromatography
8. Electrophoretic Techniques: Agarose gel electrophoresis, SDS-PAGE
9. Estimation of Protein
10. Estimation Carbohydrate
11. Estimation of Lipid.
12. Sterility testing

Reference Books

1. Rodney Boyer (2000). **Modern Experimental Biochemistry.** 3rd Edition**,** Addition Wesley Longman, San Francisco.
2. John G Webster (2004). **Bioinstrumentation**. University of Wisconsin, John Wiley & Sons, Inc. U K.
3. Keith Wilson and John Walker (1994). **Principles and Techniques of Practical Biochemistry**. 5th Edition, Cambridge University Press, New York.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER III

SEMESTER – III	**CORE – III**
20U3MBC03	**Total number of Hours: 60**
Credits – 4	**4 Hours/Week**

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Course Objectives:

- To gain knowledge about DNA and RNA
- To understand DNA replication and transcription in prokaryotes & eukaryotes
- To impart knowledge on translation and gene regulation
- To study the features of plasmid and mechanism of genetic exchange
- To gain knowledge about mutation and repair mechanisms

Course Outcome:

CO1	It enables to understand the historical perspective and background / basic knowledge of Genetics
CO2	It gives exposure on central dogma of life
CO3	It helps to uptake knowledge on translation and gene regulation in prokaryotes
CO4	It delivers basic knowledge and techniques used in gene transfer
CO5	It provides basic concepts of mutation and mutagenesis and gene repair mechanisms

UNIT – I **No. of Hours: 12**

Genetic Material (DNA & RNA): Genetics – Historical perspectives, discovery of DNA structure – Watson and Crick model – Types and forms of DNA. DNA as a genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment) RNA as genetic material. RNA types – mRNA, rRNA and t RNA. Genetic code - Salient features - Wobble hypothesis.

UNIT – II **No. of Hours: 12**

Replication and repair mechanisms: DNA replication in prokaryotes – Meselson and Stahl experiment – Mechanism and enzymology of replication - Rolling circle and theta model of replication. Eukaryotic replication. . DNA repair mechanisms – excision, mismatch, SOS, photoreactivation and recombination repair.Mutations and types of mutation - Auxotrophic mutant detection: Replica plate technique. Mutagenicity testing – Ames Test.

UNIT – III **No. of Hours: 12**

Transcription : Transcription in prokaryotes and eukaryotes: promoter, operator, repressor. Post transcriptional modification Gene regulation - Operon concept – *lac* and *trp* operons.

UNIT – IV **No. of Hours: 12**

Translation: Translational machinery, charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination in prokaryotes. Post translational modification

UNIT – V **No. of Hours: 12**

Gene transfer: Plasmids - Introduction – Properties, Types – Natural and Artificial. Applications of Plasmids. **Conjugation** – mechanism, Hfr and F' strains**. Transformation** – Discovery, mechanism of natural competence. **Transduction** – Generalized and specialized.

Text Books

1. David Freifelder (2005). **Molecular Biology**. 2nd Edition. Narosa Publishers, New Delhi.
2. Verma PS and Agarwal VK (2006). **Cell Biology, Genetics, Molecular Biology, Evolution and Ecology**. S. Chand & Company Ltd., New Delhi.

Reference Books

1. Friedberg EC, Walker GC, Siede W (2006). **DNA repair and mutagenesis**. ASM press, Washington DC.
2. Benjamin Lewin (2000). **Genes VII.** 7th Edition. Oxford University press, Inc.
3. Maloy SR, Cronan JE, FreifelderD (1994). **Microbial Genetics.** Jones and Bartlett Publishers.
4. Gardner EJ, Simmons MJ, Snustad DP (2008). **Principles of Genetics**. 8th Ed. Wiley-India.
5. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008). **Molecular Biology of the Gene**, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

Web sources:

1. http://biology.kenyon.edu/courses/biol63/watson_06.pdf
2. https://nptel.ac.in/courses/102103015/33
3. https://nptel.ac.in/courses/102103017/module26/lec26_slide9.htm

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	
CO2	✓		✓	✓	✓
CO3		✓	✓		✓
CO4	✓	✓		✓	
CO5	✓	✓	✓		✓

SEMESTER – III	**CORE PRACTICAL – III**
20U3MBCP03	**Total number of Hours: 30**
Credits – 2	**3 Hours/Week**

MOLECULAR BIOLOGY AND MICROBIAL GENETICS (PRACTICALS)

Course Objectives:

- To be aware of the isolation of chromosomal and plasmid DNA
- To obtain knowledge on physical and chemical mutagenesis
- To achieve knowledge about coli phage transfer method
- To know about the gene transfer methods
- To get information about the techniques used in genetics

Course Outcome:

CO1	The students would be skilled in chromosomal and plasmid DNA isolation from eukaryotes
CO2	They would be expertise with effects of physical and chemical agents responsible for mutagenesis
CO3	They can able to isolate antibiotic resistant and auxotrophic mutants
CO4	They would be exposed to hands on technique for the isolation of phage from sewage
CO5	They were enabled with fundamental techniques used for prokaryotic gene transfer techniques

1. Isolation of chromosomal DNA from bacteria
2. Separation of DNA using Agarose gel electrophoresis
3. Isolation of plasmid DNA from *E. coli*
4. Quantification of genetic material (DNA) by UV spectroscopy
5. Effect of UV radiation to study the survival pattern of *E.coli*
6. Isolation of antibiotic resistant mutant by Chemical mutagenesis
7. Isolation of antibiotic resistant mutant by gradient plate technique
8. Isolation of auxotrophic mutant replica plating
9. Isolation of Bacteriophage from sewage
10. Competence cell preparation
11. Bacterial Gene Transfer – Transformation
12. Bacterial Conjugation (Demonstration)

Reference Books

1. Sambrook J and Russell DW (2001). **Molecular Cloning – A laboratory manual.** 3rd Edition. Cold Spring Laboratory Press, New York.
2. Dubey RC and Maheshwari DK (2002). **Practical Microbiology**. S Chand and Co. Ltd., New Delhi.
3. Aneja KR (2010). **Experiments in Microbiology, Plant Pathology and Biotechnology.** New Age International (P) Limited Publishers.
4. Harold J Benson (2002). **Microbiological Applications: Laboratory manual in General Microbiology**. 8th Edition. Mcgraw-Hill, Boston.
5. James G Cappuccino and Natalie Sherman (2005). **Microbiology: A Laboratory manual.** 7th Edition, Pearson Education, Inc.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓
CO2		✓		✓	✓
CO3		✓	✓	✓	✓
CO4	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – III	**ALLIED – III**
20U3MBA02	**Total number of Hours: 60**
Credits – 4	**4 Hours/Week**

CELL BIOLOGY

Course Objectives:

- To understand the basic concept of cell biology
- The basic knowledge on cell and their structure
- To gain the knowledge on ultrastructure and functions of cell organelles
- To learn the ultrastructure and functions of Nucleus
- Acquire knowledge on cell division and cell cycle

Course Outcome:

CO1	To understand the about cells and the tools
CO2	Knowledge about the cells of microbes, plant and animal
CO3	To known about the cell physiology
CO4	Knowledge about the nucleus and their function
CO5	Knowledge about the cycles and division of cell

UNIT I **No. of Hours: 12**

History of Cell Biology - Tools and Techniques of Cell Biology Cell Fractionraction, Homogenization, Centrifugation, Isolation of sub cellular Components. Tissue Culture and Cell Culture Techniques. Histological Techniques - Staining - Vital Stains - Cytoplasmic and Nuclear Stains.

UNIT II **No. of Hours: 12**

Cell - Cell theory - Viruses -Types and Structure - Bacteria - Bacterial membrane - Ultra structure of Plant & Animal cell - Cytoplasm - Structure and Composition, Function - Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.

UNIT III **No. of Hours: 12**

Cell components - Plasma Membrane Ultra Structure - Different Models - Functions - Ultrastructure, Composition and Function of Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles, Plastids, Chloroplasts, Microtubules & Microfilaments, Mitochondria, and Microsomes.

UNIT IV **No. of Hours: 12**

Nucleus - Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - Nucleolus Cycle - DNA and RNAs - Protein Synthesis & regulation.

UNIT V **No. of Hours: 12**

Cell Divisions and Cell Cycle - Amitosis, Mitosis and Meiosis and their Significance - Cancer, Ageing of Cells and Stem cell studies.

Text Books

1. Powar, C.B., 2014, "Cell Biology", Third Edition, Himalaya Publications, Mumbai.
2. Rastogi.S.C., 2015, "Cell Biology", Third Edition, New age International, New Delhi.

Reference Books

1. Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.

2. Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.

3. Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi - 110 007, 495 pp

4. DeRobertis, E.D.P. and E.M.F. DeRobertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Infomed, HonKong, 734pp.

5. Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609 pp.

6. Power, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay - 400 004, 368 pp.

7. Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.

8. VeerBala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250 001.

9. Verma, P.S. and V. K.Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S.Chand & co., New Delhi - 110 055, 567 pp.

10. Loewy, A.G. and P.Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., NewDeihi - 110 020, 516 pp.

11. Swansen, C.P. and P.L.Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New Delhi - 110 001, 373 pp.

Web sources:

1. https://bio.libretexts.org/
2. https://biologydictionary.net/
3. https://www.medicalnewstoday.com/
4. https://www.microscopemaster.com/

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓
CO2		✓		✓	✓
CO3		✓	✓	✓	✓
CO4	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – III	**ALLIED PRACTICAL – III**
20U3MBAP02	**Total number of Hours: 30**
Credits – 2	**3 Hours/Week**

CELL BIOLOGY (ALLIED PRACTICAL)

Course Objectives:

- To aware the knowledge about Prokaryotic and Eukaryotic cells
- To knowledge about the cell divisions
- To achieve the knowledge about the cell media
- To known the tissue culture

Course Outcome:

CO1	Knowledge the structure and function of cells
CO2	Acquire the knowledge about growth media and cell divisions
CO3	Analyse the fugal cell structure
CO4	Knowledge about the plant tissues and the divisions
CO5	Known the squash preparation through standard method

1. Structure of Prokaryotic cell (Bacterial cell)
2. Structure of Eukaryotic cell (Plant and Animal)
3. Cell Fractionation
4. Growth of fungi on liquid media (cell structure)
5. Plant tissue culture
6. To prepare squash mounts of onion root tips to study mitosis
7. To study meiosis through permanent slides.
8. Squash preparation of Grasshopper Testis/ Tradescantia anther.

Suggested Reading

1. Renu Gupta , Seema Makhija, Ravi Toteja. **Cell Biology : Practical Manual.** Prestige Publishers
2. Julio E. Celis. Cell Biology: A Laboratory Hand Book. Elsevier Academic Press, 2006.
3. Rina Majumdar, Rama Sisodia. Laboratory manual of Cell Biology. Prestige Publishers
4. Jon Milhon. Cell Biology Laboratory manual. Bent Tree Press.

Web sources

1. http://www.ihcworld.com/
2. https://webstor.srmist.edu.in/
3. https://www.bjcancer.org/
4. https://vulms.vu.edu.pk/

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓
CO2		✓		✓	✓
CO3		✓	✓	✓	✓
CO4	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – III	**ALLIED – III**
20U3MBA03	**Total Number of Hours: 60**
Credit – 4	**4 Hours/ Week**

MICROBIOLOGY

Course Objectives:

- To study the history of microbiology and to gain knowledge on microscopy
- To impart knowledge on bacterial anatomy and staining techniques
- To study the types of culture media, to understand sterilization techniques and to cultivate the microbes
- To understand the role of microbes in the field of medical, food and Environment

Course Outcome:

CO1	Able to learn about chronological development and growth of microbiology and its importance and enables students to get motivated
CO2	It makes expertise in the art of techniques for the identification of microbes by staining methods
CO3	Enables to gather basic components of nutritional media, preparation and routine techniques used for the cultivation of microorganism in sterile condition
CO4	From this, one can stuff with medically and most prevalent diseases and its control / treatment
CO5	Helps to gain essential soil microbes and their significant role in agricultural field and food industry

UNIT – I **No. of Hours: 12**

History & Scope of Microbiology: Introduction - Contributions of various scientists to Microbiology – Biogenesis - Abiogenesis- Louis Pasteur, Antony Van Leeuwenhoek, Robert Koch, Joseph Lister, Edward Jenner, Alexander Fleming. **Microscopy:** Principles and parts of microscope -Bright field microscope, Dark field microscope, Phase contrast microscope, Fluorescent microscope

UNIT – II **No. of Hours: 12**

Identification of Microbes: Basic Structure of Bacteria – Gram positive and Gram negative bacteria. Stains and staining procedure - Types of staining - simple, differential, negative and special staining – Metachromatic granule. Biochemical methods - Fungal staining techniques – Lactophenol cotton blue staining and KOH mount.

UNIT – III **No. of Hours: 12**

Cultivation of Microbes: Culture media – Definition – Types - Media preparation – Basal, Differential, Selective, Transport and Enriched media.Sterilization – Definition – Methods - Types of agents - Physical agents - Chemical agents. Culture techniques – Methods - Streak plate, Pour plate, Spread plate. Cultivation of anaerobes – Preservation of cultures.

UNIT – IV **No. of Hours: 12**

Medical Microbiology: Host – parasite relationship - Infection – Definition – Types – Mode of disease transmission – sources, Factors influencing pathogenesis – Disease cycle, Control of disease and prophylaxis. Peptic ulcer, Typhoid, Dengue, SARS, Candidiasis, Aspergillosis, Giardiasis.

UNIT – V **No. of Hours: 12**

Applications of Microbiology: Biofertilizer – Mycorrhiza, PGPR – Bioremediation – Biopesticides – Bacteria and Fungi, Biogas production - Bioactive compounds – Probiotics and prebiotics.

Text Books

1. Pelczar MJ, Chan ECS and Kreig NR (2008). **Microbiology**. 5th Edition, Tata McGraw Hill-Hill Education Pvt. Ltd., New Delhi.
2. Dubey RC and Maheswari DK (2005). **A Textbook of Microbiology**, Revised Multicolour Edition. S Chand and Company Limited, New Delhi.
3. Sullia S.B and Santhanam S (2005). **General Microbiology**. 2nd Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books

1. Kathleen Park Talaro (2009). **Foundations in Microbiology: Basic Principles**, 7th Edition. McGraw-Hill Higher Education
2. Stanier RY, Ingraham JL, Wheelis ML and Painter PR (1987). **General Microbiology**. 5th Edition, MacMillan Education Ltd., London.
3. Gerard J Tortora, Berdell R Funke, Christine L Case (2010). **Microbiology: An Introduction.** 10th Edition, Pearson Benjamin-Cummings Publishing Company.

Web References

https://www.britannica.com/science/microbiology
https://www.atsu.edu/faculty/chamberlain/Website/Lects/Content1.htm
http://www.amm-mcrc.org/publications/Biofertilizers.pdf

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2			✓	✓	✓
CO3		✓	✓	✓	
CO4	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓

SEMESTER – III	**ALLIED PRACTICAL - I**
20U3MBAP03	**Total Number of Hours: 30**
Credits – 2	**3 Hours/ Week**

MICROBIOLOGY (PRACTICALS)

Course Objectives

- To introduce the Microbiology laboratory
- To use the basic instruments in microbiology lab
- To study the morphology and movement of microbes
- To cultivate the microbes in laboratory
- To analyze the antibiotic susceptibility of microbes
- To detect the microbes from soil
- To ensure the quality of milk and water

Course Outcome:

CO1	The very basic laboratory practices and handling of hazardous material, biosafety importance, sterility and media preparations could be learned
CO2	These techniques would be very useful for quantitative analysis of microbes from environmental resources and also their physiological detection
CO3	Provides very essential procedure to separate / isolate pure culture from mixture of microorganisms and to study its physical characteristics
CO4	To get skilled in most common antibiotic sensitivity method and isolation of microbes from soil
CO5	Routine qualitative test for milk and water could be learned

1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for bacterial cultivation.
3. Enumeration of bacteria from Soil, Water and air.
4. Pure culture technique- Serial dilution, pour plate, spread plate and streak plate.
5. Determination of bacterial motility by hanging drop and stab culture technique.
6. Staining techniques- simple, differential, negative and Acid fast.
7. Antibiotic sensitivity test by Kirby Bauer method.
8. Isolation of *Rhizobium* from root nodule
9. Determination of quality of milk –MBRT and Resazurin

Suggested Reading

1. Cappucino J and Sherman N. (2010). **Microbiology: A Laboratory Manual**. 9th edition. Pearson Education Limited.
2. P. Gunasekaran. (2005). **Laboratory Manual in Microbiology**. 1st Edition. New Age International Publishers.
3. Mette Praetorius Ibbe and Katherine Elasky. (2017). **Basic and Practical Microbiology Laboratory Manual**. 1st Edition. Cognella. Incorporated.
4. Norbel A.Tabo. (2004). **Laboratory Manual in Microbiology**. 1st Edition. Rex Book Store.
5. N.Kannan. (2002). **Laboratory Manual in General Microbiology**. 1st Edition. Panima Publishing Corporation.
6. Sundara Rajan. S. (2001). **Practical Manual of Microbiology**. 1st Edition. Anmol Publication Private

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2					
CO3		✓	✓	✓	
CO4	✓	✓			✓
CO5	✓	✓	✓	✓	✓

SEMESTER – III	**NMEC - I**
20U3MBN01	**Total number of Hours: 30**
Credits: 2	**2 Hours/Week**

PUBLIC HEALTH AND HYGEINE

Course Objectives

- To get an awareness about the public health and its significance
- To gain the knowledge on the primary health care system in India
- To provide an understanding of communicable and non communical diseases
- To differentiate Occupational, Industrial and Urban Health

Course Outcome:

CO1	The basic awareness on the public health and its significance could be learned
CO2	They could know the role of Primary health care system in India
CO3	The students were comprehend with the basic information about the communicable diseases
CO4	They could understand the basic information about the non-communicable diseases
CO5	They could aware of Occupational Safety & Health

UNIT - I **Total No. of hours: 06**

Introduction to Public Health – Introduction, Definition, Significance. Evolution of Public & community health. Determinants of Health – Biological, Behavioral, Socio-economic, Cultural, and Environmental. Pandemic diseases and its types.

UNIT - II **Total No. of hours: 06**

Concept of Primary Health Care – Immunization schedule and vaccine. Public Health delivery system in India-Introduction to National Health Policy – 1983&2002, National Rural Health Mission (NRHM) and National Urban Health Mission (NUHM), National Public Health Programs.

UNIT – III **Total No. of hours: 06**

Communicable & Infectious Diseases – General overview of communicable diseases – Typhoid, Cholera, Tuberculosis, Influenza and sexually transmitted diseases - impact of communicable diseases on developing. Metabolic disorders – Diabetics, CVD and Obesity.

UNIT - IV **Total No. of hours: 06**

Non - Communicable Diseases - Overview and introduction to NCDs-risk factors, prevention and management. NCDs programs of WHO and Government of India. Types of non communicable diseases. Detection analysis of NCD.

UNIT-V **Total No. of hours: 06**

Occupational, Industrial and Urban Health - Occupational Safety & Health - Chemical and physical exposures, occupational health disorders and diseases. Occupational health of working population of organized and unorganized sectors -Farmers, Industrial workers and health workers.

Suggested books

1. Edward, Bouchieret and et al. (1995). Principles and Practice of Medicine. Davidson, PearsonProfessional Ltd. London.
2. Jonathan Phillips, Paul Murray (1995). Biology of Disease. Black well Science Ltd. Australia.
3. Mackie and M.C. Cartney (1995). Practical Medical Microbiology. Longman Group, U.K.
4. David V. Mcqueen. Global Hand book On Non-Communicable Diseases and Health Promotion.Springer Publication.
5. S.L. Goel (2009). Education of Communicable and Non-Communicable Diseases. Deep & DeepPublications Pvt. Ltd.
6. David Vlahov, JoIvey Boufford, Clarence E. Pearson, Laurie Norris. Urban Health: GlobalPerspectives. Published by Jossey bass.
7. Jack E. Peterson (1991). Industrial Health American Conference of Governmental IndustrialHygienists.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓			✓
CO5	✓	✓	✓	✓	✓

SEMESTER IV

SEMESTER – IV	**CORE – IV**
20U4MBC04	**Total number of Hours: 60**
Credits – 4	**4 Hours/Week**

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Objectives:

- To gain knowledge about the cells and organs of the immune system.
- To impart knowledge on immunity and vaccines.
- To gain knowledge about antigens and immunoglobulins.
- To impart knowledge on antigen-antibody interactions.
- To understand about autoimmunity and hypersensitivity

Course Outcome:

CO1	Structure and function of immune system and its importance in defense mechanism would be understood
CO2	It offers to understand immunological reactions / response and functions of immune cells
CO3	Ability to learn elaborative on antigen and antibody structure, reaction, activation and production of monoclonal antibodies
CO4	Helps to gain knowledge on antigen-antibody reaction and immunological tools for detection of causative agent
CO5	Concise immunological hypersensitivity and autoimmune disorders could be learned with background information

UNIT – I **No. of Hours: 12**

Introduction and immune system: Introduction to Immunology, Historical perspectives, Haematopoeisis. Structure and functions of T cell, B cell, Macrophage, Neutrophil, NK cell, Dendritic cell, Immune organs; Structure and functions of primary lymphoid organ - Bone marrow, Bursa and Thymus. Structure and functions of secondary lymphoid organs- Spleen, Lymph node, GALT and MALT.

UNIT – II **No. of Hours: 12**

Immune response: Immunity - Concept of innate and acquired immunity; Types - Specific and non-specific - Primary and secondary immune response; Humoral Immune Response-Plasma and Memory

cells. Cell mediated immune response. Herd Immunity, Immunisation schedule, Vaccines - Definition and Types.

UNIT – III **No. of Hours: 12**

Antigen, Antibody, MHC and Complements: Antigen - Definition, types and characteristics - Haptens – Adjuvants – Epitope - Paratope. Immunoglobulins - Structure, Types, Functions and properties - Theories of antibody synthesis - Hybridoma technology and its applications. Structure and functions of class I, II & III MHC molecules. Complement system – Classical, Alternative and Lectin pathways - biological functions.

UNIT – IV **No. of Hours: 12**

Immunological Techniques: Antigen-Antibody Interactions - Agglutination-Blood grouping and Rh Typing, Haemagglutination, and HAI. Precipitation reactions. Immunoelectrophoresis-. Ouchterlony double diffusion. Immunofluorescence techniques – ELISA: Direct, Indirect and sandwich, RIA, Western blotting technique.

UNIT – V **No. of Hours: 12**

Immunological Disorders: Introduction to hypersensitivity reactions; Gell and Coomb's classification of Hypersensitivity. Immediate type hypersensitivity (Type I, II and III), Delayed type hypersensitivity (IV). Autoimmunity - Pernicious anaemia, Multiple sclerosis, and Rheumatoid arthritis.

Text Books

1. Annadurai B (2008).**A Textbook of Immunology and Immunotechnology**.1st Edition. S Chand & Co. Ltd., New Delhi.
2. Chakraborty P (2003).**A Text Book of Microbiology.** 2nd Edition. New Central Book Agency (P) Ltd, Kolkata.
3. Arti Kapil (2013). **Ananthanarayan and Paniker's Text Book of Microbiology**.9th Edition, Orient Blackswan Private Limited.

Reference Books

1. Kindt TJ, Goldsby RA, Osborne BA and Janis Kuby (2007). **Kuby Immunology.** W H Freeman and Company, New York.
2. Tizard IR (1995). **Immunology: An Introduction**. 4th Edition. Saunders College Publishers, USA.
3. Riott IM (1988). **Essentials of Immunology**, ELBS and Black Well Scientific Publishers, London

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1. https://nptel.ac.in/courses/102103038/1
2. https://nptel.ac.in/courses/102103038/39
3. https://nptel.ac.in/courses/102103038/download/module6.pdf
4. https://medlineplus.gov/ency/article/000821.html

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – IV	**CORE PRACTICAL – IV**
20U4MBCP04	**Total number of Hours: 30**
Credits – 2	**3 Hours/Week**

MAJOR PRACTICAL – IV - IMMUNOLOGY & IMMUNOTECHNOLOGY

Course Objectives:

- To know about the basics in immunology techniques
- To get trained in the blood grouping
- To gain knowledge in the agglutination tests
- To understand the working principle and methods used in immunoelectrophoresis
- To get skilled in diagnosis of various diseases through ELISA
- To get trained in basics of complement fixation test

Course Outcome:

CO1	Able to perform ABO blood grouping and separation of serum and plasma
CO2	Can do latex agglutination tests and WIDAL
CO3	Ability to analyze antigen-antibody integration by immunoelectrophoresis
CO4	Trained with ELISA principle and procedure for the diagnosis of diseases
CO5	Can able to understand complement test

1. Identification of human ABO blood groups and Rh Typing.
2. Separation of serum/plasma from the blood sample.
3. Latex agglutination test- RA Test, CRP Test, ASO Test.
4. WIDAL slide and tube agglutination technique.
5. Flocculation test – RPR test.
6. Radial and Ouchterlony double immunodiffusion (ODD) technique.
7. Rocket immunoelectrophoresis.
8. Counter current immunoelectrophoresis.
9. Enzyme Linked Immunosorbent Assay (ELISA) – (demonstration).

References:

1. Sambrook J and Russell DW (2001). **Molecular Cloning - A laboratory manual.** 3rd Edition. Cold Spring Laboratory Press, New York.
2. Surzycki S (2000). **Basic Techniques in Molecular Biology**. Springer-Verlag, New York.
3. Riott IM (1988). **Essentials of Immunology**, ELBS and Black Well Scientific Publishers, London.
4. Kindt TJ, Goldsby RA, Osborne BA and Janis Kuby (2007). **Kuby Immunology.** WH Freeman and Company, New York.
5. Chapel H and Halbey M (1986). **Essentials of Clinical Immunology**. ELBS, London.
6. Weir DM, Steward J (1993). **Immunology.** 7th Edition. ELBS, London.
7. Ausubel FM (1998). **Current Protocols in Molecular Biology.** Vol. 1 & 2. John Wiley & Sons Inc.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – IV	**NMEC - II**
20U4MBN02	**Total number of Hours: 30**
Credits: 2	**2 Hours/Week**

BIOFERTILIZER TECHNOLOGY

Course outcome

- Able to get basic idea about biofertilizer production
- For to learn application techniques about biofertilizer
- Capable to make mass multiplication
- Able to make the studentsideally skilled for self-employment

Unit – I **No. of Hours: 06**

Definition and types, importance of biofertilizers in agriculture, Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings.

Unit – II **No. of Hours: 05**

Biofertilizers – carrier materials - storage, shelf life, foliar applications, quality control and marketing.

Unit – III **No. of Hours: 06**

Organic Farming: Concepts and principles of organic farming. Key indicators of sustainable agriculture, organic farming and climate change Input management; compost production, vermicomposting, Compost quality, Compost utilization and marketing.

Unit – IV **No. of Hours: 06**

Isolation, identification, characterization, mass multiplication, formulation, field application and benefits of *Rhizobium*, *Azospirillum*, *Azotobacter*, *Azolla*, *Frankia* and Cyanobacteria

Unit – V **No. of Hours: 07**

Phosphate solubilizing bacteria - Isolation, identification, characterization, mass cultivation, formulation, field application and benefits. Mycorrhizae – Ecto and Endo (Arbuscular mycorrhizae). Isolation, identification, characterization, mass cultivation, formulation, field application and benefits.

Reference

1. Kannaiyan S and Kumar K. Azolla biofertilizers for sustainable rice production, Daya publishing house, Delhi.2005.

2. Mahendra K Rai. Hand book microbial biofertilizers. 9th edition. The Haworth press, Inc. NewYork.2015.

3. Ramesh Chandra and Raverkar KP. Bioresources for sustainable plant nutrient management, scholars world publishers, New Delhi.2014.

4. Reddy SMLV, Gangwane P, Prakash and Kunwar IK. Bioinoculants for sustainable agriculture and forestry. Scientific publishers, Jodhpur.2002.

5. Subba Rao NS. Soil microorganisms and plant growth. 4thedition. Oxford and IBH publishing co Pvt. Ltd, NewDelhi.2002.

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1. https://www.abebooks.com/Biofertilizer-Technology-Tanuja-Singh-PurohitAgrobios/1267246944/bd

2. https://www.kopykitab.com/Biofertilizer-Technology-by-R-A-Sharma

SEMESTER V

SEMESTER – V	**CORE - V**
20U5MBC05	**Total number of Hours: 75**
Credits: 5	**6 Hours/Week**

MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Objectives:

- To study the pathogenesis, laboratory diagnosis and antimicrobial sensitivity testing
- To gain knowledge about the diseases caused by Gram positive and Gram negative cocci
- To impart knowledge on the diseases caused by Gram positive bacilli and Gram negative bacilli
- To understand the fungal classification, diagnosis, cultivation and antifungal agents
- To study the superficial, cutaneous, sub cutaneous, systemic and opportunistic mycoses

Course Outcome:

CO1	Able to understand beneficial and harmful microbes
CO2	Medically important gram positive pathogens
CO3	Enterobacteria and other STI
CO4	Basics of fungal diseases and diagnostics methods
CO5	Dermatophytes and opportunistic mycosis Classification and Opportunitics

UNIT- I Introduction of Medical Bacteriology **No. of Hours:15**

Introduction and History of Medical Bacteriology-,Normal microbial flora of human body – Infection – Types, Source, Modes of Transmission, Mechanism of bacterial pathogenesis – Collection and transport of clinical samples - Laboratory diagnosis of infectious diseases.

UNIT- II Gram Positive Pathogens **No. of Hours:15**

General characteristics, pathogenesis, clinical manifestation, laboratory diagnosis and control measures of the following pathogens - *Staphylococcus aureus, Streptococcus pneumoniae, pyogens Corynebacterium diphtheriae, Bacillus anthracis,* Anaerobic wound infection-*Clostridium tetani.* Respiratory diseases -*Mycobacterium tuberculosis,* Sexually transmitted diseases: *Neisseria gonorrhoeae*

UNIT- III Gram Negative Pathogens **No. of Hours:15**

General characteristics, pathogenesis, clinical manifestation, laboratory diagnosis and control measures of the following pathogens - *Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Shigella dysenteriae, Pseudomonas aeruginosa, Vibrio cholerae, Treponema pallidum* and *Mycoplasma pneumoniae.*

UNIT- IV Introduction Medical Mycology **No. of Hours:15**

Introduction and History of Medical Mycology-Classification of medically important fungi - Laboratory diagnosis of fungal diseases - Collection and examination of fungal specimens – Culture media - Isolation and identification of pathogen from infected patient- Staining of fungi –KOH and LCB. Antifungal drugs mode of action - Antifungal susceptibility test.

UNIT- V Mycoses **No. of Hours:15**

Classification of Mycoses – superficial mycoses – *Dermatophytosis – Tinea nigra – Piedra* (White and Black) and subcutaneous mycoses- *Mycetoma - Histoplasmosis* - Systemic mycoses Blastomycoses - Opportunistic mycoses - *Candidiasis – Aspergillosis* - - *Cryptococcosis. Mycotoxicoses.*

Text Books

1. ArtiKapil (2013). **Ananthanarayan&JayaramPaniker's Text book of Microbiology**. 9th edition, Orient Longman Limited, Chennai.
2. Chakraborty P (2003). **A Text book of Microbiology.** 2nd edition, Published by New Central Book Agency (P) Ltd., Kolkata.
3. JagdishChander (2012). **Text book of Medical Mycology**. 3rd edition. Mehta Publishers, New Delhi.
4. Rajan S. **Medical Microbiology**. MJP Publishers, Chennai. 2007.

Reference Books

1. Jawetz E and JL Melnic (2001). **Medical Microbiology**, 22nd edition, Tata McGraw-Hill, New Delhi.
2. David Greenwood CB and Richard (2002). **Medical Microbiology**. 22nd edition, Tata McGraw- Hill, New Delhi.
3. Monica Cheesbrough (2003). **District Laboratory Practice in Tropical Countries**.Part 1 and 2.Low-Price edition, Cambrige University Press.

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1. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/ln_med_bact_final.pdf
2. https://mycology.adelaide.edu.au/mycoses/

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER-V	**CORE-V**
20U5MBC06	**Total number of Hours:75**
Credits: 5	**5 Hours/Week**

INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Course Objectives:

- To gain knowledge about screening techniques and strain improvement.
- To study about different types of bioreactors.
- To know about industrial production of enzymes and antibiotics.
- To understand the types of pharmaceutical products.
- To study the quality control of pharmaceutical products.

Course Outcome:

CO1	Basic background information on industrial important microbes, strain development, preservation and sterilization
CO2	Downstream and upstream process of production technology
CO3	Various industrial microbiological product synthesis by microbes
CO4	Food manufacturing practices and GLP
CO5	Qualitative and Quantitative method analyses of Environmental samples

UNIT - I **No. of Hours:15**

Introduction to industrial microbiology: Industrially important microorganisms - Screening techniques - Primary and Secondary. Strain improvement -development of inoculum, and Preservation. Types of Fermentation – Solid, Submerged, Batch, Continuous and Fed batch.

UNIT- II **No. of Hours:15**

Fermentation techniques: Industrial Fermenter –Types –Instrumentation – Scale up – Monitoring – Sensors – Upstream processing - Media formulation and Optimization – Nutrient sources- Carbon, Nitrogen, Antifoaming Agents. Down Stream Processing – Recovery, Purification of intracellular and extracellular microbial metabolites.

UNIT- III **No. of Hours:15**

Industrial production of enzymes –amylase & proteases. Organic acid -citric acid, lactic acid and acetic acid. Alcoholic beverages - Wine and Beer. Production of ethanol, Biopolymers, and Biofuels.

UNIT - IV **No. of Hours:15**

Current food manufacturing practices. Good laboratory practices. Pharmacopeia updates, US, Europea, British and Indian standards. Instrumentation operating procedures, calibration of equipment's. Federal Drug Administration Audits.

UNIT - V **No. of Hours:15**

Qualitative and quantitative methods of environmental monitoring samples. Trend analysis, results and discussions reporting (OOS& OOT) Out of specifications and Out of trends. Container Closure Integrity (CCIT). Bioburden analysis, water analysis in pharmaceutics.

Text Books

1. Patel A.H (2011). **Industrial Microbiology**. 2nd edition. Published by Mac MillanPublishers India Ltd.,Chennai.
2. Cassida L.E(1996).**Industrial Microbiology**.New Age International Publishers, Chennai.
3. Purohit S.S,Saluja A.K and KakraniH.N (2004), Pharmaceutical Microbiology,1stedition,Agrobios (India), Jodhpur.

Reference books

1. PepplerH.J and Perlman D (1979).Microbial Technology.Vol.1 and II. 2nd edition.Academic Press, New York.

2. StanburyP.F, Whitaker A and Hall S.J (1995).Principles of Fermentation Technology.2nd edition.PergamonPress, New York.

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2. https://run.edu.ng/directory/oermedia/422231995398.pdf
3. http://site.iugaza.edu.ps/mwhindi/files/Modern-Industrial-MicrobiologyBiotechnology.pdf
4. file:///H:/industrial/0c03ce4cbbae680f46362dd24207e254-original.pdf

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓		✓	✓	✓

SEMESTER – V	**CORE - VII**
20U5MBC07	**Total number of Hours: 60**
Credits: 4	**5 Hours/Week**

GENETIC ENGINEERING

Course Objectives:

- To get hold of knowledge on enzymes and vectors. To be add The learner will acquireknowledge about manipulation of genes
- To be familiar with rDNA technology, To be add The learner will got knowledge aboutheritable and nonheritable recombinant DNA constructs
- To obtain knowledge about molecular genetic techniques
- To know the basics on genetic engineering in plants and mammals
- To obtain knowledge in the production of biological medicines basics on genetic engineeringin microbes

Course Outcome:

CO1	Understand the mechanism of action of restriction endonucleases cleave DNA at specific nucleotide sequences
CO2	Understand the transfer of genetic material to bacteria. Physical and chemical methods for gene transfer
CO3	Understand the amplification of Nucleic Acid Fragments by Polymerase Chain Reaction (PCR). Molecular genome amplification techniques
CO4	Use of bacterial Ti, Ri plasmids and plant gene targeting techniques
CO5	Transgenic DNA technology in animals

UNIT - I Restriction and modification **No. of Hours: 12**

History, Restriction and modification - General introduction and function to restriction endonucleases (REs)**.** Types and application of restriction endonucleases. Restriction and modification System in Bacteria (*E.coli*).

UNIT - II Gene transfer and Recombination methods **No. of Hours: 12**

Vector and its general properties. Cloning genes - Plasmid vector, - Bacteriophage, Cosmids, Phagemids and shuttle vectors. Bacterial conjugation – transformation – transduction. Physical method Microinjection, Gene Gun, Electroporation, Hydroporation, Sonoporation, Optical Transfection & Cell sequencing. Chemical methods for gene transfer – Peptides, Biopolymers – Chitosan, Cyclodextin, DEAE-Dextran & Gelatin. Calcium phosphate transfection.

UNIT - III Molecular techniques in genetic engineering **No. of Hours: 12**

Introduction to Molecular genetics techniques – Gel electrophoresis, Polymerase Chain reaction(PCR), Types of PCR - Multiplex and nested PCR, Real Time PCR, RAPD, RFLP, AFLP and their applications. Molecular hybridization and Blotting techniques – Northern, Southern & Western.

UNIT - IV Genetic Engineering in plants **No. of Hours: 12**

Introduction to *Agrobacterium* - *A. tumefaciens* - Ti plasmid, Ri plasmid – structure and functions. Strategies for gene transfer in plant cells - Direct DNA transfer to plants, Use of plant viruses as episomal expression vectors. Introduction to plant tissue culture (PTC) – Media composition and preparation - callus and cell suspension culturing.

UNIT - V Genetic Engineering in animals **No. of Hours: 12**

Introduction to Genetically modified animals (GMAs) - Production and applications of transgenic mice – gene knockout and knock in technology, CRISPR genome editing, role of ES cells in gene targeting in mice Therapeutic products produced by genetic engineering – Vaccine, insulin, pancreatins, heparins, blood products and clotting factors.

Suggested Reading

1. Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
2. Brown T.A (2010). Gene cloning and DNA Analysis. 6th edition. Blackwell publishing, Oxford, U.K.
3. Satyanarayana U 2005 Biotechnology 1st edition. Books & Allied (p) Ltd.-Kolkata.
4. Primrose SB and Twyman RM. (2006). Principles of Gene manipulation and Genomics. 7th edition, Blackwell publishing, Oxford, U.K.
5. Dubey R. C. A Textbook of Biotechnology. Publisher: S. CHAND.
6. Primonrose SB and Twyman RM. (2008). Genomics: Application in human biology Blackwell publishing, Oxford, U.K.

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1. https://nptel.ac.in/downloads/102103013/
2. https://science.umd.edu/classroom/bsci124/lec41.html
3. http://genok.no/wp-content/uploads/2013/04/Chapter-4.pdf

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5		✓	✓		✓

SEMESTER – V	**CORE PRACTICAL - V**
20U5MBCP05	**Total number of Hours: 45**
Credits: 3	**6 Hours/Week**

PRACTICAL V

Course Objectives:

- To obtain knowledge about fungal identification methods
- To gain information about immobilization technique
- To know the techniques in amylase production from bacteria
- To update the identification methods used in clinical pathogen detection
- To get knowledge about citric acid producing fungi

Course Outcome:

CO1	Diagnosis of pathogens from clinical samples
CO2	Demonstration of fungal pathogens
CO3	Screening of bacteria for amylase production
CO4	Screening of bacteria producing citric acid
CO5	Immobilization of products for preservation

1. Isolation, Biochemical characterizations and identification of clinical pathogens from Urine,Pus, Throat swab and Sputum.
2. Identification of fungal specimens by direct microscopy – KOH and LCB preparations.\
3. Identification of Determatophytes from clinical samples
4. Screening of amylase producing bacteria from soil.
5. Production of citric acid and quantification from soil bacteria
6. Immobilization technique.
7. Screening of recombinants – Blue / white selection assay.
8. Partial purification of enzymes - (Protease/Amylase)
9. Estimation of enzymes by Lowry *et al* method

Suggested Manuals

1. Arora, B and D.R. Arora, (2013), **Practical Microbiology** CBS Publishers & distributors Pvt. Ltd, New Delhi.
2. Benson, J.H., (2001), "**Microbiological Applications: A Laboratory Manual in General Microbiology**", Eighth Edition, McGraw-Hill, New York.
3. Cappuccino, J.G. and N. Sherman, (2005), "**Microbiology - A Laboratory Manual**", Seventh Edition, Benjamin and Cummings Publications, San Francisco.
4. Gunasekaran, P., (2005), "**Laboratory Manual in Microbiology**", New Age International (P) Ltd, New Delhi.
5. Kannan, N., (2003), "**Laboratory Manual in General Microbiology**", Fourth Edition, Palani Paramount Publications, Palani.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1					
CO2					
CO3					
CO4					
CO5					✓

SEMESTER – V	**ELECTIVE - I**
20U5MBE01	**Total number of Hours: 60**
Credits: 4	**4 Hours/Week**

HAEMATOLOGY AND BLOOD BANKING

Course Objectives

- To gain knowledge about the blood cells.
- To study hematological diseases.
- To impart knowledge on hematological tests.
- To gain knowledge about immunohematology.
- To study blood banking and blood transfusion.

Course Outcome:

CO1	Basics of hematology and immune cells
CO2	Immunological and deficiency-oriented disorders
CO3	Analysis of cells by various methods
CO4	Routine hematological tests
CO5	Blood transfusion and disease transfer

UNIT - I **No. of Hours: 12**

Introduction to Haematology. Standard operating procedure. Haematopoietic system of the body – Development of blood corpuscles - Erythropoiesis – Leukopoiesis – Thrombopoiesis. Compositionof blood and its function.

UNIT - II **No. of Hours: 12**

Haematological diseases: Anaemia-Types of Anaemia. Hemolytic disease of the new born, Infectious mononucleosis, Multiple myeloma, Multiple sclerosis, Hodgkin's lymphoma, Hemoparasitic infections. Leukaemia - classification.

UNIT - III **No. of Hours: 12**

Routine haematological tests – Introduction – Collection of blood – Anticoagulants - Complete blood cell count (CBC) – Determination of haemoglobin by Sahli’s method – Cynamethaemoglobin method – RBC count – WBC count - Differential count – Determination of ESR.

UNIT - IV **No. of Hours: 12**

Haemostasis and blood Coagulation – Mechanism of coagulation – Determination of bleeding timeand clotting time – Platelet disorders. Immunohaematology – Human blood group systems – ABOgrouping and other blood group systems – Rh Typing.

UNIT - V **No. of Hours: 12**

Blood banking and blood transfusion – Screening of blood donors – Preservation and storage of donated blood - Cross matching – Blood transfusion – HLA typing - Transfusion transmitted diseases – Transfusion reaction. Cord blood banking.

Text Books

1. Drew Provan (2009). ABC of Clinical Haematology, 3rd edition. BMJ books.
2. Hoffbrand A.V, Pettit J.E and Moss P.A.H (2001). Essential Haematology. 2nd edition. Blackwell Science, New York.
3. Praful B. Godkar, Darshan P. Godkar (2003). Textbook of Medical Laboratory Technology, 3rd Edition.

Reference Books

1. Denise M Harmening (2012). Modern Blood Banking and Transfusion Practices. 6th Edition. F A Davis Company, Philadelphia.
2. Transfusion Medicine Technical Manual (2003). 2nd edition. DGHS, Ministry of Health and Family Welfare, Govt. of India,
3. Peter Delves, Seamus Martin, Dennis Burton (2006). Roitt's Essential Immunology. 11th edition. Wiley-Blackwell, New York.

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2. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/ln_hematology_mlt_final.pdf
3. http://www.rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Blood%20Banking/Introduction.pdf
4. file:///H:/Hematology/abo%20blood%20grouping.pdf

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – V	**ELECTIVE - I**
20U5MBE02	**Total number of Hours: 60**
Credits: 4	**4 Hours/Week**

ENTREPRENEURSHIP IN MICROBIOLOGY

Course Objectives

- To understand the basic concepts of entrepreneurship and become a young women entrepreneur.
- To gain business opportunities on mushroom cultivation.
- To expand systemic knowledge on different composting technology.
- To increase the comprehension on various biotechnological approaches to establish successful enterprises.
- To understand different financial agencies supporting entrepreneurship.

Course Outcome:

CO1	Entrepreneur importance towards women development
CO2	Mushroom cultivation and various products development
CO3	Bio-composting and its application
CO4	Biofertilizer manufacturing techniques
CO5	Funding agencies which supports entrepreneurial development

UNIT - I **No. of Hours: 12**

Evolution and concept of Entrepreneur – Characteristics – Functions and types of Entrepreneur – Entrepreneurship – Skills and Role of entrepreneurship in economic development –Business plan for entrepreneur. Women entrepreneurs – Problems of women entrepreneurs – Factors affecting entrepreneurial growth.

UNIT - II **No. of Hours: 12**

Finance to Entrepreneurs – Commercial banks, funding agencies – TNSCST, UGC, DST, ICMR, ICAR, CSIR, BIRAC and DBT. Project proposal writing – selection, formulation and financial plan - Project report preparation and submission

UNIT - III **No. of Hours: 12**

Mushroom cultivation: Edible mushroom – Morphology, Nutritional and medicinal value – Preparation of spawn, types of spawning – Preparation of substrate - Casing – harvesting – storage and marketing - Mushroom diseases and its management – value added products – Soup, Omlette, Samosa, Noodles, Pickles and Curry.

UNIT - IV **No. of Hours: 12**

Biofertilizer – Mass production, Cost analysis and marketing of *Rhizobium*, *Azotobacter*,

Azospirillum, BGA, *Azolla*, VAM – bioinoculum, mass production, field application and crop response – Biopesticide – bacteria and fungi. Production of SCP – *Spirulina* and Yeast – Herbal sale importance and marketing.

UNIT - V **No. of Hours: 12**

Composting - types of composting – aerobic and anaerobic, Drilospheres – Biology and ecological classification of earthworm – Physical and chemical effects of earthworm on soil, Vermicomposting - species employed, methods and types of production – preparation of vermiwash – Field application and crop response, Storage and marketing of composts.

Text Books

1. Khanka S.S (2003). **Entrepreneurial development**. 3rd edition. S.Chand & Company, New Delhi.
2. Kanniyan.S and Ramaswamy K (1980). **A Handbook of Edible Mushrooms**. Today's and Tomorrow's Printers, New Delhi.
3. Kale Radha D (1998). **Earthworm: Cinderella of organic farming**. Prism Books Pvt. Ltd., Bangalore.
4. Subba Rao, N.S. (1993). **Biofertilizers in Agriculture and Forestry**. 3rd edition. Oxfordand IBH publication Co. Pvt. Ltd., New Delhi.

Reference Books

1. Shukla M.B (2007). **Entrepreneurship and small business management.** 7th edition. Kitab Mahal publication, Allahabad.
2. Vasant Desai (2001). **Dynamics of Entrepreneurial Development and Management.** 4th edition. Himalaya Publishing House, New Delhi.
3. Chang S.T and Hayes W.A (1978). **Biology and cultivation of mushrooms**. Academic Press, New York.
4. Jogdand SN. Environmental Biotechnology, Himalaya Publishing House. New Delhi. 2010.

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2. https://extension.psu.edu/six-steps-to-mushroom-farming
3. https://www.systemekofungi.com/wp-content/uploads/Mushroom-Cultivation-Manual.pdf
4. http://www.amm-mcrc.org/publications/Biofertilizers.pdf

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER VI

SEMESTER – VI	**CORE - VIII**
20U6MBC08	**Total number of Hours: 75**
Credits: 4	**6 Hours/Week**

MEDICAL VIROLOGY AND PARASITOLOGY

Course Objectives:

- The learner will acquire knowledge about virology and parasitology, classification of viruses, parasites and their characteristics.
- The learner will learn the medically important viruses, parasites and their diseases.
- The learner will learn the diagnostic methods of microbes .
- The learner will get updated knowledge on microbes, disease control, treatment and prevention.

Course Outcome:

CO1	Understand the general characteristics and different methods of classification of viruses and parasites .
CO2	Demonstrate the basic techniques in staining,microscopy,culturing, and isolation of microbes.
CO3	Understand the medically important viruses and protozoa
CO4	Understand the clinically importance of helminths.
CO5	Understand the pathogenesis, life cycle ,prophylaxis and prevention of viral and other parasitic diseases

UNIT I **No. of Hours: 15**

Introduction and Classification of Virus: Introduction and Historical perspective of medical virology. General properties of viruses –Nomenclature and classification of viruses- ICTV system of classification , Baltimore classification of viruses. Viral related agents. - Viroids and Prions Cultivation of viruses – viral assay.– Serological and molecular diagnosis of viral infections. Biosafety and contaminent facility in virology lab.

UNIT II **No. of Hours: 15**

DNA Viruses: Pathogenesis, laboratory diagnosis, Prevention and Treatment of animal viruses: Pox viruses – Variola virus. Adenoviruses, Herpes viruses-type-I and type-II, Polio virus, Rabies virus,Hepatitis-A,B and C, Orthomyxoviridae-Influenza A, H1N1,Paromyxoviridae-Measles, Mumps.

UNIT III **No. of Hours: 15**

RNA Viruses: Pathogenesis, laboratory diagnosis, Prevention and Treatment of following animal viruses: Togoviridae- Chickungunya virus. Flaviviridae- Yellow fever virus, KFD virus, Dengue virus, Zika virus, Ebola virus, Marbug virus. Coronaviridae- MERS-CoV, SARS-CoV, SARS-CoV2, Retriviridae-HIV. Antiviral agents and vaccines.

UNIT-IV **No. of Hours: 15**

Medical Protozoa: Introduction to medical parasitology: Classification and characteristics of Protozoa Common diagnostic methods in parasitology - Examination of faeces– Concentration methods. Blood smear examination of parasites. General Characteristics, life cycle, diagnosis, prophylaxis and control of following protozoans- *Entamoeba histolytica - Giardia lamblia - Trichomonas vaginalis - Leishmania donovani - Trypanosoma brucei – Plasmodium.*

UNIT V **No. of Hours: 15**

Medical Helminths: General Characteristics, life cycle, diagnosis, prophylaxis and control of following helminths- *Ascaris lumbricoides - Ancylostoma duodenale -Schistosoma haematobium - Taenia solium –-Diphyllobothrium latum - Enterobius vermicularis- Trichuris trichiura – Wuchereria bancrofti.*

Suggested Reading

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition,Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Parija S.C. (2013) Text book of Medical Parasitology. 4th edition. All India Publishersand Distributors, New Delhi.
9. Jagdish Chander (2012). Text book of Medical Mycology. 3rd edition. Mehta Publishers, New Delhi.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		✓
CO5		✓	✓		✓

SEMESTER – VI **CORE - IX**
20U6MBC09 **Total number of Hours: 75**
Credits: 4 **5 Hours/Week**

SOIL AND ENVIRONMENTAL MICROBIOLOGY

Course Objectives

- To study the physico-chemical and microbiological properties of soil.
- To gain knowledge about the biogeochemical cycles and biofertilizer.
- To impart knowledge on microbial interactions in plants and animals and plant pathology.
- To understand the microbiology of air and water.
- To study the microbiology of sewage and sewage treatment methods.

Course Outcome:

CO1	Able to understand soil microbiota.
CO2	Concepts of metabolic pathways by soil microbes and their role.
CO3	Symbiotic relationship between microbes and plants.
CO4	Water quality parameters -Physico chemo parameters.
CO5	They could able to perform experiments to test the quality of samples.

UNIT - I **No. of Hours: 15**

Introduction to soil microbiology: Structure, Physical and chemical properties of soil –Soil Profile - Types and significance of soil microbes – Bacteria, Fungi, Actinomycetes, Protozoa, Nematodes and Viruses. Soil fertility test.

UNIT - II **No. of Hours: 15**

Microbial interactions and plant pathology: neutralism, commensalism, Amensalism, Predation, synergism, mutualism and parasitism. Interaction of microbes with plants – Rhizosphere, Phyllosphere and Mycorrhizae. Microbe-animal and ruminant interaction. Microbe microbe interaction Plant Pathology – symptoms, disease cycle and its control measures - Bacterial - Citruscanker, Fungal -Tikka leaf spot of groundnut, Viral – TMV.

UNIT - III **No. of Hours: 15**

Biogeochemical cycles: Carbon, nitrogen, phosphorous and sulphur - Mechanism of nitrogen fixation - Biofertilizer – Rhizobium, Azotobacter and Cyanobacteria – Mass cultivation and its applications. Quality guidelines for biofertilizers.

UNIT IV **No. of Hours: 15**

Microbiology of air & water – Microbes in air - Enumeration of bacteria from air – Air sampling devices (Settling under Gravity, Centrifugal action, Impingment and Electrostatic precipitation) – Air sanitation. **Microbes in water** Assessment of drinking water quality (Total

count, Membrane filter and MPN) – water standards - indicator organisms – water purification – Waterborne diseases and their control measures.

UNIT V **No. of Hours: 15**

Waste treatment: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). **Liquid waste management:** Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment and its degradation.

Text Books

1. Mishra R.R (2004). **Soil Microbiology**. CBS Publishers & Distributers, New Delhi.
2. Subba Rao (1999)**. Soil Microbiology.** 4th edition. Oxford and IBH publishing Co (P) Ltd, New Delhi.
3. Joseph C Daniel (1999). **Environmental aspects of Microbiology**. 2nd edition. Bright Sun Publications, Chennai.
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

Reference Books

1. Rangaswami.G and Bagyaraj D.J. (2009). **Agricultural Microbiology**.2nd edition. PHI Learning Pvt. Ltd., New Delhi.
2. Ralph Mitchell and Ji Dong Gu (2010). **Environmental Microbiology**. 2nd edition, Wiley-Blackwell, New Jersy.
3. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – VI	**CORE - X**
20U6MBC10	**Total number of Hours: 60**
Credits: 4	**5 Hours/Week**

FOOD AND DAIRY MICROBIOLOGY

Course Objectives

- To gain knowledge about the microorganisms involved in food
- To impart the idea in food spoilage
- To gain the knowledge in food preservation.
- To study the food borne infections
- To study the rules and regulations of food sanitation

Course Outcome:

CO1	Food pathogens and their Phsico-chemico parameter analysis
CO2	Spoilage of food by various microbes
CO3	Food Preservation methods
CO4	Able to understand microbial Fermented products
CO5	Food intoxication and determination of food pathogens

UNIT - I **No. of Hours: 12**

Introduction Bacteria, Mold and Yeasts Factors influencing the Growth of microorganisms-Intrinsic and extrinsic factors and inhibitory substances. Methods of Food preservation - Physical and Chemical preservation of food. Methods of food package.

UNIT - II **No. of Hours: 12**

Source of contamination - food spoilage and preservation - vegetables and fruits, cereals, meat and meat products-Poultry products and eggs, milk and milk products, canned food, fish and sea foods.

UNIT - III **No. of Hours: 12**

Dairy Microbiology: Milk – composition and types of milk – microflora of raw milk- microbial analysis of milk- Pasteurization of milk - dye reduction test using methylene blue and resazurin-total bacterial count – somatic cell count – Brucella ring test and test for mastitis. Fermented dairy products - Dairy starter cultures, fermented dairy products - yogurt, acidophilus milk, kumiss, kefir, curd and cheese

UNIT - IV **No. of Hours: 12**

Fermented food products - bread, Idly, sauerkraut, soy sauce, kombucha and tampeh. Probiotics – Prebiotics - Health benefits, types of microorganisms used, probiotic foods available in market, GRAS (General Regard as Safe).

UNIT - V **No. of Hours: 12**

Food born infection and intoxications – bacterial and non -bacterial – investigation of food borne diseases - Rapid detection methods for food borne pathogens. Food law and regulations – FSSAI, GMP, HACCP- Codex alimentarius - Food sanitation and control.

Text Books

1. Vijaya Ramesh K (2007). Food Microbiology. First edition, MJP Publishers, Chennai.
2. Adams MR Moss MO (2004). Food Microbiology, 2nd Edition, Panima Publishing House, New Delhi.
3. James M Jay (2003). Modern Food Microbiology. 4th Edition, CBS Publishers & Distributors, New Delhi

Reference Books

1. Frazier WC and Westhoff DC (1988). Food Microbiology, 4th Edition, Mc Graw Hill, New York
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
4. Sivashankar B – Moss (2011). Food Processing and Preservation. Eighth edition, PHI Learning P.Ltd., New Delhi.
5. Roday, S. (1998). Food Hygiene and Sanitation. Tata Mcgraw Hill Publications.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓
CO2	✓	✓		✓	✓
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓

SEMESTER – VI **ELECTIVE - II**
20U6MBE03 **Total number of Hours: 60**
Credits: 3 **4 Hours/Week**

MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Course Objectives

- To gain knowledge about the microbial diseases.
- To impart knowledge on clinical sample collection.
- To gain knowledge about microbial characters in selective media.
- To study the different detection methods.
- To gain the knowledge on antimicrobial testing & MIC.

Course Outcome:

CO1	Microbial disease diagnosis methods
CO2	To understand the clinical microbiology
CO3	Able to understand the microscopic examination
CO4	Able to understand molecular identification by molecular techniques
CO5	To understand the antibiotics test

UNIT - I **No. of Hours: 12**

Importance of Diagnosis in Diseases: Host-Pathogen Interaction: Distribution and significance of human normal microbial flora. Importance of Diagnosis of microbial Diseases - Bacterial, Viral, Fungal and Protozoal infections.

UNIT - II **No. of Hours: 12**

Collection of Clinical Samples: Guidelines for the collection, Transport, Processing of clinical samples - oral cavity,Nasal, throat, sputum, skin scrapings, Blood, CSF, urine and faeces. Disposal methods of clinical samples.

UNIT - III **No. of Hours: 12**

Examination of clinical samples: Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria. Culturing of infectious bacteria by blood, urine and sputum culturing method.

UNIT - IV **No. of Hours: 12**

Serological and Molecular diagnostic Methods: Serological Methods – Agglutination, ELISA and immunofluorescence. Molecular methods – PCR, RT-PCR & Nucleic acid probes. Rapid Detection methods - Typhoid, Dengue, Corona and HIV using diagnostic kits.

No. of Hours: 12

ance/sensitivity of bacteria using disc diffusion
concentration (MIC) and minimal bactericidal
ble dilution method, E-Test.

tbook of Microbiology, 8th edition,

logy. 26th edition. McGraw Hill

nfections – 9th Edition.

. and Mietzner, T.A. (2013).

Practicals and Viva in Medical

icrobiology, 13th edition, Mosby.

PSO3	PSO4	PSO5
✓	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓

SEMESTER – VI	**ELECTIVE - II**
20U6MBE04	**Total number of Hours: 60**
Credits: 3	**4 Hours/Week**

QUALITY CONTROL IN FOOD MICROBIOLOGY

Course Objectives:

- The learner will acquire knowledge about in quality control in food microbiology.
- The learner will learn differentiae the analysis of microorganisms in food. .
- The learner will learn the spoilage of microorganism in food.
- The learner will get updated knowledge on Identify sources of potential errors during production and confirm the quality of the final product

Course Outcome:

CO1	Understand good laboratory practices.
CO2	Understand the importance and food safety method.
CO3	Understand the isolation of microorganisms in food
CO4	Understand the how to causes spoilage the food.
CO5	Understand the quality control agencies and their regulation in food safety

UNIT I **No. of Hours: 12**

Quality control in food industry- Good laboratory practices (GLP), Good Microbiological Practices (GMP). Quality policy, quality objectives of food processing company, Standard Operating Procedures, Good Handling Practices (GHP) & GMP checklist.

UNIT II **No. of Hours: 12**

Importance and significance of microorganisms in food safety - Factors affecting the growth of micro organisms in food - intrinsic (pH, moisture, oxidation-reduction potential and nutrient content) and extrinsic (Temperature, relative humidity, gases and microbial activities).

UNIT III **No. of Hours: 12**

Determination of micro organisms and their products in food: sampling, sample collection, transport and storage, sample preparation for analysis. Microscopic and culture dependent methods- direct microscopic observation, culture enumeration and isolation methods.

UNIT-IV **No. of Hours: 12**

Food spoilage: contamination, spoilage and prevention of different groups of foods - cereal and cereal products, vegetables and fruits, meat poultry and sea foods, milk and milk products, packed and canned foods. Food preservations: principles- methods of preservations- Physical and chemical methods.

UNIT V **No. of Hours: 12**

General concepts of Food Analysis and Testing- basic/classical methods of food analysis. Microbiological quality standards of food, control and inspection, Food sanitation and control measures. Enforcement and Govt. Regulatory practices and policies. FDA, EPA, ,ISI, ,Hazard analysis criterial control points (HACCP) system for food safety, Application of HACCP principles.

Suggested Books:

1. Frazier, W.C. (1988) Food Microbiology, Mc Graw Hill Inc. 4th Edition.

2. The training manual for Food Safety Regulators. Vol.II- Food Safety regulations and food safety management. (2011) Food safety and Standards Authority of India. New Delhi.

3. Fundamentals of Dairy Microbiology by Prajapati.

4. Pelczar, M.I., and Reid, R.D. (2009) Microbiology, 5th Ed., McGraw Hill Inc., New York.

5. James, M.J. (2007) Modern Food Microbiology, 2nd Ed., CBS Publisher, New Delhi

6. Adams, M.R., and Moss, M.G., (2005) Food Microbiology, 1st Ed., New Age International (P) Ltd., New Delhi.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – VI	**SBEC - IV**
20U6MBS04	**Total number of Hours: 30**
Credits: 2	**2 Hours/Week**

ADVANCES IN MICROBIOLOGY

Course Objectives

- To understand quorum sensing.
- To gain knowledge about metagenomics.
- To become familiar with microbial fuel cell (MFC).
- To understand biotechnological potential of algae.
- To gain knowledge about modern trends in microbial production.

Course Outcome:

CO1	Able to understand the quorum sensing and their applications
CO2	Able to understand the human metagenomics projects
CO3	To understand the Microbial fuel cell Technology
CO4	Able to understand the animal cell culture methods
CO5	To understand the Modern trends in microbial production

UNIT – I **No. of Hours: 06**

Quorum sensing: Virulence factors associated with Microbial sensing.- molecular mechanisms- Biofilm formation- Bioluminescence. Quorum quenching – Mechanisms- applications of quorum quenching.

UNIT – II **No. of Hours: 06**

Metagenomics: History and development - Steps involved and application of metagenomics - bacterial diversity using metagenomics approach - Prospecting genes of biotechnological importance using metagenomics - Basic knowledge of Pangenomics.

UNIT - III **No. of Hours: 06**

Microbial fuel cell (MFC) Technology: Microorganisms involved in MFC - Working principle - Interaction between microbes and electrodes - Design and Architecture of MFC - Types: Single chambered, double chambered. Application of MFC in Bio-hydrogen production.

UNIT - IV **No. of Hours: 06**

Animal Cell Culture Technology: Introduction – types of cells - cell culture media and supplements, adherent cells – Vero, Hep-2, HepG-2, HeLa, MDCK, BHK, M059K (Neuro), A549 (Lungs), MCF-7 (Breast), A375 (Melanoma)– cultivation - sub-culturing.

UNIT – V **No. of Hours: 06**

Modern trends in microbial production: Microbial production of bioplastics – Types (Starch and Cellulose) - Biodegradation- Applications of Bioplastics. Bioinsecticide - *Bacillus thuringiensis*, Biopolymer – dextran – alginate - Xanthan. Single cell protein (SCP).

Text Books

1. Purohit SS (2005). **Biotechnology: Fundamentals and Applications.** 3rd Edition Agrobios (India).
2. Sathyanarayana U (2005). **Biotechnology.** 1st Edition, Books and Allied (P) Ltd., Kolkata.
3. Dubey RC (2006). **A Text Book of Biotechnology.** 4th Edition. S.Chand & Company (P) Ltd., New Delhi.
4. Jogdand SN (2010). **Environmental Biotechnology**. Himalaya Publishing House, New Delhi.

Reference Books

1. Bernad R Glick (2010). **Molecular Biotechnology - Principles and Applications of Recombinant DNA**. 4th Edition, ASM Press, Washington, D.C.
2. Maheswari DK and Dubey RC (2008). **Potential Microorganisms for Sustainable Agriculture**. I K International Publishing House Pvt. Ltd.
3. Sahoo D and Kaushik BD (2012). **Algal Biotechnology and Environment**.1st Edition, I K International Publishing House Pvt. Ltd.
4. Thatoi HN and Mishra BB (2011). **Microbial Biotechnology: Methods and Applications.** 1st Edition, Alpha Science International Ltd.
5. Fraser CM, Read TD and Nelson KE. (2004). **Microbial Genomes.** Humana Press.
6. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014). **Brook's Biology of Microorganisms**, 14th edition, Pearson-Bejamin Cummings.

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER – VI	**CORE - VI**
20U6MBCP06	**Total number of Hours: 45**
Credits: 3	**6 Hours/Week**

MAJOR PRACTICAL VI – MEDICAL VIROLOGY AND PARASITOLOGY,SOIL AND ENVIRONMENTAL MICROBIOLOGY, FOOD AND DAIRY MICROBIOLGY

Course Objectives:

- To obtain knowledge about virus identification methods
- To gain information about the identification of human parasites
- To know the techniques in the isolation of bacteria from root nodules
- To update the identification methods used in assess the water quality
- To get knowledge about the microbes from spoiled food materials

Course Outcome:

CO1	To understand the hemagglutination techniques
CO2	Able to understand the cultivation of viruses
CO3	Able to understand the cultivation of soil microbes
CO4	Able to understand the water quality parameter techniques
CO5	To understand the isolation of bacteria from spoiled fruits

1. Haemagglutination Assay
2. Egg inoculation methods
3. Wet mount examination of parasites.
4. Concentration methods for egg / ova
    - Flotation technique
    - Sedimentation technique
5. Isolation of bacteria from rhizosphere.
6. Isolation and Identification of Plant pathogen
7. Determination of Water Quality by MPN and Settle Plate method.
8. Determination of Milk Quality by MBRT and Resazurin test.
9. Isolation of bacteria from spoiled fruits and soft drinks.
10. Determination of indices of pollution by measuring BOD/COD of different effluents
11. Determination of indices of pollution by measuring COD of different effluents
12. Isolation of Probiotic microorganisms from curd

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓