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 9001:2008 (Certificate institution)

A U T O N O M O U S

DEPARTMENT OF MICROBIOLOGY

B.Sc MICROBIOLOGY

SYLLABUS & REGULATIONS

FOR CANDIDATES ADMITTED FROM

2017 - 2018 ONWARDS

UNDER AUTONOMOUS & CBCS 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 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
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 the Internal 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	- 30 Marks
2. Attendance	- 5 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 semesters and 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 2018 - 2019 i.e. for the students who are to be admitted to the first year of the course during the academic year 2018 - 2019 and thereafter.

13. TRANSITORY PROVISION

Candidates who were admitted to the UG course of Microbiology before 2018 – 2019 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 2021. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

Vivekanandha College

VISION

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

MISSION

1. **To provide sufficient learning infrastructure to the students to pursue their studies**
2. **To provide good opportunity for higher education and conducive environment to the students to acquire education**
3. **To provide high quality academic programme, training activities and research facilities**
4. **To facilitate industry-institute interface**

VISION

Aspires to be a microbiologist committed to progress the quality of human lives by exploring 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 microbiological problems affecting health and the environment through the programme designs

To contribute to the cutting edge in Microbiology by pursuing high quality research and other scholarly activities

To motivate the students to become a women entrepreneur by applying their knowledge in the field of microbiology

To establish as an expert resource within the geographical areas regarding all issues related to medical and environmental microbiology

B.Sc., MICROBIOLOGY

PROGRAMME OUTCOME:

The programme aims to communicate the scientific knowledge relating to microbiology and their role in the ecosystem and health issues. It is designed to teach and practice the fundamentals of microbiology, by experts in microbiology for the development of microbiology across the society.

PROGRAMME SPECIFIC OUTCOME:

1. To describe about the basics of microbiology, genetics, metabolism and ecology.
2. To make the students understand the integration of microbes and their role in causing disease with the immune status of immune system in diagnosis and treatment.
3. To train them in the application of microbiology with the components of laboratory skills.
4. To explain the ubiquitous nature of microbes in terms of their wide range of ecological habitats.
5. To comprehend the effectiveness of microbes in biotechnology, fermentation technology, medicine and other industries for human welfare.

UG MICROBIOLOGY SCHEME – 2018 – 2019 ONWARDS

Sem	Subject code	Part	Course	Subjects	Hrs/ Week	Credits	Int. Marks	Ext. Marks	Tot. Marks
I	18U1LT01	I	Language – I	Tamil – I	4	3	25	75	100
	18U1LH01			Hindi – I					
	18U1LM01			Malayalam – I					
	18U1LE01B	II	English – I		4	3	25	75	100
	18U1MBC01	III	Core – I	Principles of Microbiology	5	5	25	75	100
	18U1MBCP01			Major Practical – I	5	3	40	60	100
	181U1BCA01	III	Allied – I	Biochemistry	4	4	25	75	100
	18U1BCAP01			Allied Practical – I	4	3	40	60	100
	18U1VE01			Value education – (Yoga)	2	2	25	75	100
				Sports	1	-	-	-	-
				Library	1	-	-	-	-
				Total	**30**	**23**	**125**	**495**	**700**
II	18U2LT02	I	Language – II	Tamil – II	4	3	25	75	100
	18U2LH02			Hindi – II					
	18U2LM02			Malayalam – II					
	18U2LE02B	II	English – II		4	3	25	75	100
	18U2MBC02	III	Core – II	Microbial Physiology and Metabolism	5	5	25	75	100
	18U2MBCP02	III		Major Practical – II	5	3	40	60	100
	18U2MBA01	III	Allied – II	Bioinstrumentation Techniques	4	4	25	75	100
	18U2MBAP01	III		Allied Practical – II	4	3	40	60	100
	18U2ES01	IV		Environmental studies	2	2	25	75	100
				Sports	1	-	-	-	-
				Library	1	-	-	-	-
				Total	**30**	**23**	**205**	**495**	**700**
III	18U3LT03	I	Language – III	Tamil – III	4	3	25	75	100
	18U3LH03			Hindi – III					
	18U3LM03			Malayalam – III					
	18U3LE03B	II	English – III		4	3	25	75	100
	18U3MBC03	III	Core – III	Molecular Biology and Microbial Genetics	5	5	25	75	100
	18U3MBCP03			Major Practical – III	4	3	40	60	100
	18U3MBA02	III	Allied – III	Bioinformatics	4	4	25	75	100
	18U3MBAP02			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
				Sports	1	-	-	-	-
				Library	1	-	-	-	-
				Total	**30**	**24**	**150**	**570**	**800**
IV	18U4LT04	I	Language – IV	Tamil – IV	4	3	25	75	100
	18U4LH04			Hindi – IV					
	18U4LM04			Malayalam – IV					
	18U4LE04	II	English – IV		4	3	25	75	100
	18U4MBC04	III	Core – IV	Immunology and Immunotechniques	5	5	25	75	100

	18U4MBCP04			Major Practical – IV	4	3	40	60	100
	18U4BTA01	III	Allied – IV	Biotechnology	4	4	25	75	100
	18U4BTAP01			Allied Practical – IV	3	2	40	60	100
		IV	NMEC – II	Elected by Students	2	2	25	75	100
	18U4MBS02	IV	SBEC – II	Plant Diseases and Management	2	2	25	75	100
				Sports	1	-	-	-	-
				Library	1	-	-	-	-
				Total	**30**	**24**	**230**	**570**	**800**
V	18U5MBC05	III	Core – V	Medical Bacteriology and Mycology	5	5	25	75	100
	18U5MBC06	III	Core – VI	Industrial and Pharmaceutical Microbiology	5	5	25	75	100
	18U5MBC07	III	Core – VII	Genetic Engineering	5	5	25	75	100
	18U5MBE01	III	Elective – I	Elected By Students	4	4	25	75	100
	18U5MBS03	IV	SBEC – III	Computer Applications in Biology	2	2	25	75	100
	18U5MBMP01			Mini Project	2	1	-	-	-
	18U5MBCP05			Practical – V	6	3	40	60	100
				Library/Sports	1				
				Total	**30**	**25**	**150**	**435**	**600**
VI	18U6MBC08	III	Core – VIII	Medical Virology and Parasitology	5	5	25	75	100
	18U6MBC09	III	Core – IX	Soil and Environmental Microbiology	5	5	25	75	100
	18U6MBE02	III	Core – X	Food and Dairy Microbiology	5	5	25	75	100
	18U6MBE03	III	Elective – II	Elected by Students	4	4	25	75	100
	18U6MBS04	IV	SBEC – IV	Advances in Microbiology	2	2	25	75	100
	18U6MBCP06	III	Core	Practical – VI	6	3	40	60	100
	18U6MBEX01	-	-	Extension activity	2	1	-		
				Library/Sports	1				
				Total	**30**	**25**	**230**	**435**	**600**
Overall Total					**180**	**140**	**1090**		

MAJOR ELECTIVE COURSES:

Semester – V

1. Hematology and Blood Banking (18U5MBE01)
2. Entrepreneurship in Microbiology (18U5MBE02)

Semester – VI

1. Microbial Diagnosis in Health Clinics (18U5MBE03)
2. Microbial Quality Control in Food and Pharmaceutical Industries (18U5MBE04)

NON MAJOR ELECTIVE COURSES:

1. Personal Hygiene (18U5MBN01)
2. Diseases Epidemics and Control (18U5MBN02)
3. Quality Control Microbiology (18U5MBN03)

B.Sc., Microbiology

(CBCS PATTERN)

Theory Question Paper Pattern

Maximum Marks 75

PART- A (20 x 1 = 20 Marks)

(Answer all the questions)

PART- B (5 x 5 = 25 Marks)

(Internal choice)

PART- C (3 x 10 = 30 Marks)

(Answer any three out of five)

M.Sc., Applied Microbiology

(CBCS PATTERN)

Theory Question Paper Pattern

Maximum Marks 75

PART- A (20 x 1 = 20 Marks)

(Answer all the questions)

PART- B (3 x 5 = 15 Marks)

(Internal choice)

PART- C (4 x 10 = 40 Marks)

(Answer any four out of six)

SEMESTER I

SEMESTER – I	**CORE - I**
18U1MBC01	**Total Number of Hours: 75**
Credits - 5	**5 Hours/ Week**

PRINCIPLES OF MICROBIOLOGY

Course Objectives:

- To study the history of microbiology
- To gain knowledge about microscopes and staining techniques.
- To understand the cultivation of microbes and sterilization techniques.
- To study the classification of bacteria.
- 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 – 1 **No. of Hours: 12**

History and Development of Microbiology: Spontaneous generation verses biogenesis. Contributions of Anton von 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 Selman A. Waksman. Paul Ehrlich, Elie Metchnikoff and Edward Jenner. Scope of microbiology.

UNIT – 2 **No. of Hours: 12**

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

UNIT – 3 **No. of Hours: 12**

Cultivation of Microbes: Culture media and its types. Cultivation of anaerobes – Pyrogallol and Gas Pak method – Pure culture isolation techniques. **Sterilization:** Physical and Chemical methods of sterilization. Preservation of cultures. Antibiotics classification based on mode of action – Tests for sensitivity to antimicrobial agents.

UNIT – 4 **No. of Hours: 12**

Microbial Diversity: Evolution, Phylogeny, Microbial Taxonomy and Classification – Haeckel, Whittaker and Carl Woese system, Numerical Taxonomy and Molecular based classification. Bacterial diversity – General characteristics of bacteria and classification – Bergeys' Manual of Systematic Bacteriology (up to order level) and Actinobacteria.

UNIT – 5 **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.

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.

Mapping

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

18U1MBC01

(For the candidates admitted from 2018- 19 onwards)

B.Sc., DEGREE EXAMINATIONS

-------- / ------- 2018.

First Semester

Microbiology

PRINCIPLES OF MICROBIOLOGY

Time: Three hours **MaximumMarks : 75**

PART A- (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks.

1. Chondroid of some bacteria are better known as:
   a. Bacterial mitochondria b. Mesosomes
   c. Bacterial plastids d. Plasmids
2. The resolving power of an optical microscope is
   a. 0.2µm b. 0.2 Å c. 0.2 nm d. 0.2 mm
3. Which of the following structure is absent in Gram positive bacteria?
   a. Cell wall b. Teichoic acid c. Murein d. Outer membrane
4. Bacterial cells can be stained with _____to reveal the presence of lipid inclusions
   a. Saffranin b. Methylene blue c. Trypan blue d. Sudan dyes
5. Who discovered *Mycobactyerium tuberculosis*?
   a. Koch b. Jenner c. Pasteur d. Virchow
6. Who discovered *Bacillus anthracis*?
   a. Koch b. Pasteur c. Jenner d. Hansen
7. Scientist who discovered theory of spontaneous generation
   a. Koch b. Pasteur c. Jenner d. Hansen
8. The iodine used in Gram staining serves as
   a. Chelator b. Catalyst c. Mordant d. Cofactor
9. The organism which obtain their energy from chemicals are designated as
   a. Prototroph b. Chemotrophs c. Organotrophs
   b. d. Autotrophs
10. In the process of freeze drying, a dense cell suspension is placed in small vials and is frozen at
    a. -60 to 78°C b. -20 to -30 °C c. -30 to -48 °C
    d. -48 to -58 °C
11. Which of the following may contain fimbriae
    a. G+ ve bacteria b. G-ve bacteria c. Both a and b d. None of these
12. Which were the investigators lived at the same time?
    a. Koch and Pasteur b. Darwin and Woese c. Leeuwenhoek and Ricketts
    d. Berg and Hooke

13. Which of the following articles can be sterilized in an autoclave?
    a. Gloves b. Culture media c. Dressing material d. All of these
14. Which of the following is not a disinfectant containing a heavy metal?
    a. Silver nitrate b. Mercurochrome c. Copper sulphate d. Chlorine
15. The oldest eukaryotic organisms are consider to be
    a. Diplomonads like Giardia b. Archaea c. Fungi d. Animals
16. Which of the following is considered the most unifying concept in biology?
    a. Taxonomy b. Anatomy c. Genetics d. Evolutiojn
17. Which of the following structure is absent in eukaryotic cell?
    a. Mitochondria b. Chloroplasts c. Golgi structure d. Mesosome
18. The five kingdom system of classification was set up by
    a. Louis Pasteur b. Robert Whittaker c. Robert Koch d. Masaki Ogata
19. Which of the following bacteria lack a cell wall and are therefore resistant to penicillin?
    a. Cyanobacteria b. Mycoplasma c. Bdellovibrios d. Spirochetes
20. Which of the following best represents the hierarchy of levels of biological classification?
    a. Phylum, kingdom, class, order, genus, species, family
    b. Kingdom, phylum, class, order, family, genus, species
    c. Kingdom, phylum, family, class, order, genus, species
    d. Class, order, kingdom, phylum, family, genus, species

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21.(a). What are Koch's postulates **(or)**
    (b).Write about the scope of microbiology.
22. (a).Write about dark field microscope **(or)**
    (b). Write short notes on Gram staining.
23. (a). Write short notes on transport media **(or)**
    (b). What are antibiotics? Write about their types
24. (a). Write an account on numerical taxonomy **(or)**
    b) Write short notes on Whittaker's five kingdom classification.
25. (a). Give an account of thermophiles. **(or)**
    (b). Briefly explain about actinomycetes.

PART C- (3 × 10 = 30 Marks)

Answer **ANY THREE** Questions

All questions carry equal marks.

26. Write a brief account on the historical developments of microbiology.
27. Write about Phase contrast microscope and their applications in microbiology.
28. Write in detail about the physical methods of sterilization.
29. Give an account of classification of bacteria according to Bergey's manual of systematic bacteriology
30. Give a brief account on microbial diversity on diverse environment.

SEMESTER – I	**CORE PRACTICAL - I**
18U1MBCP01	**Total Number of Hours: 45**
Credits - 3	**5 Hours/ Week**

PRINCIPLES OF MICROBIOLOGY (PRACTICALS)

Course Objectives

- To introduce the Microbiology laboratory
- To use the basic instruments in microbiology lab
- To study the morphology of microbes
- To cultivate the microbes in laboratory
- To see the movement of microbes
- To analyze the impact of antibiotics on 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

1. Microbiology Good Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Cultivation of anaerobic bacteria by candle jar method.
5. Enumeration of bacteria and actinobacteria from environment (soil/ water).
6. Staining techniques- simple, differential, negative, endospore, capsular, metachromatic granules and flagellar staining.
7. Pure culture technique- Serial dilution, pour plate, spread plate and streak plate.
8. Determination of bacterial motility by hanging drop technique.
9. Antibiotic sensitivity test by Kirby Bauer 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	✓	✓	✓		

SEMESTER II

SEMESTER – II	**CORE - II**
18U2MBC02	**Total Number of Hours: 75**
Credits – 5	**5 Hours/ Week**

MICROBIAL PHYSIOLOGY AND METABOLISM

Course Objectives:

- To study the Cellular structure of Prokaryotes and Eukaryotes
- 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 difference between the Eukaryotic and Prokaryotic cellular organizations were understood
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 – 1 **No. of Hours: 12**

Cellular structures of prokaryotes and eukaryotes: Different-Ultra structure and Functions of Prokaryotic cell wall, flagella, slime layer, capsule, pili, cytoplasmic membrane and cytoplasmic inclusions – Sporulation and its mechanism – Structure and functions of cyanobacteria.

UNIT – 2 **No. of Hours: 12**

Growth of bacteria: multiplication – nutritional types of bacteria – nutritional requirements – factors influencing microbial growth – growth curve – Generation time - Determination and mathematical determination of growth. Nutrients – Synchronous, Batch, continuous and diauxic growth culture.

UNIT – 3 **No. of Hours: 10**

Microbial transport: Structure and organization of membrane – Methods of nutrients transport in bacteria – Diffusion, active transport and facilitated diffusion – group translocation.

UNIT – 4 **No. of Hours: 14**

Microbial metabolism: glycolysis, pentose phosphate pathways, EMP, TCA and Glyoxalate cycle - ATP synthesis and utilization – photophosphorylation, oxidative phosphorylation, substrate level phosphorylation - Fermentation types – Lactic acid, Butanol and Propionic acid. Respiration types – aerobic and anaerobic respiration.

UNIT – 5 **No. of Hours: 12**

Photosynthesis: Characteristics and metabolism of autotrophs - autotrophic CO_2 fixation and mechanism of photosynthesis – Oxygenic (cyanobacteria) and Anoxygenic (purple sulfur, green sulfur and halobacteria) – 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 Tamilnadu 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.

Mapping

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

18U2MBC02

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

-------- / ------- 2017.

Second Semester

Microbiology

MICROBIAL PHYSIOLOGY AND METABOLISM

Time: Three Hours **Maximum Mark: 75**

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Bacterial cell wall is made up of
   a. Chitin
   b. Cellulose
   c. Dextran
   d. Peptidoglycan
2. Bacterial flagella is made up of
   a. Microtubules
   b. Tubulin
   c. Flagellin
   d. Spinin
3. Surface appandages of bacteria on cell-cell attachment during conjugation is
   a. Pili
   b. Flagella
   c. Spinae
   d. Cilia
4. The region where bacterial genome resides is called as
   a. Nucleus
   b. Cytoplasm
   c. Nucleiod
   d. Ribosome free region
5. Bacteria reproduce vegetatively by
   a. Fission only
   b. Fission and fragmentation
   c. Fission, fragmentation and budding
   d. None of the above
6. Growth in a closed system, affected by nutrient limitation nd waste product accumulation is called
   a. Batch culturing
   b. Ascus
   c. Fruiting body
   d. Continuous culturing
7. The organisms that obtain energy from chemicals are called
   a. Prototrophs
   b. Chemotrophs
   c. Organotrophs
   d. Autotrophs

8. Which of the following is the characteristics of a growth curve
   a. shows development of microbial population under relatively stable environmental conditions
   b. Plotted with logarithmic numbers
   c. Graphs numbers of microbes versus time
   d. Each growth curve consists of four distinct phases
9. The significance of plasma membrane is that
   a. It selectively allow a some molecules to pass into the organism
   b. It prevents movement of molecules out of the organism
   c. It is the site of protein synthesis
   d. All of the above

10. The most important role of the prokaryotic cell wall is to
    a. Maintain the shape of the cell
    b. Protect the cell from osmotic pressure
    c. Prevent ions from diffusing away from the cell
    d. Block the effects of antibiotics like penicillin
11. Which of the following describes the fluid mosaic model of the plasma membrane structure
    a. Phospholipid monolayer with embedded proteins
    b. Phospholipid bilayer with embedded proteins
    c. Phospholipid trilayer with embedded proteins
    d. Triglyceride bilayer with embedded protein
12. ---------- Protein combines with the substance and helps to move across the membrane
    a. Carrier
    b. Channel
    c. Cell-recognition
    d. receptor
13. Hetero lactic bacteria produce
    a. Lactic acid only
    b. Lactic acid + carbon di oxide
    c.. Lactic acid +water + carbon di oxide
    d. Lactic acid + alcohol + carbon di oxide
14. In aerobic respiration, the terminal electron acceptor is
    a. Oxygen
    b. Nitrogen
    c. Hydrogen
    d. nitrate
15. The process of converting chemical energy into chemical bond of ATP is called
    a. Glycolysis
    b. Conversion
    c. Cellular aspiration
    d. Energy
16. The light trapping pigment molecule in plant, algae and cyanobacteria
    a. Chorophyll a
    b. Cholorophyll b
    c. Porphyrin
    d. Rhodopsin
17. The oxygen released into the air as a product of photosynthesis comes form
    a. Chlorophyll
    b. Carbon di oxide
    c. Water
    d. None of the choices are correct
18. Which of the following does not produce oxygen as a product of photosynthesis
    a. Oak trees
    b. Purple Sulphur bacteria
    c. Cyanobacteria
    d. Phytoplankton
19. Hexose monophosphae pathway is also known as
    a. Phosphogluconate pathway
    b. Malate pathway
    c. Oxaloacetate pathway
    d.Fumerate pathway
20. The glyoxylate cycle is used by some microorganisms when _____ is the sole carbon source.
    a. Acetate
    b. Nitrate
    c. Carbon di oxide
    d. All of these.

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. (a)Write about the cell wall structure of bacteria. (or)
    (b) Write a short note on capsule.

22. (a) Add a brief account on growth curve. (or)
    (b) Write about the nutritional requirements of microbes.
23. (a) Explain the fluid mosaic model of cell membrane (or)
    (b) Describe passive diffusion.
24. (a) Explain Kreb's cycle. (or)
    (b) Explain mixed acid fermentation.
25. (a) Briefly describe the metabolism of autotrophs. (or)
    (b) Write an account on anoxygenic photosyntheis.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Explain in detail about the mechanism of sporulation.
27. Explain the various factors that affecting the microbial growth.
28. Describe the various mechanisms of active transport.
29. Discuss in detail about microbial photosynthesis.
30. Explain briefly about the Physiology of Biolumninescence

SEMESTER – II	**CORE PRACTICAL – II**
18U2MBCP02	**Total Number of Hours: 45**
Credits – 3	**5 Hours/ Week**

MICROBIAL PHYSIOLOGY AND METABOLISM (PRACTICAL)

Course Objectives

- To study the bacterial growth
- To study the effect of bacterial growth on temperature, pH, carbon, nitrogen and salt concentration, incubation time, inoculums size were studied
- To learn the difference in biochemical parameters for different organisms used for the identification of bacteria

Course Outcome:

CO1	Different stages of bacterial growth could be studied
CO2	The impact of different physical and chemical parameters on bacterial growth are to be learnt
CO3	The characterization of microorganisms based on biochemical characteristics are to be introduced

1. Bacterial growth curve – Turbidometric assay.
2. Effect of temperature on growth of bacteria.
3. Effect of pH on growth of bacteria.
4. Effect of carbon and nitrogen sources on growth of bacteria.
5. Effect of salt concentration on growth of bacteria.
6. Effect of incubation time and inoculum size on growth of bacteria
7. Biochemical parameters –

   a) IMViC

   b) Sugar assimilation (glucose, lactose, maltose, mannitol and sucrose)

   c) Catalase

   d) Oxidase

   e) Urease

   f) TSI

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	✓	✓	✓		

Semester – II	**Core – II**
18U2MBA01	**Total number of Hours: 75**
Credits: 5	**5 Hours/Week**

BIOINSTRUMENTATION TECHNIQUES

Course Objectives:

- To gain knowledge about laboratory management, safety and quality control.
- 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	
CO3	
CO4	
CO5	

UNIT – 1 **No. of Hours:10**

Microbiological Instruments: Basic requirements of a Microbiology Laboratory –Basic Microbiological Instruments - Colony counter, Neubaeur chamber, inoculation loop, transilumintor, cyclo mixer, Incubator types - shaker incubator, BOD incubator, CO_2 Incubator. Microscopy – SEM, TEM and confocal. Balance types – mono pan, dono, top and physical.

UNIT – 2 **No. of Hours: 14**

Chromatography: Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography, Gel filtration chromatography, Ion-exchange chromatography, affinity chromatography, GLC and HPLC.

UNIT – 3 **No. of Hours:14**

Electrophoresis: Principle and applications – Agarose gel electrophoresis, Pulse Field Gel Electrophoresis, SDS – polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing and Zymogram preparation.

UNIT – 4 **No. of Hours:10**

Spectrophotometry: Principle and applications – Beer Lambert's Law – Principle and applications of Colorimeter, spectrophotometer, Atomic Adsorption Spectrophotometer, Raman spectrophotometer – Analysis of biomolecules using UV and visible spectrophotometer – Spectroflourimeter.

UNIT – 5 **No. of Hours: 12**

Centrifugation: Centrifuge – Sedimentation principle, Relative centrifugal force, Sedimentation coefficient, factors affecting sedimentation velocity, Centrifuge rotors, Types of centrifuges, Ultracentrifuge – Preparative and Analytical – Centrifugation – Types - Differential and Density gradient centrifugation.

Learning Outcomes

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.

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	✓	✓		✓	✓

18U2MBA01

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

-------- / ------- 2017.

Second Semester

Microbiology

BIOINSTRUMENTATION TECHNIQUES

Time: Three Hours **Maximum Mark: 75**

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. The instrument used for homogenous mixing is

a. Incubator b. Cyclomixer

c. Centrifuge d. Shaker

2. The modern version of counting colony is

a. Digital Counter b. Colony Counter c. Ultra Counter d. Mechanical Counter

3. The source of light used in transilluminator is

a. Sodium vapor b. UV c. Fluorescent d. IR

4. Who first described colony counter…….

a. Robert Koch b. Quebec c. Fannie Hesse d. Antony von Leewenhoek

5. The light source for imaging in electron microscope

a. Neutron b. Electron c. All the above d. Proton

6. The sterilization technique used for inoculation loop is

a. alcohol b. incineration c. boiling d. Pasteurization

7. The optimum temperature for bacterial growth

a. 35ºC b. 36ºC c. 37ºC d. 38ºC

8. The balance normally used in microbiology lab

a. Top pan b. Mono pan c. Physical d. Chemical

9. DNA is stained by --------- in Agarose gel electrophoresis

a. EtBr b. Bromothymol blue c. Casein d. Bromophenol blue

10. PUFE is a technique used for the separation of large --------- molecules

a. RNA b. DNA c. Protein d. Lipid

11. PAGE stands for

a. Polyacrylamide gel electrophoresis b. Polyarylamide gel electrophoresis

c. Polyamide gel electrophoresis d. Poly gel electrophoresis

12. Zymography is an electrophoretic technique for the detection of

a. hydrolytic enzymes b. Proteins c. catalysts d. substrates

13. Spectrophotometry is a tool that hinges on the ---------- analysis of molecules

a. quantative b. semiquatitative c. qualitative d. semiqualitative

14. A spectrophotometer is an instrument that measures the amount of photons

a. quantative b. semiquatitative c. qualitative d. semiqualitative

15. Beer-Lambert Law states that there is a linear relationship between the absorbance and the ---------- of a sample.

a. concentration b. strength c. amount d. equivalence

16. The proportion of light absorbed by a medium is ---------- of the intensity of incident light.

a. independent b. dependent c. direct d. indirect

16. RPM means .

a. rotation per minute b. reel per minute c. random per minute d. redeem per minute

17. Density gradient centrifugation Is considered one of the more efficient methods of

a. separating suspended particle b. separating particle

c. suspended particle d. particle

18. The forces involved in centrifugation is

a. Centripetal b. centrifugal c. gravity d. external

19. CeCl is a type of

a. gradient centrifuge b. Normal centrifuge c. differential centrifuge d. microfuge

20. The shaft is attached with

a. rotor b. motor c. rod d. bucket

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. (a)Write about structure and application of BOD incubator. (or)
    (b) Write a short note on transiluminator.
22. (a) Add a brief account on paper chromatography. (or)
    (b) Describe about thin layer chromatography.
23. (a) Explain about the principle and application of agarose gel electrophoresis (or)
    (b) Describe about Zymogram preparation.
24. (a) Explain Beer Lambert's law. (or)
    (b) Explain about spectroflourimeter.
25. (a) Briefly describe the sedimentation principle. (or)
    (b) Write an account on density gradient centrifugation.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Explain in detail about the mechanism and application of electron micrscope.
27. Explain the various factors that affecting chromatography.
28. Describe in detail about SDS electrophoresis.
29. Discuss in detail about UV Spectrophotometr.
30. Explain briefly about the ultracentrifuge.

Semester – II	**Core – II**
18U2MBAP01	**Total number of Hours: 45**
Credits – 3	**4 Hours/Week**

BIOINSTRUMENTATION TECHNIQUES – PRACTICALS

Objectives:

- To impart knowledge on chromatographic techniques.
- To understand electro chemical techniques.
- To study electrophoretic techniques.
- To gain knowledge about blotting techniques.
- To impart knowledge on radioisotopic techniques.

1. Calculation in preparation of reagents: Normality of solution, Molarity of solution

2. **Chromatographic Techniques**: Preparation and Packing of columns, Adsorption (Partition chromatography), Ion-exchange (Affinity chromatography), Gel filtration chromatography, Paper and Thin layer chromatography

3. **Electrophoretic Techniques:** Agarose gel electrophoresis, SDS-PAGE
4. **Spectrophotometry**: Principle and operating mechanism of Spectrophotometry, Estimation of biomolecules like Protein and Carbohydrate and Lipid using UV and visible Spectrophotometer.

Learning Outcomes

The course helps the students to understand the basic and the principles of chromatographic, electrophoretic and Spectrophotometric techniques. This course will help the students in research with the all the basic skills to handle the instruments.

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.

SEMESTER III

Semester – III	**Core – III**
18U3MBC03	**Total number of Hours: 75**
Credits – 5	**5 Hours/Week**

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

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.

Learning Outcomes

The contents of this course will help students to understand DNA and RNA as the genetic material. Students will understand the central dogma of the cell, mechanism of genetic exchange and molecular basis of mutation and various repair mechanisms.

UNIT – 1 **No. of Hours: 12**

Genetic Material (DNA & RNA): Genetics – Historical perspective. Discovery of DNA structure – Watson and Crick model – Types and forms of DNA, Genome organization in Prokaryotes, Viruses and Eukaryotes. DNA as a genetic material. RNA as genetic material. Physical structure and chemical composition of nucleic acid. RNA types – t RNA, mRNA and rRNA.

UNIT – 2 **No. of Hours: 12**

Replication and transcription: DNA replication in prokaryotes – Meselson and Stahl experiment – Mechanism and enzymology of replication - Rolling circle and theta model of replication. Transcription in prokaryotes: promoter, RNA polymerase.

UNIT – 3 **No. of Hours: 12**

Genetic code: salient features - Wobble hypothesis. Translational machinery, charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination in prokaryotes. Transcriptional regulation in prokaryotes (inducible and repressible system, positive and negative regulation); Operon concept – *lac* and *trp* operons.

UNIT – 4 **No. of Hours: 12**

Plasmid and Mechanisms of Genetic Transfer: Types of plasmids – F plasmid, R Plasmids, Col plasmids, Ti plasmids, Plasmid replication and partitioning, Host range, plasmid –Incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids. Transformation – Discovery, mechanism of natural competence. Conjugation – mechanism, Hfr and F' strains, Transduction – Generalized transduction, specialized transduction.

UNIT – 5 **No. of Hours: 12**

Mutation and DNA repair mechanisms: Mutations and mutagenesis – Molecular basis of mutations (physical and chemical mutagen), types of mutation: point, frame shift, lethal,

conditional lethal, inversion and deletion, null mutation, reversion of mutations, intra and intergenic suppression mutations. Auxotrophic mutant detection: Replica plate technique. Mutagenicity testing – Ames Test. DNA repair mechanisms – excision, mismatch, SOS, photoreactivation and recombination repair.

Learning Outcomes

The contents of this course will help students to understand DNA and RNA as the genetic material. Students will understand the central dogma of the cell, mechanism of genetic exchange and molecular basis of mutation and various repair mechanisms.

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

Semester – III	**Core – III**
18U3MBCP03	**Total number of Hours: 45**
Credits – 3	**5 Hours/Week**

MOLECULAR BIOLOGY AND MICROBIAL GENETICS (PRACTICAL)

1. Isolation of chromosomal DNA from bacteria.
2. Isolation of plasmid DNA from *E. coli*.
3. Mutagenesis – Effect of Physical and Chemical mutagens on bacterial cells.
4. Isolation of antibiotic resistant mutant by gradient plate technique.
5. Isolation of auxotrophic mutant (replica plating).
6. Isolation of coli phage from sewage.
7. Bacterial Gene Transfer – Transformation, conjugation and transduction – (Demonstration).

REFERENCES

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.

Semester – III	**ALLIED – II**
18U5MBA02	**Total number of Hours: 60**
Credits – 4	**4 Hours/Week**

BIOINFORMATICS

Objectives:

1. To gain knowledge about the fundamentals of computer.
2. To impart knowledge on bioinformatics and biological database.
3. To gain knowledge about sequence alignments and phylogeny tree.
4. To impart knowledge on genome organization.
5. To understand about protein structure prediction

This course aims to introduce the fundamentals of computer that supports to impart knowledge on bioinformatics and biological database of an organisms and to gain the diversity of an organism by analyze the phylogeny tree.

UNIT – 1 **No. of Hours: 08**

Introduction and Databases: Introduction, database model, types of database - primary, secondary database, raw database and processed database, data mining, data storage and retrieval, querying in database and tools for querying – BLAST, FASTA.

UNIT – 2 **No. of Hours: 14**

Introduction to Bioinformatics and Biological Databases: Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB

UNIT – 3 **No. of Hours: 16**

Sequence Alignments, Phylogeny and Phylogenetic trees: Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood

UNIT – 4 **No. of Hours: 10**

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes. Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi Toff spectroscopy. **Major features of completed genomes:** *E.coli, S.cerevisiae, Arabidopsis,* Human

UNIT – 5 **No. of Hours: 12**

Protein Structure Predictions: Hierarchy of protein structure - primary, secondary and tertiary structures, modeling. Structural Classes, Motifs, Folds and Domains. Protein structure prediction in presence and absence of structure template. Energy minimizations and evaluation by Ramachandran plot. Protein structure and rational drug design

SUGGESTED READING

1. Saxena Sanjay (2003). **A First Course in Computers**, Vikas Publishing House
2. Pradeep and Sinha Preeti (2007). **Foundations of Computing**, 4th ed., BPB Publications
3. Lesk M.A.(2008). **Introduction to Bioinformatics** . Oxford Publication, 3rd International Student Edition
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007). **Bioinformatics: methods and applications, genomics, proteomics and drug discovery**, 2nd ed. Prentice Hall India Publication
5. Primrose and Twyman (2003). **Principles of Genome Analysis & Genomics**. Blackwell

Semester – III	**ALLIED PRACTICAL – II**
18U5MBAP02	**Total number of Hours: 45**
Credits – 2	**5 Hours/Week**

BIOINFORMATICS (PRACTICAL)

1. Introduction to LINUX comments

2. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB

3. Sequence retrieval using BLAST

4. Sequence alignment & phylogenetic analysis using clustalW & phylip

5. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool

6. Protein structure prediction: primary structure analysis, secondary structure prediction using psi-pred, homology modeling using Swissmodel. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK)

7. Prediction of different features of a functional gene

SUGGESTED READING

1. Saxena Sanjay (2003). **A First Course in Co**mputers, Vikas Publishing House
2. Pradeep and Sinha Preeti (2007). **Foundations of Computing**, 4th ed., BPB Publications
3. Lesk M.A. (2008). **Introduction to Bioinformatics** . Oxford Publication, 3rd International Student Edition
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007). **Bioinformatics: methods and applications, genomics, proteomics and drug discovery**, 2nd ed. Prentice Hall India Publication
5. Primrose and Twyman (2003). **Principles of Genome Analysis & Genomics**. Blackwell

SEMESTER – III	**ALLIED – III**
18U3MBA03	**Total Number of Hours: 60**
Credit – 4	**4 Hours/ Week**

MICROBIOLOGY

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 applications of Microbiology in the field of Agricultural, food and dairy.
- To understand the applications of Microbiology in the field of Medical and Environmental.

UNIT – 1 **No. of Hours: 12**

History & Scope of Microbiology: Introduction - Contributions of various scientists to Microbiology - Louis Pasteur, Antony Von Leuwenhoek, Robert Koch, Joseph Lister, Edward Jenner, Alexander Fleming. **Microscopy:** Bright field microscope, Dark field microscope, Phase contrast microscope, Fluorescent microscope and Electron microscope – TEM & SEM.

UNIT – 2 **No. of Hours: 10**

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

UNIT – 3 **No. of Hours: 12**

Cultivation of Microbes: Culture media – Definition – Types - composition – Media preparation – Basal, Differential, Selective, Transport and Anaerobic culture 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 – 4 **No. of Hours: 12**

Medical Microbiology: Infection – Definition – Types – Mode of disease transmission – sources, Factors influencing pathogenesis – Disease cycle, Control of disease and prophylaxis. **Environmental Microbiology:** Introduction - Indicator organisms - Detection of water quality tests. Water borne diseases - Cholera, Typhoid, Polio virus, Hepatitis B Virus.

UNIT – 5 **No. of Hours: 14**

Applications of Microbiology: Agricultural Microbiology - Microbial interactions - Nitrogen fixation. Types of associations - Rhizosphere, Phyllosphere, Mycorrhiza. Food and Dairy Microbiology - Microbes involved in spoilage - Methods in food preservation - food poisoning – botulism. Detection of bacteria in milk.

Learning Outcome

The course enables the students to understand the history and scope of microbiology. It also gives an understanding about the basic concepts of microbiology which includes microscopy, structure of bacteria, bacterial growth and sterilization techniques.

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.

SEMESTER – III	**ALLIED - I**
18U3MBAP03	**Total Number of Hours: 30**
Credits – 2	**3 Hours/ Week**

ALLIED MICROBIOLOGY PRACTICALS

Objectives

- To introduce the Microbiology laboratory
- To use the basic instruments in microbiology lab
- To study the morphology of microbes
- To cultivate the microbes in laboratory
- To see the movement of microbes
- To analyze the impact of antibiotics on microbes
- To detect the microbes from soil
- To ensure the quality of milk
- To test the quality of water

1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for bacterial cultivation.
3. Enumeration of bacteria from environment (soil/ water).
4. Staining techniques- simple, differential and negative staining.
5. Pure culture technique- Serial dilution, pour plate, spread plate and streak plate.
6. Determination of bacterial motility by hanging drop technique.
7. Antibiotic sensitivity test by Kirby Bauer method.
8. Isolation of microbes from rhizosphere soil.
9. Detection of quality of milk – Resazurin, MBRT
10. Water Quality testing - MPN

Learning Outcomes

- The knowledge on microbiology laboratory, working practices, basic instruments to be imparted
- The handling of microscope for visualizing the morphology, size and movement of microbes could be learnt
- The non pathogenic microbial cultivation may be practiced

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

14U3MBA03

(For the candidates admitted from 2017-18 onwards)

B.Sc.,DEGREE EXAMINATIONS

----------/--------2018.

Third semester

MICROBIOLOGY

Time: Three hours **Maximum Marks:** 75

PART-A (2 x 10 = 20 Marks)

Answer **ALL** Questions

All questions carry equal marks

1.Edward Jenner
2. Spontaneous Generation
3.Shadow casting
4.TEM
5. Gram Positive bacteria
6.Dyes
7.Anaerobes
8.Media
9.Sterilization
10.Halogens

PART-B (5 x 5 = 25 Marks)

Answer **ALL** Questions

All questions carry equal marks

11a) Mention the contributions of Antony von Leewenhoek. **(or)**

b) Explain the experiment of Pasteur concerning the spontaneous generation.

12 a) With a neat sketch, explain the components of Bright field microscope. **(or)**

b) Explain the working principle of Fluorescent microscope.

13 a) Write briefly about the structure of bacteria. **(or)**

b) Explain the types of fungal staining methods.

14 a) Explain the preparation of culture media.**(or)**

b) Write in brief about the composition and preparation of nutrient agar.

15 a) Give an account of hot air oven **(or)**

b) Explain the working principle of an autoclave.

PART-C (3 x 10 = 30 Marks)

Answer **ANY THREE** Questions

All questions carry equal marks

16. Explain the various contributions of Louis Pasteur.
17. Explain the working principle of an Electron microscope.
18. Describe in detail about the principle and procedure of Gram's staining.
19. Explain the different types of media in detail with example.
20. Define Disinfectant. Explain about the chemical agents used as disinfectant.

SEMESTER IV

Semester – IV	**Core – IV**
18U5MBC04	**Total number of Hours: 75**
Credits – 5	**5 Hours/Week**

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Objectives:

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

UNIT – 1 **No. of Hours: 12**

Cells and organs of immune system: History and scope of immunology - Haematopoiesis - Cells of the immune system: Structure, function and properties of Lymphocytes, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell - Primary lymphoid organs: Structure and function of Bursa, Bone Marrow and Thymus - Secondary lymphoid organs: Structure and function of Lymph Node, Spleen, GALT, MALT, CALT - lymphatic system and lymph circulation.

UNIT – 2 **No. of Hours: 12**

Immune response: Immunity - Concept of Innate and Adaptive immunity; Types - Specific and Non-specific - Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals) - Herd Immunity, Immunisation schedule, Vaccines - Definition and Types.

UNIT – 3 **No. of Hours: 12**

Antigen, Antibody, MHC and Complement: Antigen - Definition, types and characteristics - Haptens - Adjuvants. Immunoglobulins - Structure, Types, Functions and Properties - Theories of antibody synthesis - Hybridoma Technology and its Applications. Structure and Functions of MHC I & II molecules; Components of the Complement system; Activation pathways (Classical and Alternative pathways) - Biological consequences of complement Activation.

UNIT – 4 **No. of Hours: 12**

Immunological Techniques: Principles and salient feature of Antigen-Antibody Interactions - Antibody affinity and avidity, Cross reactivity. Agglutination reactions - Blood grouping and Rh Typing, Haemagglutination, HAI, Bacterial agglutination, Passive agglutination. Precipitation reactions - in fluid and in gel. Immunoelectrophoresis, Immunofluorescence techniques - ELISA: Direct, Sandwich and Indirect, Biotin-Avidin system, RIA, Western blotting technique, Flowcytometry and Immunoelectron microscopy

UNIT – 5 **No. of Hours: 12**

Immunological Disorders: Hypersensitivity - Immediate and Delayed type Hypersensitivity - Gell and Coomb's classification of Hypersensitivity – Type I, II, III & IV - outline mechanisms with examples. Autoimmunity - Pernicious anaemia and Rheumatoid arthritis.

Learning Outcomes:

This course aims to introduce the host defense mechanism and host-microbial interactions. It focuses on the essential concepts of immune factors and the immune system. It elaborates further on the immunotechniques and its applications, an emerging advancement of immunology.

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.** WHFreeman 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.

Semester – IV	**Core – IV**
18U5MBCP04	**Total number of Hours: 45**
Credits – 3	**5 Hours/Week**

PRACTICAL - IMMUNOLOGY & IMMUNOTECHNOLOGY

1. Identification of human ABO blood groups and Rh Typing.
2. Separation of serum/plasma from the blood sample (demonstration).
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 ODD immunodiffusion technique.
7. Perform rocket immunoelectrophoresis.
8. Counter current immunoelectrophoresis.
9. Enzyme Linked Immunosorbent Assay (ELISA) – demonstration
10. Coomb's test – complement fixation.

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.

SEMESTER V

Semester – V	**Core – V**
18U5MBC05	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

MEDICAL BACTERIOLOGY AND MYCOLOGY

Objective:

- 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.

UNIT – 1 **No. of Hours: 10**

Normal microbial flora of human body – Infection – Types, Source, Modes of Transmission, Mechanism of bacterial pathogenesis – Laboratory diagnosis of infectious diseases – Antibiotic Sensitivity Test, Antibacterial drugs and mechanism of action.

UNIT – 2 **No. of Hours: 14**

General characteristics, pathogenesis, clinical manifestation, laboratory diagnosis and control measures of the following Gram positive bacterial pathogens - *Staphylococcus aureus, Streptococcus pneumoniae, Neisseria gonorrhoeae, Corynebacterium diphtheria, Bacillus anthracis, Clostridium tetani* and *Mycobacterium tuberculosis.*

UNIT – 3 **No. of Hours: 12**

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

UNIT – 4 **No. of Hours: 12**

Classification of medically important fungi - Laboratory diagnosis of fungal diseases - Collection and examination of fungal specimens - Isolation and identification of fungi - Staining of fungi - KOH, LCB, PAS, H&E and GMS - Cultivation of fungi - Antifungal drugs mode of action - Antifungal susceptibility test .

UNIT – 5 **No. of Hours: 12**

Classification of Mycoses - *Tinea nigra - Piedra - Dermatophytoses - Mycetoma - Histoplasmosis - Cryptococcosis - Candidiasis - Aspergillosis - Mycotoxicoses.*

Learning outcomes

The course deals with importance of microorganisms in human health. Students will study the important diseases caused by bacterial and fungal pathogens with reference to etiology, pathogenesis, clinical features, laboratory diagnosis and prevention.

TEXT BOOKS

1. Arti Kapil (2013). **Ananthanarayan & Jayaram Paniker'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. Jagdish Chander (2012). **Text book of Medical Mycology**. 3rd edition. Mehta Publishers, New Delhi.

REFERENCES

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

Semester – V	**Core – V**
18U5MBC06	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Objective:

- 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 production of fermented foods.
- To study the quality control of pharmaceutical products.

UNIT – 1 **No. of Hours: 12**

Introduction to industrial microbiology - Industrially important microorganisms - Screening techniques - Primary and Secondary - Strain improvement - Development of inoculums – Production media – Industrial sterilization.

UNIT – 2 **No. of Hours: 12**

Industrial Fermentor - Components of fermentor – Types of bioreactors –Types of fermentor instrumentation –Scale up of fermentation - Upstream processing - Down Stream Processing – Recovery and Purification of intracellular and extracellular products.

UNIT – 3 **No. of Hours: 12**

Industrial production of enzymes – α amylase. Organic acid - citric acid, lactic acid and acetic acid. Alcoholic beverages - Wine and Beer. Aminoacid – glutamic acid. Vitamin - B12. Microbiological production of antibiotics – Penicillin and streptomycin.

UNIT – 4 **No. of Hours: 12**

Types of pharmaceutical products - Antimicrobial agents - Bioassay of antimicrobial agents – Contamination, spoilage and preservation of pharmaceutical products – Sterilization of pharmaceutical products - Microbiological quality control - Sterility test- Pyrogen test- Toxicity test- Carcinogenicity test.

UNIT – 5 **No. of Hours: 12**

Drug delivery systems - Drug distribution in body - Bio-availability- Adverse drug reaction and drug interaction. Drug discovery - Phases of drug discovery - Clinical studies: phase I, phase II, phase III and phase IV of clinical trials - Bioprospecting - Extraction, purification and characterization of bioactive molecules from natural resources.

Learning outcomes:

The course is oriented towards the industrial applications and production of useful products using microorganisms. The students will know the industrial aspects of microbiology such as screening techniques, preservation methods, strain improvement, fermentor, upstream and downstream processing and fermented microbial products. Quality control and assay of the pharmaceutical products are also focused in this paper.

TEXT BOOKS

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

REFERENCE BOOKS

1. Peppler H.J and Perlman D (1979). **Microbial Technology**.Vol.1 and II. 2nd edition. Academic Press, New York.
2. Stanbury P.F, Whitaker A and Hall S.J (1995). **Principles of Fermentation Technology**.2nd edition. Pergamon Press, New York.

SEMESTER – V	**CORE - VII**
18U5MBC05	**Total number of Hours: 60**
Credits: 5	**5 Hours/Week**

GENETIC ENGINEERING

Course Objectives:

1. To get hold of knowledge on enzymes and vectors
2. To be familiar with rDNA technology
3. To obtain knowledge about moler techniques
4. To know the basics on genetic engineering in plants
5. To obtain knowledge in the basics on genetic engineering in plants

Course Outcome:

The students could expertise in

CO1	Restriction modification system and vectors
CO2	Natural gene transfer methods
CO3	Molecular genome amplification techniques
CO4	Use of bacterial Ti, Ri plasmids and plant gene targeting techniques
CO5	Transgenic technology and animals

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

History and introduction to restriction enzymes – types - I, II & III. Restriction and modification System in Bacteria (*E.coli*) - Vectors - Plasmids - Phage, Cosmids, Phagemids and special vectors-broad host range expression in bacteria, shuttle vectors.

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

Bacterial conjugation – transformation – transduction. Gene transfer methods – Physical - Microinjection, Electroporation, Gene Gun, Ultrasonication, Microlaser gene transfer. Chemical methods – Liposome mediated, Transfection with DEAE-dextran, Calcium phosphate transfection.

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

PCR and Its applications Advanced techniques in genetic engineering

Introduction to PCR technology - gene amplification – PCR primer designing and optimization. Types of PCR - Multiplex and nested PCR, Reverse Transcriptase PCR, Real Time PCR, RACE, RAPD, RFLP, AFLP and their applications.

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

Uses of Introduction to *Agrobacterium tumefaciens* and *rhizogenes* - 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. Gene targeting in plants Introduction to plant tissue culture – Media composition and preparation - callus and cell suspension culturing.

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

Introduction to genetically modified organisms (GMO) - Production and applications of transgenic mice – gene knockout technology, role of ES cells in gene targeting in mice, transgenic cow. Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines.

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.

Web Sources

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

SEMESTER – V	**CORE PRACTICAL - V**
18U5MBCP05	**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:

They students could able to do

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, Identification and Biochemical characterizations and identification of clinical pathogens from clinical samples – Urine, Pus, Throat swab and Sputum.

2. Identification of fungal specimens by direct microscopy – KOH and LCB preparations.

3. Screening of amylase producing bacteria from soil.

4. Screening Production of citric acid producing bacteria and quantification from soil bacteria sample.

5. Immobilization technique.

6. Isolation of plasmid DNA from *E. coli.*

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.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits: 5	**5 Hours/Week**

MEDICAL VIROLOGY AND PARASITOLOGY

UNIT – 1 **No. of Hours: 12**

Nature and Properties of Viruses: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin. **Structure of Viruses:** Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses. **Viral multiplication and replication strategies:** Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna), Assembly, maturation and release of virions.

UNIT – 2 **No. of Hours**: **10**

Structure and function, Classification, one step multiplication curve, lytic and lysogenic phages (lambda phage), phage therapy. Oncogenic viruses. Antiviral compounds and their mode of action. Interferon and their mode of action. General principles of viral vaccination.

UNIT – 3 **No. of Hours**: **14**

Modes of viral transmission: Persistent, non-persistent, vertical and horizontal. **Salient features of viral Nucleic acid:** Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV).

UNIT – 4 **No. of Hours: 12**

Introduction to medical parasitology – Classification - Common diagnostic methods in parasitology - Examination of faeces for ova and cyst – Concentration methods – Blood smear examination of parasites. *Entamoeba histolytica - Giardia lamblia - Trichomonas vaginalis - Leishmania donovani - Trypanosoma brucei - Plasmodium falciparum – Plasmodium malariae*

UNIT – 5 **No. of Hours: 12**

General Characteristics, life cycle, diagnosis, prophylaxis and control of *Ascaris lumbricoides - Ancylostoma duodenale - Schistosoma haematobium - Taenia solium – Taenia saginata - 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. Bos L. (1999) **Plant viruses-A text book of plant virology** by. Backhuys Publishers.
9. Versteeg J. (1985). **A Color Atlas of Virology**. Wolfe Medical Publication.
10. Parija S.C. (2013) **Text book of Medical Parasitology.** 4th edition. All India Publishers and Distributors, New Delhi.
11. Chatterjee (1986). **Medical Parasitology**. Tata McGraw Hill, New Delhi.
12. Jagdish Chander (2012). **Text book of Medical Mycology**. 3rd edition. Mehta Publishers, New Delhi.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits: 5	**5 Hours/Week**

MEDICAL VIROLOGY AND PARASITOLOGY (PRACTICAL)

1. Studying isolation and propagation of animal viruses by chick embryo technique.
2. Study of cytopathic effects of viruses using photographs (Demonstration)
3. Haemagglutination
4. Haemagglutination Inhibition
5. Microscopic examination of ova, cyst, Egg and Fungi by saline wet mount, LCB, KOH, Iodine, Heamtoxylin and eosin, Giemsa staining, Leishman Staining.
6. Concentration of ova and cyst, egg – sedimentation and flotation techniques.

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**. 2nd Edition, 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. Bos L. (1999) **Plant viruses-A text book of plant virology** by. Backhuys Publishers.
9. Versteeg J. (1985). **A Color Atlas of Virology**. Wolfe Medical Publication.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

SOIL AND ENVIRONMENTAL MICROBIOLOGY

Objective:

- 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.

The course focuses on the concepts of soil and environmental microbiology such as biogeochemical cycles, major plant diseases caused by bacteria, fungi and viruses, biofertilizers and microbiology of air, water and sewage.

UNIT – 1 **No. of Hours: 12**

Introduction to soil microbiology – Physical and chemical properties of soil -Types and significance of soil microbes – Bacteria, Fungi, Actinomycetes, Protozoa, Nematodes and Viruses. Factors affecting microbial population.

UNIT – 2 **No. of Hours: 12**

Biogeochemical cycles – Carbon, nitrogen, phosphorous and sulphur - Mechanism of nitrogen fixation - Biofertilizer – Rhizobium, Azotobacter and Cyanobacteria – Mass cultivation, field study and its applications.

UNIT – 3 **No. of Hours: 12**

Structure and function of ecosystems. Microbial interactions – neutralism, commensalism, synergism, mutualism and parasitism. Interaction of microbes with plants – Rhizosphere, Phyllosphere and Mycorrhizae. Microbe-animal interaction**:** Microbes in ruminants, and symbiotic luminescent bacteria. Plant Pathology – symptoms, disease cycle and its control measures - Bacterial - Citrus canker, Fungal - Wilt of Cotton and Tikka leaf spot of groundnut, Viral – TMV.

UNIT – 4 **No. of Hours: 12**

Microbiology of air & water – Enumeration of bacteria from air – Air sampling devices – Air sanitation. Assessment of drinking water quality – water standards - indicator organisms – water purification – Waterborne diseases and their control measures.

UNIT – 5 **No. of Hours: 12**

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill), Biogas production. **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. Biodegradation, Bioremediation, Biodetoriation of leather, paint and xenobiotics.

Learning outcomes:

The course focuses on the concepts of soil and environmental microbiology such as biogeochemical cycles, major plant diseases caused by bacteria, fungi and viruses, biofertilizers and microbiology of air, water and sewage.

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.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

FOOD AND DAIRY MICROBIOLOGY (THEORY)

Objective

- •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

UNIT – 1 **No. of Hours: 12**

Foods as a substrate for microorganisms – Importance of microorganisms in food - Bacteria, Mold and Yeasts. Sources of food contamination. Factors affecting the Growth - Intrinsic factors - (pH, moisture, oxidation - reduction potential, and nutrient content), extrinsic factors - (temperature, relative humidity, gases and microbial activities) and inhibitory substances.

UNIT – 2 **No. of Hours: 12**

Microbial spoilage of various foods - General Principles underlying food spoilage and contamination - Spoilage and preservation of vegetables and fruits, meat and eggs, dairy products and sea foods.

UNIT – 3 **No. of Hours: 12**

Principles and methods of food preservation – Physical and chemical methods - Physical methods – Asepsis, temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging – tetra packing. Chemical methods - salt, sugar, organic acids, SO_2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

UNIT – 4 **No. of Hours: 12**

Fermented food products - Dairy starter cultures, fermented dairy products - yogurt, acidophilus milk, kumiss, kefir, dahi and cheese. Other fermented foods - dosa, sauerkraut, soy sauce and tampeh. Probiotics - Health benefits, types of microorganisms used, probiotic foods available in market, GRAS (General Regard on Safe).

UNIT – 5 **No. of Hours: 12**

Food borne diseases and Food sanitation: Food intoxications and food borne diseases. Rapid detection methods of food borne pathogens. Food sanitation and control.

TEXTBOOK:

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 BOOK

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.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

Objectives:

- To understand concept of Good laboratory practice.
- To gain knowledge about culture methods of food & pharmaceutical samples.
- To become familiar with pathogen in food industry.
- To understand Microbiological quality in Milk.
- To gain knowledge about HACCP & Food safety standards.

UNIT – 1 **No. of Hours: 09**

Microbiological Laboratory and Safe Practices: Good laboratory practices - Good microbiological practices. Biosafety cabinets - Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste - Methodology of Disinfection, Autoclaving & Incineration

UNIT – 2 **No. of Hours: 09**

Determining Microbes in Food / Pharmaceutical Samples: Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods - Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products. Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – 3 **No. of Hours: 10**

Pathogenic Microorganisms of Importance in Food & Water: Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. Quality assessment of chemicals, media and stains used in microbiological testing and MPN test.

UNIT – 4 **No. of Hours: 10**

Microbial quality control in Milk: Micro flora of milk - Milk borne diseases - Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay) - Food control agencies and its regulations – HACCP, FDA, WHO, FSSAI, ISI, EPA, BIS.

UNIT – 5 **No. of Hours: 10**

HACCP for Food Safety and Microbial Standards: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

Learning outcomes:

The content of this paper provides understanding on Good laboratory practice, medium and culturing methods in food and pharmaceutical industry, conventional and modern method to determine the microbes in food and dairy industry and HACCP & Food safety standards.

Text Books:

1. Rajesh Bhatia (2000). **Quality Assurance in Microbiology**. CBS publishers and Distributors Pvt. Ltd., New Delhi.
2. Adams M.R and Moss M.O (2008). **Food Microbiology**, 2nd Edition, Royal Society of Chemistry.
3. Frazier W.C and Westhoff D.C (2013). **Food Microbiology**, 5th edition, Tat McGraw Education, New Delhi

Reference Books:

1. Mandal S.K (2007). **Total Quality Management - Principles and Practice**. 1st Edition. Vikas Publishing House Pvt. Ltd.-Noida.
2. James M Jay, Martin J Loessner and David A Golden (2006). **Modern Food Microbiology**, 7th edition, Springer Science and Business Media, New York.
3. Richard K. Robinson (2005). **Dairy Microbiology Hand book: The Microbiology of Milk and Milk Products**, 3rd edition, John Wiley and Sons, New York.
4. Baird RM, Hodges NA and Denyer SP (2005). **Handbook of Microbiological Quality control in Pharmaceutical and Medical Device**s, Taylor and Francis Inc.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Objective:

- 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 production of fermented foods.
- To study the quality control of pharmaceutical products.

UNIT – 1 **No. of Hours: 12**

Introduction to industrial microbiology – Importance of microorganisms - Screening techniques - Primary and Secondary - Strain improvement - Development of inoculums – Production media – Industrial sterilization.

UNIT – 2 **No. of Hours: 12**

Industrial Fermentor - Components of fermentor – Types of bioreactors –Types of fermentor instrumentation – Fermentor and use - Scale up of fermentation - Upstream processing - Down Stream Processing – Recovery and Purification of intracellular and extracellular products.

UNIT – 3 **No. of Hours: 12**

Industrial production of enzymes – α amylase - Organic acid - citric acid, lactic acid and acetic acid - Aminoacid – Lysine - Vitamin B12 - Microbiological production of antibiotics – Penicillin & Streptomycin.Alcoholic beverages – Beer & Wine

UNIT – 4 **No. of Hours: 12**

Types of pharmaceutical products - Antimicrobial agents - Bioassay of antimicrobial agents – Contamination, spoilage and preservation of pharmaceutical products – Sterilization of pharmaceutical products - Microbiological quality control - Sterility test- Pyrogen test- Toxicity test- Carcinogenicity test

UNIT – 5 **No. of Hours: 12**

Drug delivery systems - Drug distribution in body, Bio-availability- Adverse drug reaction and drug interaction. Drug discovery - Phases of drug discovery - Clinical studies: phase I, phase II, phase III and phase IV of clinical trials - Bioprospecting - Extraction, purification and characterization of bioactive molecules from natural resources

Learning outcomes

The course is oriented towards the industrial applications and production of useful products using microorganisms. The students will know the industrial aspects of microbiology such as screening techniques, preservation methods, strain improvement, fermentor, upstream and downstream processing and fermented microbial products. Quality control and assay of the pharmaceutical products are also focused in this paper.

Text Books:

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

Reference books:

1. Peppler H.J and Perlman D (1979). **Microbial Technology**.Vol.1 and II. 2nd edition. Academic Press, New York.
2. Stanbury P.F, Whitaker A and Hall S.J (1995). **Principles of Fermentation Technology**. 2nd edition. Pergamon Press, New York.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

FOOD AND DAIRY MICROBIOLOGY (PRACTICAL)

1. Standard plate count of milk (SPC)
2. MBRT test of milk samples.
3. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
4. Isolation of Lactobacilli and Staphylococci from curd.
5. Isolation of any food borne bacteria from food products.
6. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
7. Isolation of spoilage microorganisms from bread.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Peppler H.J and Perlman D (1979). **Microbial Technology**.Vol.1 and II. 2nd edition. Academic Press, New York.
2. Stanbury P.F, Whitaker A and Hall S.J (1995). **Principles of Fermentation Technology**. 2nd edition. Pergamon Press, New York.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

ADVANCES IN MICROBIOLOGY

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.

UNIT – 1

Quorum sensing: Virulence factors associated with quorum sensing - Quorum sensing in Gram positive and Gram negative bacteria - molecular mechanisms. Quorum quenching - prokaryotic to prokaryotic quorum quenching - Eukaryotic to prokaryotic quorum quenching - applications of quorum quenching.

UNIT – 2

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 viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

UNIT – 3

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

UNIT – 4

Algal technology: Algal technology - Definition, Concepts -History, biotechnological potentials of microalgae - food - feed - Colorant - fuel and pharmaceutically variable compounds. Production of microbial biofertilizers - Mass cultivation of Cyanobacteria (Spirullina), Azolla and other N2 fixers.

UNIT – 5

Modern trends in microbial production: Modern trend in microbial production of bioplastics - Bioinsecticide (thruricide) - biopolymer (dextran, alginate, Xanthan) - Biofertilizer (N_2 fixer - Azotobacter, phosphate solubilizer) - Single cell protein (SCP).

Learning outcomes

The content of this paper provides understanding on quorum sensing, metagenomic, biofilms, microbial fuel production, biopesticides, bioinsecticide, bioherbicide, biofertilizers and biotechnological applications of microalgae.

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. 7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014). **Brook's Biology of Microorganisms**, 14th edition, Pearson-Bejamin Cummings
7. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011). **Bacterial Pathogenesis - A molecular Approach**, 3rd edition, ASM Press,

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

PRACTICAL - ADVANCES IN MICROBIOLOGY

1. Isolation of luminous Vibrio from sea water as a quorum sensing model.
2. Extraction of metagenomic DNA from soil (Demonstration)
3. PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers (Demonstration)
4. Bio-gas production from cow-dung slurry (demonstration)
5. Isolation of blue green algae from paddy field.
6. Field study of Azolla cultivation.
7. Isolation and identification of N_2 fixing Azotobacter and phosphate solubilizer.

REFERENCES

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**. 8thEdition. Mcgraw-Hill, Boston.
5. James G Cappuccino and Natalie Sherman (2005). **Microbiology: A Laboratory manual.**7th Edition, Pearson Education, Inc.

Semester – V	**Core – V**
18U5MBC	**Total number of Hours: 60**
Credits – 5	**5 Hours/Week**

ENTREPRENEURIAL MICROBIOLOGY

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.

UNIT – 1 **No. of Hours: 12**

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

UNIT – 2 **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 – 3 **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.

UNIT – 4 **No. of Hours: 12**

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

UNIT – 5 **No. of Hours: 12**

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

Learning outcomes

The course deals with the study of designing, launching and running a new business using potential microorganisms. Entrepreneur implies qualities of leadership, initiative and innovation in new venture designing of small scale business like production of mushroom, biocompost, vermicompost, biofertilizer and biopesticides.

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**. Todays's and Tomorrows 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. Oxford and 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.

HAEMATOLOGY AND BLOOD BANKING

Total Number of Hours: 48 **CREDITS - 04**

Objective:

- 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.

UNIT – 1 **No. of Hours: 10**

Introduction to Haematology – Blood – Components and its function - Haematopoietic system of the body – Development of Blood corpuscles - Erythropoiesis – Leukopoiesis – Thrombopoiesis

UNIT – 2 **No. of Hours: 10**

Haematological diseases – Anaemia - Types of Anaemias – Iron deficiency anaemia – Haemolytic disease of the new born – Infectious Mononucleosis – Multiple myeloma – Parasitic infections of blood – Leukaemia - classification.

UNIT – 3 **No. of Hours: 10**

Routine haematological tests – Introduction – Collection of blood – Anticoagulants - Complete Blood Cell count (CBC) – Determination of Haemoglobin by Sahli's method – Cyanmethemoglobin method – RBC count – WBC count - Differential count – Determination of ESR.

UNIT – 4 **No. of Hours: 09**

Haemostasis and Blood Coagulation – Mechanism of coagulation – Determination of Bleeding time and Clotting time – Immunohaematology – Human blood group systems – ABO grouping and other blood group systems – Rh Typing .

UNIT – 5 **No. of Hours: 09**

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.

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.

REFERENCES:

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.

MICROBIAL DIAGNOSIS IN HEALTH CLINICS

TOTAL HOURS: 30 **CREDITS: 2**

Objective:

- 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.

UNIT – 1 **No of Hours: 05**

Importance of Diagnosis of Diseases: Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

UNIT – 2 **No of Hours: 05**

Collection of Clinical Samples: Guidelines for the collection, Transport, Processing and analysis of samples - oral cavity, throat, sputum, skin scrapings, Blood, CSF, urine and faeces and its precautions. Storage method of clinical samples in laboratory.

UNIT – 3 **No of Hours: 05**

Direct Microscopic Examination and Culture: Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa -stained thin blood film for malaria. Preparation and use of various selective media - Distinct colony properties of various bacterial pathogens in selective medium.

UNIT – 4: **No of Hours: 05**

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

UNIT – 5: **No of Hours: 05**

Testing for Antibiotic Sensitivity in Bacteria: Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

TEXT BOOKS:

1. Ananthanarayan R and Paniker CKJ (2009). **Textbook of Microbiology**, 8th edition, Universities Press Private Ltd.

2. Jawetz, Melnick and Adelberg's **Medical Microbiology**. 26th edition. McGraw Hill Publication

REFERENCE BOOK

1. Topley & Wilsons – **Microbiology & Microbial Infections** – 9th Edition

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013)

3. Randhawa, VS, Mehta G and Sharma KB (2009) **Practicals and Viva in Medical Microbiology** 2nd edition, Elsevier India Pvt Ltd

4. Tille P (2013) **Bailey's and Scott's Diagnostic Microbiology**, 13th edition, Mosby