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

2019 - 2020 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 and 2020 - 2021 i.e. for the students who are to be admitted to the first year of the course during the academic year 2017-2018 and 2020 - 2021 thereafter
c) Any examination with biology as major subjects of any other University or Board accepted as equivalent there to by Periyar University.
d) Academic and vocational stream candidates are eligible.

5. DURATION OF THE COURSE

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

6. CONTINUOUS INTERNAL ASSESSMENT

The performance of the students will be assessed continuously and 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	- 25 Marks
2. Attendance	- 10 Marks
3. Observation note	- 5 Marks
Total	**40 Marks**

Break-up Details for Attendance

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

PASSING MINIMUM

INTERNAL

There shall be no passing minimum for internal

EXTERNAL

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

7. ELIGIBILITY FOR EXAMINATION

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

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES

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

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

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

9. ELIGIBILITY FOR AWARD OF THE DEGREE

A candidate shall be eligible for the award of the degree only if she has undergone the above degree for a period of not less than three academic years comprising of six 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 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.

13. TRANSITORY PROVISION

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

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.

SCHEME OF CURRICULUM – B.Sc., IN MICROBIOLOGY

(For the candidates admitted during the academic year 2018 – 2019 and 2020 – 2021 onwards)

Sem	Subject code	Part	Course	Subjects	Hrs/ Week	Credits	Int. Marks	Ext. Marks	Tot. Marks
I	18U1LT01	I	Language – I	Tamil – I	6	3	25	75	100
	18U1LH01			Hindi – I					
	18U1LM01			Malayalam – I					
	18U1LE01	II	English – I		6	3	25	75	100
	18U1MBC01	III	Core – I	Principles of Microbiology	5	5	25	75	100
	18U1MBCP01			Major Practical – I	4	3	40	60	100
	18U1BCA01	III	Allied – I	Biochemistry	4	4	25	75	100
	18U1BCAP01			Allied Practical – I	3	2	40	60	100
	18U1VE01	IV		Value education – (Yoga)	2	2	25	75	100
				Total	**30**	**22**	**205**	**495**	**700**
II	18U2LT02	I	Language – II	Tamil – II	6	3	25	75	100
	18U2LH02			Hindi – II					
	18U2LM02			Malayalam – II					
	18U2LE02B	II	English – II		6	3	25	75	100
	18U2MBC02	III	Core – II	Microbial Physiology and Metabolism	4	4	25	75	100
	18U2MBCP02	III		Major Practical – II	3	2	40	60	100
	18U2MBA01	III	Allied – II	Bioinstrumentation Techniques	4	4	25	75	100
	18U2MBAP01	III		Allied Practical – II	3	2	40	60	100
	18U2ES01	IV		Environmental studies	4	4	25	75	100
				Total	**30**	**22**	**205**	**495**	**700**
III	18U3LT03	I	Language – III	Tamil – III	6	3	25	75	100
	18U3LH03			Hindi – III					
	18U3LM03			Malayalam – III					
	17U3LE03B	II	English – III		6	3	25	75	100
	18U3MBC03	III	Core – III	Molecular Biology and Microbial Genetics	4	4	25	75	100

	18U3MBCP03			Major Practical – III	3	2	40	60	100
	18U3MBA02	III	Allied – III	Bioinstrumentation Techniques	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
				Total	**30**	**22**	**230**	**570**	**800**
IV	18U4LT04	I	Language – IV	Tamil – IV	6	3	25	75	100
	18U4LH04			Hindi – IV					
	18U4LM04			Malayalam – IV					
	18U4LE04	II	English – IV		6	3	25	75	100
	18U4MBC04	III	Core – IV	Immunology and Immunotechnology	4	4	25	75	100
	18U4MBCP04			Major Practical – IV	3	2	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
				Total	**30**	**22**	**230**	**570**	**800**
V	18U5MBC05	III	Core – V	Medical Bacteriology and Mycology	6	6	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
	18U5MBE01/02	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	III		Practical – V	6	3	40	60	100
				Total	**30**	**26**	**165**	**435**	**600**
VI	18U6MBC08	III	Core – VIII	Medical Virology and Parasitology	6	6	25	75	100
	18U6MBC09	III	Core – IX	Soil and Environmental Microbiology	5	5	25	75	100

	18U6MBC10	III	Core – X	Food and Dairy Microbiology	5	5	25	75	100
	18U6MBE03/04	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		Practical – VI	6	3	40	60	100
	18U6MBEX01	-	-	Extension activity	2	1	-		
				Total	**30**	**26**	**165**	**435**	**600**
Overall Total					**180**	**140**	**1200**	**3000**	**4200**

MAJOR ELECTIVE COURSES:

Semester – V

1. Hematology and Blood Banking (18U5MBE01)
2. Entrepreneurship in Microbiology (18U5MBE02)
3. Mushroom Cultivation Technology (18U5MBE02A)

Semester – VI

1. Microbial Diagnosis in Health Clinics (18U6MBE03)
2. Quality Control in Food Microbiology (18U6MBE04)
3. Vermi Tech (18U6MBE04A)

NON MAJOR ELECTIVE COURSES:

1. Public Health and Hygiene (18U3MBN01)
2. Diseases - Epidemics and Control (18U4MBN02)

SEMESTER I

SEMESTER – I	**CORE - I**
18U1MBC01	**Total Number of Hours: 60**
Credits - 5	**5 Hours/ Week**

PRINCIPLES OF MICROBIOLOGY

Course Objectives:

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

Course Outcome:

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

UNIT – I **No. of Hours: 12**

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

UNIT – II **No. of Hours: 12**

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

UNIT – III **No. of Hours: 12**

Cultivation of Microbes: Culture media – solid, liquid, semisolid and its types - Basal- Differential- Selective- Enrichment, Enriched and transport media. Cultivation of anaerobes – Pyrogallol and Gas Pak method. Pure culture isolation techniques – Spread. Pour and Streak plate methods. Preservation of cultures. **Sterilization:** Physical and Chemical methods of sterilization. Antibiotics classification based on mode of action – Tests for sensitivity to antimicrobial agents.

UNIT – IV **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 – V **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.

Web References

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

Mapping

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

20U1MBC01

(For the candidates admitted from 2020- 21 onwards)

B.Sc., DEGREE EXAMINATIONS

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First Semester

Microbiology

PRINCIPLES OF MICROBIOLOGY

Time: Three hours **Maximum Marks: 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 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. Evolution

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**
19U1MBCP01	**Total Number of Hours: 45**
Credits - 3	**4 Hours/ Week**

PRINCIPLES OF MICROBIOLOGY (PRACTICALS)

Objectives

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

Course Outcome:

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

1. Microbiology Good Laboratory Practices and Biosafety.
2. The principle and applications of instruments (Laminar air flow, biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for aerobic and anaerobic bacteria.
4. Pure culture technique- Serial dilution, pour plate, spread plate and streak plate.
5. Enumeration of bacteria and actinobacteria from environmental water sample (soil/ water).
6. Staining techniques- simple, differential, negative, Metachromatic, endospore, capsular, metachromatic granules and flagellar staining.
7. Determination of bacterial motility by hanging drop technique.
8. Microscopic Examination of fungus by LCB
9. Microscopic examination of Algae
10. 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			✓	✓	✓
CO4	✓	✓		✓	
CO5	✓	✓	✓		✓

SEMESTER II

SEMESTER – II	**CORE - II**
18U2MBC02	**Total Number of Hours: 60**
Credits – 4	**4 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 – I **No. of Hours: 12**

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

UNIT – II **No. of Hours: 12**

Growth of bacteria: Nutritional requirements of bacteria Nutritional types of bacteria - Classification of bacteria based on nutrients - Autotroph, Phototroph and Chemotroph - factors influencing microbial growth – growth curve – Generation time - Specific Growth Rate - Mathematical determination of growth. Multiplication, Sporulation and its mechanism. Mechanism of sporulation.

UNIT – III **No. of Hours: 10**

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

UNIT – IV **No. of Hours: 14**

Aerobic respiration and Fermentation: 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.

Bacterial Photosynthesis and Fermentation: Distribution of the phototropic bacteria – the elementary processes of photosynthesis – anoxygenic photosynthesis –oxygenic photosynthesis – photosynthesis in halobacteria. Outline mechanisms and ATP regeneration by fermentation. Alcoholic fermentation by yeasts and bacteria ethanol formation. Lactic acid fermentation

UNIT – V **No. of Hours: 12**

Anaerobic respiration: 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, Nitrogen fixation.

Aerobic and Anaerobic respiration: Aerobic - Glycolysis, Pentose Phosphate Pathways, EMP, TCA and Glyoxalate cycle - Anaerobic respiration (Nitrate reduction, Sulfidogenesis Methanogenesis and Acetogenesis) - . Physiology of Bio luminescence.

Text Books

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

Reference Books

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

Web sources

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

Mapping

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

(For the candidates admitted from 2020- 2021 onwards)

20U2MBC02

B.Sc., DEGREE EXAMINATIONS

-------- / ------- 2020.

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 wall 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 and waste product accumulation is called as ----------
   a. Batch culturing b. Ascus c. Fruiting body d. Continuous culturing
7. The organisms that obtain energy from chemicals are called
   a. Prototrophs b. Organotrophs c. Chemotrophs 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. graph 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 wall
    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. ---------- protein combines with the substance and helps to move across the membrane
    a. Carrier b. Channel c. Cell recognition d. Receptor

12. 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 proteins

13. Hetero lactic bacteria produce -----
    a. lactic acid only b. lactic acid + water + carbon di oxide
    c. lactic acid + 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. Chlorophyll a b. Chlorophyll b c. Porphyrin d. Rhodopsin
17. The oxygen released into the air as a product of photosynthesis comes from -------
    a. Chlorophyll b. Carbon di oxide c. Water d. None of the above
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 monophosphate pathway is also known as
    a. Phosphogluconate pathway b. Oxalocaetate pathway
    c. Malate pathway d. Fumerate pathway
20. The glyoxylate cycle is used by some organisms when ----- is the sole carbon source
    a. Acetate b. Nitrate c. Carbon di oxide d. All of the above

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**
20U2MBCP02	**Total Number of Hours: 45**
Credits – 2	**3 Hours/ Week**

MAJOR PRACTICAL – II - MICROBIAL PHYSIOLOGY AND METABOLISM

Course Objectives

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

Course Outcome:

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

Bacterial growth curve – Turbidometric assay.

1. Determination of generation time.
2. Effect of temperature and pH on growth of bacteria.
3. Effect of temperature on growth of bacteria.
4. Effect of pH on growth of bacteria.
5. Effect of carbon and nitrogen sources on growth of bacteria.
6. Effect of salt concentration on growth of bacteria.
7. Effect of incubation time and inoculum size on growth of bacteria
8. Determination of microbial biomass: Wet and Dry
9. Biochemical parameters

   a) IMViC

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

   c) Catalase

   d) Oxidase

   e) Urease

   f) TSI

   g) Nitrate reduction test

Reference Books

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

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

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

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

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

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

Mapping

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

SEMESTER – II **ALLIED – II**
18U2MBA01 **Total number of Hours: 60**
Credits: 4 **4 Hours/Week**

BIOINSTRUMENTATION TECHNIQUES

Course Objectives:

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

Course Outcome:

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

UNIT – I **No. of Hours: 12**

Microbiological Instruments: Basic requirements of a SOP Guidelines for Microbiology Laboratory – Basic microbiological Instruments – Laminar Airflow, Biosafety Cabinets – levels – 1 to 3, Inoculation loop, Colony counter, Anaerobic jar, Neubaeur chamber, Transillumintor, Cyclo mixer, Homogenizer, Sonicator and fumigator. Incubators - Shaker incubator, BOD incubator, CO_2 Incubator – water and air jacketed. Microscopy – SEM, TEM and Confocal and Atomic. Weighing Balance – microbalance mono pan, top and physical, Deep freezers – horizontal, verticle – Lyophilizer and rotary evaporator.

UNIT – II **No. of Hours: 12**

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

UNIT – III **No. of Hours: 10**

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

UNIT – IV **No. of Hours: 12**

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

UNIT – V **No. of Hours: 14**

Chromatography: Introduction, Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography, Column chromatography, Gel filtration chromatography, Gas chromatography coupled with mass spectrometry, Ion-exchange chromatography, affinity chromatography and HPLC.

Text Books

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

Reference Books

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

Mapping

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

20U2MBA01

(For the candidates admitted from 2020- 2021 onwards)

B.Sc., DEGREE EXAMINATIONS

-------- / ------- 2020.

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. Proton d. All the above
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 microscope.
27. Explain the various factors that affecting chromatography.
28. Describe in detail about SDS electrophoresis.
29. Discuss in detail about UV Spectrophotometer.
30. Explain briefly about the ultracentrifuge.

SEMESTER – II	**ALLIED PRACTICAL – II**
18U2MBAP01	**Total number of Hours: 45**
Credits – 2	**4 Hours/Week**

ALLIED PRACTICAL – II - BIOINSTRUMENTATION TECHNIQUES

Course Objectives:

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

Course Outcome:

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

1. **Calculation in preparation of reagents:** Normality of solution, Molarity of solution
2. **Chromatographic Techniques**: (A) Paper and (B) Thin layer chromatography (C) Column 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.

Reference Books

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

Mapping

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

SEMESTER III

SEMESTER – III	**CORE – III**
18U3MBC03	**Total number of Hours: 60**
Credits – 4	**4 Hours/Week**

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Course Objectives:

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

Course Outcome:

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

UNIT – I **No. of Hours: 12**

Genetic Material (DNA & RNA): Genetics – Historical perspectives, discovery of DNA structure – Watson and Crick model – Types and forms of DNA, 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 – II **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. Eukaryotic replication. Transcription in prokaryotes and eukaryotes: promoter, operator, RNA polymerase functions.

UNIT – III **No. of Hours: 12**

Translation: Salient features of genetic code - Wobble hypothesis. Translational machinery, charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination in prokaryotes. Operon concept – *lac* and *trp* operons.

UNIT – IV **No. of Hours: 12**

Plasmid: Types of plasmids – F plasmid, R Plasmids, Col plasmids, pBR322, PUC vectors Ti plasmids, Plasmid - replication, partitioning, Host range, plasmid incompatibility, plasmid amplification, regulation of copy number and curing of plasmids.

UNIT – V **No. of Hours: 12**

Gene transfer, Mutation and DNA repair mechanisms: Transformation – Discovery, mechanism of natural competence. Conjugation – mechanism, Hfr and F' strains, Transduction – Generalized transduction and specialized. transduction. Mutations and types of mutation - Auxotrophic mutant detection: Replica plate technique. Mutagenicity testing – Ames Test. DNA repair mechanisms – excision, mismatch, SOS, photoreactivation and recombination repair.

Text Books

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

Reference Books

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

Web sources:

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

Mapping

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

18U3MBC03

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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

Third Semester

Microbiology

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. **A nucleoside is composed of**

a) a base+ a sugar b) a base+ a sugar+ phosphate c) a base+ a phosphate d) none of these

2. Two strands in a DNA double helix is joined by

a) Covalent bond b) Hydrogen bond c) Ionic bond d) Phosphodiester bond

3. The sugar in RNA Is

a) Deoxyribo sugar b) Ribo sugar c) Fructose d) Sucrose

4. Thymine in DNA replaced by

a) Uracil b) Adenine c) Guanine d) Cytosine

5. Which enzymes remove supercoiling in replicating DNA ahead of the replication fork?

a) Helicases b) DNA polymerases c) Primases d) Topoisomerases

6. During which phase of the cell cycle is DNA replicated?

a) G1 phase b) S phase c) G2 phase d) M phase

7. True replication of DNA is possible due to

a) Hydrogen bonding b) Phosphate backbone c) Complementary base pairing d) None of above

8. Most of mistakes during DNA replication are corrected by

a) DNA polymerase b) DNA ligase c) gyrase d) Helicase

9. The accepted hypothesis for DNA replication is

a) Conservative theory b) Dispersive theory c) Semi-conservative theory d) Evolutionary theory

10. Telomeres are usually rich in which nucleotide?

a) Adenine b) Guanine c) Cytosine d) Thymine

11. In prokaryotes, the first aminoacid in the polypeptide chain is

a) Methionine b) N-Methyl methionine c) N-Formyl methionine d) N-Acetyl methionine

12. On which of the following molecules would you find a codon?

a) mRNA b) rRNA c) tRNA d) SnRNA

13. What amino acid is coded by the triplet of bases UAU?

a) Phenylalanine b) Tyrosine c) Serine d) Cysteine

14. Ti plasmid that is used as a plant vector is obtained from

a) *Agrobacterium tumefaciens* b) *Agrobacterium rhizhogenes*

c) *Agrobacterium radiobacter* d) *Thermas aquaticus*

15. Which of the following cells of *E.coli* are referred to as F-

a) Male b) Female c) Both A&B d) Neither A or B

16. Point mutation involves

a) Deletion b) Insertion c) Duplication d) Change in single base pair

17. When viral genome can become integrated into the bacterial genome they are known as

a) Temperate phage b) Prophage c) Bacteriophage d) Episome

18. Name a type of Radiation in induced mutations

a) Microwave b) UV radiation c) Heat d) Both A & C

19. The function of enzyme involved in base excision repair is

a) Addition of correct base b) Addition of correct nucleotide

c) Removal of incorrect base d) Removal of phosphodiester bond

20. The enzyme photolyase is used in what method of repair?

a) Base exicision b) Photoreactivation c) Nucleotide excision d) SOS repair

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. Describe the Watson and Crick model of DNA **(OR)**
    b) Discuss about the types of RNA.
22. a) Write short notes on Rolling circle model of replication **(OR)**
    b) Explain about the bidirectional replication.
23. a) Write short notes on Lac operon **(OR)**
    b) Differentiate the Transcription and Translation process.
24. a) Discuss about the Ti plasmid **(OR)**
    b) Give short notes on Conjugation.
25. a) Write short notes on mutation and its types **(OR)**
    b) Discuss about the Replica plate technique.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Briefly explain about the DNA as the genetic material.
27. Explain about the replication in prokaryotes.
28. Discuss the operon concept in detail.
29. Give a brief account on Transduction.
30. Explain briefly about the DNA Repair mechanisms.

SEMESTER – III	**CORE PRACTICAL – III**
18U3MBCP03	**Total number of Hours: 30**
Credits – 2	**3 Hours/Week**

MOLECULAR BIOLOGY AND MICROBIAL GENETICS (PRACTICALS)

Course Objectives:

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

Course Outcome:

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

1. Isolation of chromosomal DNA from bacteria
2. Isolation of plasmid DNA from *E. coli*
3. Quantification of genetic material
4. Physical and Chemical mutagenesis
5. Isolation of antibiotic resistant mutant by gradient plate technique
6. Isolation of auxotrophic mutant (replica plating Complete plating)
7. Isolation of coli phage Bacteriophage from sewage
8. Bacterial Gene Transfer – Transformation (Demonstration)

Reference Books

1. Sambrook J and Russell DW (2001). **Molecular Cloning** – **A laboratory manual.** 3rd Edition. Cold Spring Laboratory Press, New York.

2. Dubey RC and Maheshwari DK (2002). **Practical Microbiology**. S Chand and Co. Ltd., New Delhi.
3. Aneja KR (2010). **Experiments in Microbiology, Plant Pathology and Biotechnology.** New Age International (P) Limited Publishers.
4. Harold J Benson (2002). **Microbiological Applications: Laboratory manual in General Microbiolog**y. 8th Edition. Mcgraw-Hill, Boston.
5. James G Cappuccino and Natalie Sherman (2005). **Microbiology: A Laboratory manual.** 7th Edition, Pearson Education, Inc.

Mapping

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

SEMESTER – III	**ALLIED – III**
20U3MBA02	**Total number of Hours: 45**
Credits – 4	**4 Hours/Week**

CELL BIOLOGY

Course Objectives:

1. To understand the basic concept of cell biology
2. The basic knowledge on cell and their structure
3. To gain the knowledge on ultrastructure and functions of cell organelles
4. To learn the ultrastructure and functions of Nucleus
5. Acquire knowledge on cell division and cell cycle

Course Outcome:

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

UNIT I **No. of Hours: 09**

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

UNIT II **No. of Hours: 09**

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

UNIT III **No. of Hours: 09**

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

UNIT IV **No. of Hours: 09**

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

UNIT V **No. of Hours: 09**

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

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

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

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

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

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

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

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

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

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

Web sources:

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

Mapping

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

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

CELL BIOLOGY (ALLIED PRACTICAL)

Course Objectives:

1. To aware the knowledge about Prokaryotic and Eukaryotic cells
2. To knowledge about the cell divisions
3. To achieve the knowledge about the cell media
4. To known the tissue culture

Course Outcome:

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

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

Mapping

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

SEMESTER – III	**ALLIED – III**
18U3MBA03	**Total Number of Hours: 45**
Credit – 4	**4 Hours/ Week**

MICROBIOLOGY

Course Objectives:

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

Course Outcome:

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

UNIT – I **No. of Hours: 09**

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

UNIT – II **No. of Hours: 09**

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

UNIT – III **No. of Hours: 09**

Cultivation of Microbes: Culture media – Definition – Types - composition – Media preparation – Basal, Differential, Selective, Transport and Enriched media 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 – IV **No. of Hours: 09**

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

UNIT – V **No. of Hours: 09**

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

Text Books

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

Reference Books

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

Web References

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

Mapping

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

18U3MBA03

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Second Semester

Microbiology

ALLIED MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Robert Koch discovered

a. *Bacillus anthracis* b. *Salmonella typhi* c. *Ebola* virus d. *Amoeba* parasite

2. Anton Von Leeuwenhoek discovered

a. Animalcules b. Virus c. Fungi d. Yeast

3. Which one of the following is used to visualize live cells?

a. Bright field microscopy b. Dark field microscopy

c. Phase contrast microscopy d. SEM

4. Electron microscope was made by

a. Robert hooke b. Knoll and Ruska c. Kepler and Galileo d. F.Janssen and Z.janssen

5. Gram staining is the example for

a. Simple staining b. Differential staining c. Special staining d. None of the above

6. Lipopolysaccharide is found in cell wall of

a. Gram positive bacteria b. Gram negative bacteria c. Both d. Fungi

7. Which one of the following is used as disinfectant in LCB staining?

a. Lactic acid b. Phenol c. Glycerol d. Methylene blue

8. Which of the staining technique helps in demonstrating spore structure in bacteria as well as free spores?

a. Acid-fast stain b. Endospore stain c. Capsule stain d. Flagella stain

9. Which of the following is a rich source of nitrogen?

a. Peptone b.Yeast extract c. Beef extract d. Agar

10. The importance of agar in culture media were discovered by

a. Ehrlich b. Petri c. Finly d. Hessy

11. During preservation of microbes their --------

a. characteristics change b. metabolism stop c. metabolism continue d. metabolism change

12. Which of the following method is widely used for the preservation of microbes?

a. Drying in vacuum b. Storage in sterile soil

c. Lyophilization d. Storage in saline

13. Transmission of 'pathogens' during pregnancy from mother to child is called as

a. Direct transmission b. Horizontal transmission

c. Vertical transmission d. Indirect transmission

14. An insect or animal carrier of disease is known as

a. Carrier b. Vector c. Fomite d. Vehicle

15. Water quality is measured by
a. MBRT b. Resazurin test c. Staining d. MPN
16. Cholera is caused by
a. Vibrio b. *E.coli* c. *Salmonella* d. *Pseudomonas*
17. Pasteurization technique is used for
a. Milk b. Cheese c. Bread d. Antiseptic
18. The undesirable change that makes the unsafe food consumption is called -----
a. Food decay b. Food spoilage c. Food loss d. All the above
19. Botulism is caused by
a. *E.coli* b. *Clostridium botulinum* c. *Clostridium tetani* d. *Salmonella typhi*
20. Which one is the example for qualitative analysis of milk?
a. MBRT b. KOH mount c. LCB mount d. MPN test

PART – B (5 x 5 = 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a) Write the contributions of Alexander Fleming **(OR)**
    b) Write the contributions of Robert Koch.
22. a) Briefly explain bright field microscopy **(OR)**
    b) Describe the principle and application of Dark field microscopy.
23. a) Explain the principle and steps involved in capsule staining **(OR)**
    b) Explain the principle and steps involved in endospore staining.
24. a) Briefly explain the types of infection **(OR)**
    b) Give a short note on Giardiasis.
25. a) Give a brief note on bioactive compounds (**OR)**
    b) Write about the probiotics.

PART – C (3 X 10 = 30 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Describe the contributions of Louis Pasteur.
27. Describe the specimen preparation for Electron microscopy.
28. Explain Gram staining and acid fast staining.
29. Discuss in detail about Aspergillosis.
30. Explain in detail about the bacterial biopesticides.

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

MICROBIOLOGY (PRACTICALS)

Course Objectives

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

Course Outcome:

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

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

10. Water Quality testing - MPN.

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.

SEMESTER – IV	**CORE – IV**
18U4MBC04	**Total number of Hours: 60**
Credits – 4	**4 Hours/Week**

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course 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

Course Outcome:

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

UNIT – I

Introduction and 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.

No. of Hours: 12

UNIT – II **No. of Hours: 12**

Immune response: Immunity - Concept of innate and acquired immunity; Types - Specific and non-specific - Primary and secondary immune response; 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 – III **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 class

I&II molecules.of MHC I & II molecules; Complement system;- Classical and Alternative pathways.- Biological consequences of complement Activation.

UNIT – IV **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, and HAI. Bacterial agglutination, Passive agglutination. Precipitation reactions - in fluid and in gel. Immunoelectrophoresis-. Ouchterlony double diffusion. Immunofluorescence techniques - ELISA: Direct, Indirect and sandwich, Biotin-Avidin system, RIA, Western blotting technique. Flowcytometry and Immunoelectron microscopy.

UNIT – V **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. Autoimune diseases.

Text Books

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

Reference Books

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

Web sources

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

Mapping

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

18U4MBC04

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B.Sc., DEGREE EXAMINATIONS

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Fourth Semester

IMMUNOLOGY AND IMMUNOTECHNOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Macrophages are derived from ----------
a) Monocytes b) Lymphocytes c) Neutrophils d) Basophils
2. Cells which kills cells that display foreign motifs on their surface are ----------
a) plasma cells b) red blood cells c) antigens d) cytotoxic T lymphocytes
3. Antibodies are secreted by ----------
a) Stem cells b) tissue cells c) plasma cells d) membranous cells
4. Major components of an immune system include ----------
a) T-lymphocytes b) B-lymphocytes c) antibodies d) All of Above
5. The two types of immunity in humans are ----------
a) Intrinsic & Extrinsic b) Innate & Acquired
c) Overt & Covert d) Internal & External
6. T cell mediates ----------
a) Cell mediated immune response b) Humoral immune response
c) Non specific defence d) None of these
7. Immunologic memory is provided by ----------
a) B cells b) T cells c) Both a & b d) Phagocytes
8. Origin & maturation of B cells takes place at ---------
a) Spleen b) Thymus c) Bonemarrow d) Lymphnodes
9. A foreign macromolecule that binds selectively to an antibody is called ----------
a) Stem cell b) Antigen c) Antibody d) Lymph
10. IgM is structurally characterized as
a) Monometric b) Bimetric c) Pentametric d) Tetrametric
11. The classical pathway is activated by a combination of ----------
a) Bacteria, Antigen & Antibody b) Complement, Antigen & Antibody
c) Antigen & Antibody d) Virus, Antigen & Antibody
12. MHC class I molecules are primarily involved in ----------
a) Recognition of glycolipid antigens b) Resistance to fungi
c) Resistance to viruses d) Activation of neutrophils
13. O blood group is universal donor because the blood has ---------
a) Antigen A b) Antigen B c) Antigen A & B d) No antigens
14. The precipitation test is relatively less sensitive for the detection of ----------
a) Antigens b) Antibodies c) Complement d) Antigen-Antibody complexes
15. Commercially available ELISA kits are used for the detection of ----------
a) Hepatitis B surface antigen b) Anti -HIV antibodies c) Rota virus d) All of these
16. In 1959 radio immune assay was developed by ----------

a) Soloman b) Benson c) Rosalyn d) All of the above

17. Inflammation reaction is brought about by ----------
a) Plasma cells b) Macrophages c) Mast cells d) Adipose cells
18. Which of the following binds to an Fc receptor on mast cells and basophils?
a) IgA b) IgD c) IgM d) IgE
19. Pernicious anaemia develops from the deficiency of --------
a) ATP b) Cobalt c) Hormones d) The intrinsic factors
20. What is the pathognomonic feature of rheumatoid arthiritis?
a) Rheumatoid factor b) Rheumatoid nodule c) Morning stiffness d) ulnar drift of fingers

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. a) Describe about the Primary lymphoid organs (or)
b) Discuss about the History of immunology.
22. a) Write short notes on Specific immunity**(or)**
b) Explain about the T cell activation
23. a) Write short notes on Immunoglobulin structure **(or)**
b) Explain about MHC II molecules
24. a) Discuss about the Haemagglutination **(or)**
b) Give short notes on RIA (**or)**
25. a) Write short notes on Type I hypersensitivity reactions **(or)**
b) Discuss about the Type IV hypersensitivity reaction.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Briefly explain about the Haematopoiesis.
27. Explain about the generation of humoral immune response.
28. Discuss the Complement pathways.
29. Give a detailed account on ELISA.
30. Explain briefly about the autoimmunity

SEMESTER – IV	**CORE PRACTICAL – IV**
18U4MBCP04	**Total number of Hours: 45**
Credits – 2	**3 Hours/Week**

MAJOR PRACTICAL – IV - IMMUNOLOGY & IMMUNOTECHNOLOGY

Course Objectives:

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

Course Outcome:

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

1. Identification of human ABO blood groups and Rh Typing.
2. Separation of serum/plasma from the blood sample (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. Rocket immunoelectrophoresis.
8. Counter current immunoelectrophoresis (demonstration).
9. Enzyme Linked Immunosorbent Assay (ELISA) – (demonstration).

References:

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

Mapping

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

SEMESTER – IV	**NMEC - II**
18U4MBN02	**Total number of Hours: 30**
Credits: 2	**2 Hours/Week**

DISEASES - EPIDEMICS AND CONTROL

Course Objectives:

i) To get an awareness about the infectious diseases and its epidemiology
ii) To gain the knowledge on various chronic diseases
iii) To impart the outbreak investigations and the role of laboratory
iv) To endow with an geographic information system in infectious disease
v) To aware the students in prevention of infectious diseases

Course Outcome:

CO1	They could learn about the infectious diseases and its epidemiological reports
CO2	They could learn the various chronic diseases
CO3	Able to learn about outbreak investigations and its diagnostic methods
CO4	Helps to gain the geographic informations in diseases
CO5	It makes expertise in the prevention of infectious diseases

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

History of infectious disease and epidemiology – Introductory concepts – Laboratory methods in the study of infectious diseases - Models to study infectious diseases - Modeling the spread of a disease- Emergent characteristics of Infectious diseases - Mathematical Epidemiology of Infectious disease.Introduction of microorganisms,types of diseases.Identification of infectious diseases.

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

Chronic diseases – common bacterial zoonotic diseases - Anthrax, Brucellosis – Vector borne diseases - Malaria and Dengue, Food borne Illness - Salmonellosis, Ameabiasis, Sexually Transmitted Diseases - HIV/ AIDS. Disease Detection & Analysis

UNIT III **Total No. of hours: 06**

Outbreak investigation - Confirm outbreak and diagnosis - advance knowledge about a disease. Role of the Public Health Laboratory - Disease Surveillance - Principles of Screening and Screening Tests. Food poisoning and staining techniques

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

Geographic information systems in infectious disease – Pandemic outbreak, Healthcare associated infections/ infection prevention – Development of Drug Resistance & Infection Control in a Hospital Setting.

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

Principles of elimination and eradication – Vaccination. Behavior change and HIV/STDs - Blood Safety - Immigrant and Refugee Health - International Research in Resource Poor Settings - Critical Reading of Medical Literature. Antibiotics – Penicillin, Kanamycin, Streptomycin, Amoxycillin and Colistin.

Suggested Reading

1. Kenrad Nelson and Carolyn Williams (2014). Infectious Disease Epidemiology. Third Edition.

2. David L. Heymann (2015). Control of Communicable Diseases Manual. 20th Edition, American Public Health Association.

3. Annual Summary of Communicable Diseases Reported to the Minnesota Department of Health, 2015. Minnesota Department of Health.

Web sources

1. www.health.state.mn.us/divs/idepc/newsletters/dcn/sum15/2015dcn.pdf
2. http://www.journals.uchicago.edu/CID/home.html

Mapping

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

18U4MBN02

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Fourth Semester

Microbiology

DISEASES – EPIDEMICS AND CONTROL

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. In which of these do you see clue cells?

a. *Trichomonas vaginalis* b. Bacterial vaginosis c. *Candida* d. HSV 2

2. In CSF of a patient with viral meningitis, the most prominent white cell is usually

a. Monocytes b. Lymphocytes c. Eosinophils d. Polymorphs

3. Which is the most common organism/s causing osteomyelitis in all age groups?

a. Streptococci b. Staphylococci c. Hemophilus d. Fungal

4. Which organism cannot be detected by antigen testing of CSF, serum of urine?

a. *Cryptococcus neoformans* b. *Mycobacterium tuberculosis* c. *E. coli* d. *Hemophilus*

5. Which is not an AIDS defining illness?

a. Oesophageal candidiasis b. PCP c. Pulmonary TB d. Invasive cervical cancer

6. Which is not a common cause of respiratory symptoms in HIV/AIDS patients?

a. Community acquired bacterial pneumoniae b. Non Hodgkins lymphoma

c. Pulmonary Embolus d. CMV

7. Which of these pulmonary conditions is most likely to be seen with a CD4 count between 200 and 500?

a. Pulmonary TB b. CMV c. Karposi sarcoma d. Cryptococcus

8. Which is false regarding PCP pneumonia in AIDS?

a. It is usually only seen when the CD4 count <200

b. Prophylaxis should be given in all pts with CD4 count <200

c. CXR characteristically shows bilateral diffuse infiltrates

d. Once a patient has had it they are unlikely to get it again

9. Which statement is true regarding CT and LP in AIDS patients?

a. They should all have a CT prior to LP b. If they are not febrile they do not need a CT

b. If they have no focal neurology they do no need CT d. All of the above

10. Which vaccination should not be given to HIV suffers?

a. ADT b. Pneumococcal c. DPT d. Inactivated polio vaccine

11. Which drug should not be given with midazolam?

a. Zidovidine b. Lamivudine c. Nevirapine d. Ritinovir

12. Which drug regimen in AIDS is usually used?

a. 2 nucleosides and nevirapine b. 2 nuclease and a protease inhibitor

c. 1 nucleoside, nevirapine and a protease inhibitor d. All of the above

13. Which agent should not be part of the management of generalized tetanus?
a. Metronidazole b. Penicillin c. Tetanus immunoglobulin d. Labetalol
14. A 60 year old lady presents with a skin tear to her left skin on her coffee table. She is unsure of her previous immunization status. How should this be managed?
a. ADT b. immunoglobulin c. ADT and immunoglobulin c. None of the above
15. Which is not a differential diagnosis for tetanus?
a. Strychnine poisoning b. Dystonic reactions c. Quinsy d. Cyanide poisoning
16. Which animal is least associated with rabies?
a. Dogs b. Skunks c. Rats d. Bats
17. Which does not require post exposure prophylaxis for rabies?
a. Scratch b. Bite on face
c. Bite on extremity d. Skin contact with blood, urine or faeces
18. In which illness can hydrophobia be seen?
a. Tetanus b. Malaria c. Rabies d. EBV
19. Which organism is least likely to show the characteristic periodicity of fever in malaria?
a. *P. malariae* b. *P. vivax* c. *P. ovale* d. *P. falciparum*
20. Which statement is not true?
a. Negative thick and thin smears does not adequately rule out malaria
b. Falciparum malaria will always show up on thick and thin smears where the others may not
c. Chloroquine is the drug of choice to treat falciparum
d. Vivax and ovale are more likely to reactivate at a later stage

PART – B (5 x 5 = 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a) Explain in detail epidemiology of infection (OR)
b) Give short note on model study infections disease.
22. a) What are all the impacts of communicable diseases (OR)
b) Explain on pollutants reach humans.
23. a) Give short note on food borne illness (OR)
b) Give an overview on non communicable diseases.
24. a) Explain on evolution of public and community health (OR)
b) Give an account on communicable diseases.
25. a) Write on blood safety (OR)
b) Explain on occupational public health.

PART – C (3 X 10 = 30 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Explain and detail infectious disease and epidemiology.
27. Describe the concept of vector borne diseases.
28. Explain in detail about communicable diseases.
29. Give a detailed account on various risk factors and policies of non communicable diseases.
30. Give a detailed account on vaccination.

SEMESTER – IV	**ALLIED – III**
18U4MBA03	**Total Number of Hours: 45**
Credit – 4	**4 Hours/ Week**

MICROBIOLOGY

Course Objectives:

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

Course Outcome:

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

UNIT – I **No. of Hours: 09**

History & Scope of Microbiology: Introduction - Contributions of various scientists to Microbiology - Louis Pasteur, Antony Van Leeuwenhoek, 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 – II **No. of Hours: 09**

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 – III **No. of Hours: 09**

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 – IV **No. of Hours: 09**

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

UNIT – V **No. of Hours: 09**

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

Text Books

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

Reference Books

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

Web References

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

Mapping

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

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Second Semester

Microbiology

ALLIED MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Robert Koch discovered

a. *Bacillus anthracis* b. *Salmonella typhi* c. *Ebola* virus d. *Amoeba* parasite

2. Anton Von Leeuwenhoek discovered

a. Animalcules b. Virus c. Fungi d. Yeast

3. Which one of the following is used to visualize live cells?

a. Bright field microscopy b. Dark field microscopy

c. Phase contrast microscopy d. SEM

4. Electron microscope was made by

a. Robert hooke b. Knoll and Ruska c. Kepler and Galileo d. F.Janssen and Z.janssen

5. Gram staining is the example for

a. Simple staining b. Differential staining c. Special staining d. None of the above

6. Lipopolysaccharide is found in cell wall of

a. Gram positive bacteria b. Gram negative bacteria c. Both d. Fungi

7. Which one of the following is used as disinfectant in LCB staining?

a. Lactic acid b. Phenol c. Glycerol d. Methylene blue

8. Which of the staining technique helps in demonstrating spore structure in bacteria as well as free spores?

a. Acid-fast stain b. Endospore stain c. Capsule stain d. Flagella stain

9. Which of the following is a rich source of nitrogen?

a. Peptone b.Yeast extract c. Beef extract d. Agar

10. The importance of agar in culture media were discovered by

a. Ehrlich b. Petri c. Finly d. Hessy

11. During preservation of microbes their --------

a. characteristics change b. metabolism stop c. metabolism continue d. metabolism change

12. Which of the following method is widely used for the preservation of microbes?

a. Drying in vacuum b. Storage in sterile soil

c. Lyophilization d. Storage in saline

13. Transmission of 'pathogens' during pregnancy from mother to child is called as

a. Direct transmission b. Horizontal transmission

c. Vertical transmission d. Indirect transmission

14. An insect or animal carrier of disease is known as

a. Carrier b. Vector c. Fomite d. Vehicle

15. Water quality is measured by
a. MBRT b. Resazurin test c. Staining d. MPN
16. Cholera is caused by
a. Vibrio b. *E.coli* c. *Salmonella* d. *Pseudomonas*
17. Pasteurization technique is used for
a. Milk b. Cheese c. Bread d. Antiseptic
18. The undesirable change that makes the unsafe food consumption is called -----
a. Food decay b. Food spoilage c. Food loss d. All the above
19. Botulism is caused by
a. *E.coli* b. *Clostridium botulinum* c. *Clostridium tetani* d. *Salmonella typhi*
20. Which one is the example for qualitative analysis of milk?
a. MBRT b. KOH mount c. LCB mount d. MPN test

PART – B (5 x 5 = 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a) Write the contributions of Alexander Fleming **(OR)**
    b) Write the contributions of Robert Koch.
22. a) Briefly explain bright field microscopy **(OR)**
    b) Describe the principle and application of Dark field microscopy.
23. a) Explain the principle and steps involved in capsule staining **(OR)**
    b) Explain the principle and steps involved in endospore staining.
24. a) Briefly explain the types of infection **(OR)**
    b) Give a short note on Giardiasis.
25. a) Give a brief note on bioactive compounds (**OR)**
    b) Write about the probiotics.

PART – C (3 X 10 = 30 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Describe the contributions of Louis Pasteur.
27. Describe the specimen preparation for Electron microscopy.
28. Explain Gram staining and acid fast staining.
29. Discuss in detail about Aspergillosis.
30. Explain in detail about the bacterial biopesticides.

SEMESTER – IV	ALLIED PRACTICAL - III
18U4MBAP03	Total Number of Hours: 30
Credits – 2	3 Hours/ Week

ALLIED PRACTICAL - MICROBIOLOGY

Course Objectives

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

Course Outcome:

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

1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for bacterial cultivation.
3. Enumeration of bacteria from 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.

Suggested Reading

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

Mapping

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

SEMESTER V

SEMESTER – V	**CORE - V**
18U5MBC05	**Total number of Hours: 60**
Credits: 6	**6 Hours/Week**

MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Objectives:

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

Course Outcome:

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

UNIT- I Introduction of Medical Bacteriology **No. of Hours:12**

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

UNIT- II Gram Positive Pathogens **No. of Hours:12**

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

UNIT- III Gram Negative Pathogens **No. of Hours:12**

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

UNIT- IV Introduction Medical Mycology **No. of Hours:12**

Introduction and History of Medical Mycology-Classification of medically important fungi - Laboratory diagnosis of fungal diseases - Collection and examination of fungal specimens – Culture media - Isolation and identification of pathogen from infected patientfungi - Staining of

fungi –KOH and LCB.PAS, H&E and GMS - Cultivation of fungi - Antifungal drugs mode of action - Antifungal susceptibility test.

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

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

Text Books

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

Reference Books

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

Web sources

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

Mapping

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

18U5MBC05

(For the candidates admitted from 2017 - 18 onwards)

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Fifth Semester

Microbiology

MEDICAL BACTERIOLOGY AND MYCOLOGY

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

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. Which of the following microorganism produces colicins in intestine?
a. *E. coli* b. *B.subtilis* c. *Clostridium botulinum* d. *Streptococcus salivarius*
2. Lactobacillus is a human pathogen that is also part of normal flora and found in
a. Colon b. Mouth c. Genital Tract of female d. All of above
3. Metachromatic granules can be stained as follows except:
a. Ponder' stain b. Albert stain c. Gram stain d. Neisser's stain
4. The disease transmitted by tick -----
a. Rocky mountain fever b. Endemic fever c. Both A&B d. None of the above
5. *Treponema pallidum* is ----------
a. Spirochatae b. *Vibrio* c. *Mycoplasma* d. Acid fast bacilli
6. Ascoli's thermoprecipitation test is used for ----
a. Streptococci b. Staphylococci c. Anthrax d. *Clostridium difficile*
7. Lepra bacilli are best cultivated in -------
a. Armadila b. Mouse foot pad c. Guinea pig d. Rabbit
8. *Staphylococcus* commonly inhabits ------
a. Nose b. Skin c. Throat d. Groin
9. Transport medium for *Vibrio cholerae* is ----------
a. VR medium b. Blood agar c. Tellurite broth d. Alkaline bile salt agar
10. Bartholin cyst is caused by --------
a. *T. pallidum* b. LGV c. Gonococci d. *Haemophilus ducryi*
11. Elberth Gaffky bacillus is -------
a. *Salmonella* b. *Shigella* c. Streptococci d. Streptobacillus
12. Dark field microscopy is useful to identify --------
a. Spirochaetes b. Mycoplasma c. Chlamydia d. Rickettsiae
13. Hyphal wall consists of microfibrils composed of _____
a. hemicellulose or chitin b. Cellulose c. lipids d. proteins
14. What do the term dimorphic mean?
a. Bisexual b. Unisexual c. Exists in two forms d. Exists in single form
15. Which stain is used to study fungal morphology in tissue sections?
a. Periodic acid–Schiff b. Alizarin Red c. Masson's Trichrome d. Von Kossa
16. Nystatin belongs to which class of antifungal drugs
a. Allylamines b. Polynes c. Echinocandis d. Thiocarbamate

17. Which of the following is not the characteristic of histoplasmosis?
a. Person to person transmission b. Specific geographic distribution
c. Yeasts in tissue d. mycelial phase in the soil
18. Causative agent for 'ringworm' is ----------
a. Epidermatophyton b. *Tinea nigra* c. Mycetoma d. *Histoplasma*
19. Tinea pedis' is scientific name of a foot disease that is commonly called as
a**.** Athlete's foot b. Ringworm c. Skin rash d. Skin infection
20. Which one is considered as class one carcinogen?
a**.** Aflatoxin b. Ergotoxin c. Fumonisin d. Ochratoxin

PART - B (5 × 5 = 25 Marks)
Answer **ALL** the Questions
All questions carry equal marks

21. a) What are the types of infections? (OR)
b) Briefly explain the antibacterial susceptibility testing.
22. a) What are the virulence factors involved in Staphylococcal infections? (OR)
b) Discuss the different types of anthrax.
23. a) Write a note on different kinds of diarrhea caused by *E.coli*. (OR)
b) Describe about cholera and its diagnosis.
24. a) Explain about classification of medically important fungi (OR)
b) Write a short note on systemic mycosis samples
25. a) Explain about *Tinea nigra* (OR)
b) Write a short note on Histoplasmosis

PART - C (3 × 10 = 30 Marks)
Answer **ANY THREE** the Questions
All questions carry equal marks

26. Explain in detail the normal flora of the human's different anatomical sites.
27. Write a detailed note on morphology, virulence factors and pathogenicity of *Clostridium perfringens.*
28. Write the pathogenesis and laboratory diagnosis of Syphilis.
29. Explain about Antifungal susceptibility test.
30. Write a short note on Candidiasis and cryptococcosis.

SEMESTER – V	**CORE - VI**
18U5MBC06	**Total number of Hours: 60**
Credits: 5	**5 Hours/Week**

INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Course Objectives:

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

Course Outcome:

The students could able to gain knowledge on

CO1	Basic background information on development and sterilization industrial strain
CO2	Downstream and upstream process of production technology
CO3	Various industrial microbiological product synthesis
CO4	Synthesis of antimicrobial drugs using fermentation technology
CO5	Drug delivery mechanism and clinical trials

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

Introduction to industrial microbiology: Industrially important microorganisms - Isolation, preservation and improvement of strains - handling - development of inoculum for various fermentation processes,upstream processing - media for industrial fermentation - formulation - sterilization. Screening techniques - Primary and Secondary. Upstream processing - Strain improvement - Development of inoculums – Production media – Raw materials, optimization and Industrial sterilization.

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

Industrial Fermenter – Components, of fermentor - Types of bioreactors – Types - of fermentor Instrumentation – Scale up – Monitoring – Sensors - of fermentation -Upstream processing - Strain improvement- Down Stream Processing – Recovery, Purification of intracellular and extracellular products and natural sources.

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

Industrial production of enzymes –α amylase & proteases.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.Introduction; general

aspects, production of nucleotides &nucleotides, production of alcohols-acetone-butanol, production of ethanol, Biopolymers, and Biofuels.

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

Types of pharmaceutical products – production of Vitamin B_{12} - Microbiological production of antibiotics – Penicillin and streptomycin.. Antimicrobial agents - Bioassay of antimicrobial agents – Contamination, spoilage and preservation of pharmaceutical products – Microbiological quality control - Sterility test- Pyrogen test- Toxicity test- Carcinogenicity test.

UNIT - V **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 and phase II of clinical trials. Bioprospecting - Extraction, purification and characterization of bioactive molecules from natural resources.

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 KakraniH.N (2004), Pharmaceutical Microbiology, 1stedition,Agrobios (India), Jodhpur.

Reference books

1. PepplerH.J and Perlman D (1979).Microbial Technology.Vol.1 and II. 2nd edition. Academic Press, New York.
2. StanburyP.F, Whitaker A and Hall S.J (1995).Principles of Fermentation Technology.2nd edition.PergamonPress, New York.

Web Sources

https://pdfs.semanticscholar.org/635d/da50cbf522a7c860ddf899925ffa703123b1.pdf

https://run.edu.ng/directory/oermedia/422231995398.pdf

http://site.iugaza.edu.ps/mwhindi/files/Modern-Industrial-MicrobiologyBiotechnology.pdf

file:///H:/industrial/0c03ce4cbbae680f46362dd24207e254-original.pdf

Mapping

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

CO5	✓		✓	✓	✓

18U5MBC06

(For the candidates admitted from 2017 - 18 onwards)

B.Sc., DEGREE EXAMINATIONS
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Fifth Semester

Microbiology

INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

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

PART - A (20 × 1 = 20 Marks)
Answer **ALL** the Questions
All questions carry equal marks

1. The best medium for the production of Penicillin is ----------
a. Nutrient agar b. Corn steep liquor c. Sulfite waste liquor d. Whey
2. Industrially important Antibiotic producing organisms shall be isolated by
a. Disk plate method b. Direct plate method c. Serial dilution method d. Crowded plate method
3. In the industrial production of streptomycin, the secondary metabolite or by products is
a. Vitamin – B12 b. Vitamin – C c. Vitamin – B6 d. Ethanol
4. The fungus used in the industrial production of citric acid:
a. *Rhizopus Oryzae* b. *Fusarium moniliformae* c. *Rhizopus nigricans* d. *Aspergillus nigricans*
5. Vitamin B12 can be estimated and determined by using organism
a. *Lactobacillus* spp b. *Lactobacillus Leichmanni* c. *Bacillus subtilis* d. *E. coli*
6. Batch fermentation is also called
a. Closed system b. Open system c. Fed-Batch system d. Sub-merger system
7. Industrial microbiology, mainly depends on the phenomenon
a. Pasteurisation b. Fermentation c. Vaccination d. Purification
8. For thorough mixing of medium and inoculum the part of fermentor useful is
a. Shaft b. Headspace c. Impeller d. Sparger
9. Different methods of strain improvement are
a. Protoplast fusion b. Recombinant DNA technique c. Genetic recombination d. All of these
10. The purification and recovery of the production after fermentation is called
a. Upstream process b. Downstream process c. Surface fermentation d. None of these
11. Who developed the concept of specific toxicity?
a. Pasteur b. Fleming c. Watson d. Ehrlich
12. The susceptibility of a microorganism to antibiotics and other chemotherapeutic agents can be determined by using
a. tube dilution technique b. paper disk plate c. both (a) and (b) d. none of these
13. The process that is used to prove that a drug is safe and effective in treating specific conditions in certain patient populations?
a. Drug discovery b. Preclinical development c. The patent process d. Clinical development
14. Which of the following packaging material is protect the drug content against light
a. Plastic containers b. Amber colored glass containers

c. metal containers d. all of the above

15. What is the purpose of pre-clinical testing?
a. To verify that a drug is sufficiently safe and effective to be tested in humans.
b. To undergo preliminary testing in healthy humans to monitor the effects of the drug.
c. Both a and b
d. To create a basic outline for the larger scale future tests on a widespread population.
16. On what do Phase 2 clinical trials test?
a. Animals b. Large-scale tests in people with the target disease/population
c. People with the target disease/condition d. Healthy human volunteers
17. Bioprospecting is ----------
a. the search for gold from marine sources
b. the search for fuel in sea
c. the search for pharmacological or other chemicals from natural resources
d. none of the above
18. In fermenter, up to the production of desirable product is termed
a. Upstream process b. Downstream process c. Fermentation d. Sterilisation
19. Which method of purification allows separation of solids from fluids (liquids or gases) by interfering a medium through which only the fluid can pass?
a. Filtration b. Precipitation c. Centrifugation d. Sedimentation
20. Which separation technique is based on differential partitioning between two phases that is mobile and stationary?
a. Filtration b. Precipitation c. Centrifugation d. Chromatography

PART - B (5 × 5 = 25 Marks)
Answer **ALL** the Questions
All questions carry equal marks

21. a). Write a short note on auxanography technique (OR)
b). List out the different methods of inoculumdevelopment.
22. a). Give an account on upstream process (OR)
b).Write in detail about different types of fermentor.
23. a). Elaborate the protocol for the industrial production of α-amylase (OR)
b). Write a note on the production of citric acid
24. a).Explain the bioassay of antimicrobial agents? (OR)
b).Write about the contamination, spoilage and preservation of pharmaceutical products? (OR)
25. a). Write short notes on phases of drug discovery
b). Explain the drug distribution in body?

PART - C (3 × 10 = 30 Marks)
Answer **ANY THREE** the Questions
All questions carry equal marks

26. Give an account on the various methods of screening the industrially important Microorganisms
27. Draw a neat sketch of a fermentor and explain in detail about its parts.
28. Write an account on the industrial production of acetic acids
29. Describe the phases of clinical studies
30. Explain about the drug distribution in body?

SEMESTER – V	**CORE - VII**
18U5MBC07	**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 molecular 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 PCR and Its applications Advanced techniques in genetic engineering

No. of Hours: 12

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

Mapping

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓

CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5		✓	✓		✓

18U5MBC07

(For the candidates admitted from 2017 - 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Fifth Semester

Microbiology

GENETIC ENGINEERING

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

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1) Thymosin proved effective against brain an

a) Liver cancer b) Stomach cancer c) Lung cancer d) Blood cancer

2. What is the final product of the RNase H method?

a) blunt ended dsDNA b) staggered dsDNA at both ends

c) staggered dsDNA at 3' end d) staggered dsDNA at 5' end

3. What would not happen if the RNA strand is completely removed from RNA: DNA hybrid?

a) There are no chances of the synthesis of the second DNA strand

b) Chance complementarity would take place

c) Hairpin structure would be formed

d) Hairpin structure is formed is not the final structure

4. The loop region is single stranded. It can be cleaved by using which enzyme?

a) Exonuclease b) S1 nuclease c) RNaseH d) DNase

5. Choose the correct statement with respect to the self priming method of cDNA synthesis.

a) It is less preferred than RNaseH method

b) A hairpin structure is formed with guarantee

c) The sequence corresponding to the 5' end is lost

d) Reverse transcriptase is not used

6. Choose the incorrect statement for the method homopolymer tailing.

a) The first step is the RNA: DNA hybrid synthesis

b) Terminal transferase is used for the addition of nucleotides on 3' end

c) Terminal transferase adds only at DNA strands

d) The DNA strand is now having known sequence at 3' end

7. Choose the correct statement for RACE.

a) It stands for Random Amplification of cDNA ends

b) It is for cloning particular cDNA ends

c) It is only of one type, which is 5' RACE

d) Sequence data is not available in any case

8. The first primer in the case of 3' RACE is _____
a) internal sequence b) oligo-dT adaptor molecule
c) oligo-dA adaptor molecule d) adaptor oligo-dT primer
9. The first cDNA strand in 5' RACE is tailed with oligo-dA tail.
a) True b) False
10. What is the second primer in the case of 5' RACE?
a) Internal primer b) Oligo-dA sequence
c) Adaptor-oligo-dT primer d) Oligo-dT adaptor molecule
11. A vector is a plasmid used to transfer the
a) Chromosome b) Gene c) Nucleus d) Cell
12) gene therapy healthy gene are used to replace
a) Dead gene b) Abnormal gene c) Defective gene d) Old gene
13) Genetic engineering increases effeciency and
a) Productivity b) Metabolism c) Meiosis d) Mitosis
14) A genetic code is a message store in
a) Cell b) Nucleus c) Cytoplasm d) Gene
15) Fermenter are used to culture
a)Algae b) Fungi c) Virus d) Bacteria
16) Process of manipulating genes usually outside normal reproductive process is known as
a) genetic modification b) gene targeting c) genome recombination d) gene linking
17) First genetically modified organism generated was
a)Fish b) bacteria c) mice d) virus
18) First genetically modified mice is generated in
a) 1968 b) 1964 c) 1974 d) 1978
19) First genetically modified pet was sold in United States in
a) 2003 b) 2008 c) 2006 d) 2004
20) Enzyme which is used to remove or knockout genes is known as
a) Nucleolus b) nuclease c) nucleotide d) clones

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Describe enzymes used in genetic engineering (or)
    b) Discuss bacterial conjugation.
22. a) Write short notes on microinjection (or)
    b) Explain ultrasonication.
23. a) Write short notes on isolation of plasmid DNA (or)
    b) State about transformation and transfection.
24. a) Write the significant application of PCR (or)
    b) Give short notes on Ti plasmids.
25. a) Write short notes on gene technology in medicine (or)
    b) Discuss transgenic animal and its application.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** Questions

All questions carry equal marks

26. Write an essay on production and application of transgenic mice?

27. Explain restriction endonucleases type I and type II.
28. Elaborate the various methods of Microlaser gene transfer technology.
29. Give a brief account on PCR and its application.
30. Explain briefly about transformation

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.

Mapping

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

SEMESTER – V	**ELECTIVE - I**
17U5MBE01	**Total number of Hours: 45**
Credits: 4	**4 Hours/Week**

HAEMATOLOGY AND BLOOD BANKING

Course Objectives

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

Course Outcome:

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

UNIT - I **No. of Hours: 09**

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

UNIT - II **No. of Hours: 09**

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

UNIT - III **No. of Hours: 09**

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

UNIT - IV **No. of Hours: 09**

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

UNIT - V **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. Cord blood banking.

Text Books

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

Reference Books

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

Web sources

https://nptel.ac.in/courses/102103012/pdf/mod7.pdf

https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/ln_hematology_mlt_final.pdf

http://www.rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Blood%20Banking/Introduction.pdf

file:///H:/Hematology/abo%20blood%20grouping.pdf

Mapping

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

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Fifth Semester

Microbiology

HAEMATOLOGY AND BLOOD BANKING

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. The process of platelet production by the bone marrow
   A. Leukopoiesis B. Thrombopoiesis C. Haemopoiesis D. Erythropoiesis
2. Component of the red blood cell to which the oxygen is attached
   A. Haemoglobin B. Nucleus C. Plasma D. Blast cell
3. Blood test that indicates the percentage of each type of white blood cell in a sample of blood
   A. Bone marrow biopsy B. ESR C. RBC count D. Differential count
4. Hormone that stimulates the production of RBC's
   A. Hemoglobin B. Interleukin C. Erythropoietin D. Insulin
5. Lymphopoiesis occur in
   A. Lymphatic tissue B. Lymphocytes C. Bone marrow D. Plasma
6. Is concerned primarily with phagocytosis
   A. Antibodies B. RBC C. Platelets D. WBC
7. Is decreased in anemia
   A. Platelets B. Stem cells C. RBC D. WBC
8. Primarily concerned with hemostasis
   A. Platelets B. WBC C. Erythrocyte D. Haemoglobin
9. Involved in a hemolytic blood transfusion reaction
   A. WBC B. RBC C. Platelets D. Blastocyte
10. Enzyme that converts prothrombin to thrombin
    A. Heparin B. Calcium C. Prothrombin activator D. Histamine
11. An anticoagulant that removes thrombin from the clotting process
    A. Coumadin B. Heparin C. Calcium D. Thrombus
12. Enzyme that activates fibrinogen to fibrin
    A. Thrombus B. Erythropoietin C. Platelets D. Thrombin
13. The universal recipient
    A. A+ B. O- C. B+ D. AB+
14. The plasma of this blood type contains both anti-A antibodies and anti-B antibodies
    A. AB+ B. O- C. A+ D. B-
15. A person with this blood type can receive (by transfusion) only type O- blood
    A. AB+ B. O- C. B+ D. O+
16. The positive and negative signs (e.g., A+, A-) refer to this antigen
    A. Kernicterus B. Hemolysis C. Rh factor D. ABO grouping
17. Reticulocytes are usually absent
    A. Sickle cell anemia B. Aplastic anemia C. Iron deficiency anemia D. Leukemia

18. A megaloblastic anemia that is treated with vitamin B12 injections
    A. Pernicious anemia B. Sickle cell anemia
    C. Aplastic anemia D. Iron deficiency anemia
19. An individual who has recently been diagnosed with syphilis is deferred for:
    A. 4 weeks B. 2 weeks C. Permanently D. 1 year
20. Red blood cells can be frozen and stored up to:
    A. 3 years B. 5 years C. 7 years D. 8 years

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. (a).Write notes on Blood components **(OR)**
    (b). Give the details about the Erythrpoiesis
22. (a). Discuss about Infectious Mononucleosis **(OR)**
    (b). Explain about Blood parasitic infections.
23. (a). Give an account on Anticoagulants **(OR)**
    (b). Discuss on Differential count
24. (a). Give an account on Determination of Clotting time **(OR)**
    (b). Explain about ABO grouping.
25. (a). Account on Preservation and storage of donated blood. **(OR)**
    (b). Explain the HLA typing.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Haematopoietic system of the body? Explain.
27. Explain about Leukaemia and its classification.
28. Determination of Haemoglobin by Sahli's method – Cynamethaemoglobin method.
29. Explain in detail on Mechanism of Blood coagulation.
30. Explain the Transfusion reactions.

SEMESTER – V	**ELECTIVE - I**
18U5MBE02	**Total number of Hours: 45**
Credits: 4	**4 Hours/Week**

ENTREPRENEURSHIP IN MICROBIOLOGY

Course Objectives

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

Course Outcome:

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

UNIT - I **No. of Hours: 09**

Evolution of the and 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 - II **No. of Hours: 09**

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 - III **No. of Hours: 09**

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.

UNIT - IV **No. of Hours: 09**

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 - V **No. of Hours: 09**

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

Text Books

1. Khanka S.S (2003). **Entrepreneurial development**. 3rd edition. S.Chand & Company, New Delhi.
2. Kanniyan.S and Ramaswamy K (1980). **A Handbook of Edible Mushrooms**. Today's and Tomorrow's Printers, New Delhi.
3. Kale Radha D (1998). **Earthworm: Cinderella of organic farming**. Prism Books Pvt. Ltd., Bangalore.
4. Subba Rao, N.S. (1993). **Biofertilizers in Agriculture and Forestry**. 3rd edition. 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.
4. Jogdand SN. Environmental Biotechnology, Himalaya Publishing House. New Delhi. 2010.

Web sources

https://www.biospace.com/article/microbiology-a-field-ripe-for-entrepreneurship/
https://extension.psu.edu/six-steps-to-mushroom-farming
https://www.systemekofungi.com/wp-content/uploads/Mushroom-Cultivation-Manual.pdf
http://www.amm-mcrc.org/publications/Biofertilizers.pdf

Mapping

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

18U5MBE02

CO5	✓	✓	✓	✓	✓

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Fifth Semester

Microbiology

ENTREPRENEURSHIP IN MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Entrepreneurial behaviours includes:
(a) Solving problems (b) Taking initiatives (c) Taking responsibility (d) All of above
2. Entrepreneurs attributes includes:
(a) Preservence (b) Hard working (c) Determination (d) All of above
3. Entrepreneurs skills includes ----------
(a) Creative problem solving (b) Persuading (c) Negotiation (d) All of above
4. The term entrepreneurs was applied to business initially by the French economist in the 18th century
(a) Cantillon (b) Jan Tinbergen (c) J.S.Mill (d) None of above
5. Which business function do experts agree, you should focus on first when preparing to start a business?
(a) Financing (b) Marketing vision (c) Operation (d) None of above
6. Which of the following is not something that can be invested
(a) Energy (b) Experties (c) Money (d) Time
7. From the following which one is factor affecting entrepreneurial growth
(a) Social (b) Economic (c) Psychological (d) All of above
8. What is the need of entrepreneurship?
(a) For new innovation (b) To fill gap in growth (c) For healthy competition (d) All of above
9. Which one of the following is the process of entrepreneur developing new products that over time make current products obsolete?
(a) New business model (b) Anatomization (c) Creative Destruction (d) None of above
10. The level at which an individual is viewed by society is called:
(a) Financial status (b) Qualification (c) Social Status (d) Achievement
11. Which of the following shows the process of creating something new
a) Business model b) Modeling c) Creative flexibility d) Innovation Question
12. Which one of the following gives suggestions for new product and also help to market new products?
a) Existing products and services b) Federal government
c) Distribution Channels d) Consumers Question
13. Which of the following is used by entrepreneurs to acquire experience in an international market before making a major commitment?
a) Merger b) Minority Interest c) Joint venture d) Majority interest Question

14. GATT is established in 1947, under:
a) German leadership b) U.S. leadership c) French leadership d) U.K. leadership Question
15. The entrepreneur was distinguished from capital provider in:
a) Middle ages b) 17th century c) 18th century d) 19th and 20th century
16. A person who managed large project was termed as the entrepreneur in the _____.
a) Earliest period b) Middle ages c) 17th century d) 19th and 20th century
17. What is the process by which individuals pursue opportunities without regard to resources they currently control?
a) Startup management b) Entrepreneurship c) Financial analysis d) Feasibility planning
18. Having less than 50 percent of equity share in an international venture is called:
a) Joint Venture b) Majority interest c) Minority interest d) Exporting
19. Having more than 50% ownership position that provides the entrepreneur with managerial control is called:
a) Joint venture b) Majority interest c) Horizontal merger d) Diversified activity merger
20. Which one of the following is the process of entrepreneurs developing newproducts that over time make current products obsolete?
a) New business model b) Anatomization c) None of the given options d) Creative destruction

PART – B (5 x 5= 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a) Explain the factors affecting of entrepreneurial growth **(or)**
    b) Describe various types of entrepreneurs.
22. a) Give a short notes on Mushroom diseases and its management **(or)**
    b) Write about the method of spawn production.
23. a) Explain aerobic composting. Add notes on its uses **(or)**
    b) Digramatticaly explain the structure of an earthworm.
24. a) Write short note on VAM bioinoculum (**or)**
    b) Explain *Spirulina* cultivation.
25. a) Write about role of DST in Entrepreneurship development **(or)**
    b) Describe various funding agencies.

PART – C (5 x 5= 25 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Write an essay on role of Women entrepreneurs for our national economy.
27. Elaborate various methods of Mushroom cultivation.
28. Write an essay on Vermicomposting.
29. Discuss in detail about the Rhizobium biofertlizer production.
30. Give a detailed significance of project report and project appraisal.

SEMESTER VI

SEMESTER – VI **CORE - VIII**
18U6MBC08 **Total number of Hours: 60**
Credits: 6 **6 Hours/Week**

MEDICAL VIROLOGY AND PARASITOLOGY

Course Objectives

To gain basic knowledge on medical virology and parasitology
To get exposure with medically important microbes and their diseases
To get expertise in diagnostic methods
To get an updated knowledge on microbes, disease control, treatment and prevention

Course Outcome:

CO1	Introduction and background on medical virology & parasitology
CO2	Able to gain knowledge on medically important common viruses
CO3	Recently emerged viral infections
CO4	Clinically important Protozoas
CO5	Clinical importance of helminthic infections

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

Introduction and Historical perspective of medical virology. General characteristics properties of viruses – Viral replication. Multiplication Baltimore classification of viruses. Cultivation of viruses – viral assay - Classification of viruses - Viroids and Prions. – Collection, Transport, Serological and molecular diagnosis of viral infections. Antiviral agents and vaccines. HSV type 1 – type 2 – type 3 – type 4 – type 5, Variola-vaccinia virus.

UNIT - II **No. of Hours**: **14**

Poxviridae: *Othropoxviruses – Variola, Vaccinia* and *Cowpox virus*. ***Herpesviridae***: *Human herpes viruses - type 1 to 8*. ***Papillomaviridae***: - *Human papilloma viruses*. ***Picornaviridae:*** *Enterovirus - Polio virus*. ***Rhabdoviridae***: *– Lyssavirus - Rabies virus*. ***Hepatitis viruses:*** A, B, C, D and E. ***Orthomyxoviridae***: *Influenza A*. ***Paramyxoviridae***: *Morbillivirus – Measles*; *Orthorubulavirus – Mumps* and *Henipavirus - Nipahvirus*. German measles

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

Arthropod borne and Rodent borne diseases: ***Togoviridae****: Alphavirus* **–** *Chickungunya virus*. ***Flaviviridae****: flavivirus – Yellow fever, KFD virus, Dengue* and *Zika virus*. ***Filoviridae:*** *Ebola* and *Marburg virus*. ***Coronoviridae****: Betacoronavirus – SARS-CoV, MERS-CoV* and *SARS-CoV-2*. ***Retirovidae:*** *Lentivirus - Human Immunodeficiency virus*.

UNIT - IV **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* and *malariae*.

UNIT - V **No. of Hours: 10**

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.

Mapping

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

18U6MBC08

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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

Sixth Semester

Microbiology

MEDICAL VIROLOGY AND PARASITOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Protein coat of virus enclosing nucleic acid is called
a. Vector b. Capsid c. Envelop d. Spikes
2. Virus inoculation onto CAM of embryonated egg and growth identified by ……
a. Pustule formation b. Edema c. Pock formation d. All
3. Which of the following is smallest virus?
a. HSV b. HIV c. POX virus d. Polio virus
4. Most common and existing way to control herpes virus infections are ……..
a. Vaccines b. Antiviral drugs c. Immunoglobulins d. Interferons
5. Which unique form does the rabies virus take?
a. The virion has a dumbbell appearance b. It is shaped like a bullet from a gun
c. The virus is star shaped d. The virion is very pleomorphic
6. Which of the following virus contains hemagglutinin spikes?
a. Entero virus b. Influenza virus c. VZV d. HSV
7. Which of the following virus is arthropod born virus?
a. HIV b. HSV c. Dengue d. Hepatitis
8. When was smallpox eradicated from the world?
a. In 1977 following a WHO b. In 2000 campaign
c. Is not yet eradicated d. In 1796 after Jenner's first vaccine
9. Which one of the following virus can cause severe hemorrhages?
a. Chikungunya b. Ebola c. Dengue d. Nipah
10. Describe the morphology of a togavirus
a. Non-enveloped with an icosahedral structure
b. Enveloped spherical particles with an icosahedral structure
c. Small round viruses
d. Filamentous virus with protruding glycoproteins
11. Which of the following is **not** a mosquito-borne illness?
a. Nipah virus b. Zika virus c. Dengue virus d. Chikungunya
12. Viral vaccination was invented by……
a. Jenner b. Pasteur c. Watson d. Crick
13. The cytoplasm of the trophozoite may contain ingested _____ when it is invasive in tissue
a. WBCs b. Carbohydrates c. RBCs d. Macrophages
14. The stool is the specimen for the diagnosis of the infection cause by ---------
a. *Balantidium coli* b. *Acanthamoeba polyphaga* c. *Naegleria fowleri* d. *Leishmania donavani*

15. Which one of the following causes the more severe type of Malaria?
a. *Plasmodium falciparum* *b.Plasmodium ovale* *c. Plasmodium malariae* *d. Plasmodium vivax*
16. Leishmania infection occurs due to bite of female sand fly and deposites……..
a. Amastigote b. Promastigote c. Cyst d. Larvae

17. The usual infective stage of Trematodes to man is the……..
a. Cercariae b. Metacercariae c. Egg d. Miracidium
18. What parasite whose migrating larvae break the pulmonary capillaries of man?
a. Ancylostoma braziliense b. Enterobius vermicularis c. Ascaris lumbricoides d. Trichuris trichiura
19. What parasite is associated with pork?
a. *Diphyllobothrium latum b. Taenia saginata c. Dipylidium caninum d. Taenia solium*
20. Wuchereria bancrofti causes……
a. Kala-azar b. Sleeping sickness c. Lymphatic filariasis d. Black water fever

PART – B (5 x 5 = 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a. Give introduction to interferons and explain types, impact on viral infection (OR)
b. Explain chickenpox and shingles caused by VZV
22. a. Write a short note on on poliomyelitis (OR)
b. Explain on the causative agent of measles and pathogenesis, symptoms.
23. a. Summaries overall impact of *Ebola virus* infection (OR)
b. Explain incidence of Kyasanur forest disease and its impact
24. a. Explain on Giardiasis (OR)
b. Write on African Trypanosomiasis
25. a. Give account on Taeniasis (OR)
b. Write mode of transmission and life cycle of *Ankylostoma duodenale*

PART – C (3 X 10 = 30 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Give introduction to antiviral agents and explain each type.
27. Write characteristics, pathogenesis, clinical manifestation of rabies virus.
28. Write infection, pathogenesis, clinical manifestation and lab diagnosis of Dengue virus.
29. Write in detail on acquisition of infection by *Entamoeba histolytica* and explain intestinal and extraintestinal infections and treatment.
30. Explain in detail on pathogenesis, clinical manifestation, lab diagnosis and treatment of *Schistosoma haematobium.*

SEMESTER – VI	**CORE - IX**
18U6MBC09	**Total number of Hours: 60**
Credits: 5	**5 Hours/Week**

SOIL AND ENVIRONMENTAL MICROBIOLOGY

Course Objectives

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

Course Outcome:

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

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

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

UNIT - II **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. Quality guidelines for biofertilizers.

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

Microbial interactions and plant pathology: neutralism, commensalism, synergism, mutualism and parasitism. Interaction of microbes with plants – Rhizosphere, Phyllosphere and Mycorrhizae. Microbe-animal interaction - Microbes in ruminants. 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 IV **No. of Hours: 12**

Microbiology of air & water – Enumeration of bacteria from air – Air sampling devices (Settling under Gravity, Centrifugal action, Impingment and Electrostatic precipitation) – Air sanitation.

Assessment of drinking water quality (Total count, Membrane filter and MPN) – water standards - indicator organisms – water purification – Waterborne diseases and their control measures.

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

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). **Liquid waste management:** Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment. Biodegradation, Bioremediation, Biodeterioration of wood, paints, leather and textile. Xenobiotics.

Text Books

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

Reference Books

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

Mapping

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

18U6MBC09

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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

Sixth Semester

Microbiology

SOIL AND ENVIRONMENTAL MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. The population of algae in soil is _____ that of either bacteria or fungi
a. Generally smaller than b. Generally greater than c. Equal to d. None of the above
2. Soil organic matter a good indicator of _____
a. Biological health b. Chemical health c. Physical health d. All of the above
3. Soil microorganisms are most active at _____
a. 15-20°C b. 20-25°C c. 34-36°C d. 40-45°C
4. _____ play a key role in the transformation of rock to soil
a. Cyanobacteia b. Pectin decomposing bacteria
c. Nitrifying bacteria d. De-nitrifying bacteria
5. The association which involves the exchange of nutrients between two species is referred to as __
a. Mutualism b. Syntrophism c. Commensalism d. Antagonism
6. Which of the following conditions decreases the level of denitrification?
a. Abundance of organic matter b. Acidic pH c. Elevated temperatures d. Availability of oxygen
7. Which of the following is a symbiotic nitrogen fixing bacteria?
a. *Rhizobium trifolii* b. *Clostridium pasteurianum* c. *Azotobacter* sp. d. *Escherichia coli*
8. The word Rhizosphere and Phyllosphere is respectively given by
a. Hiltner and Ruinen b. Ruinen and Hiltner c. Winogradsky and Beijernickia d. Frank
9. Tikka disease of groundnut is caused by -------
a. *Puccini* b. *Aspergillus* c. *Cercospora* d. *Fusarium*
10. Ammonia oxidizers and nitrite oxidizers are _____
a) Gram-negative chemolithotrophs b) Gram-positive chemolithotrophs
c) Gram-negative photolithotrophs d) Gram-positive photolithotrophs
11.Which among the following is not an ammonia-oxidizing bacteria?
a) *Nitrosomonas europaea* b) *Nitrosovibrio tenuis*
c) *Nitrospina gracilis* d) *Nitrosococcus oceanus*
12. How much time does nitrifying bacteria requires to grow at an incubation of 250 to 300 C?
a) 1 day b) 2-3 days c) 15 days d) 1 to 4 months
13. Which of the following is/are inorganic gas(es)?
a. Carbon monoxide b. Hydrogen sulphide c. Chlorine d. All of the above
14. Which type of Hepatitis spreads through polluted water?
a. Hepatitis A b. Hepatitis B c. Hepatitis C d. Both A and B

15. Haemophillia' is a disease associated with
a. Heart b. Kidney c. Blood d. Lever
16. The following Disease is water borne
a. Typhoid b. Tuberculosis c. Hepatitis B d. Scurvy
17. The biological oxygen demand (BOD) would be most directly affected by the presence of which of the following pollutants?
a. Heavy metals b. Organic wastes c. Salt (Sodium chloride)
d. Waste minerals from mining e. Fertilizer runoff from farms
18. The microorganisms that is mainly used as an indicator of fecal pollution in water is:
a. *Escherichia coli* b. *Clostridium tetani* c. *Clostridium botulinum*
d. Cyanobacteria e. All of these
19. Which of the following waste water treatments is most likely to produce carcinogens as a byproduct?
a. Chlorination b. Ozonation c. Ultraviolet light (UV)
d. Sand filtration e. Carbon filtration
20. A major disadvantage of bioremediation is:
a. Long times may be required b. It is more expensive than other treatments
c. It can not be used to treat contamination with hydrocarbons
d. It requires removing contaminated soil to a bioreactor
e. It requires introducing new microorganisms into an environment

PART – B (5 x 5 = 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a) Write about properties of soil (OR)
b) Explain the role of Bacteria and Actinomycetes in soil?
22. a) Write short notes on ammonification, nitrification and denitrification? (OR)
b) Types of Biofertilizers with examples.
23. a) Explain the types of microbial interaction? (OR)
b) Write a short note on Mycorrhizae
24. a) How to Enumerate bacteria from air? (OR)
b) Types of Air sanitation methods?
25. a) Role of microbes in Sewage treatment (OR)
b) Effect of thermal pollution in the environment?

PART – C (3 X 10 = 30 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Explain the significance of soil microbes: Fungi, Microalgae, Protozoa and Viruses?
27. Write an essay on Nitrogen cycle.
28. Explain the bacterial diseases & fungal disease in plant?
29. Write in detail about the waterborne diseases?

SEMESTER – VI	**CORE - X**
18U6MBC10	**Total number of Hours: 60**
Credits: 5	**5 Hours/Week**

FOOD AND DAIRY MICROBIOLOGY

Course Objectives

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

Course Outcome:

CO1	Learn about Food pathogens and their Phsico-chemico parameter analysis
CO2	Evaluate the factors in Spoilage of food by various microbes
CO3	Gain the knowledge on food Preservation methods
CO4	Understand microbial Fermented products
CO5	Food intoxication and determination of food pathogens

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

Introduction – importance of food microbiology- types of microorganism in food- - Bacteria, Mold and Yeasts Foods as a substrate for microorganisms – Importance of microorganisms in food - Bacteria, Mold and Yeasts. Sources of food contamination. Factors influencing the Growth of microorganisms- Intrinsic factors - (pH, moisture, oxidation - reduction potential, and nutrient content), extrinsic factors - (temperature, relative humidity, gases and microbial activities) and inhibitory substances. Principles of preservation - physical and chemical methods.

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

Source of contamination - Microbial spoilage on various foods - General Principles underlying food spoilage and contamination –**food spoilage and preservation** - vegetables and fruits, cereals, meat and meat products-, Sugar products, Poultry products and eggs, milk and milk products, dairy products, canned food, fish and sea foods. Spoilage and preservation of vegetables and fruits, meat and eggs, dairy products, canned food and sea foods.

UNIT - III **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. Food additives

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

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

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

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

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

Text Books

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

Reference Books

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

Mapping

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

18U6MBC10

CO5	✓	✓	✓	✓	✓

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Sixth Semester

Microbiology

FOOD AND DAIRY MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Spoilage in food because of microbial activity can be prevented or delayed by
a. Prohibiting the entry of micro-organisms in food b. Physical removal of micro-organisms
c. Hindering the activity of micro-organisms d. All of above
2. The growth of aerobic food spoilage and pathogenic microorganisms can be suppressed by
a. Humectants b. Exhausting c. Both a and b d. None of above
3. The target microorganism in canning is
a. *Clostridium botulinum* b. *Streptococcus thermophillus* c. PA 3679 d. *Lactobacillus bulgaricus*
4. Pasteurization is the heat treatment designed primarily to kill
a. Vegetable forms of microorganisms b. All form of microorganisms c. Spore d. None of above
5. In spore forming bacteria maximum resistance occurs at pH
a. 4 b. 5 c. 6 d. 7
6. The time required to kill microorganism at a given lethal temperature is known as
a. Z value b. D value c. C value d. B value
7. The microorganisms multiply and die in
a. Geometric order b. Logarithmic order c. A-logarithmic order d. None of above
8. *Acetobactor aceti* converts ----------into acetic acids
a. Ethyl alcohol b. Glucose c. Methyl alcohol d. Starch
9. Two types of fermentations are carried out for the production of
a. Pickle b. Yoghurt c. Vinegar d. Sausages
10. In bread manufacturing, alcoholic fermentation is carried out by
a. *Streptococcus thermophillus* b. *Saccharomyces cerevisae*
c. *S. carlsbergensis* d. *Lactobacillus bulgaricus*
11. *Clostridium botulinum* mainly result in spoilage of ---------- foods

a. High acid Food b. Acidic Food c. Medium acid Food d. Low acid Food

12. Any change that renders food unfit for human consumption is called

a. Processing b. Spoilage c. Deterioration d. Preservation

13. The temperature resistance of microorganism in high acid food is

a. High b. Medium c. Low d. No effect

14. Food intoxication is the ingestion of

a. enzymes producing microorganism b. Toxin producing microorganism

c. Non of both d. Both of these

15. *Clostridium Botulinum* is ----------

a. Bacteria b. Mold c. Yeast d. Virus

16. *Thermophiles* grows at

a. 8 to 45°C b. 25 to 30°C c. 0 to 20°C d. 50-600 C

17. Type of yeast used for alcoholic fermentation is

a. *Saccharomyces Cerevisiae* b. *Streptococcus thermophillus*

c. *Acetobacter acceti* d. *Clostridium botulinum*

18. Lactic acid bacteria include ----------

a. *Lactococcus lactis* b. *Lactococcus cremoris* c. *Bifidobacterium* d. All above

19. Which of the following products have higher acidity and lacks aroma?

a) Cultured buttermilk b) Cultured sour cream c) Bulgarian milk d) Acidophilus milk

20. The microbiological examination of coliform bacteria in foods preferably use

a. MacConkey broth b. MacConkey agar c. eosine Methylene blue agar d. all of these

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. a) Write about microorganism involved in food spoilage **(or)**
    b) Discuss the principles of food preservation.
22. a) Write short notes on contamination and spoilage of fruits and vegetables**(or)**
    b) Explain the spoilage and preservation of fish and other sea foods.
23. a) Write short notes on botulism **(or)**
    b) Describe the parasitic infections.
24. a) Discuss about the methods of fermentation **(or)**
    b) Give short notes on production of beer.
25. a) Write short notes on yoghurt production **(or)**
    b) Discuss about the microflora of milk.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Briefly explain the factors influencing microbial growth in food.
27. Explain the contamination, spoilage and preservation of Cereal and Cereal product.
28. Discuss the food borne intoxication in detail.
29. Give a brief account on production of Wine.
30. Detail about the role and responsibilities of food control agencies and its regulations.

SEMESTER – VI	**ELECTIVE - II**
18U6MBE03	**Total number of Hours: 45**
Credits: 4	**4 Hours/Week**

MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Course Objectives

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

Course Outcome:

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

UNIT - I **No. of Hours: 5**

Importance of Diagnosis of Diseases: Host-Pathogen Interaction: Distribution and significance of normal human microbial flora. Importance of Diagnosis of Diseases - Bacterial, Viral, Fungal and Protozoan disease of human beings. Bacterial, Viral, Fungal and Protozoan - Diseases of various human body systems - Disease associated clinical samples for diagnosis.

UNIT - II **No. of Hours: 5**

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

its precautions - Storage method of clinical samples in laboratory. Disposal methods of clinical samples.

UNIT - III **No. of Hours: 5**

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

UNIT - IV **No. of Hours: 5**

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

UNIT - V **No. of Hours: 5**

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

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 Books

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.

Mapping

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

18U6MBE03

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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Sixth Semester

Microbiology

MICROBIAL DIAGNOSIS IN HEALTH CLINICS

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Enrichment media is always ----------
   a. Liquid medium b. Solid medium c. Semi-solid medium d. Selective medium
2. Mycobacterium culture grown on ----------
   a. Lowenstein-Jensen medium b. blood agar c. Nutrient agar d. MacConkey agar
3. What is the temperature of liquid nitrogen?
   a. -120 degree C b.0 degree C c. -150 degree C d. -196 degree C
4. Which of the following method can be used to determine the number of bacteria quantitatively?
   a. Streak plate b. Spread-plate c. Pour plate d. Pour-plate and spread plate
5. Which of the following are not performed in lyophilization?
   a. Agar slant is covered with mineral oil b. Cell suspension is frozen at -60 degree to -78 degree C
   c. Vials are connected to high-vacuum line d. Bacterial sample is dehydrated
6. Which of the following is a function of cryoprotective agents?
   a. For long-term preservation of cultures b. Prevents cell damage due to ice crystal formation
   c. Prevents formation of ice d. To trap the liquid nitrogen
7. Crystal violet is ----------
   a. Primary stain b. Mordant c. Secondary stain d. All of these
8. The system of antiseptic surgery was developed by ----------
   a. John Tyndall b. Joseph Lister c. Louis Pasteur d. Robert Koch
9. Tuberculosis is a ----------
   a. Water borne disease b. Air borne disease c. Food borne disease d. Althropod disease

10. EMB agar is a ----------
a. Enriched media b. Differential media c. Selective media d. Enrichment media
11. *Mycobacterium* culture grown on ----------
a. Lowenstein-Jensen medium b. blood agar c. Nutrient agar d. MacConkey agar
12. Whose is known as Father of Immunology?
a. Robert Koch b. Edward Jenner c. Louis Pasteur d. Fleming
13. Nichrome loop wire is used in which of the following techniques?
a. Pour plate b. Streak plate c. Spread-plate d. Roll-tube technique
14. Which one of the following is true?
a. Agar has nutrient properties b. Chocolate medium is selective medium
c. Nutrient broth is basal medium d. Liquid medium is selective medium
15. Counter stain used in gram staining is ----------
a. Safranin b. Crystal violet c. Carbol fuschion d. Acetoacramine
16. Anthracis was isolated by ----------
a. Robert Koch b. Edward Jenner c. Anton Von Leeuwenhoek d. Fleming
17. Which one of the following is true?
a. Agar has nutrient properties b. Chocolate medium is selective medium
c. Nutrient broth is basal medium d. Liquid medium is selective medium

18. Counter stain used in gram staining is ----------
a. Safranin b. Crystal violet c. Carbol fuschion d. Acetoacramine
19. *Mycobacterium* culture grown on ---------
a. Lowenstein-Jensen medium b. blood agar c. Nutrient agar d. MacConkey agar
20. Whose is known as Father of Immunology?
a. Robert Koch b. Edward Jenner c. Louis Pasteur d. Fleming

PART – B (5 x 5 = 25 Marks)
Answer **ALL** questions
All questions carry equal marks

21. a) Write a short note on bacterial diseases (OR)
b) Write a short note on fungal diseases.
22. a) Discuss about collect and transport of clinical sample (OR)
b) Describe the storage method of clinical sample.
23. a) Describe the gram staining technique (OR)
b) Explain the Giemsa stained thin blood film for malaria.
24. a) Briefly explain about typhoid (OR)
b) Briefly explain about Dengue.
25. a) Discuss about serial tube dilution method (OR)
b) Write about the disc diffusion method.

PART – C (3 X 10 = 30 Marks)
Answer **ANY THREE** questions
All questions carry equal marks

26. Describe the importance of diagnosis of diseases.
27. Describe the collection and transport of clinical samples.
28. Explain Gram staining and acid fast staining.
29. Discuss in detail about PCR.
30. Briefly explain about MIC.

SEMESTER – VI	**ELECTIVE - II**
18U6MBE04	**Total number of Hours: 45**
Credits: 4	**4 Hours/Week**

QUALITY CONTROL IN FOOD MICROBIOLOGY

Course Objectives:

- GLP practices are intended to promote the quality and validity of test data.
- To get an idea for food business sets around producing and providing safe.
- To be able to differentiate between different enumeration techniques and learn when each should be used.
- To gain knowledge on spoilage microorganisms affects the appearance, smell, texture and taste.
- To Identify sources of potential errors during production and confirm the quality of the final product

Course Outcome:

CO1	Able to understand good laboratory practices
CO2	Able to understand the importance and food safety method

CO3	To gained knowledge about microbes and their food product
CO4	Able to understand food spoilage methods
CO5	Able to understand food preservation technologies

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

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

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

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

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

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

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

Food spoilage: characteristic features, dynamics and significance of spoilage of different groups of foods - cereal and cereal products, vegetables and fruits, meat poultry and sea foods, milk and milk products, packed and canned foods.

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

Rules and regulations for setting up of a processing unit. Criteria for ingredients and finished products. Aspects of microbiological safety in food preservation technologies, Establishment and implementation of HACCP, Continuous Assessment System, Total quality management and quality audits in food industries.

Microbiological quality standards of food, control and inspection, Enforcement and Govt. Regulatory practices and policies. FDA, EPA, HACCP,ISI, Detection of various methods of food toxicity, Hazard analysis criteria control points (HACCP) system for food safety, HACCP principles, Application of HACCP principles.

Suggested Books:

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

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

3. Fundamentals of Dairy Microbiology by Prajapati.

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

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

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

Mapping

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

18U6MBE04

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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

Sixth Semester

Microbiology

QUALITY CONTROL IN FOOD MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Good work practices include
 a. smelling and tasting chemicals b. not washing hands before and after lab
 c. confining long hair and loose clothing d. using damaged equipment and glassware.
2. Chemical, reagents or broth cultures should be pipetted by _____?
a. mouth b. pipetter c. ear d. nose
3. The desire to maintain a safe laboratory environment for all begins with _____?
a. prevention b. microbiology c. ubiquity d. accidents

4. To prevent the contamination of microscopes and surrounding areas disenfect/clean used slides, prepared by student, with ----------
a. 70% ethanol and lens paper b. acetone and lens paper
c. 5% methylene blue and lens paper d. water and lens paper
5. _____ is needed as a source of nutrient for the growth and reproduction of microbes.
a. pathogens b. reagents c. bacteria d. media
6. The growth of aerobic food spoilage and pathogenic microorganisms can be suppressed by
a. Humectants b. Exhausting c. Both a and b d. None of above
7. Pasteurization is the heat treatment designed primarily to kill
a. Vegetable forms of microorganisms b. All form of microorganisms c. Spore d. None of above
8. Clostridium botulinum mainly result in spoilage of ---------- foods
a. High acid Food b. Acidic Food c. Medium acid Food d. Low acid Food
9. Bacteria which is present in raw or undercooked meat, eggs, sea food and unpasteurized milk is
a. *E.coli* b. *Salmonella* c. *Staphylococcu*s d. Cyanobacteria
10. Milk and curry left over can be turned into sour and spoiled at ----------
a. high temperature b. very low temperature c. room temperature d. constant temperature
11. Diarrhea, vomiting and severe abdominal cramps shows their sign in
a. food poisoning b. constipation c. heart diseases d. muscle cramps
12. The undesirable change in a food that makes it unsafe for human consumption is referred as
a) food decay b) food spoilage c) food loss d) all of the above
13. Common food poisoning microbes are
a) *Clostridium and Salmonella* b) *Clostridium and E.coli*
c) *E.coli and Salmonella* d) *Clostridium and Streptococcus*

14. Which of the following statements are true regarding Staphylococcus food poisoning is
a) an enterotoxin b) causes gastroenteritis c) is produced by *Staphylococcus aureus* d) all of these

15. Bacterial cell grown on hydrocarbon wastes from the petroleum industry are a source of ------
a) carbohydrates b) proteins c) vitamins d) fats
16. Which of the following products have higher acidity and lacks aroma?
a) Cultured buttermilk b) Cultured sour cream c) Bulgarian milk d) Acidophilus milk
17. The microbiological examination of coliform bacteria in foods preferably use
a. MacConkey broth b. MacConkey agar c. eosine Methylene blue agar d. all of these
18. How many HACCP reguatios are there
a. 2 b. 3 c. 4 d. None of these
19. Which of the following disease is best diagnosed by serologic means?
a. Pulmonary tuberculosis b. Gonorrhea c. Actinomycosis d. Q Fever
20. HACCP stands for ----------
a. Hazard Activity Critical Control Plan b. Hazard Analysis Critical Control Points
c. Hygiene Analysis Critical Control Points d. Hygiene Analysis Contamination Control Plan

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. a. Write about the good laboratory practices (or)
    b. Discuss about the standard operating procedures.
22. a. Write a short note on Food and Drug administration (or)
    b. Describe about the factors affecting the growth of Micro organisms if food.
23. a. Write about the Sample preparation for analysis (or)
    b. Describe about the direct microscopic observation of pathogens in food sample.
24. a. How the micro organisms spoiled the packed and canned foods (or)
    b. Write about the factors involved in food spoilage.
25. a. Explain about the HACCP (or)
    b. Write a short note on total quality management.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Discuss about the quality objectives of food processing company.
27. Explain importance and significance of micro organisms in food safety.
28. Explain about the determination of organisms if food products.
29. Discuss the significance of organisms in spoilage of different groups of foods.
30. Write the Rule and regulations for setting up of a processing unit.

SEMESTER – VI	**SBEC - IV**
18U6MBS04	**Total number of Hours: 30**
Credits: 2	**2 Hours/Week**

ADVANCES IN MICROBIOLOGY

Course Objectives

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

Course Outcome:

CO1	Able to understand the quorum sensing and their applications
CO2	Able to understand the human metagenomics projects
CO3	To understand the Microbial fuel cell Technology

CO4	Able to understand the animal cell culture methods
CO5	To understand the Modern trends in microbial production

UNIT – I **No. of Hours: 04**

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

UNIT – II **No. of Hours: 04**

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

UNIT - III **No. of Hours: 04**

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

UNIT - IV **No. of Hours: 04**

Animal Cell Culture Technology: Introduction – types of cells - cell culture media and supplements, adherent cells – Vero, Hep-2, HepG-2, HeLa, MDCK, BHK – cultivation - sub-culturing.– preservation. – revival.

UNIT – V **No. of Hours: 04**

Modern trends in microbial production: Microbial production of bioplastics – Types (Starch and Cellulose) - Biodegradation- Applications of Bioplastics. Bioinsecticide -thruricide *Bacillus thuringiensis*, Biopolymer – dextran – alginate - Xanthan. Biofertilizer - N_2 fixer - Azotobacter, phosphate solubilizer, Single cell protein (SCP).

Text Books

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

Reference Books

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

Mapping

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

18U6MBS04

(For the candidates admitted from 2017- 18 onwards)

B.Sc., DEGREE EXAMINATIONS

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

Sixth Semester

Microbiology

ADVANCES IN MICROBIOLOGY

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

PART – A (20 x 1= 20 Marks)

Answer **ALL** questions

All questions carry equal marks

1. Form of gene expression which is regulated in response to cell density. Used as form of communication between cells through autoinducers. Commonly found in biofilms ----------
a. Signal peptides b. Quorum sensing c. Autoinducer d. Biofilm
2. Which of the following mode of microbial communication is likely to be faster, and more effective for less denser populations?

a. Quorum sensing making use of chemical signals b. Both will happen at almost same speed
c. Communication using physical signals such as sound d. None of the above
3. Signal molecule fits the binding site on its complementary receptor called as
a. Specificity b. Amplification c. Integration d. Cooperativity
4. The information which is represented by a signal is detected by specific receptors and converted to a cellular response; this conversion is called
a. Signal amplification b. Signal transversion c. Signal transduction d. Signal integration
5. Restriction fragment length polymorphisms (RFLPs)
a. Are used to determine the position of restriction sites in a genome
b. Are used in physical mapping
c. Are used in genetic mappind. Usually occur as multiple (more than 2) alleles in a genome
6. Which of these projects would be best suited for Next Generation Sequencing?
a) To determine if a tumour sample contains a common missense mutation
b) To find the transcriptome of a tumour sample
c) To genotype ten genomic DNA samples for a known single nucleotide polymorph
d) All of the above
7. What is metagenomics?
a. Genomics as applied to a species that most typifies the average phenotype of its genus
b. The sequence of one or two representative genes from several species
c. The sequencing of only the most highly conserved genes in a lineage
d. Sequencing DNA from a group of species from the same ecosystem
8. What is proteomics?
a. The linkage of each gene to a particular protein
b. The study of the full protein set encoded by a genome
c. The totality of the functional possibilities of a single protein
d. The study of how amino acids are ordered in a protein
e. The study of how a single gene activates many proteins
9. A fuel cell is used to convert chemical energy into
a. Mechanical energy b. Solar energy c. Electrical energy d. Potential energy
10. _____ and suitable catalyst are required to promote high rate of electrode processes.
a. Lower temperature b. Higher temperature c. Moderate temperature d. Very low temperature
11. _____is the device used to measure the emf of the cell.
a. Voltmeter b. Potentiometer c. Ammeter d. Multimeter
12. The temperature maintained in the standard hydrogen electrode is _____
a. 22˚C b. 23˚C c. 24˚C d. 25˚C
13. Hybridoma cells have an application to produce ----------
a. Antigens b. Antibodies c. Cancer cells d. Cell lines
14. The following are a list of essential components of cell culture media. Match them to the requirements for effective cell culture which they fulfil?
a. Phenol red b. Glutamine c. Inorganic salts d. Bicarbonate
15. Eicosanoids is a type of _____
a. Hormone b. Antibiotic c. Vaccine d. Antigen
16. The first vaccine developed from animal cell culture was ----------
a. Hepatitis B vaccine b. Influenza vaccine c. Small Pox vaccine d. Polio vaccine
17. Biofertilizers include _____
a. Cow dung manure and farmyard waste b. Quick growing crop ploughed back
c. BGA/Anabaena and Azolla d. All of the above
18. Which of the following material is used as bioplastic?

a. Polystyrene b. Polypropylene c. Polyhydroxybutrate d. Dextran

19. Technique of SCP is introduced by

a. Gregor Mendel b. Louis Pasteur c. Professor Scrimshaw d. Ian Wilmot

20. By using single-cell protein, amount of protein that can be produced by algae grown in ponds (per acre) is ----------

a. 20 tons b. 30 tons c. 40 tons d. 50 tons

PART – B (5 x 5 = 25 Marks)

Answer **ALL** questions

All questions carry equal marks

21. a) Describe the molecular mechanism of quorum sensing in Myxobacteria (OR)
    b) Shortly explain about the application of biofilm
22. a) Write about the definition and types of biofilm (OR)
    b) Discuss the impact factor of biofuel production
23. a) Write the short notes on metal recovery of copper and iron (OR)
    b) Write the brief account on the biodegradable plastics.
24. a) Discuss about Rhizosphere, Rhizoplane & Phyllosphere (OR)
    b) Write short note on Azospirillum
25. a) Explain the role of microalgae as colourant (OR)
    b) Describe the Spirullina cultivation method in detail.

PART – C (3 X 10 = 30 Marks)

Answer **ANY THREE** questions

All questions carry equal marks

26. Discuss about the bacterial quorum sensing.
27. Write the essay notes on bioenergy production.
28. Discuss about the processing of microbial leaching.
29. Describe types and application of Biopesticide.
30. Give a detailed account on Mass cultivation of *Rhizobium*.

SEMESTER – VI	**CORE - VI**
17U6MBCP06	**Total number of Hours: 60**
Credits: 3	**6 Hours/Week**

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

Course Objectives:

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

Course Outcome:

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

1. . Haemagglutination.

3. Egg inoculation methods (Demostration).

4. Wet mount examination of parasites.

5. Concentration methods for egg / ova

    - Flotation technique
    - Sedimentation technique

6. Isolation of bacteria from rhizosphere.

7. Plant diseases – Fungi and Bacteria.

8. MPN and Settle Plate method.

9. 10. Dissolved oxygen.

10. MBRT and Resazurin test.

11. Isolation of bacteria from spoiled fruits and soft drinks.

12.Determination of indices of pollution by measuring BOD/COD of different effluents

13.Isolation of microorganisms from curd.

SEMESTER -	**ELECTIVE –06**
18U6MBE04A	**TOTAL NO.HOURS –20hrs**
CREDIT – 4	**4HOURS/4 CREDIT**

VERMI TECH

CO1	Produce good quality of Vermicompost and Vermiculture
CO2	Acquire skills for entrepreneurship .
CO3	Will get the knowledge of biodiversity of local earthworms
CO4	Will help to maintain the environment pollution free
CO5	Will help to maintain the environment pollution free and

UNIT – I

Introduction to vermiculture. Definition, meaning, history, economic important, their value in maintenance of soil structure, role as four r's of recycling reduce, reuse, recycle, restore. Choosing the right worm. Useful species of earthworms. Local species of earthworms. Exotic species of earthworms. Complementary activities of autoevaluation.

UNIT-II

Limit factors (gases, diet, humidity, temperature, PH , light, and climatic factors). Physio-chemical parameters of vermicompost Different Methods of Vermicomposting: Small- and large-scale Bed method, Pit method Small Scale Earthworm farming for home gardens - Earthworm compost for home gardens Conventional commercial composting - Earthworm Composting larger scale Pest and diseases of earthworms. Frequent problems.

UNIT -III

Small Scale Earthworm farming for home gardens - Earthworm compost for home gardens. Conventional commercial composting - Earthworm Composting larger scale- Earthworm Farming (Vermiculture), Extraction (harvest), vermicomposting harvest and processing.

UNIT -IV

Nutritional Composition of Vermicompost for plants, comparison with other fertilizers. Vermiwash collection, composition &use. Enemies of Earthworms, Sickness and worm's enemies. Frequent problems. How to prevent and fix them. Complementary activities of auto evaluation.

UNIT -V

The working group experience with E. fetida populations comportment with farm industrial residues (frigorific, cow places, feed-lot, aviaries exploitations, and solid urban residues). b) Lineaments to vermicomposting elaboration projects. Considerations about economical aspects of this activity. Research and ratability according to different exploitation orientations (worm's meat production, worm's humus production, or integrated projects). Toxins released by the worms (harmful effects) Complementary activities of auto evaluation.

CERTIFICATE COURSE
(For any UG and PG students)

SPIRULINA CULTIVATION

OBJECTIVES

To enable the students to

i. be familiar with blue green algae
ii. acquire knowledge on taxonomy of blue green algae
iii. know the significance of single cell protein
iv. be familiar with the production of *Spirulina*
v. be acquainted with harvesting of *Spirulina*

UNIT – I **05 Hrs**

Blue green algae (BGA)- Introduction, morphology and distribution of BGA. Economic importance of BGA. Historical background on the use of Spirulina. Economic importance of Spirulina.

UNIT – II **06 Hrs**

Taxonomy of BGA-major taxonomic genera of BGA – characters –diagnostic key or the identification of BGA with special reference to Spirulina. BGA collection centers.

UNIT – III **08 Hrs**

Single Cell Protein (SCP)- Introduction – characteristics of SCP. BGA as a single cell protein: Nutritional value of Spirulina. Therapeutic value of Spirulina. Cosmetic value of Spirulina. Dosage of Spirulina as food and feed. Advantage of algae as SCP.

UNIT – IV **10 Hrs**

Cultivation of Spirulina - media formulation, indoor cultivation-fish tank method. Outdoor cultivation - inoculum preparation - trough, pit and pot culling method. Large scale production - pond method - Monitoring of production by feeding method, temperature, pH, contamination and density. Spirulina cultivation in waste water.

UNIT – V **06 Hrs**

Harvesting and Drying of Spirulina, post-harvest technology. Quality control and standards of Spirulina products. Common Spirulina products and their formulations (any three). Socio economic feasibility forSpirulina cultivation.

REFERENCE BOOKS

1. Barsanti,L. and P. Gualtieri, 2006, "Algal-anatomy, biochemistry, and biotechnology", CRC Press, Florida.
2. Baum, A.W., 2013, "Grow your own Spirulina super food",Algaelaborg, USA.

3. Richmond, A., 2004, "Handbook of Microalgal Culture" Blackwell Science Ltd, USA.
4. Vonshak, A., 2004, "*SprilinaPlantensis* (Arthrospira): Physiology, cell biology and biotechnology", Taylor & Francis, London.

LAB IN SPIRULINA CULTIVATION -PRACTICAL

OBJECTIVES

To enable the students to

i. be familiar with isolation of*Spirulina*
ii. gain knowledge on media preparation for *Spirulina* cultivation
iii. understand indoor cultivation of *Spirulina*
iv. be familiar with nutritional analysis
v. be acquired with commercial formulation preparation

LIST OF PRACTICALS 15 Hrs

1. Isolation of Spirulina
2. Microscopic examination of *Spirulina*
3. Preparation of Media for *Spirulina* cultivation
4. Inoculum development and mass cultivation of *Spirulina* (indoor cultivation)
5. Mass cultivation of *Spirulina* (outdoor cultivation)

REFERENCE BOOKS

1. Andersen, R.A., 2005, "Algal Culturing Techniques", First Edition,Elsevier Academic Press, San Diego.
2. Barsanti,L. and P. Gualtieri, 2006, "Algal-Anatomy, Biochemistry, and Biotechnology", CRC Press, Florida.
3. Richmond, A., 2004, "Handbook of Microalgal Culture: Biotechnology and Applied Phycology", Blackwell Science, Iowa.
4. Sinha, R.K. and R. Sinha, 2008, "Environmental Biotechnology" Aavishkar Publishers, Jaipur.
5. Vonshak, A., 2004, "*Spirulinaplatensis* (Arthrospira)-Physiology, Cell Biology and Biotechnology", Taylor & Francis Ltd., London.