# CAUVERY COLLEGE FOR WOMEN(AUTONOMOUS)

**NATIONALLY ACCREDITED (III CYCLE) WITH "A" GRADE BY NAAC**

**ISO 9001:2015 Certified**

**Annamalai Nagar, Trichy**

## PG AND RESEARCH DEPARTMENT OF MICROBIOLOGY

## SYLLABUS

## FOR

# B.Sc., MICROBIOLOGY

# 2021-2024

## PROGRAMME EDUCATIONAL OBJECTIVES

- Our program will produce graduates to impart skill-oriented education
- To provide quality education with innovative technology to gain technical expertise
- To enrich the ambitions of our students to steer with constructive collaboration to wards excellence

# PROGRAMME OUTCOMES

1. Enable students to acquire expertise in the use and application of various methods used in microbiology
2. Provide learning opportunity to be reflective about their role as are searcher
3. Handle and independently work on lab protocols involving molecular techniques
4. Awareness of ethical issues in Microbiology research and career options.
5. Production of substantial original research of significance and quality sufficient for publications.

# B.Sc., Microbiology Course Structure

**(For the candidates admitted from the academic year 2021- 2022 onwards)**

| SEM. | PART | COURSE | TITLE | COURSE CODE | INST. HOURS / WEEK | CREDIT | EXAM HOURS | MARKS | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | INT | EXT | |
| I | I | Language Course I (LC) Tamil*/Other Languages**# | இக்கால இலக்கியம் | 19ULT1 | 6 | 3 | 3 | 25 | 75 | 100 |
| | | | Story, Novel, Hindi Literature-I & Grammar-I | 19ULH1 | | | | | | |
| | | | Communication in French-I | 19ULF1 | | | | | | |
| | | | History of Popular Tales Literature and Sanskrit Story | 19ULS1 | | | | | | |
| | II | English Language Course- I(ELC) | Functional Grammar for Effective Communication-I | 19UE1 | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course–I (CC) | General Microbiology | 19UMB1CC1 | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Practical–I (CP) | General Microbiology and Microbial Physiology - Practicals | 19UMB1CC1P | 3 | - | - | | - | - |
| | | First Allied | Fundamentals of Biochemistry -I | 19UMB1AC1 | 4 | 4 | 3 | 25 | 75 | 100 |
| | | First Allied Practical–II(AP) | Fundamentals of Biochemistry I and II- Practicals | 19UMB1AC1P | 3 | - | - | - | - | - |
| | IV | UGC Jeevan Kaushal Life Skills | Universal Human Values | 20UGVE | 2 | 2 | 3 | 25 | 75 | 100 |
| | | | **TOTAL** | | **30** | **18** | | | | **500** |
| II | I | Language Course–II(LC)–Tamil*/Other Languages | இடைக்கால இலக்கியமும் புதினமும் | 19ULT2 | 6 | 3 | 3 | 25 | 75 | 100 |
| | | | Prose, Drama, Hindi Literature-2 & Grammar-II | 19ULH2 | | | | | | |
| | | | Communication in French-II | 19ULF2 | | | | | | |
| | | | Poetry Textual Grammar and Alakara | 19ULS2 | | | | | | |
| | II | English Language Course–II(ELC) | Functional Grammar for Effective Communication-II | 19UE2 | 6 | 3 | 3 | 25 | 75 | 100 |
| | | Core Course–II | Microbial Physiology | 19UMB2CC2 | 6 | 6 | 3 | 25 | 75 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | III | (CC) | | | | | | | | |
| | | Core Practical–I (CP) | General Microbiology and Microbial Physiology - Practicals | 19UMB1CC1P | 3 | 3 | 3 | 40 | 60 | 100 |
| | | First Allied Practical–II(AP) | Fundamentals of Biochemistry I and II- Practicals | 19UMB1AC1P | 3 | 3 | 3 | 40 | 60 | 100 |
| | | First Allied Course–III(AC) | Fundamentals of Biochemistry-II | 19UMB2AC2 | 4 | 2 | 3 | 25 | 75 | 100 |
| | IV | Environmental Studies | Environmental Studies | 21UGES | 2 | 2 | 3 | 25 | 75 | 100 |
| | V | Extra Credit Course | Swayam Online Course | To be fixed later | As per UGC Recommendation | | | | | |
| | | | | **TOTAL** | **30** | 22 | - | - | - | **700** |
| **III** | I | Language Course–III(LC)– Tamil*/Other Languages | காப்பியமும் நாடகமும் | 19ULT3 | 6 | 3 | 3 | 25 | 75 | 100 |
| | | | Medieval,Modern Poetry & History of Hindi Literature-3 | 19ULH3 | | | | | | |
| | | | Communication in French-III | 19ULF3 | | | | | | |
| | | | Prose,Textual Grammar and Vakyarachana | 19ULS3 | | | | | | |
| | II | English Language Course-III(ELC) | Reading and Writing for Effective Communication-I | 19UE3 | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – III (CC) | Introductory Virology | 19UMB3CC3 | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Practical– II (CP) | Introductory Virology and Immunology - Practicals | 19UMB3CC2P | 3 | - | - | - | - | - |
| | | Second Allied Course–I (AC) | Biostatistics | 19UMB3AC3 | 4 | 4 | 3 | 25 | 75 | 100 |
| | | Second Allied Practical-II (AP) | Biostatistics and Bioinformatics - Practicals | 19UMB3AC2P | 3 | - | 3 | - | - | - |
| | IV | Non Major Elective I | Herbal Medicine | 19UMB3NME1 | 2 | 2 | 3 | 25 | 75 | 100 |
| | | | a)Basic Tamil (for otherlanguage students) | 19ULC3BT1 | | | | | | |
| | | | b)Special Tamil (for those who studied Tamil upto +2 but opt for other languages in degree Programme) | 19ULC3ST1 | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| | V | Extra Credit Course | Swayam Online Course | To be fixed later | As per UGC Recommendation | | | | | |
| | | | | **TOTAL** | **30** | **18** | **-** | **-** | **-** | **500** |
| **IV** | I | Language Course–IV(LC)-Tamil*/other Languages | பண்டைய இலக்கியம் | 19ULT4 | 6 | 3 | 3 | 25 | 75 | 100 |
| | | | Letter writing, General Essays, Technical Terms, Proverbs, Idioms &Phrases, Hindi Literature-4 | 19ULH4 | | | | | | |
| | | | Communication in French IV | 19ULF4 | | | | | | |
| | | | Drama, History of Drama Literature | 19ULS4 | | | | | | |
| | II | English Language Course–IV(ELC) | Reading and Writing for Effective Communication-II | 19UE4 | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – IV (CC) | Immunology | 19UMB4CC4 | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical– II (CP) | Introductory Virology and Immunology - Practicals | 19UMB3CC2P | 3 | 3 | 3 | 40 | 60 | 100 |
| | | Second Allied Practical-II(AP) | Biostatistics and Bioinformatics - Practicals | 19UMB3AC2P | 3 | 3 | 3 | 40 | 60 | 100 |
| | | Second Allied III(AC) Course- | Computer Application in Biology | 19UMB4AC4 | 3 | 2 | 3 | 25 | 75 | 100 |
| | IV | Non Major Elective II | Pharmacognosy | 19UMB4NME2 | 2 | 2 | 3 | 25 | 75 | 100 |
| | | | a) Basic Tamil | 19ULC4BT2 | | | | | | |
| | | | b) Special Tamil | 19ULC4ST2 | | | | | | |
| | | Skill Based Elective-I | (A) Mushroom Technology | 19UMB4SBE1A | 2 | 2 | 3 | 25 | 75 | 100 |
| | | | (B) Clinical Parasitology | 19UMB4SBE1B | | | | | | |
| | V | Extra credits Course | SWAYAM Online Course | To be fixed later | As per UGC Recommendation | | | | | |
| | | | | **TOTAL** | **30** | **23** | **-** | **-** | **-** | **800** |

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|---|---|---|---|---|---|---|---|---|---|---|
| **V** | III | Core Course–V (CC) | Medical Microbiology | 19UMB5CC5 | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course–VI (CC) | Agricultural Microbiology | 19UMB5CC6 | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course–VII (CC) | Molecular Biology | 19UMB5CC7 | 6 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical-III (CP) | Medical Microbiology, Agricultural Microbiology and Molecular Biology-Practicals | 19UMB5CC3P | 3 | 3 | 3 | 40 | 60 | 100 |
| | | Major Based Elective-I | (A)Fundamentals of Botany and Zoology | 19UMB5MBE1A | 5 | 5 | 3 | 25 | 75 | 100 |
| | | | (B)Organic Farming | 19UMB5MBE1B | | | | | | |
| | IV | Skill Based Elective– II Practical | (A) Biofertilizer Technology Practical | 19UMB5SBE2AP | 2 | 2 | 3 | 40 | 60 | 100 |
| | | | (B) Solid Waste Management Practical | 19UMB5SBE2BP | | | | | | |
| | | Skill Based Elective– III Practical | (A) Medical Laboratory Technology Practical | 19UMB5SBE3AP | 2 | 2 | 3 | 40 | 60 | 100 |
| | | | (B) Vermitechnology Practical | 19UMB5SBE3BP | | | | | | |
| | | UGC Jeevan Kaushal Life Skills | Professional Skills | 19UGPS | 2 | 2 | 3 | 25 | 75 | 100 |
| | V | Extra Credit Course | Swayam Online Course | To be fixed later | As per UGC Recommendation | | | | | |
| | | | **TOTAL** | | **30** | **29** | **-** | **-** | **-** | **800** |
| **VI** | III | Core Course – VIII (CC) | Industrial Microbiology | 19UMB6CC8 | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Course – IX (CC) | Food Microbiology | 19UMB6CC9 | 6 | 6 | 3 | 25 | 75 | 100 |
| | | Core Practical – IV (CP) | Industrial and Food Microbiology - Practicals | 19UMB6CC4P | 6 | 5 | 3 | 40 | 60 | 100 |
| | | Major Based Elective-II | (A) Microbial Biotechnology | 19UMB6MBE2A | 6 | 6 | 3 | 25 | 75 | 100 |
| | | | (B) Food Adulteration | 19UMB6MBE2B | | | | | | |
| | | Major Based Elective-III | (A) Recombinant DNA Technology | 19UMB6MBE3A | 5 | 5 | 3 | 25 | 75 | 100 |
| | | | (B) Biological Techniques | 19UMB6MBE3B | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | V | Extension Activity | | 19UGEA | - | 1 | - | - | - | - |
| | | Gender Studies | Gender Studies | 19UGGS | 1 | 1 | 3 | 25 | 75 | 100 |
| | | | **TOTAL** | | **30** | **30** | **-** | **-** | **-** | **600** |
| | | | **GRANDTOTAL** | | **180** | **140** | **-** | **-** | **-** | **3900** |

Note: Part – I - Language – Tamil/Hindi/French/Sanskrit
Part –II - English

**Total No. of :**

Core Papers - 9
Core Practicals - 4
Allied Papers - 4
Allied Practicals - 2
Part I Language - 4
Part II English - 4
Non-Major Elective - 2
Skill Based Elective Theory - 1
Skill Based Elective practical - 2
Extra Credit Course - 4
Major Based Elective - 3
Universal Human Values - 1
Environmental Studies - 1
Professional Skills - 1
Gender Studies - 1
Extension Activities - 1 (Credit only) *

**The internal and external marks for theory and practical papers are as follows:**

| **Subject** | **Internal Marks** | **External Marks** |
|---|---|---|
| Theory | 25 | 75 |
| Practical | 40 | 60 |

**For Theory:**

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)
b) The passing minimum for End Semester Examinations shall be 40% out of 75 marks (i.e. 30 marks)

**For Practical:**

a) The passing minimum for CIA shall be 40% out of 40 marks (i.e. 16 marks)
b) The passing minimum for End Semester Examinations shall be 40% out of 60 marks (i.e. 24 marks)

**CORE COURSE–I (CC)**
**GENERAL MICROBIOLOGY**

| Semester I | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB1CC1** | **General Microbiology** | **Core** | **90** | **6** | **-** | **6** |

**Preamble**:

This subject aims to introduce the history and development of Microbiology. The contents of this course will help students understand history, biology of microorganisms, growth and control of microbes. Thus the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Recite the Development of Microbiology | K1 |
| CO 2 | Explain the Size and Shape of Microorganisms using Microscope | K2 |
| CO 3 | Illustrate the knowledge about Bacteria and Viruses | K2 |
| CO 4 | Revise the systematic classification of bacteria | K3 |
| CO 5 | Apply various technology for microbial cultivation | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **M** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **M** | **M** | **M** | **S** | **M** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

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

**UNITI : 18 hours**

Introduction- Definition, scope and History of Microbiology- theories of spontaneous generation. Domain and kingdom concepts. Microscopy: Principles and applications of brightfield, dark field, phase contrast, fluorescent SEM and TEM.

**UNITII : 18 hours**

Difference between prokaryotic and eukaryotic microorganisms. Bergey's manual of systemic bacteriology. Structural organization of bacteria – Size, shape and arrangement of bacterial cells - Ultrastructure of a bacterial cell - cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores , cysts, plasmid, mesosomes and cytoplasmic inclusions.

**UNIT III : 18 hours**

General characteristics and nature of Archaeobacteria, Cyanobacteria, Mycoplasma, Rickettsiae, Chlamydia, Spirochaetes, Actinobacteria, Protozoa, Algae, Fungi, lichens and Viruses. Basic understanding of classification of viruses -ICTV, algae - Fritch, fungi –Alexopoulos and protozoa.

**UNITIV: 18 hours**

Sterilization: Principles and methods – physical moist heat, dry heat, filtration and media preparation. Cultivation of microbes- Types of culture media with specific examples for each type. Aerobic and Anaerobic culture techniques- Pure culture techniques – Methods of maintenance and preservation of microbes. Principles and types of staining– Simple, differential Capsule staining.

**UNIT V: 18 hours**

Introduction to extremophiles –thermophiles, hyper thermophiles, psychrophiles, halophiles, alkanophiles, acidophiles, methanogenesis and their applications.

**Unit - VI:** Current Contours: (For Continuous Internal Assessment only) Quiz and Self reading on Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

**References:**

1. Alcamo IE. Fundamentals of Microbiology, sixth edition, Addison wesley Longman, Inc. California. 2001.

2. Atlas RA and Bartha R. Microbial Ecology. Fundamentals and Application,Benjamin Cummings, New York. 2000.

3. Black JG. Microbiology-principles and explorations, 6th edition.John Wiley and Sons, Inc. New York. 2005.

4. Dubey RC and Maheswari DK. A Text Book of Microbiology. S Chand, New Delhi. 2010

5. Kanika Sharma. Textbook of Microbiology – Tools and Techniques.1st edition, Ane Books Pvt. Ltd., New Delhi. 2011.

6. Madigan MT, Martinko JM, and Parker J. Biology of Microorganisms, 12th Edition, MacMillan Press, England. 2009.

7. Moselio Schaechter and Joshua Leaderberg. The Desk encyclopedia of Microbiology. Elseiver Academic press, California. 2004.

8. Pelczar MJ, Chan ECS and Kreig NR. Microbiology, fifth edition. McGraw- Hill.Book Co. Singapore. 2009.

9. Prescott LM, Harley JP, and Klein DA. Microbiology (7th edition) McGraw Hill,Newyork. 2008.

10. Schlegel HG. General Microbiology, Cambridge University Press, U.K. 2008.

11. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore. 2009.

12. Rajan S and Selvi Christy R. Essentials of Microbiology, Anjanaa Book House, Chennai, 2015.

**CORE PRACTICALS- I (CC)**
**GENERAL MICROBIOLOGY & MICROBIAL PHYSIOLOGY–PRACTICALS**

| Semester I & II | Internal Marks : 40 | External Marks : 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB1CC1P** | **General Microbiology and Microbial Physiology– Practicals** | **Core Practical** | **45** | **-** | **3** | **3** |

**Preamble**:

To enable the students to understand the basic knowledge about Bacterial size,shapes and Gram nature.

**Course outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Recall the safety practice in microbiological laboratory | K1 |
| CO 2 | Explain the ubiquitous nature of microorganisms | K2 |
| CO 3 | Understand the isolation and identification of Bacteria, Actinobacteria, Fungi and Cyanobacteria | K2 |
| CO 4 | Prepare various culture media, cleaning of glasswares and sterilization of media | K3 |
| CO 5 | Compute various pure culture techniques and biochemical test for identification of bacteria | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **M** | **S** |
| **CO2** | **M** | **S** | **M** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **S** | **M** | **S** |
| **CO5** | **S** | **S** | **S** | **M** | **S** |

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

**General Microbiology: 30 Hours**

1. Safety & Good laboratory practices

2. Basic concepts of Microscope and its operation

3. Principles and operations – Autoclave, Hot Air Oven, Incubators, Laminar Air Flow, Filtration, colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer

4. Cleaning and sterilization of glassware.

5. Preparation of culture media – solid, semi-solid and liquid.

6. Demonstration of ubiquitous nature of microorganisms.

7. Measurement of size of microbes – micrometry.

8. Isolation of bacteria, actinobacteria, fungi and cyanobacteria.

9. Enumeration of bacterial numbers by viable count (Plate count) and Total count (Haemocytometer count).

10. Pure culture techniques - Streak plate, Pour plate and Spread plate.

11. Test for motility of bacteria – Hanging drop method

12. Staining techniques – Simple staining, Gram's staining, Spore-staining, Capsular staining and LCB.

*13.* Observation of permanent slides to study the structural characteristics of algae (*Anabena, Nostoc, Spirulina, Oscillotoria), fungi (Pythium, Rhizopus,Saccharomyces, Penicillium, Aspergillus, Agaricus) and protozoa (Entamoebahistolytica and Plasmodium spp.).*

**Microbial Physiology: 15 Hours**

1. Bacterial growth curve: Cell count/viable count/absorbance (total count)

2. Carbohydrate fermentation tests: Glucose, Lactose, Sucrose and Mannitol.

3. Biochemical test for identification of bacteria: IMViC tests – TSI agar test- Urease- Catalase- Oxidase.

**REFERENCES:**

1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.

2. Gunasekaran P. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.

3. Harry W. Seeley JR, Paul J. Van Demark and John J Lee. Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York. 1997.

4. Kanika Sharma. Manual of Microbiology – Tools and Techniques.2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.

## FIRST ALLIED COURSE – I (AC)

## FUNDAMENTALS OF BIOCHEMISTRY -I

| Semester I | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB1AC1** | **Fundamentals of Biochemistry -I** | **Allied** | **60** | **4** | **-** | **4** |

**Preamble:**

To understand the structure, function and interrelationship of various biomolecules and consequences of deviation from normal.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Recite the views of carbohydrates and their classification | K1 |
| CO 2 | Explain the structure of protein | K2 |
| CO 3 | Illustrate an idea about structure and function of nucleic acids | K2 |
| CO 4 | Relate the structure and properties of lipids | K3 |
| CO 5 | Compute view of vitamins and their deficiency diseases | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **S** |
| **CO3** | **M** | **S** | **S** | **S** | **S** |
| **CO4** | **M** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **M** | **S** | **S** |

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

### UNIT I: 12 Hours

Introduction to biochemistry – concepts of macromolecules - Carbohydrate– Definition, sources, classification-monosaccharide, disaccharide and polysaccharide, structure of glucose, biological significance, digestion and absorption.

### UNIT II: 12 Hours

Proteins – Definition, sources, classification and structure of proteins - structural and non- structural proteins, Amino acids–structure- classification - essential and nonessential, protein and non-protein amino acids. Biological Significance of Proteins.

**UNIT III: 12 Hours**

Definition, basic ideas about the biochemical functions of lipids. Classification of lipids with examples, classification of fatty acids, List of Essential and non-essential fatty acids. Compound lipids: Structure and functions of phospholipids and glycolipids, Steroids: C 27, 21, 19 sterols.

**UNIT IV: 12 Hours**

Nucleic acids – Definition, structure – Nucleoside, Nucleotides, forms and functions of DNA.Types, structure and functions of RNA. Difference between DNA & RNA (mRNA, tRNA, rRNA).

**UNIT V: 12 Hours**

Vitamins micro and macro minerals and their biological importance – Definition, sources, deficiency syndromes and functions of Fat soluble vitamins (A, D, E and K) and Water soluble vitamins (B complex and C).

**UNIT VI:** Current Contours: (For Continuous Internal Assessment only) Quiz and Self

reading on Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

**References:**


1. Deb AC. Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) ltd, London. 2011.

2. AmbikaShanmugam. Fundamentals of Biochemistry for Medical students.Nagaraj and Company Pvt ltd, India. 1998.

3. Thomas M Devlin. Textbook of Biochemistry with Clinical Correlations, 7th edition, Wiley publisher. 2010.

4. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition Wiley publisher. 2013.

5. Albert L Lehninger, David L Nelson and Michael M Cox. Lehninger Principles of Biochemistry, 2nd edition, Wiley publisher. 2010.

6. Rajagopal G. Concise textbook of biochemistry, 2nd edition, Ahuja Publishing House. 2010.

7. Reginald H Garrett and Charles M Grisham, 5th edition. Biochemistry, Brooks Cole publishers. 2012.

8. Denise R Ferrier. Biochemistry, 6th edition, LWW publishers. 2013.

9. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier publishers. 2013.

10. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2014

## FIRST ALLIED PRACTICALS – I (AC)

## FUNDAMENTALS OF BIOCHEMISTRY I AND II -PRACTICALS

| Semester I &II | Internal Marks : 40 | External Marks : 60 | | | | |
|---|---|---|---|---|---|---|
| **Course code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB1AC1P** | **Fundamentals of Biochemistry I and II -Practicals** | **Allied Practical** | **45** | **-** | **3** | **3** |

**Preamble:**

To understand the structure, functions of various biomolecules and consequences of deviationfrom normal

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Identify the carbohydrate, amino acid, protein, lipid and nucleicacid both quantitatively and quantitatively | K1 |
| CO 2 | Interpret the amount of ascorbic acid present in the biological sample. | K2 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **M** | **S** |
| **CO2** | **S** | **S** | **S** | **M** | **S** |

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

**FUNDAMENTALS OF BIOCHEMISTRY I & II (P):45 hours**

1. Qualitative analysis of carbohydrates, amino acids, proteins, lipids and nucleic acids.
2. Quantitative estimation of Glucose by Anthrone Method
3. Quantitative estimation of Amino acids by Ninhydrin Method
4. Quantitative estimation of Protein by Lowry's Method
5. Quantitative estimation of Cholesterol by Jacks Method
6. Quantitative estimation of DNA by DPA Method
7. Quantitative estimation of RNA by Orcinol Method

**References:**

1. Shawn O' Farrell and Ryan T Ranallo. Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.

2. Manipal manual of clinical Biochemistry.2013, JB brother medical publisher.

3. Practical clinical Biochemistry, Ranjna Chawla.2014, JB brother medical publisher.

4. Practical Biochemistry, Damodaran Geetha K.2016, JB brother medical publisher.

**CORE COURSE - II (CC)**
**MICROBIAL PHYSIOLOGY**

| Semester II | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB2CC2** | **Microbial Physiology** | **Core** | **90** | **6** | **-** | **6** |

**Preamble**:

To understand the growth, enzymology and physiological processes of microbes

**Course outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | State the Nutritional requirements of microorganisms | K1 |
| CO 2 | Explain the enzyme mechanisms | K2 |
| CO 3 | Describe the Carbohydrate metabolism | K2 |
| CO 4 | Illustrate the Protein and Amino acid Metabolism | K2 |
| CO 5 | Compute the view of Aerobic and Anaerobic Respiration | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **M** | **S** |
| **CO3** | **M** | **S** | **S** | **M** | **S** |
| **CO4** | **M** | **S** | **S** | **M** | **S** |
| **CO5** | **S** | **S** | **M** | **S** | **S** |

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

**UNIT I : 22 Hours**

Nutritional types, Growth and requirements of Microorganisms. Factors influencing the growth of microorganisms – temperature, pH, Osmotic pressure, moisture, radiations and different chemicals, Physiology of growth – Significance of various stages of growth.

**UNIT II :14 Hours**

Bacterial enzymes – classification –oxidoreductase, transference, hydrolase, lyases, ligasesand isomerases - properties, coenzymes and cofactors, isozymes.

**UNIT III :18 Hours**

Metabolism of carbohydrates : Anabolism – photosynthesis – oxygenic – anoxygenic, synthesis of carbohydrate– catabolism of glucose – Embden Mayer– Hoff – Parnas pathway –Pentose pathway, Entener- Doudoroff (ED) pathway, Kreb's cycle (TCA) –electron transport system and ATP production.

**UNIT IV :18 Hours**

Metabolism of protein – metabolic pathways of nitrogen utilization, synthesis of amino acids,peptides, proteins.

**UNIT V :18 Hours**

Anaerobic Respiration – Nitrate, sulphate& Methane respiration – Fermentations – alcohol, mixed acid, lactic acid fermentation - Anabolic and catabolic processes of lipids.

**Unit VI:** Current Contours: (For Continuous Internal Assessment only) Quiz and Self readingon Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

**REFERENCES:**


1. Nelson David L, Albert L Lehninger and Michael M Cox. Lehninger principles of biochemistry. Macmillan.2008.

2. Murray RK, Granner DK, Mayes PA and Rodwell VW. "Harper‘s Biochemistry, Appleton and Lange: New York, NY. 2004.

3. Doelle HW. Microbial Metabolism, Academic Press. 2005.

4. Gerhart G. Bacterial Metabolism, Springer Verlag. 1986.

5. Hall DC and Rao KK. Phototsynthesis, 6th edn, Cambridge University Press.1999.

6. Lansing M. Prescott JP, Harley and Donald A Klein. Microbiology, 5th edition, McGraw-Hill Company, New York. 2003.

7. Mathews CK and Holde KEV. Biochemistry – The Benjamin/Cummings Publishing company, Inc., New York. 2003.

8. Murray RK, Granner MD, Mayes PA and Rodwell VW. Biochemistry – Prentice Hall International Inc., London. 2000.

9. Salle AJ. Fundamental principles of Bacteriology, 7th edition, Tata McGraw- Hill publishing company limited, New Delhi. 1996.

10. Stryer L. Biochemistry, 4th edition, W.H. Freeman and company, New York. 1995.

11. Zubey CL. Parson WW and Vance DE. Principles of Biochemistry – Wim. C. BrownPublishers, Oxford, England. 1994.

## FIRST ALLIED COURSE–III (AC)

## FUNDAMENDALS OF BIOCHEMISTRY-II

| Semester II | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB2AC2** | **Fundamentals of Biochemistry-II** | **Allied** | **60** | **4** | **-** | **2** |

**Preamble:**

To understand the structure and functions of blood, hormones and phytohormones.

**Course Outcome**

| CO Number | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Recall basic hematology | K1 |
| CO 2 | Identify the deficiency diseases associated with endocrine hormones | K1 |
| CO 3 | Explain the structure and functions of hormones | K2 |
| CO 4 | Restate the basic ideas about secondary metabolites | K2 |
| CO 5 | Apply the use of plant hormones and their biological role | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **M** | **M** |
| **CO2** | **S** | **S** | **M** | **S** | **S** |
| **CO3** | **S** | **M** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **M** | **M** | **S** | **S** |

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

**UNIT I : 12 Hours**

Blood – origin of blood cells, characterization and coagulation, composition - Serum and plasma, RBC, WBC and haemoglobin-structure and functions. Deficiency disease – anemia and haemophilia.

**UNIT II : 12 Hours**

Cytochemistry – structure and biochemical composition of plasma membrane – fluid mosaic model, Trilaminarmodel. Transport mechanisms –Active, Passive and Facilitated diffusion-Uni, sym and antiports.

**UNIT III : 12 Hours**

Endocrine glands – pituitary, thyroids, parathyroid, pancreas, adrenal, testis and ovary. Hormones – Definition – classification –protein hormone, steroid hormones, functions, regulations, diseases associated with deficiency of hormones.

**UNIT IV : 12 Hours**

General account and biosynthesis of major and accessory plant pigments – chlorophylls, carotenoids-astaxanthin, phycobilins and anthocyanins.

**UNIT V : 12 Hours**

Phytohormones and plant's secondary metabolites – structure and functions of auxin, gibberellins, cytokinins and abscisic acid.

**UNIT VI:**

Current Contours: (For Continuous Internal Assessment only) Quiz and Self reading on Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

**REFERENCES:**


1. Stryer, L.1995.Biochemistry. 4th Ed. W.H. Freeman and Company, New York.

2. Donald voet and Judith voet.1990. Biochemistry. John Wiley and Sons, New York.

3. Henry, R.Mahler and Eugene, H.Cerdesz, 1966. Biological Chemistry. Harper International Edition, New york.

4. Hubert, Stryer, 1995. Biochemistry – Freeman and Company, New York.

5. Dawn, B.Markus, 1994. Biochemistry.Harwal Publishing, New York.

6. William, J.Marshall and Stephan, K.Bangert.1995. Clinical Biochemistry – Metabolic and Clinical Aspects – Churchill Livingston, New York

## ENVIRORMENTAL STUDIES

| Semester II | Internal Marks :25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **21UGES** | **Environmental Studies** | **Part IV** | **30** | **2** | **-** | **2** |

### Preamble

To train the students to get awareness about total environment and its related problems and tomake them to participate in the improvement and protection of the environment.

### Course Outcome

| COs | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Outline the nature and scope of environmentalstudies | K2 |
| CO2 | Illustrate the various types of natural resources and its importance. | K2 |
| CO3 | Classification of various types of ecosystemwith its structure and function. | K2 |
| CO4 | Develop an understanding of various types of pollution and biodiversity. | K3 |
| CO5 | List out the various types of social issues related with environment . | K4 |

**Unit: 1**

Introduction to environmental studies Definition, scope and importance.
Need for public awareness

**Unit: 2**

Natural Resources: Renewable and non-renewable resources:

a) Forest resources: use and over-exploitation, deforestation, case studies. Timber

extraction, mining, dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resources, land degradation, man induced Landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources.

**Unit: 3 Ecosystems**

- Concept, Structure and function of an ecosystem.
- Producers, consumers and decomposers
- Energy flow in the ecosystem and Ecological succession.
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:-

  a. Forest ecosystem

  b. Grassland ecosystem

  c. Desert ecosystem

  d. Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)

**Unit: 4 Biodiversity and Environmental Pollution**

- Introduction, types and value of biodiversity
- India as a mega diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Definition, Causes, effects and control measures of :
  a. Air Pollution

  b. Water Pollution

c. Soil Pollution

d. Noise pollution

e. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- E-Waste Management: Sources and Types of E-waste. Effect of E-waste on environment and human body. Disposal of E-waste, Advantages of Recycling E-waste.
- Role of an individual in prevention of pollution
- Disaster management: floods, earthquake, cyclone and landslides.

**Unit: 5 Social Issues and the Environment**

- Water conservation, rain water harvesting, watershed management.
- Climate change, global warming, acid rain, ozone layer depletion,
- Wasteland reclamation.
- Environment Protection Act
- Wildlife Protection Act.
- Forest Conservation Act.
- Population explosion – Family Welfare Programmes
- Human Rights - Value Education
- HIV/ AIDS - Women and Child Welfare
- Role of Information Technology in Environment and human health

**References:**

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Public Ltd Bikaner.

2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt ltd, Ahamedabad – 380013, India, E-mail: mapin@icenet.net(R)

3. Brunner R.C. 1989, Hazardous Waste Incineration, McGraw Hill Inc 480 p

4. Clark R.S. Marine Pollution, Clanderson Press Oxford (TB)

5. Cunningham, W.P.Cooper, T.H.Gorhani E & Hepworth, M.T. 2001.

6. De A.K. Environmental Chemistry, Wiley Eastern Ltd

7. Down to Earth, Centre for Science and Environment (R)

8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford University, Press 473p.

9. Hawkins, R.E. Encyclopedia of India Natural History, Bombay Natural History Society, Bombay (R)

10. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press 1140 p.

11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws Himalaya Pub.

House, Delhi 284 p.

12. Mckinney, M.L. & Schoch R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition 639

13. Mhaskar A.K. Matter Hazardous, Techno-Science Publications (TB)

14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)

15. Odum, E.P. 1971 Fundamentals of Ecology. W.B. Saunders Co. USA. 574 p

16. Rao MN & Datta, A.K. 1987 Waste Water treatment, Oxford & IBH Publication Co. Pvt Ltd 345 p.

17. Sharma B.K. 2001 Environmental chemistry Goel Publ House, Meerut.

18. Survey of the Environment, The Hindu (M ).

19. Townsend C. Harper, J and Michael Begon, Essentials of Ecology, Blackwell science (TB)

20. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R).

21. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB).

22. Wagner K.D. 1998 Environmental Management. W.B. Saunders Co. Philadelphia USA 499 p

(M) Magazine (R) Reference (TB) Textbook

23.http://nbaindia.org/uploaded/Biodiversityindia/Legal/33%20Biological%20Diversity%20Rules,%202004.pdf.

**CORE COURSE-III**
**INTRODUCTORY VIROLOGY**

| Semester III | Internal Marks :25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB3CC3** | **Introductory Virology** | **Core** | **90** | **6** | **-** | **6** |

## Preamble:

To enable the students to understand the basic knowledge about Viruses and their Specific Isolation, Cultivation Techniques.

**Course Outcome:**

| CO Number | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Define the basic knowledge of Viruses | K1 |
| CO 2 | Select the suitable Purification and Characterization methods of Viruses | K1 |
| CO 3 | Compare and Contrast Bacteriophages Life cycle | K2 |
| CO 4 | Illustrate impacts of the Plant Viral diseases | K2 |
| CO 5 | Organised views of Animal Viruses | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **M** |
| **CO2** | **S** | **S** | **M** | **S** | **S** |
| **CO3** | **M** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **M** |
| **CO5** | **M** | **S** | **S** | **S** | **S** |

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

## UNIT–I: 16 Hours

Introduction – Definition, History of virology. General properties of viruses– cultivation of Viruses– Structure and replications of viruses–classification of Viruses.

## UNIT- II: 18 Hours

Purification and characterization of viruses, separation and characterization of viral components and quantification of viruses. Assay of viruses – physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy). Infective assay of Bacteriophages (plaque method, end point method). Infective assay of Plant Viruses.

## UNIT – III: 16 Hours

Bacterial Viruses–Classification and structure of Bacteriophage, The Lytic life cycle (T- Even coli phages) – Lysogenic life cycle (Escherichia coli, Phage Lambda). Bacteriophage typing, Phage therapy (Bacteriophage therapy).

## UNIT - IV: 18 Hours

Plant Viruses, common plant viral diseases: TMV, Bunchy top of Banana, Cauliflower Mosaic Virus, Potato Leaf Roll Virus, and Rice Tungro Virus. Satellite Viruses, Viroid. Transmission of Plant Viruses with Vectors - Insects, Nematodes, Fungi - without vectors (Contact, Seed and Pollens). Control Measures of Plant Viruses- Generation of Virus-Virus free planting material, Vector Control.

## UNIT- V: 22 Hours

Animal viruses: Morphology, pathogenesis and laboratory diagnosis of Prions, Rinder pest, Blue tongue, Raniketdion, Foot and Mouth Disease. Human Viruses– Retro, Hepatitis Pox, Polio, Rabies, Dengue Viruses, Oncogenic Viruses. Viral Vaccines. Prevention and Treatment of Viral Diseases. Antiviral agents.

## Text Books:


1. Ananthanarayan and Paniker's Textbook of Microbiology. 10th E-edition, Universities Press .United States. 2017.
2. David Greenwood , Richard C. B. Slack M.A, Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control.17th Edition, Churchill Livingstone. 2007.
3. Geo. Brooks, Karen C. Carroll, Janet Butel, Stephen Morse. Jawetz Mel nick & Adel bergs Medical Microbiology. 26th Edition, McGraw-Hill Education. 2012


## References:


1. Alan J. Cann. Principles of Molecular Virology. 6th edition, Academic press, California.2015.
2. Baishali C, Sumanta K Dutta, Patra Lekha RC and Ranjita S. Topley and Wilson's: Principles of bacteriology, Virology and immunity. 11th edition, vol 4, Edward Arnold, London. 2005.

3. Cook and Killington, R. Instant Notes in Microbiology. (2nd edition).Viva Books private limited, New Delhi. 2003.
4. Dimmock NJ and Primerose SB. Introduction to modern virology. 6th edition. Blackwell scientific publication, Oxford, London. 2007.
5. John Carter and Venetia Saunders. Virology: Principles and applications, 2nd Edition, John wiley and son's publishers, USA. 2013.
6. Maureen A Harrison and Ian F Rae. General techniques of cell cultures, Cambridge University Press, England. 2010.
7. Nayudu MV. Plant viruses, Tata McGraw Hill education, US. 2008
8. Robert I.Krasner.The microbial challenge: Human Microbe Interactions, American society for Microbiology, Washington. 2002.
9. Roger Hull. Mathews' Plant Virology. (4thEdition). Academic press- Aharcourt Science and technology company, NewYork. 2002.

**Web links:**

1. http://www.bocklabs.wisc.edu/ed/virustax.html
2. http:// www.bocklabs.wisc.edu/ed/genomes.html
3. http://www.virology.net/Big_Virology/BVHomePage.html

**Pedagogy :**

Power point presentations, Group Discussion, Seminar, Quiz , Assignment, Brain StormingActivity

## SECOND ALLIED COURSE-II
## BIOSTATISTICS

| Semester III | Internal Marks :25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB3AC3** | **Biostatistics** | **Allied** | **60** | **4** | **-** | **4** |

**Preamble:**

- To study the basic concepts of statistics and sampling design
- To equip analytical thinking to solve biological problems

**Course Outcomes**

| COs | CO Statement | Knowledge Level |
|---|---|---|
| **CO1** | Explain the basic concepts of biostatistics, functions and limitations | K3 |
| **CO2** | Classify the data and sampling deign | K3 |
| **CO3** | Compute the measures of central tendency and measures of dispersion | K3 |
| **CO4** | Apply the concepts of skewness, moments, kurtosis, correlation and regression to solve the problems. | K4 |
| **CO5** | Examine the various testing of hypothesis | K4 |

**Mapping with Programme Outcomes**

| Cos/ Pos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | S | S | S | S | S |
| CO2 | S | S | S | S | S |
| CO3 | S | S | M | S | S |
| CO4 | S | S | S | S | S |
| CO5 | S | S | S | S | S |
| CO6 | S | S | S | S | S |

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

## UNIT I: 12 Hours

Introduction to biostatistics - definition, statistical methods, biological measurement, kind of biological data, functions of statistics and limitation of statistics - Collection of data,sampling and sampling design.

## UNIT II:12 Hours

Tabulation and Frequency distribution, types of representations graphic-bar diagrams,pie diagrams and curves.

## UNIT III: 12 Hours

Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean - Measures of dispersion and variability changes- Mean deviation, standard deviation,and coefficient of variation.

## UNIT IV: 12 Hours

Skewness, Moments and Kurtosis - Meaning - test of skewness, characteristics of dispersion and skewness. Measures of skewness, objectives - Karl Pearson's coefficient ofskewness, Bowley's Coefficient of skewness- Correlation and regression analysis.

## UNIT V: 12 Hours

Testing of hypothesis for small samples-Students' T -Test- Chi square test-F-test orFisher's F test.

## Text Books:

1. P.N. Arora & P.K. Malhan, Biostatistics, Himalaya Publishing house, 2008

## References:

1. Bernard Rosner, Fundamentals of Biostatistics, Lengage learning, 2006
2. Norman TJ, Bailey. Statistical methods in biology, University press Cambridge Rastogi. 2009.
3. Bernard Rosner. Fundamentals of Biostatistics. 7th edition, Lengage learning,. 2010
4. R.S.N. Pillai & V.Bagavathi, Statistics Theory and Practice, S.Chand, 2016

**Pedagogy**

Group Discussion, Seminar, Quiz, Assignment.

## NON MAJOR ELECTIVE - I

## HERBAL MEDICINE

| Semester III | Internal Marks :25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB3NME1** | **Herbal Medicine** | **NME** | **30** | **2** | **-** | **2** |

**Preamble:**

To create a traditional knowledge of medicinally important plants in day to day life.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Define ethnomedicine | K1 |
| CO2 | Recite the knowledge about medicinally important plants. | K1 |
| CO3 | Describe about tribal medicine and their uses in diseases. | K2 |
| CO4 | Apply the traditional knowledge of medicinal plants in Tamilnadu | K3 |
| CO5 | Associate of plants in day to day life. | K4 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **S** | **M** | **S** | **M** |
| **CO2** | **S** | **S** | **M** | **S** | **S** |
| **CO3** | **M** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **M** | **S** | **S** |
| **CO5** | **S** | **S** | **M** | **M** | **S** |

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

**UNIT I : 6 Hours**

Ethnomedicine – definition, history and its scope – Inter disciplinary approaches in ethnobotany – Collection of ethnic information.

**UNIT II : 4 Hours**

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

**UNIT III : 6 Hours**

Tribal medicine – methods of disease diagnosis and treatment – Plants in folk tradition – *Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodond actylonand Sesamum indicum.*

**UNIT IV: 6 Hours**

Traditional knowledge and utility of some medicinal plants in Tamilnadu – *Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathod avasica, Azadirachat indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus fraternus, Cathanranthus roseus*

**UNIT V : 10 Hours**

Plants in day today life – *Ocimum sanctum, Centellaasiatica, Cassia auriculata, Aloe vera.* Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa, Solanum nigrum,* Cabbage).

**References :**


1. Ethnobiology – R.K.Sinha&ShwetaSinha. Surabhe Publications – Jaipur. 2001
2. Tribal medicine – D.C. Pal & S.K. Jain NayaPrakash, 206, BidhanSarani, Calcutta , 1998
3. Contribution to Indian ethnobotany – S.K. Jain, 3rd edition, Scientific publishers, B.No. 91, Jodhpur, India. 2001
4. A Manual of Ethnobotany – S.K.Jain, 2nd edition, 1995.
5. Quality control of herbal drugs by Pulok K Mukarjee, Ist edition, Business horizons Pharmaceutical publisher, New Delhi, 2002
6. Indian Herbal Pharmacopoeia, Vol.1&2, RRL, 1DMA, 1998, 2000
7. PDR for herbal medicines, 2nd edition, medicinal economic company, New Jersey, 2000
8. Drug industry by R.D. Choudhary, Ist edition, eastern publisher, NewDelhi: 1996

**Web link:**

1. http://www.ehtpa.eu/pdf/corecurriculum/Core%20Curriculum%20v11%2011-02-08.pdf
2. http://www.srtmun.ac.in/images/NEWBCUD/AcademicSection/Syllabus/MSc/MSC_CBCS/MScSecondYearCBCSJUne2015HerbalMedicine1.pdf

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, BrainStorming Activity

## CORE PRACTICAL - II

## INTRODUCTORY VIROLOGY AND IMMUNOLOGY -PRACTICALS

| Semester III &IV | Internal Marks :40 | External Marks: 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB3CC2P** | **Introductory Virology and Immunology - Practicals** | **Core Practical** | **45** | **-** | **3** | **3** |

**Preamble:**

To enable the students to identify, analyze and observe various techniques in virology and immunology

**Course Outcome:**

| COs | CO Statement | Knowledg elevel |
|---|---|---|
| CO1 | Identify and isolate bacteriophages from sewage. | K1 |
| CO2 | Illustrate of various immune haematological techniques. | K2 |
| CO3 | Describe the virus cultivation methods. | K2 |
| CO4 | Apply knowledge about selected bacterial plant and animal viruses. | K3 |
| CO5 | Organized view on bacterial, plant and animal viruses | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **S** |
| **CO3** | **S** | **S** | **M** | **S** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **M** |
| **CO5** | **M** | **S** | **S** | **S** | **M** |

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

**Introductory Virology: 30 Hours**

1. Isolation of Bacteriophage from sewage
2. Concentration of bacteriophages
3. Demonstration of mechanical transfer of viruses in plants
4. Demonstration of cultivation of viruses by embryonated egg inoculation method.
5. Observation of selected bacterial, plant and animal viruses – T4 and M13 Phage, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus

**Immunology: 15 Hours**

1. ABO Blood grouping
2. Rh typing
3. Widal Test
4. RPR
5. CRP
6. ASO
7. Total and differential blood cell count by haemocytometer
8. Double immunodiffusion (Ouchterlony method)
9. Demonstration of ELISA

**References:**


1. Atlas Ronald M. Hand book of media for clinical and public health microbiology, Boca Raton, FL: CRC press, Francis. 2013.
2. Li Zongxi, Zheng Li, FengHui, Cao Yan, Li Cheng and Pang Wei. Immunology Methods for Medical Students.Department of Immunology, China medicaluniversity.2006.
3. Fleming, Diane O, Debra long and Hunt. Biological safety: Principles andpractices, 4th edition, ASM press, Washington, DC.2006.
4. Florence G Burleson, Thomas M Chambers and Danny L Wiedbrauk. Virology: A laboratory Manual. Academic Press, UK.1992.
5. Goldman, Emanuel and Lorrence H Green. Practical Handbook of Microbiology, Boca Raton, FL: CRC press, Francis. 2009.
6. James G Cappuccino. Microbiology.The Benjamin / Cummings Pub.Co.California.1996.
7. Morag C Timbury. Medical Virology.10th edition, Churchill Livingston.1994.
8. O'Gorman, Manrice RG and Albert David Donnenberg. Hand book of humanImmunology. Boca Raton, FL: CRC press, Francis.2008.
9. Rajan S and Selvi Christy R. Experiments in Microbiology. Anjana Books House, Chennai. 2015.
10. Richard A Glodsby, Thosmas J Kindt and Barbera A Osborne. Kuby 10. Immunology (4th edition). W.H. Freeman and Company, New York. 2000.

**Web link**

1. https://microbiologyinfo.com/techniques-of-virus-cultivation/
2. .https://www.scribd.com/doc/53764085/Immunotechniques

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

## SECOND ALLIED PRACTICAL - II
## BIOSTATISTICS AND BIOINFORMATICS -PRACTICALS

| Semester III & IV | Internal Marks :40 | External Marks: 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB3AC2P** | **Biostatistics and Bioinformatics - Practicals** | **Allied Practical** | **45** | **-** | **3** | **3** |

**Preamble:**

To collect various data for representation using biological materials and to computenucleic acid sequence databanks

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Identify and collect various data for representation using biological materials. | K1 |
| CO2 | Illustrate t' test, 'chi' square, standard error and Deviation using SPSS programme. | K2 |
| CO3 | Compared views on Nucleic acid sequence databanks | K3 |
| CO4 | Compute multiple sequence alignment. | K3 |
| CO5 | Construct nucleic acid and protein structure databases. | K3 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **S** | **M** | **M** | **S** |
| **CO2** | **S** | **M** | **M** | **S** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **M** | **M** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

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

**BIOSTATISTICS AND BIOINFORMATICS (P): 45 Hours**

1. Collection of Data, Sampling Designs, Tabulation and Graphic Representation using Biological Materials.
2. To find Mean, Mode, Median, Co-efficient of Variance using Biological Materials.
3. Tests of Significance‘t’ test, ‘chi’ Square, Standard Error and Standard Deviation.
4. ‘t’ Test, Chi Square, Statistical Error, Standard Deviation also, to be practically done through SPSS programme [statistical Package for Social Sciences].
5. Study of Nucleic acid Sequence Databanks – Gen Bank, NCBI, EMBL Nucleotide Sequence Databank, and DDBJ.
6. Study of Protein Structure and Classification Databases – PDB, SCOP and CATH.
7. Multiple alignments – Clustal W.
8. Evaluation of Protein Structure by Swiss PDB viewer and RASMOL.

**REFERENCES:**


1. Maicello Pagano, Kimberlee Gauvreau. Principles of Biostatistics, 2nd edition, Duxbury Press. 2000.
2. Roland Ennos. Statistical and Data Handling Skills in Biology, 3rd edition. Pearson. 2011.
3. http://en.m.wikipedia.org/wiki/Nucleotide sequence database
4. http://en.m.wikipedia.org/wiki/Multiple sequence alignment
5. http://en.m.wikipedia.org>wiki>Swiss PDB viewer
6. http://en.m.wikipedia.org>wiki>Rasmol


**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

**CORE COURSE – IV (CC)**
**IMMUNOLOGY**

| Semester IV | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **P** | **T** | **Credits** |
| **19UMB4CC4** | **Immunology** | **Core** | **75** | **-** | **5** | **5** |

**Preamble:**

The aim of the course is to teach the types of immunity, immune system, antigen, antigen – antibody reaction, T and B cell activation, lymphokines and cytokines, hyper sensitivity reaction, immune deficiency disorders, immune hematology and transplantation of immunity.

**Course Outcome**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Understand the history and types of immunity. | K4 |
| CO2 | Demonstrate the various antigen-antibody techniques. | K4 |
| CO3 | Differentiate the structure of MHC, Cytokines and lymphokines. | K6 |
| CO4 | Explain immuno technology and its applications. | K6 |
| CO5 | Explain the knowledge about hypersensitivity reactions | K6 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **S** | **M** | **M** | **L** |
| **CO2** | **S** | **M** | **M** | **S** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

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

**UNIT-I: 15 hours**

History and overview of the Immune system. Cells and organs of the Immune system – Origin, development. Immuno haematology - blood groups, blood transfusion, Rh incompatibility. Immunity - types of immunity - cell mediated, Innate and acquired immunity. Differentiation of T and B cells and their receptors.

**UNIT-II: 15 hours**

Antigen- properties, types, biology of antigens- Haptens, adjuvants, epitope, paratope, cross reactivity and Forssman antigen. Immunoglobulin - structure, properties, types and functions. Theories of antibody production. Complement- alternative and classical pathways. Antigen - Antibody reaction - Precipitation, Agglutination, Immunodiffusion and Complement Fixation.

**UNIT-III: 17 hours**

Immune response - Cell mediated and humoral. MHC, Cytokines, lympokines - structure, function and their receptors. Vaccines – types, toxoids and anti-toxin. Transplantation Immunology- types of transplants, Tissue typing, Graft - rejection mechanism.

**UNIT IV: 15 hours**

Immunotechniques: Monoclonal antibody production, properties and its applications. ELISA, RIA, Immuno fluorescence - FISH, Immuno electrophoresis and WIDAL.

**UNIT V: 13 hours**

Hypersensitivity Reactions – Introduction, Definition - allergy, allergens, types - Immediate (Type I, Type II, Type III) and delayed (Type IV) Hypersensitivity reactions. Cancer Immunology - Introduction, tumour of immune system, tumour antigens, types of tumoursand immuno therapy . Basic concept of autoimmunity and immuno deficiency disorders.

**Text Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai | Basic Immunology: Functions and Disorders of the Immune System 6th Edition | Elsevier | 2019 |
| 2. | Robert R. Rich, Thomas A Fleisher , William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand | Clinical Immunology: Principles and Practice | Elsevier | 2018 |
| 3. | Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai | Cellular and Molecular Immunology 9th Edition | Elsevier | 2017 |
| 4. | Peter J. Delves , Seamus J. Martin , Dennis R. Burton , Ivan M. Roitt | Roitt's Essential Immunology | Wiley-Blackwell | 2017 |
| 5. | Richard Coico, Geoffrey Sunshine | Immunology: A Short Course | Wiley-Blackwell | 2015 |

**Reference Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Kenneth Murphy, Casey Weaver | Janeway's Immunobiology 9th Edition | Garland Science | 2016 |
| 2. | William E. Paul | Fundamental Immunology 7th Edition, Kindle Edition | Lippincott Williams | 2012 |

| | | | | |
|---|---|---|---|---|
| 3. | A Wesley Burks , Stephen T Holgate , Robyn E O'Hehir , Leonard B. Bacharier, David H. Broide , Gurjit K. Khurana Hershey , Jr. R. Stokes Peebles | Middleton's Allergy E-Book: Principles and Practice | Elsevier | 2019 |
| 4. | John E. Bennett , Raphael Dolin, Martin J. Blaser | Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases: 2-Volume Set 8th Edition, | Saunders | 2014 |
| 5. | Lauren M. Sompayrac | How the Immune System Works | Wiley-Blackwell | 2019 |

**Web links**

1. https://www.immunology.org/public-information/what-is-immunology
2. https://aacijournal.biomedcentral.com/articles/10.1186/1710-1492-7-S1-S1
3. https://onlinelibrary.wiley.com/journal/13652567
4. https://www.frontiersin.org/articles/10.3389/fimmu.2019.00684/full
5. https://emedicine.medscape.com/allergy_immunology

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz , Assignment, Brain Stormingactivity

## SECOND ALLIED COURSE – III (AC)
## COMPUTER APPLICATION IN BIOLOGY

| Semester IV | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **P** | **T** | **Credits** |
| **19UMB4AC4** | **Computer application in biology** | **Allied** | **45** | **-** | **3** | **2** |

**Preamble:** The most important objective is to make the students understand inherent structure of biological information and to analyze the gene and protein sequences to reveal protein evolution. This syllabus would enlighten the students to understand the applications of computers in biology and acquiring basic knowledge about computers and internet.

**Course Outcome**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Define the basics of computer | K1 |
| CO2 | Recite the knowledge about internet | K1 |
| CO3 | Critique knowledge about bioinformatics | K4 |
| CO4 | Generalize the structure and classification of protein visualization tools | K6 |
| CO5 | Expand about the role of computers in biology | K6 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **S** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **M** |
| **CO3** | **S** | **S** | **M** | **L** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **M** |
| **CO5** | **S** | **M** | **M** | **M** | **M** |

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

**UNIT-I: 09 Hours**

Introduction and History of Computers, Basic Anatomy of Computers. Input and output devices, hardware and software. Operating system.

**UNIT-II: 09 Hours**

Internet –History and Uses of internet. Connection to Internet - Getting connection-Web page-Modem-Internet Service providers-E-mail and Voice Mail, Creating E-mail Address.

**UNIT-III: 09 Hours**

Introduction to bioinformatics – history and its development – Scope and applications of bioinformatics. Biological database – GenBank -NCBI, EMBL, DDBJ.

**UNIT-IV: 09 Hours**

Sequence Alignment Pairwise (BLAST and FASTA) and Multiple sequence alignment (ClustalW). Structure of Protein, Classification –PDB, Swiss-PROT, SCOP, CATH. Protein visualization tools-RASMOL, Swiss PDB viewer.

**UNIT-V: 09 Hours**

Computers in Taxonomy and Systemic Data Analysis in Microbiology. Computers in clinical microbiology - Computer applications in fermentation – application of Computers in Drug - Designing using various software's.

**Text Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Sumita Arora | A textbook of Information technology | Dhanpat Rai & Co | 2020 |
| 2. | Nell Dale and John Lewis | Computer Science Illuminated | Jones and Bartlett Publishers | 2019 |
| 3. | Arthur Lesk | Introduction to Bioinformatics | OUP Oxford | 2019 |
| 4. | Daniel McGuire | Bioinformatics: Design, Sequencing and Gene Expression | Callisto | 2019 |
| 5. | Vinay Sharma , Ashok Munjal and Ashish Shanker | Bioinformatics | Rastogi Publications | 2018 |

**Reference Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Alka Vishwa | Computer Organization and Architecture | Dreamtech Press | 2019 |
| 2. | William T. Loging | Bioinformatics and Computational Biology in Drug Discovery and Development Reprint Edition | Cambridge University Press | 2018 |
| 3. | Kevin P Hare | Computer Science Principles: The Foundational Concepts of Computer Science | Kevin P Hare LLC | 2018 |
| 4. | Hamid Arabnia Quoc Nam Tran | Emerging Trends in Computational Biology, Bioinformatics, andSystems Biology | Morgan Kaufmann | 2015 |
| 5. | Ramsden | Bioinformatics An Introduction | Springer-Verlag London | 2015 |

**Web links**

1. http://en.m.wikipedia.org/wiki/Nucleotide sequence database
2. www.bioinformatics.org/wiki/sequence alignment
3. https://academic.oup.com/bioinformatics
4. https://www.ebi.ac.uk/training/online/course/bioinformatics-terrified/what-bioinformatics-0
5. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics

**Pedagogy**

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain stormingactivity.

**NON MAJOR ELECTIVE II**
**PHARMACOGNOSY**

| Semester IV | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB4NME2** | **Pharmacognosy** | **NME** | **30** | **2** | **-** | **2** |

**Preamble:** To create awareness on traditional knowledge of medicinally important plants inday to day life.

**Course Outcome**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Outline study of traditional Indian medicine | K1 |
| CO2 | Explain the needs of crude drugs | K2 |
| CO3 | Demonstrate the crude and commercial drugs | K4 |
| CO4 | Compile view of Oraganoleptic study | K3 |
| CO5 | Relate the analytical Pharmacognosy of available medicinal plants | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **S** | **M** | **S** | **S** |
| **CO3** | **S** | **M** | **S** | **M** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **M** | **S** | **S** |

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

**Unit I: 5 Hours**

History, Definition and scope of Pharmacognosy; Systems of Indian Medicines – Siddha, Unani, Ayurveda, Homeopathy; Terminologies in Pharmacognosy: Medical Ethnobotany, Ethno pharmacology, Phytotheraphy, Phytochemistry.

**Unit II: 5 Hours**

Classification of Crude drugs – Taxonomical, Morphological, Pharmacological and Chemical classifications; Chemistry of drugs and its evaluation.

**Unit III: 6 Hours**

Preparation of crude and commercial drugs. Making infusion, decoction, lotion, washers, insect repellents, suppositories, tincture, making herbal syrups, compresses, poultice, plasters, ointments, herbal oils and herbal salves,surgical fibres, sutures and dressing.

**Unit IV: 7 Hours**

Organoleptic study of the following medicinal plants: Fruit – Amla, Bulb – Garlic, Rhizome – Ginger, Seed – Castor, Bark – Cinchona, Leaves – Neem, Flower – Clove.

**Unit V: 7 Hours**

Analytical Pharmacognosy – drug adulteration and detection. Biological testing of herbal drug. Phytochemical investigations with reference to secondary metabolites of locally available medicinal plants: Phyllanthus amarus, Curcuma longa, Ocimum sanctum, Aloe vera.

**Text Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | S.B.Gokhale &Dr.C.K. Kokate | Pharmacognosy | Nirali Prakashan,Pune | 2019 |
| 2. | S.B.Gokhale, Dr.C.K. Kokate & A U Tatiya | Pharmacognosy And Phytochemistry | Nirali Prakashan, Pune | 2019 |
| 3. | Bhandari & Singh | Textbook of Pharmacognosy | CBS Publishers and Distributors Pvt Ltd,Delhi | 2019 |
| 4. | J.S.Qadry | A Textbook of Pharmacognosy Theory and Practicals | CBS Publishers and Distributors Pvt Ltd,Delhi | 2019 |

| | | | | |
|---|---|---|---|---|
| 5. | Bire shah & A.K.seth | Textbook of Pharmacognosy and Phytochemistry | CBS Publishers and Distributors Pvt Ltd,Delhi | 2019 |
| 6. | Penelope Ody | The Complete MedicinalHerbal | Skyhorse, US | 2017 |

**Reference Books**

| S.No | Authors Name | Title of thebook | Publishers Name | Year |
|---|---|---|---|---|
| 1. | A.N.Kalia | Textbook of Industrial Pharmacognosy | CBS Publishers and Distributors Pvt Ltd, Delhi | 2019 |
| 2. | Henry Kraemer | Scientific and Applied Pharmacognosy, Intended for the Useof Students in Pharmacy, as a HandBook for Pharmacists, and as a Reference Book for Food and Drug Analysts and Pharmacologists | Wentworth Press,Sydney | 2018 |
| 3. | Ned Burnett | Encyclopedia of Drug Discovery and Development | Foster Academics,USA | 2015 |

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|---|---|---|---|---|
| 4. | Roy Upton, Alison Graff, Georgina Jolliffe & Reinhard Länger | American Herbal Pharmacopoeia: Botanical Pharmacognosy | CRC Press (Taylor & Francis), Florida | 2015 |
| 5. | Francesco Capasso , Timothy.S, Gaginella& Giuliano Grandolini | Phytotherapy: A Quick Reference to Herbal Medicine | Springer, Newyork | 2012 |

**Web Links**

1. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H
2. https://www.pdfdrive.com/fundamentals-of-pharmacognosy-and-phytotherapy-2d-edition-e186515176.html
3. https://www.pdfdrive.com/textbook-of-pharmacognosy-and-phytochemistry-e184620437.html
4. https://www.pdfdrive.com/pharmacognosy-practice-e34345777.html
5. https://www.pdfdrive.com/an-introduction-to-pharmacognosy-e58091191.html
6. https://www.pdfdrive.com/pharmacognosy-fundamentals-applications-and-strategies-e158282041.html
7. https://www.pdfdrive.com/therapeutic-use-of-medicinal-plants-and-their-extracts-pharmacognosy-e186979045.html
8. https://www.pdfdrive.com/pharmacognosy-2-e38501617.html
9. https://www.pdfdrive.com/a-text-book-of-botany-and-pharmacognosy-e158788414.html
10. https://www.pdfdrive.com/introduction-to-pharmacognosy-e57734502.html

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

**SKILL BASED ELECTIVE–I**

**MUSHROOM TECHNOLOGY**

| **Semester IV** | **Internal Marks : 25** | **External Marks : 75** | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **P** | **T** | **Credits** |
| **19UMB4SBE1A** | **Mushroom Technology** | **SBE** | **30** | **-** | **2** | **2** |

**Preamble:**

To make the students to understand about the types of mushrooms, cultivation requirements and techniques, its storage and various mushroom food items.

| **COs** | **CO Statement** | **Knowledge level** |
|---|---|---|
| CO1 | Differentiateedible and Poisonous mushrooms | K5 |
| CO2 | Examine cultivation system of mushroom | K4 |
| CO3 | Create an nutrient profile of mushroom | K6 |
| CO4 | Formulation of mushroom food preparation | K6 |
| CO5 | Determine health benefits of mushroom | K4 |

**Mapping with Programme Outcomes**

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **M** | **M** | **S** |
| **CO2** | **M** | **M** | **M** | **M** | **M** |
| **CO3** | **M** | **M** | **M** | **M** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

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

**Unit–I: 6 hours**

Introduction – History–scope of edible mushroom. Types of Mushrooms – Poisonous and Edible Mushroom. Different parts of a typical Mushroom and Variations in mushroom morphology. Natural Habitats – Humicolous, Lignicolous and Coprophilus. Color of Mushroom Spores.

**Unit–II: 6 hours**

Cultivation of mushroom - small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform, equipments & facilities, pasteurization room & growing rooms. Principles ofcomposting, machinery required for compost making, materials for compost preparation. Methods of Composting- Long method of composting (LMC) & Short method of composting (SMC). Facilities required for spawn preparation, Preparation of spawn substrate,preparation of pure culture, media used in raising pure culture, culture maintenance, and storage of spawn.

**Unit–III: 6 hours**

Biology of mushroom - Button, Straw, Milky & Oyster- General morphology, distinguishing characteristics, spore germination and life cycle. Nutrient profile of mushroom - Protein, amino acids, Crude fibre, calorific values, carbohydrates, fats, vitamins & minerals.

**Unit–IV: 6 hours**

Cultivation of Button, Oyster, Milky & Straw mushroom - Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing. Visit to relevant Labs/Field Visits.Mushroom Food preparation - soup, sauce, cutlet, omelette, samosa, pickles, curry & biriyani.

**Unit–V: 6 hours**

Health benefits of Mushroom - Antiviral, Antibacterial, Antifungal, Anti-tumour Properities, haematological value of cardiovascular &Renal health therapeutic diets for adolescence, aged persons & diabetes mellitus.

**Text Books:**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | R.Gogoi, Y.Rathaiah, T.R.Borah | Mushroom Cultivation Technology | Scientific Publisher | 2019 |
| 2. | T.Parveen Kumar | Mushroom Cultivation and Marketing | Jaya Publishing House | 2019 |
| 3. | Bahl N | Handbook on Mushrooms | Oxford and Ibh Publishing | 2018 |
| 4. | Santosh Kumar and Gireesh Chand | Techniques of Mushroom Cultivation | Daya Publishing House | 2018 |
| 5. | B.C.Suman, V.P. Sharma | Mushroom Cultivation in India | Daya Publishing House | 2017 |

**Reference Books**

| S. No | Author | Title | Publisher | Year |
|---|---|---|---|---|
| 1. | Russell, Stephan. | The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques forGrowing *Shiitake, Oyster,Lion's Mane*and *Maitake Mushroom* at Home. | Storey Publishing | 2014 |
| 2. | Cotter, Tradd. | Organic Mushroom Farmimg and Mycoremediation: Simple to Advanced and Experimental Techniques forIndoor and OutdoorCultivation. | Chelsea Green Publishing | 2014 |

| | | | | |
|---|---|---|---|---|
| 3. | Pathak Yadav Gour | Mushroom Production and Processing Technology | Agrobios | 2010 |
| 4. | Krieger,L.C. | The Mushroom Handbook | Sufi Press | 2010 |

**Web Links**

1. http://www.fungi.com
2. http://www.mushworld.com/home
3. http://forums.mycotopia.net/faq-frequently-asked-questions/5594-mushroom-growers-handbook-1-mushworld-com.html.
4. http://forums.mycotopia.net/faq-frequently-asked-questions/6556-mushroom-growers-handbook-2-mushworld-com.html
5. http://www.americanmushroom.org/news.html

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Stormingactivity.

**SKILL BASED ELECTIVE I**
**CLINICAL PARASITOLOGY**

| Semester IV | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **P** | **T** | **Credits** |
| **19UMB4SBE1B** | **Clinical Parasitology** | **SBE** | **30** | **-** | **2** | **2** |

**Preamble:** Gain knowledge about clinical parasitology. The classification of clinically important protozoa, helminths and arthropods. Acquire knowledge about the areas in which parasitic infections are endemic.

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Generalize diagnostic techniques in parasitology | K6 |
| CO2 | Examine the clinical significance of *Entamoebahistolytica* | K4 |
| CO3 | Elaborate the pathogenicity of *Leishmania donovani* | K6 |
| CO4 | Discuss about the *Plasmodium spp.* | K6 |
| CO5 | Determine *Taenia solium* | K4 |

**Mapping with Programme Outcomes**

| COs | PO 1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **M** | **M** | **S** |
| **CO2** | **M** | **M** | **M** | **M** | **M** |
| **CO3** | **M** | **M** | **M** | **M** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

**S – Strong, M- Medium, L - Low**

**UNIT – I: 6 Hours**

Introduction and Classification of Parasites – Protozoa and helminthic infection. Laboratory Diagnostic Techniques in Parasites – Direct Identification and Indirect Identification. Concentration methods - flotation techniques and sedimentation techniques.

**UNIT - II: 6 Hours**

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Entamoeba histolytica, Naegleria fowleri, Acanthamoeba* spp. *Cryptosporium.*

**UNIT - III: 6 Hours**

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Giardia intestinalis, Leishmania donovani, Trypanosoma cruzi* and *Tripanosoma brucei*.

**UNIT - IV: 6 Hours**

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Toxoplasma gondii*, *Plasmodium* spp, *Fasciolopsis buski* and *Ascaris lumbricoids.*

**UNIT - V: 6 Hours**

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention – *Taenia solium, Fasciola hepatica, Ancylostoma duodinale* and *Wuchereria bancrofti.*

**Text Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Apurba S Sastry, SandhyaBhat | Essentials of Medical Microbiology | Jaypee Brothers Medical Publishers; | 2018 |

| | | | | |
|---|---|---|---|---|
| 2. | Ananthanarayan & Paniker's | Microbiology | The Orient Blackswan | 2017 |
| 3. | Paniker's | Medical Parasitology | Jaypee Brothers Medical Publishers | 2017 |
| 4. | Chatterjee K D | Parasitology, Protozoology& Helminthology | CBS Publishers | 2016 |
| 5. | S. C. Parija Srinivasa and H – Trop | Medical Parasitology | All India Publishers and Distributors | 2013 |

**Reference Books**

| **S.No** | **Authors Name** | **Title of the Books** | **Publishers Name** | **Year of Publication** |
|---|---|---|---|---|
| 1. | Burton J. Bogitsh, Thomas N. Oeltmann Clint E. Carter | Human Parasitology | Elsiver Publishers | 2019 |
| 2. | Stefan Riedel, Stephen Morse, Timothy Mietzner&Steve Miller | Medical Microbiology | McGraw-Hill Education | 2019 |
| 3. | Kenneth Ryan, Nafees Ahmad, J. Andrew Alspaugh, W. Lawrence Drew | Medical Microbiology | McGraw-Hill Education | 2018 |
| | Mahmud**,** Rohela, Lim**,** Yvonne Ai Lian, Amir**,** | Medical Parasitology | Springer International | 2017 |

| | | | | |
|---|---|---|---|---|
| 4. | Amirah | | Publishing | |
| 5. | B. S. Nagoba and Asha Pichare | Microbiology & Parasitology | Elsevier India | 2016 |

**Web References**

1. http://dmoz.org/Science/Biology/Microbiology/
2. http://microbiology.mtsinai.on.ca/manual/default.asp
3. http://cal.vet.upenn.edu/parasite/links.html
4. http.www.suite101.com/links.cfm/microbiology
5. http://www.biosci.ohio-state.edu/-zoology/parasite/home.html

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.

## CORE COURSE – V (CC)

## MEDICAL MICROBIOLOGY

| Semester V | Internal Marks: 25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5CC5** | **Medical Microbiology** | **Core** | **75** | **5** | **-** | **5** |

**Preamble:** To impart the students with advanced knowledge of the characteristics of medically important human diseases. To focus the pathogenicity of the medically important microorganisms. To familiarize the lab diagnosis, prophylaxis and treatment of the diseases

**Course Outcome:**

| CO Number | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Describe and Classify the various pathogens and its Characterization. | K3 |
| CO 2 | Diagnose the various bacterial pathogens | K4 |
| CO 3 | Analyze various human viral diseases | K4 |
| CO 4 | Evaluate and compare the various fungal infections and protozoan diseases | K5 |
| CO 5 | Identification of pathogens from sample | K6 |

**Mapping with Programme Outcome:**

| Cos/ Pos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | L | M | L | S | S |
| **CO2** | S | S | S | S | M |
| **CO3** | S | S | S | S | M |
| **CO4** | S | S | S | S | M |
| **CO5** | S | M | M | M | M |

**S-Strong M-Medium L –Low**

## UNIT – I: INTRODUCTION (15 Hours)

History, Koch's and River's Postulates-Normal microbial flora of the healthy human body, Host- pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity - virulence - toxigenicity, carriers and its types, endemic, epidemic, pandemic diseases and epidemiology – Infectious disease cycle.

## UNIT – II: BACTERIAL DISEASES (15 Hours)

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal pneumonia infections (b) *Staphylococcus aureus* infections (c) Meningitis - Neisseria, (d) Leprosy, (e) Leptospirosis, (f) Respiratory diseases: Tuberculosis (g) Gastrointestinal disorders: typhoid and cholera (h) Sexually transmitted diseases: syphilis (i) Anaerobic wound infection – tetanus.

## UNIT – III: VIRAL DISEASES (15 Hours)

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following viral diseases (a) Respiratory diseases: common cold and influenza (b) Neurological diseases: Rabies (c) Muscular diseases – Polio (d) Liver diseases: Viral hepatitis (e) Immunodeficiency disease: - AIDS. A brief account on Prion diseases.

## UNIT – IV: FUNGAL & PROTOZOAN DISEASES (15 Hours)

Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following fungal and protozoan diseases (a) Fungal – superficial and subcutaneous mycoses, (b) Protozoan: Amoebiasis, Malaria (c) Helminths – Filariasis, Ascariasis. Zoonotic diseases, Nosocomial and Community acquired infections.

## UNIT – V: LAB DIAGNOSIS (15 Hours)

Isolation and identification of pathogens from an infected patient: Collection and transport of various clinical specimens (Urine, stool, sputum and blood) for diagnosis – General methods of isolation and identification of bacterial, fungal, viral pathogens and protozoan parasites.

**Text Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Aejaz Iqbal and Zafar Nowshad | Medical microbiology: Millennium Edition | Notion Press | 2020 |
| 2. | Baveja V and Baveja C P | Medical Parasitology | Arya Publishing company | 2019 |
| 3. | Mishra B | Text Book of Medica Virology | CBS | 2018 |
| 4. | Ananthanarayan and Paniker | A Text book of Microbiology | Kindle Edition | 2013 |
| 5. | Greenwood | Medical Microbiology | International Edition | 2012 |

**Reference Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Geo Brooks, Karen C Carroll, Janet Butel and Stephen Morse | Medical Microbiology | Mc Graw Hill Publication | 2020 |
| 2 | Sastry Apurba S and Bhat Sandhya | Essentials of Medical Microbiology | Jaypee brothers Medica publishers | 2020 |
| 3 | Patrick R Murray , Ken S Rosenthal and Michael A PFaller | Medical Microbiology | Elsevier | 2020 |
| 4 | Ananthanarayan Paniker | A Text book of Microbiology | University Press | 2020 |
| 5 | Kenneth J Ryan, Nafees Ahmad and Andrew Alspaugh J | Sherris Medical Microbiology | McGraw-Hill Education | 2018 |

**Web References**

1. https://www.cdc.gov/tb/education/corecurr/pdf/chapter2.pdf
2. http://apps.searo.who.int/PDS_DOCS/B5123.pdf3.http://loyce2008.free.fr/Microbiologie/%20Micro%20%20Gillespie%20Hawkey%20%20Principles%20And%20Practice%20Of%20Clinical%20Bacteriology%202Nd%20Ed.pdf

**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

## CORE COURSE – VI (CC)

## AGRICULTURAL MICROBIOLOGY

| Semester V | Internal Marks: 25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5CC6** | **Agricultural Microbiology** | **Core** | **75** | **5** | **-** | **5** |

**Preamble:** To transform the knowledge as an eco-friendly one by introducing the relationship between microbes and nature, its roles and its utilization for the creation of sustainable environment and their concepts, Biofertilizer role, Biogeochemical cycles and Plant diseases.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Define the basic view of soil Microorganisms | K1 |
| CO 2 | Explain the Microbial association in soil & organic forming | K2 |
| CO 3 | Understand the production of Biofertilizer | K4 |
| CO 4 | Discuss about Biogeochemical cycles | K6 |
| CO 5 | Discuss about Plant diseases & Control measures | K6 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | M | S | M | S |
| **CO2** | S | M | S | M | S |
| **CO3** | S | S | S | S | S |
| **CO4** | S | S | S | S | S |
| **CO5** | S | M | S | M | S |

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

**UNIT-I (15 hours)**

Introduction to soil microorganisms–Bacteria- PGPR- Cyanobacteria and Actinobacteria, Algae- *Chlorella, Nostoc*, Fungi- VAM, Protozoans- *Amoeba, Flagellates*, Nematodes- *Ascarids, Filarias* and Viruses –Role of microbes in soil fertility.

**UNIT-II (15 hours)**

Microbial associations in phytosphere: rhizosphere – phyllosphere – spermosphere. Mycorrhiza – types and importance to agriculture – Organic farming- organic matter decomposition – humus formation.

**UNIT-III (15 hours)**

Biofertilizer –Isolation, mass inoculum production, quality control, field application, Importance and marketing of bioinoculants – *Rhizobium*, *Azotobacter*, *Azospirillum*, *Frankia*, *Cyanobacteria*, *Azolla* and phosphate solubilizing microorganisms.

**UNIT-IV (15 hours)**

Biogeochemical cycles – carbon, nitrogen, phosphorus, Sulphur cycles; nitrogen fixers – root nodule formation – nitrogenase, hydrogenase – biochemistry of nitrogen fixation.

**UNIT-V (15 hours)**

Plant diseases (Mode of entry of pathogens, Symptoms, Disease cycle and control measures) Bacterial disease–Citrus canker, Fungal disease- Blast of paddy, Viral disease–*cauliflower mosaic*- Microbial Pesticides – types and applications – Bacteria: *Bacillus thuringiensis* – Fungi: *Beauveria bassiana*- Virus: Nuclear Polyhedrosis Virus (NPV). Biocontrol agents- *Pseudomonas fluorescens and Trichoderma viride.*

**Text Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Subba Rao | Soil Microbiology | Oxford Publishing | 2020 |
| 2. | Mangesh Y Dudhe | Agriculture- Microbiology | New Vishal Publications | 2020 |
| 3. | Krishnendu Acharya, Surjit Sen and Manjula Rai | Biofertilizers and Biopesticides | Techno World | 2019 |
| 4. | Prabhakaran | Introduction-Soil-Agricultural- Microbiology | Himalaya Publishing House Pvt. Ltd. | 2018 |
| 5. | Aneja | Fundamental- Agricultural-Microbiology | New Age International (P) Ltd Publishers | 2017 |

**Reference Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Pareek and Navneet Pareek | Agricultural Microbiology | Scientific Publishers | 2019 |
| 2. | Madigan, Bender, Buckley, Sattley and Stahl | Brock Biology of Microorganisms | Global Edn | 2017 |
| 3. | Paul | Soil Microbiology, Ecology and Biochemistry | Academic Press | 2015 |
| 4. | Glick | Beneficial Plant Bacterial Interactions | Springer | 2015 |
| 5. | Trivedi | Agriculture Microbiology and Microbial Applications | Pointer Publishers | 2015 |

**Web links**

**1.** https://agrimoon.com/agricultural-microbiology-icar-ecourse-pdf-book/\
**2.** https://www.pdfdrive.com/principles-of-soil-microbiology-e19270224.html
**3.** https://www.pdfdrive.com/soil-microbiology-ecology-and-biochemistry-e44718717.html
**4.** https://www.pdfdrive.com/principles-and-practice-of-soil-science-the-soil-as-a-natural-resource-e34478756.html
**5.** https://www.pdfdrive.com/microbes-and-microbial-technology-agricultural-and-environmental-applications-e185517816.html

**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

**CORE COURSE – VII (CC)**
**MOLECULAR BIOLOGY**

| Semester V | Internal Marks: 25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5CC7** | **Molecular Biology** | **Core** | **90** | **6** | **-** | **5** |

**Preamble:** The paper Molecular Biology encompasses the basic study and understanding the central dogma. It helps in understanding the basic organization of the genome of prokaryotes and eukaryotes. It is followed by prokaryotic and eukaryotic replication, transcription, translation processes and regulation. This knowledge can be employed in determining the function of various genes and proteins for better understanding of cellular life processes.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | State the Basic concept of Prokaryotic Genes | K1 |
| CO2 | Define the Prokaryotic DNA Replication | K1 |
| CO3 | Explain the DNA & RNA Transcription in Prokaryotes | K2 |
| CO4 | Apply the view of Gene Transfer Mechanisms | K3 |
| CO5 | Prepare the Mutation and DNA Repair Mechanisms | K3 |

**Mapping with Programme Outcomes:**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | M | S | M |
| **CO2** | S | S | S | S | M |
| **CO3** | S | S | S | S | M |
| **CO4** | S | S | S | S | S |
| **CO5** | S | S | S | S | S |

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

## Unit–I (18 Hours)

Milestones in history–Definition of nucleic acids-Experimental proofs of DNA as the genetic material (Griffith and Hershey Chase) – Experimental proofs of RNA as the genetic material - Chemistry and molecular structure of DNA double helix – Discovery of DNA structure – Brief account on types and forms of DNA –Definition of a gene. Organization of DNA in eukaryotic cell; Palindromic DNA; Types of RNA-rRNA; mRNA, SnRNA the 5' cap, non- coding region, initiation, coding region, termination codon; Poly (A) region, post transcriptional modification. Brief note on plasmids: structure and its types.

## Unit–II (18 Hours)

Watson and Crick's model of DNA replication (experimental evidence); Enzyme involved in DNA replication (DNA polymerase I, Pol II, Pol III, DNA ligase); Mechanism of DNA replication; Models of DNA replication, inhibitors of DNA replication. Exonuclease and endonuclease. Theta replication and Rolling circle replication. Replication of RNA – reverse transcriptase.

## Unit–III (18 Hours)

DNA Transcription: Definition – Brief account on transcriptional machinery and mechanism of transcription — RNA Translation: Definition – Brief account on translational machinery, mechanisms of translation and Splicing mechanism. Regulation of gene expression: Concept of Gene, Genetic code & its properties. Wobble concept, prokaryotic and eukaryotic ribosomes, detailed account of structure, function and regulation of *lac* operon, *trp* operon and *ara* operon.

## Unit–IV (18 Hours)

Gene transfer mechanisms: Conjugation, Transformation and Transduction. Discovery of Transformation, Natural competence and its mechanism - Conjugation - Discovery, F+ v/s F-, Hfr+ v/sF. Transduction – Generalized and specialized transductions. Transposons – Structure, genetic organization and mechanism of transposition. Polymerase Chain Reaction & types.

## Unit–V (18 Hours)

Definitions of mutations, mutagenesis and mutants - types of mutations; Gene diversity; Split genes, overlapping gene; Molecular nature of Mutation, Spontaneous and Induced mutation; DNA damage repair – Types of damage (deamination, Oxidative damage, Alkylation, Pyrimidine dimmers. Hybridization techniques: Southern, Northern & Western Blotting. Physical and Chemical mutagens, Carcinogenicity testing (AMES Test)- Applications of Mutations.

**Text Books:**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Clark David | Molecular Biology | Academic Cell | 2019 |
| 2. | Gerald Karp, Janet Iwasa and Wallace Marshall | Karp's Cell and Molecular Biology | Wiley | 2016 |
| 3. | Joanne Willey, Linda Sherwood and Christopher J Woolverton | Prescott's Microbiology | Mc-Graw – Hill Publishing Company Ltd. | 2016 |
| 4. | Veer Bala Rastogi | Principles of Molecular Biology | Med tech | 2015 |
| 5. | Verma P S and Agarwal V K | Cell biology, Genetics, Molecular Biology Evolution and Ecology | S. Chand and Company Ltd. | 2015 |

**Reference Books:**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Ahern and Kevin | Biochemistry and Molecular Biology | Teaching company | 2019 |
| 2. | Bruce Alberts, Karen Hopkin, Alexander D Johnson, David Morgan, Martin Raff, Keith Roberts and Peter Walter | Essential Cell Biology | Norton Publisher | 2018 |
| 3. | David Clark, Nanette Pazdernik and Michelle McGehee | Molecular Biology | Academic Cell | 2018 |
| 4. | Bernard R Glick and Cheryl L Patten | Molecular Biotechnology: Principles and Applications of Recombinant DNA | ASM Press | 2017 |
| 5. | Geoffrey M Cooper | Cell: A Molecular Approach | Sinauer Associates Inc. | 2016 |

**Web Links**

1. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf
2. https://www.fmed.uniba.sk/uploads/media/Introduction_to_Medical_and_Molecular_Biology.pdf
3. https://www.aacb.asn.au/documents/item/3400
4. https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology.pdf
5. https://users.ugent.be/~avierstr/pdf/principles.pdf
6. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf

**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

## CORE PRACTICAL – III (CP) MEDICAL MICROBIOLOGY, AGRICULTURAL MICROBIOLOGY AND MOLECULAR BIOLOGY - PRACTICALS

| Semester V | Internal Marks: 40 | External Marks: 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5CC3P** | **Medical Microbiology, Agricultural Microbiology and Molecular Biology-Practicals** | **Core Practical** | **45** | **-** | **3** | **3** |

**Preamble:** To impart the knowledge on isolation, identification of medically important organisms. To perform water and soil analysis and isolation of chromosomal and plasmid DNA.

**Course Outcome:**

| CO Number | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Illustrate the isolation procedures | K2 |
| CO 2 | Explain the symptoms of diseases | K2 |
| CO 3 | Sketch out the water borne microbes | K3 |
| CO 4 | Demonstration of auxotrophic mutants | K3 |
| CO 5 | Analyze agarose gel electrophoresis | K4 |

**Mapping with Programme Outcomes:**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S |
| **CO2** | M | S | M | S | M |
| **CO3** | S | S | M | S | M |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

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

**SYLLABUS**

**MEDICAL MICROBIOLOGY (25 Hours)**

1. Isolation of bacterial flora of skin by swab method.
2. Isolation of bacteria from urine, stool and sputum.
3. Identification of Gram-positive organisms (using laboratory strains): *Streptococcus pneumoniae*, *Staphylococcus aureus* and *Bacillus sp.* and Gram-negative organisms (using laboratory strains): *Escherichia coli*, *Proteus sp*. and *Klebsiella pneumoniae* on the basis of microbiological, cultural and biochemical characteristics.
4. Saline and iodine wet mount to demonstrate protozoan parasites
5. Giemsa staining for the demonstration of blood parasites
6. KOH and Lactophenol cotton blue mount to demonstrate fungi.
7. Antibacterial sensitivity test – Kirby- Bauer method.

**AGRICULTURAL MICROBIOLOGY (10 Hours)**

8. Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.
9. Microbial assessments of air quality – open plate method and air sampler technique.
10. Isolation and counting of faecal bacteria from water.
11. Soil Analysis -pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
12. Isolation of cyanobacteria from water.
13. Isolation of *Rhizobium* form legume nodule.
14. Isolation of phosphobacteria from soil.
15. Observation of VAM from plant root.

**MOLECULAR BIOLOGY (10 Hours)**

16. Isolation of Chromosomal DNA from bacteria
17. Isolation of Plasmid DNA from bacteria
18. Isolation of Auxotrophic mutants.
19. Demonstration of Bacterial transformation technique.
20. Demonstration of Agarose gel electrophoresis (to study DNA/ RNA) and SDS – PAGE (to study proteins).

**References:**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Ananthanarayan and Paniker | Textbook of Microbiology | Universities Press | 2020 |
| 2. | Subba Rao N S | Soil Microbiology | Oxford Publishing | 2020 |
| 3. | Mangesh Y Dudhe | Agriculture-Microbiology | New Vishal Publications | 2020 |
| 4. | Michael J Leboffe and Burton E Pierce | Microbiology: Laboratory Theory & Application | Morton Publishing Company. | 2019 |
| 5. | Ashwani Kumar, Gakhar S K andMonika Miglani | Molecular Biology: A Laboratory Manual | Dreamtech Press | 2019 |
| 6. | Tripathi K D | Essentials of Medical Pharmacology | Jaypee Brothers Medical publishers | 2018 |
| 7. | Harsh Mohan | Textbook of Pathology with Pathology | Jaypee Brothers Medical publishers | 2018 |
| 8. | Rajan S and Selvi Christy R | Experimental procedures in Life Sciences | CBS Publishers & Distributors Pvt Ltd | 2018 |
| 9. | Aneja K R | Fundamental and Agricultural Microbiology | New Age International (P) Ltd | 2017 |
| 10. | Koliantz.G and Szymanski D B | Genetics: A Laboratory Manual | American Society of Agronomy | 2016 |
| 11. | RanganathanKapilan | Laboratory Manual of Molecular Biology | LAP Lambert Academic Publishing | 2015 |

**Web links**

1.https://mountainscholar.org/bitstream/handle/20.500.11919/4774/OERW_MOLB_2021_20190101_ Spring%202019%20Micro%20Lab%20Manual.pdf?sequence=1

2.https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf3.https://batch.libretexts.org/print/url=https://bio.libretexts.org/Bookshelves/Ancillary_Materials/Laboratory_Experiments/Microbiology_Labs/Book%3A_General_Microbiology_Lab_Manual_(Pakpourand_Horgan).pdf

4. https://readfreepdf.com/read/medical-books/221-microbiology-laboratory-theory-application-brief-3e/

5. https://www.researchgate.net/publication/320508474_Molecular_Biology_Laboratory_manual

**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

## MAJOR BASED ELECTIVE – I (A)

## FUNDAMENTALS OF BOTANY AND ZOOLOGY

| Semester V | Internal Marks: 25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5MBE1A** | **Fundamentals of Botany and Zoology** | **Major Based Elective-I (A)** | **75** | **5** | **-** | **5** |

**Preamble:** To gain the basic knowledge about plants and animals. To impart knowledge on botanical nomenclature, classifications, merits and demerits of various systems of classifications. To understand the systematic of the selected families of the flowering plants with their economic importance. To help our students to distinguish various animal kingdoms to know the evolutionary sequence of them.

**Course Outcome:**

| CO Number | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | State the Basic knowledge of Plant Nomenclature | K1 |
| CO 2 | Describe the Salient features and Economic importance of Monocot and Dicot Plants | K2 |
| CO 3 | Illustrate the views of Plant Physiology and Reproduction | K2 |
| CO 4 | Prepare Animal Kingdom and Reproduction | K3 |
| CO 5 | Prepare the Process of Animal Cell reproduction | K3 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | M | S | M |
| **CO2** | M | S | S | S | M |
| **CO3** | M | S | M | S | S |
| **CO4** | M | S | S | S | S |
| **CO5** | S | S | M | S | S |

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

**UNIT– I (15 hours)**

Binomial Nomenclature – ICBN rules – taxonomic types, systems of Classification – Phylogenetic Artificial and Natural. Bentham and Hooker classification - merits and demerits. Plant taxonomy, Plant Nomenclature - Forms of Scientific names. Technical description of flower and floral diagram.

**UNIT– II (17 hours)**

General characteristics and economic importance of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

**UNIT–III (13 hours)**

Plant Physiology – Photosynthesis, Respiration and Transpiration. Reproduction of plants in Angiosperms - Vegetative, Asexual and Sexual.

**UNIT–IV (15 hours)**

Introduction to principles of taxonomy and outline classification of Animal Kingdom – Invertebrates - Prolifera, Cnidaria, Worms, Echinoderms, Molluscs and Arthropods. Vertebrates - Mammals, Birds, Reptiles, Fish and Amphibians. Darwin’s and Lamarck’s theory of evolution.

**UNIT–V (15 hours)**

Animal Physiology – Digestive, Respiratory, Circulatory, Excretion and Nervous system. Cell division – Mitosis and Meiosis.

**Text Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Kishore R Pawar and Ashok E Desai | An Introduction to Zoology | Nirali Prakashan | 2020 |
| 2. | Sunidhi Miglani | Text Book of Economic Botany | ABS Publications | 2016 |
| 3. | Kotpal R L | Modern text book of Zoology | Rastogi Publications | 2016 |
| 4. | Afroz Alam | Textbook of Botany | I K International Publishing House Pvt. Ltd | 2015 |
| 5. | Nanda A K | Text Book of Botany | Kitab Mahal - Cuttack | 2015 |

**Reference Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | James Bidlack and Shelley Jansky | Plant Biology | McGraw-Hill Education | 2020 |
| 2. | James D Mauseth | An introduction to plant biology | Jones & Bartlett Learning | 2019 |
| 3. | Smithsonian | Zoology | DK; Illustrated edition | 2019 |
| 4. | NVS, KVS and DSSSB | Botany | Unique Publisher | 2018 |
| 5. | Stephen Miller and Todd A. Tupper | Zoology | McGraw-Hill Education | 2018 |

**Web References**

1. https://www.biologydiscussion.com/plant-taxonomy/quick-notes-on-plant-taxonomy/47582
2.https://www.studyandscore.com/studymaterial-detail/international-code-of-botanical- nomenclature-icbn-history-principles-and-aim
3. https://byjus.com/biology/plant-physiology/
4. https://www.slideshare.net/mjnepa/cell-reproduction-notes
5. https://biologywise.com/vertebrates-invertebrates

**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

**MAJOR BASED ELECTIVE – I (B)**
**ORGANIC FARMING**

| Semester V | Internal Marks: 25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5MBE1B** | **Organic Farming** | **Major Based Elective-I (B)** | **75** | **5** | **-** | **5** |

**Preamble:** This course focuses on the need and generating knowledge and skill on various organic farming practices, so as to carry out organic agricultural production and management system that sustains the health of soils and ecosystems.

**Course Outcome:**

| CO Number | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Determine the origin and importance of organic farming | K4 |
| CO2 | Explain the scope of organic farming | K5 |
| CO3 | Evaluate the methodology practiced in organic farming | K5 |
| CO4 | Generalize the management strategies in crop protection | K6 |
| CO5 | Compile the strategies for the commercialization of organic products | K6 |

**Mapping with Programme Outcomes:**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | M | M | M |
| **CO2** | S | M | M | S | M |
| **CO3** | S | S | S | S | S |
| **CO4** | S | S | S | S | S |
| **CO5** | S | S | S | S | S |

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

**UNIT–I (15 hours)**

Introduction- concept, Principles and development of organic farming. Types - Natural farming- Biodynamic farming. Conventional farming v/s Organic farming.

**UNIT–II (15 hours)**

Scope of organic farming - requirements for organic farming. Organic nutrients resources and their management, organic ecosystems and their concepts- Bioinoculants.

**UNIT–III (15 hours)**

Composting - principles – stages - types and factors. Composting methods – Vermicomposting. Biofertilizers - methods of application, advantages and limitations.

**UNIT–IV (15 hours)**

Plant protection- Insect Pest and disease management in organic farming- biopesticides, - biocontrol agents, Weed management in organic farming- preventive practices, biological control of weeds- mechanical control.

**UNIT–V (15 hours)**

Organic crop production, certification process and standards of organic farming in India, economic viability of organic farming, marketing and export potential of organic products.

**Text Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Maliwal P L | Principles of Organic Farming | Scientific Publisher | 2020 |
| 2. | Joanne M Willey, Kathleen M Sandman and Dorothy H Wood | Prescotts microbiology | McGraw-Hill Education | 2019 |
| 3. | Unni M R and Sabu Thomas | Organic Farming Global Perspectives and Methods | Woodhead publishing | 2018 |
| 4. | Amitava Rakshit and H B Singh | ABC of Organic Farming | Jain Brothers | 2018 |
| 5. | Reddy S R | Principles of Organic Farming | Kalyani Publisher | 2017 |

**References Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Bansal M | Basics of Organic Farming | CBS publishers and Distributors Pvt. Ltd. | 2020 |
| 2. | Janet Wilson | Composting: Sustainable and Low- Cost Techniques for Beginners | Drip Digital Publisher | 2020 |
| 3. | Debabrata Biswas, Shirley A. Micallef | Safety and Practice for Organic Food | Academic press Elsevier Science | 2019 |
| 3. | Rhonda Sherman | The Worm Farmer's Handbook | Chelsea Green Publishing Company | 2018 |
| 4. | Vinaya Kumar Sethi | Organic farming and bio-fertilizers | Discovery publishing house Pvt. Ltd. | 2018 |

**Web References**

1. http://agrimoon.com/organic-farming-pdf-book/
2. https://www.britannica.com/topic/organic-farming
3. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
4. https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
5. https://agritech.tnau.ac.in/org_farm/IPM%20Booklet%20for%20OF-Dr.P.D.pdf
6. https://agritech.tnau.ac.in/org_farm/orgfarm_oc%20guidelines.html

**Pedagogy**

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity

**SKILL BASED ELECTIVE PRACTICAL - II (A)**
**BIOFERTILIZER TECHNOLOGY-PRACTICAL**

| Semester V | Internal Marks: 40 | External Marks: 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5SBE2AP** | **Biofertilizer Technology-Practical** | **Skill Based Elective Practical** | **30** | **-** | **2** | **2** |

**Preamble:** The aim of the course is to make the student to know the importance of biofertilizers in agriculture and production technologies.

**Course Outcome:**

| COs | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Explain Biofertilizers and Production technology | K2 |
| CO2 | Illustrate Symbiotic Biofertilizers and study the mass cultivation methods | K2 |
| CO3 | Analyze Non- Symbiotic Biofertilizers and study the cultivation methods | K4 |
| CO4 | Create Knowledge about Phosphate solubilization and study the cultivation methods | K6 |
| CO5 | Expand view of Mycorrhizae and Bioinsecticides and study the cultivation methods | K6 |

**Mapping with Programme Outcome**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | L | M | L | S | S |
| **CO2** | S | S | S | S | M |
| **CO3** | S | S | S | S | M |
| **CO4** | S | S | S | S | M |
| **CO5** | S | M | M | M | M |

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

**BIOFERTILIZER TECHNOLOGY-PRACTICAL (30 Hours)**

1. Isolation and identification of *Rhizobium* from leguminous plant roots
2. Isolation and identification of *Azospirillum* and *Azotobacter*
3. Isolation, identification and cultivation of Cyanobacteria from paddy field soil and water.
4. Isolation and cultivation of *Anabaena* from *Azolla*.
5. Isolation, identification and cultivation of Phosphate solubilizing bacteria from soil.
6. Isolation and identification of VAM from onion roots.
7. Isolation and identification of bioinsecticides - *Bacillus thurengiensis* and *Verticillium* sps
8. Preparation of liquid based inoculums.

**Text Books:**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Krishnendu Acharya, Surjit Sen & Manjula Rai | Biofertilizer and Biopesticide | Techno World | 2019 |
| 2. | S. Rajan & R. Selvi Christy | Experimental Procedures in Life Sciences | CBS publications | 2018 |
| 3. | Dr. Reeta Khosla | Biofertilizers and Biocontrol Agents for Organic Farming | Kojo Press | 2017 |
| 4. | Dr. Hyma | Biofertilizers: Commercial Production Technology and Quality | Random publications | 2017 |
| 5. | Mahendra K Rai | Hand book microbial biofertilizers. 9th edition. | The Haworth press, Inc. | 2015 |
| 6. | Borkar S.G. | Microbes as Bio-fertilizers and their Production Technology | Woodhead Publishing India in Agriculture | 2015 |

**Reference Books:**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Rao B.N.S | Biofertilizers in Agriculture and Forestry | Oxford & IBH Publishing House | 2019 |
| 2. | Sharma R.A. | Biofertilizer Technology | Agro tech Publishing Academy | 2019 |
| 3. | Ameta O.P and Sharma U.S | Biopesticides for Sustainable Agriculture | Agro tech Publishing Academy | 2018 |
| 4. | Somani .L | Biofertilizers: Commercial Production Technology and Quality control | Agro tech Publishing Academy | 2018 |
| 5. | Bikas R. Pati<br>Santi M. Mandal | Recent Trends in Biofertilizers | I K International Publishing House | 2016 |

**Web links:**

1. https://agritech.tnau.ac.in/ta/org_farm/orgfarm_biofertilizers.html
2. https://agritech.tnau.ac.in/org_farm/orgfarm_biofertilizertechnology.html
3. http://www.techno-preneur.net/technology/new-technologies/food-agro/vam-fungi.html
4. http://14.139.187.9/ta/org_farm/orgfarm_faq's.html

## Pedagogy

Power point presentation, Seminar, Assignment and Quiz.

**SKILL BASED ELECTIVE PRACTICAL-II (B)**

**SOLID WASTE MANAGEMENT -PRACTICAL**

| Semester -V | Internal Marks - 40 | External Marks - 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **P** | **T** | **Credits** |
| **19UMB5SBE2BP** | **Solid Waste Management - Practical** | **Skill Based Elective Practical** | **30** | **2** | **-** | **2** |

**Preamble:** To make the students conversant with the types, collection, transport, processing and disposal of municipal solid waste.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Explain the Sample collection methods | K2 |
| CO2 | understanding of the Physical characteristics of municipal solid wastes | K4 |
| CO3 | Determine the Chemical compounds of solid waste | K4 |
| CO4 | Discuss about the Processing techniques of solid waste | K6 |
| CO5 | Elaborate Mushroom Cultivation methods by using organic Solid wastes | K6 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | M | M | M | S |
| **CO2** | M | M | M | M | M |
| **CO3** | M | M | M | M | M |
| **CO4** | S | S | M | S | S |
| **CO5** | S | S | S | S | S |

**S – Strong, M- Medium, L – Low**

**SOLID WASTE MANAGEMENT –PRACTICAL (30 Hours)**

1. Visit and collect the sample from a local polluted site -Urban/Rural/Industrial/Agricultural.
2. Determination of physical parameters of solid waste. a) Temperature b) Colour c) pH
3. Determination of Nitrogen and phosphorus of solid waste.
4. Isolation and identification of Microorganisms from solid waste.
5. Physical and chemical treatment processes of solid waste (Saccharification, Gasification, Pyrolysis)
6. Biological treatment processes of solid waste by composting- Indore Method
7. *Pleurotus* mushroom production by using house hold solid waste
8. Button mushroom production by using Agro-solid waste

**Text Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Maulin P. Shah, GauravSaxena and Vineet Kumar | Bioremediation for Environmental Sustainability | Elsevier Science | 2020 |
| 2. | Tobias Richards and Mohammad J. Taherzadeh | Resource Recovery to Approach Zero Municipal Waste | CRC Press | 2018 |
| 3. | Kumar S | Integrated Waste Management Volume II | Intech Publishers | 2016 |
| 4. | AmmaiyappanSelvam, Rao Y. Surampalli, R. D. Tyagi and Jonathan W. C. Wong | Sustainable Solid Waste Management | American Society of Civil Engineers | 2016 |
| 5. | M.N.V. Prasad | Bioremediation and Bioeconomy | Elsevier Science | 2015 |

**Weblinks:**

1. https://en.wikipedia.org/wiki/Waste_management
2. http://www.houstontx.gov/solidwaste/
3. https://www.unc.edu/courses/2009spring/.../SolidWasteIndiaReview2008.pdf
4. https://www.cyen.org/innovaeditor/assets/Solid%20waste%20management.pdf

**Pedagogy**

Power point presentation, Seminar, Assignment and Quiz.

**SKILL BASED ELECTIVE PRACTICAL – III (A)**
**MEDICAL LABORATORY TECHNOLOGY-PRACTICAL**

| Semester V | Internal Marks: 40 | External Marks: 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB5SBE3AP** | **Medical Laboratory Technology – Practical** | **Skill Based Elective Practical** | **30** | **-** | **2** | **2** |

**Preamble:** Medical Laboratory Technology (MLT) is a Clinical laboratory science effectively and comprehensively meets the requirements of students to develop manpower for health sector by providing them the necessary knowledge and skill to ensure the quality services in health care sector. This is an innovative, need-based and relevant training program meant to create job opportunities and self-employment.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Understand the safety practice, anatomy and instrumentation in microbiological laboratory | K2 |
| CO2 | Describe the cleaning of glasswares and sterilization of media | K2 |
| CO3 | Analyses and estimation of clinical specimen | K4 |
| CO4 | Explain blood grouping and Rh typing | K5 |
| CO5 | Summarize the serological tests | K6 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | S | M | S |
| **CO2** | M | S | M | M | M |
| **CO3** | S | S | S | S | M |
| **CO4** | S | S | S | M | S |
| **CO5** | S | S | S | M | S |

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

**SYLLABUS: (30 hours)**

1. Ethics of laboratory practice and general laboratory safety rules.
2. Study of body parts and bony landmarks on body surface (charts and models).
3. Principles and operations – Autoclave, Hot Air Oven, Incubators, Laminar Air Flow, Filtration, colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer.
4. Cleaning of glasswares and sterilization techniques.
5. Preparation of culture media – solid, semi-solid and liquid.
6. Study on simple, differential, capsule and acid-fast staining.

7. Specimen collection: blood, urine, stool and swab (nose and throat).
8. Separation of serum and plasma.
9. Determination of blood cell count: RBC, WBC and differential leucocyte count.
10. Haemoglobin estimation – Sahli's acid hematin method.
11. Erythrocyte sedimentation rate – Westergren method.
12. Physical examination and Chemical examination of urine: Albumin, Creatinine, Urea, Bile salt (Hay's Test), Bile pigments (Fouchet's Test) and urobilinogen test.
13. Urine sugar determination by Benedict's method.
14. Blood grouping and Rh typing.
15. Serology – Widal test (slide and tube method), VDRL (RPR method), CRP, ASO, Beta-HCG in urine (pregnancy test).

**References:**


| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Kanai L. Mukherjee and Anuradha Chakravarthy | Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests | Mc Graw Hill, India | 2017 |
| 2. | Harsh M. | Textbook of Pathology | Jaypee Publications | 2017 |
| 3. | Solomon E.P. | Introduction to Human Anatomy and Physiology | Saunders | 2016 |
| 4. | Vasudevan D.M., Sreekumari S. and Vidhyanathan K. | Textbook of Biochemistry for Medical students | Jaypee& Brothers Medical Publishers (P) Ltd. | 2016 |
| 5. | Arora D.R and Arora B.B. | Textbook of Microbiology | CBS Publishers & Distributors | 2016 |
| 6. | Nanda M. | Clinical Pathology Hematology and Blood Banking (For DMLT Students) | Jaypee Brothers Medical Publishers (P) Ltd. | 2016 |
| 7. | Praful. B. Godkar | Text book of Medical Laboratory Technology | Bhalani Publications | 2016 |
| 8. | Gary W.Procop and Elmer W.Koneman | Koneman's Color Atlas and Textbook of Diagnostic Microbiology | Wolters Kluwer Health | 2016 |
| 9. | Sood Ramnik | Text book of Medical Laboratory Technology | Jaypee Publications | 2015 |
| 10. | **Baker** F.J., **Silverton** R.E. and **Luckcock** E.D. | An Introduction to Medical Laboratory Technology | Elsevier Science | 2015 |

Web links:

1. https://www.pdfdrive.com/medical-laboratory-technician-hematology-serology-blood-banking-and-immunohematology-e21321666.html

**2.** https://www.pdfdrive.com/medical-laboratory-technician-microbiology-afsc-90470-e17289142.html

**3.** https://www.pdfdrive.com/introduction-to-medical-laboratory-technician-e184576491.html

**4.** http://downloadinfobook1.firebaseapp.com/Medical-Laboratory-Technology-Kanai-Mukherjee-PDF-c3f0077fe.pdf

**Pedagogy:**

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

**SKILL BASED ELECTIVE PRACTICAL-III (B)**
**VERMITECHNOLOGY- PRACTICAL**

| Semester -V | Internal Marks - 40 | External Marks - 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **P** | **T** | **Credits** |
| **19UMB5SBE3BP** | **Vermitechnology-Practical** | **Skill Based Elective Practical** | **30** | **2** | **-** | **2** |

**Preamble:** The aim of this course is to make the student to know the importance of Vermitechnology in decomposing food waste into nutrient-rich fertilizer.

**Course Outcome**:

| COs | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Explain Vermitechnology and Production technology | K2 |
| CO2 | Illustrate methods of composting in a limited space and describe the decomposing process | K2 |
| CO3 | Analyze and study the biodiversity of local earthworms | K4 |
| CO4 | Create and maintain the environment pollution free | K6 |
| CO5 | Expand view of using worms to convert decomposing food waste into nutrient-rich fertilizer | K6 |

**Mapping with Programme Outcome**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | L | M | L | S | S |
| **CO2** | S | S | S | S | M |
| **CO3** | S | S | S | S | M |
| **CO4** | S | S | S | S | M |
| **CO5** | S | M | M | M | M |

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

**VERMITECHNOLOGY –PRACTICAL (30 Hours)**

1. Key to identify different types of earthworms.
2. Field trip- Collection of native earthworms & their identification.
3. Study of sytematic position, habits, habitat &external characters, comparison of morphology & life stages of *Eisenia fetida* & *Eudrilus eugeniae.*
4. Study of vermiculture, vermiwash & vermicompost equipments
5. Preparation of vermibeds, maintenance of vermicompost & climatic conditions.
6. Harvesting, packaging, transport and storage of Vermicompost and separation of life stages.
7. Study the effects of vermicompost & vermiwash on any two short duration crop plants.
8. Study the effects of sewage water on development of worms.

**Text Books:**

| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Debnarayan Roy | A Handbook of Vermitechnology | LAP Lambert Academic Publishing | 2018 |
| 2. | LakshmiPrabha and Shanmuga Priya | Vermitechnology | LAP Lambert Academic Publishing | 2014 |
| 3. | ShwetaYadav, Vinay Kumar Singh | Vermitechnology: Rebuilding of Sustainable Rural Livelihoods (Global Agriculture Developments) | Nova Science Publishers Inc | 2014 |
| 4. | Madhab Chandra Dash | Charles Darwin's Plough Tool for Vermitechnology | I K International Publishing House | 2013 |
| 5. | A Mary Violet Christy | Vermitechnology | MJP Publishers | 2008 |

**Weblinks:**

1. https://composting.ces.ncsu.edu/vermicomposting-2/
2. https://www.planetnatural.com/composting-101/indoor-composting/vermicomposting/
3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/vermicomposting
4. https://foodprint.org/eating-sustainably/composting-and-food-waste/vermicomposting-101/

## Pedagogy:

Power point presentation, Seminar, Assignment and Quiz.

**CORE COURSE– VIII (CC)**
**INDUSTRIAL MICROBIOLOGY**

| Semester VI | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB6CC8** | **Industrial Microbiology** | **Core** | **90** | **6** | **-** | **6** |

**Objective:**

To inculcate the student knowledge about Industrial developments with respect to Microorganisms and find out the suitable technology for cultivating them under Industrial scale so as to develop them for employment in bioprocess industry. To learn the screening of industrial strains, fermenters, media, fermentation process and downstream process.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | List the History and Concept of Strain development | K1 |
| CO 2 | State the Fermentor and Fermentation media | K2 |
| CO 3 | Explain the Production and Purification Industrial Important Microbial Products | K2 |
| CO 4 | Describe the Production of Industrially valuable products. | K2 |
| CO 5 | Prepare the mass cultivation protocol for Pharmaceutical Products. | K3 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **S** | **M** | **M** | **S** |
| **CO2** | **S** | **S** | **S** | **M** | **S** |
| **CO3** | **S** | **S** | **S** | **M** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

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

**UNIT I: 18 Hours**

Introduction, Chronological development, Scope of Industrial Microbiology. Isolation and Identification of Industrially important microorganisms, major classes of products and processes. Isolation, Screening, preservation and improvement of industrially important Microbes. Development of inoculum for various fermentation processes. Strain improvements - Mutations, protoplast fusion and rDNA techniques for strain development.

**UNIT II: 18 Hours**

Fermentor design – Construction material for fermentors, Aeration and agitation in a fermentor, Temperature control in a fermentor, Foam control in fermenters. Types of fermentor and fermentation process - Batch, Fed batch and continuous.

**UNIT III: 18 Hours**

Solid and Submerged fermentation – Advantages & Disadvantages. Downstream processing –The recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation (Ammonium sulphate and Solvents), filtration, centrifugation, solvent recovery, chromatography (TLC), ultra filtration, drying, cell immobilizations and its applications.

**UNIT IV: 18 Hours**

Industrial media formulation strategies- economic means of providing energy- carbon, nitrogen, vitamin and mineral sources. Role of buffers, Prosthetic groups, Inducers, inhibitors and Antifoams. Computer applications in fermentation technology. Mass production of industrially important Products: Beer, Wine, Citric acid, Lactic acid and Lysine.

**UNIT V: 18 Hours**

Industrial production of pharmaceutically important Products: Amylase, Protease, Penicillin, tetracycline, Riboflavin, Cyanocobalamin, Steroids, Biopolymers, Recombinant vaccine (Hep B vaccine), Production of herbal drugs. Recycling and Safe disposal of industrial wastes by Trickling filter, Activated sludge and Oxidation ponds.

**Text Books:**

| S.No | Author | Title | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Aydin Berenjian | Essentials in Fermentation technology | Springer | 2020 |
| 2. | Hrudayanath Thatoi, Pradeep K. Das Mohapatra, Sonali Mohapatra and Keshab C. Mondal | Microbial Fermentation and Enzyme Technology | CRC Press | 2020 |
| 3. | Casida LE | Industrial Microbiology | New Age International Private Limited | 2019 |
| 4. | Stanbury P.F.A. Whitaker and S.J. Hall | Principles of fermentation techniques | Elsevier | 2017 |
| 5. | Crueger W and Crueger A | Biotechnology: A Test Book of Industrial Microbiology | Medtech | 2017 |
| 6. | Patel AH | Industrial Microbiology | Laxmi Publication | 2011 |

**Reference Books:**

| S.No | Author | Title | Publisher | Year of Publication |
|---|---|---|---|---|
| **1.** | Angelo Basile and Kamran Ghasemzadeh | Current Trends and Future Developments on (Bio-) Membranes: | Elsevier | 2020 |
| 2. | T. A. Brown | Gene Cloning and DNA Analysis: An Introduction. | Wiley Blackwell., New Jersey | 2020 |
| 3. | Michael L. Shuler and Fikret Kargi | Bioprocess Engineering: Basic Concepts | Pearson Education India | 2015 |
| 4. | Agarwal AK and Pradeep Parihar | Industrial Microbiology | AGROBIOS | 2012 |
| 5. | Doran | Bioprocess Engineering Principles | Elsevier | 2012 |
| 6. | Richard H. Baltz, Arnold L. Demain and Julian E. Davies | Manual of Industrial Microbiology and Biotechnology | American Society for Microbiology | 2010 |
| 7. | Prescott and Dunns | Industrial microbiology | CBS | 2004 |

## Web Links

1. https://www.youtube.com/watch?v=emUoAVOBGec
2. https://www.youtube.com/watch?v=eXEpiarmYkY
3. https://www.youtube.com/watch?v=Tdb0N_PMpEI
4. https://www.youtube.com/watch?v=opfPTm3z0rE
5. https://www.youtube.com/watch?v=YT34E_DJH24
6. https://www.youtube.com/watch?v=Uut1cUs6GpA
7. https://www.youtube.com/watch?v=RUoAmns7NiQ
8. https://www.youtube.com/watch?v=fL0CN_iyylA
9. https://www.youtube.com/watch?v=uOWS6q9HQGk
10. https://www.youtube.com/watch?v=D8jfLf_bODs

**Pedagogy**

Power point presentation, Group Discussion, Seminar, Quiz, Assignment, Animations.

**CORE COURSE-IX (CC)**

**FOOD MICROBIOLOGY**

| Semester VI | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB6CC9** | **Food Microbiology** | **Core** | **90** | **6** | **-** | **6** |

**Preamble:** To understand the interactions between food, microorganisms and their environment to ensure food safety, quality, and value. Students study methods to preserve foods and prevent them from spoiling the food production chain.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | List the types of nutrition | K1 |
| CO 2 | State the sources of contamination in food | K2 |
| CO 3 | Explain the spoilage and preservation of food products | K2 |
| CO 4 | Describe food borne diseases | K2 |
| CO 5 | Prepare the physical and chemical methods of food preservation | K3 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **S** | **M** | **M** | **S** |
| **CO2** | **S** | **S** | **S** | **M** | **S** |
| **CO3** | **S** | **S** | **S** | **M** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

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

**UNIT I: 18 Hours**

Nutrition- Introduction and types of Nutrition- carbohydrates, proteins, vitamins, minerals & lipids. Nutrition for different ages – infants, adult, pregnant and lactating women, old age.

**UNIT II: 18 Hours**

Microorganisms in Food- bacteria, yeasts and molds. Types (chemical, physical and biological) and Sources of contamination (water, air, dust, equipment, sewage, insects, rodents, and employees)- Factors influencing microbial growth in food- Intrinsic factors: pH, water activity, oxidation reduction potential, nutrient content- Extrinsic factors: temperature, relative humidity, gaseous environments and processing operations.

**UNIT III: 18 Hours**

Contamination and spoilage of Food products- dairy products, cereals, Vegetables, Fruits, and meat. Fermented foods- Yogurt, cheese, bread, sauerkraut, pickles, beer- probiotics & prebiotics. Principles of food fermentation and the role of beneficial microbes.

**UNIT IV: 18 Hours**

Food borne diseases and food poisoning- *Staphylococcus*, *Clostridium*, *Escherichia coli* and *Salmonella* infections, Hepatitis, Amoebiosis. The role of microorganisms in food spoilage, pathogenic microorganisms, infection and intoxication, mycotoxin.

**UNIT V: 18 Hours**

Food preservations: principles- methods of preservations- Physical (drying, cooling, deep-freezing and heating) and chemical methods (Salting, sugaring and smoking), food sanitations. Microbiological quality standards of food. Goverment regulatory practices and policies. HACCP, ISI, Food safety- control of hazards.

**Text Books:**

| S. No | Author | Title | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | M. R Adams and M. O Moss | Food Microbiology | New Age International | 2018 |
| 2. | R. C Dubey and D. K Maheshwari | A Textbook of Microbiology | S. Chand | 2013 |
| 3. | G. Subbulakshmi and Shobha A Udipi | Food Processing and Preservation | New Age International | 2006 |
| 4. | B. Srilakshmi | Food Science | New Age International | 2018 |
| 5. | R.P Srivastava and Sanjeev Kumar | Fruit and Vegetable Preservation | CBS Publishers and distributors | 2019 |

**Reference Books:**

| S.No | Author | Title | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | W.M Foster | Food Microbiology | CBS Publishers and distributors | 2020 |
| 2. | Dr. M. Swaminathan | Handbook of Food and Nutrition | Bappco | 2010 |
| 3. | William C Frazier and Dennis C Westhoff | Food Microbiology | Mc Graw Hill | 2017 |
| 4. | James M Jay, Martin J. Loessner | Modern Food Microbiology | Springer | 2005 |
| 5. | Bibek Ray, Arun Bhunia | Fundamentals of Food Microbiology | CRC Press | 2014 |

**Web Links**

1. https://www.youtube.com/watch?v=kFvN_gZd2A4
2. https://www.youtube.com/watch?v=3qV0cqhH3JA
3. https://www.youtube.com/watch?v=T8_y24Wiugc
4. https://www.youtube.com/watch?v=3gi2IU520KA
5. https://www.youtube.com/watch?v=SIz19L2YbgI

**Pedagogy**

Power point presentation, Group Discussion, Seminar, Quiz, Assignments.

**CORE PRACTICAL- IV (CP)**

**INDUSTRIAL AND FOOD MICROBIOLOGY – PRACTICALS**

| Semester VI | Internal Marks : 40 | External Marks : 60 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB6CC4P** | **Industrial and Food Microbiology- Practicals** | **Core Practical** | **90** | **-** | **6** | **5** |

**Preamble:** The main objective of this course is to understand the basic skills and production technologies applied in Industrial and Food Microbiology.

**Course Outcome:**

| COs | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Illustrate the immobilization of Yeast cell | K2 |
| CO2 | Describe about the Fermentation | K2 |
| CO3 | Organized view of industrially important products from microbes | K3 |
| CO4 | Critique knowledge about production of fermented foods | K4 |
| CO5 | Explain about the isolation of microbes from foods | K5 |

**Mapping with Programme Outcome:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | S | M | S |
| **CO2** | S | M | S | S | L |
| **CO3** | S | S | M | S | M |
| **CO4** | S | S | S | L | S |
| **CO5** | S | M | L | S | M |

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

**SYLLABUS**

**INDUSTRIAL & FOOD MICROBIOLOGY - PRACTICALS**

**INDUSTRIAL MICROBIOLOGY**

1. Immobilization of yeast cell using sodium alginate
2. Alcohol fermentation by *Saccharomyces cerevisiae*.
3. Estimation of alcohol using Potassium Di-chromate method.
4. Production of Citric acid from whey using *Aspergillus niger*
5. Production of antimicrobial substances from Lactic acid bacteria
6. Starch (Amylase), casein (Protease) and lipid ( Lipase) hydrolyses tests

**FOOD MICROBIOLOGY**

1. Assessment of milk quality by methylene blue reduction test
2. Performance of phosphatase test for pasteurized milk.
3. Isolation and identification of bacteria from food by Standard Plate Count
4. Isolation and identification of Yeast from grapes.
5. Wet mount preparation of microbes in spoiled food- bread, tomato, grapes, potato.
6. Preparation of fermented food – Yoghurt, cheese and Wine
7. Industrial visit

**References**


| S.No | Authors Name | Title of the Books | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Neelima Garg, K.L. Garg & K.G. Mukerji | Laboratory manual of Food Microbiology | Dream tech Press | 2020 |
| 2. | S. Rajan & R. Selvi Christy | Experimental Procedures in Life Sciences | CBS publications | 2018 |
| 3. | L. Arnold. Demain & Julian E. Davies | Manual of Industrial Microbiology and Biotechnology | ASM Press | 2018 |
| 4. | Dr.Shalini Sehgal | Laboratory manual of Food Canners and Processors | Med tech Publishers | 2018 |
| 5. | K.R.Aneja | Laboratory manual of Microbiology and Biotechnology | Med tech Publishers | 2018 |
| 6. | Kulanthaivel S and. Janarthanan S. | Practical Manual on Fermentation Technology | I.K. International publishing | 2012 |
| 7. | Ponmurugan P, Nithya R and Fredinose M | Experimental Procedure in Bioprocess Technology and Downstream Processing | Anjana Book House | 2012 |


**Web links:**

1. https://en.wikipedia.org/wiki/Ethanol_fermentation
2. https://www.biologydiscussion.com/acids/citric-acid/citric-acid-discovery-fermentation-and-recovery-microbiology/66045
3. https://www.dairyknowledge.in/content/alkaline-phosphatase-test-pasteurized-milk
4. https://en.wikipedia.org/wiki/Yogurt

5. https://en.wikipedia.org/wiki/Cheese

## Pedagogy

Power point presentation, Seminar, Assignment and Quiz.

**MAJAR BASED ELECTIVE - II (A)**

**MICROBIAL BIOTECHNOLOGY**

| Semester VI | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB6MBE2A** | **Microbial Biotechnology** | **Major Based Elective** | **90** | **6** | **-** | **6** |

**Preamble:**

The students will be able to understand the biological processes undergoing in Industries and exploit the knowledge to improve the process.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Predict the primary and secondary screening of microbes. | K3 |
| CO2 | Determine the applications of microbes | K4 |
| CO3 | Critique knowledge about industrial production | K4 |
| CO4 | Outline views of bio control agents | K5 |
| CO5 | Expand about Process of Bioremediation | K6 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **L** | **M** | **L** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **M** |
| **CO5** | **S** | **M** | **M** | **M** | **M** |

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

**UNIT I: 18 hours**

Biotechnology: Definition –Milestones in History - Scope of microbial biotechnology and its applications. Industrially important microorganisms- Bacteria (Lactobacillus, Bacillus), fungi (Aspergillus, Penicillium), Actinomyces (Streptomyces).

**UNIT II: 18 hours**

Microbial production of bio fertilizers (Rhizobia, Azospirillum, BGA, Azolla, Frankia and VAM). Microbial production of bio-control Agents (Pseudomonas, Trichoderma viride). Microbial production of bioplastics.

**UNIT III: 18 hours**

Single cell protein (algae and yeast). Micro algal technology - Industrial cultivation methods of Spirulina biotechnological potentials of Spirulina as: food and feed. Fuel (bio-diesel) production from microalgae, pharmaceutically valuable compounds from microalgae. Commercial production of bio-ethanol using lignocellulosic waste.

**UNIT IV: 18 hours**

Genetic engineering of plants: Features of Ti plasmid and Mechanism of DNA Transfer, Role of virulence gene, Use of Ti vectors, promoters, Genetic markers, Methods of nuclear transfer – Electroporation, Microinjection. Herbicide and insect resistance. Transgenic plants-BT Cotton. Production of human growth hormone-Insulin.

**UNIT V: 18 hours**

Introduction to the use of Efficient microbes in environmental applications, Bioremediation- Degradation of xenobiotics, bioaugemntation, Bioemulsifiers, biosurfactants, MEOR (Microbial enhanced oil recovery), Leaching of ores.

**REFERENCES**

**Text Books**


| S.No | Authors Name | Title of the Books | Publishers Name | Year of Publication |
|---|---|---|---|---|
| 1 | Singh, J., Vyas, A., Wang, S.,Prasad, R | Microbial Biotechnology: Basic Research and Applications | Springer | 2020 |
| 2 | Prakash Kumar Sarangi & Sonil Nanda | Biotechnology for Sustainable Energy and Products | I.K. International Publishing House Pvt. Ltd | 2019 |
| 3 | Jayanta Kumar Patra, Chethala N. Vishnuprasad, Giti shree Das | Microbial Biotechnology: Applications in Agriculture and Environment. | Springer | 2017 |
| 4 | Dr. Rita Singh and Dr. S.K. Ghosh | Industrial Biotechnology | Gvph-Publishers | 2016 |
| 5 | R C Dubey | Textbook of Biotechnology | S.Chand Publishing | 2015 |

**Reference Books**

| S.No | Authors Name | Title of the Books | Publishers Name | Year of Publication |
|---|---|---|---|---|
| 1 | William J. Thieman, Michael A. Palladino . | Introduction to Biotechnology (What's New in Biology), | Pearson Publications | 2018. |
| 2 | N. Dane Scott. | Food, Genetic Engineering and Philosophy of Technology | Hardcover, Springer ; | 2018. |
| 3 | Fernandes | Comprehensive Biotechnology, | M. Moo Young, Pergamon Press, UK | 2016 |
| 4 | Mahendra K Rai | Hand book microbial biofertilizers | The Haworth press, Inc. New York. | 2015. |
| 5 | Ashim K. Chakravarty. | Introduction to Biotechnology, | Oxford University Press | 2015 |

**Web References**

1.https://blackopscool.blogspot.com/2018/10/download-industrial-biotechnology-pdf.html

2.https://www.researchgate.net/publication/311576484_Industrial_Biotechnology_An Overview

3.https://onlinelibrary.wiley.com/doi/book/10.1002/9783527807833

4.https://stuvera.com/biotechnology-books-pdf/

5. https://content.kopykitab.com/eReader.html

**Pedagogy**

Power point presentation, Seminar, Assignment and Quiz.

**MAJOR BASED ELECTIVE – II (B)**

**FOOD ADULTERATION**

| Semester VI | Internal Marks : 25 | External Marks : 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credit** |
| **19UMB6MBE2B** | **Food Adulteration** | **Major Based Elective** | **90** | **6** | **-** | **6** |

**Preamble:** The course is designed to provide comprehensive knowledge to the students regarding food safety and standardization act and quality control of foods.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Define the basics of Food adulteration | K1 |
| CO2 | Recite the knowledge about Food Safety and Standards | K1 |
| CO3 | Critique knowledge about Standardization of Foods | K4 |
| CO4 | Generalize the basic idea of Food additives | K6 |
| CO5 | Expand the role of Quality control | K6 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **S** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **M** |
| **CO3** | **S** | **S** | **M** | **L** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **M** |
| **CO5** | **S** | **M** | **M** | **M** | **M** |

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

**UNIT – I: 18 hours**

Food adulteration – Introduction of food adulteration, definition. New adulterants in foods, Historical food legislation in India; Central food laboratory, Municipal laboratories, Export inspection council laboratory, Central grain analysis laboratory, standards of weights and measures act, solvent extracted oil, de-oiled meal and edible flour order, export and quality control, inspection act, other acts and orders.

**UNIT –II: 18 hours**

Food Safety and Standards Act 2006.vertical standards Vs horizontal standards .Food safety officer; powers, procedures, role of food analyst most important international laws; Codex alimentarius, FDA, USDA, FAO,HACCP,FSSAI and WHO. National and International regulatory bodies.

**UNIT – III: 18 hours**

Standardization of Foods; Definition, Standards of Quality, for cereals, starchy foods, spices and condiments, sweetening agents, meat and meat products, vinegar, sugar and confectionary, beverages-alcoholic and non-alcoholic , carbonated water, milk and milk products , oils and fats , canned foods , fruits and vegetables products.

**UNIT – IV: 18 hours**

Food additives – classification, nature and characteristics and use of additives in food such as antioxidants, chelating agents, coloring agents - algal colorants (natural & artificial), curing agents, emulsions, flavors and flavor enhancers, flour improvers, humectants and anti-caking agents, nutrient supplements, non-nutritive sweeteners, pH control agents, stabilizers and thickeners. Raising agents – types and their role in food processing.

**UNIT-V: 18 hours**

Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories for companies ,private testing laboratories, Quality control laboratories of consumer co-operatives. Consumer education, consumer problems rights and responsibilities, Consumer protection act (COPRA 1986), tips for wise purchasing, redressal measures how to give complaints and proforma of complaints.

**Text Books:**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Mousumi Sen | Food Chemistry: Role of Additives, Preservatives and Adulteration | John Wiley and Sons | 2021 |
| 2. | *Jonathan Rees* | Food Adulteration and Food Fraud (Food Controversies) | Reaktion Books | 2020 |
| 3. | *Fredric Accum* | A Treatise on Adulterations of Food, And Culinary Poisons | Lector House LLP | *2019* |
| 4. | *Rowland J. Atcherley* | Adulteration of Foods | Wentworth Press | 2019 |
| 5. | *United States Congress* | Adulteration of Food | Forgotten Books | 2019 |

**Reference Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Rosalee S. Hellberg<br>Karen Everstine<br>Steven A. Sklare | Food Fraud: A Global Threat with Public Health and Economic Consequences | Academic Press Inc. | 2020 |
| 2. | James Bell | The Analysis and Adulteration of Foods | Forgotten Books | 2019 |
| 3. | Harvey Washington Wiley | Foods and Food Adulterants, Vol. 4 | Forgotten Books | 2019 |
| 4. | John W. Spink | Food Fraud Prevention: Introduction, Implementation, and Management (Food Microbiology and Food Safety) | Springer | 2019 |
| 5. | William Ernest Mason | Adulteration of Food Products | Forgotten Books | 2018 |

**Web links:**

1. https://www.sciencedirect.com/topics/food-science/food-adulteration
2. https://www.vedantu.com/biology/food-adulteration
3. https://www.publichealthnotes.com/food-adulteration-types-of-food-adulteration-and-mitigation-measures/
4. https://en.wikipedia.org/wiki/Adulterated_food
5. https://www.slideshare.net/SurajPanpatte1/different-methods-of-food-adulteration

**Pedagogy**

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

**MAJOR BASED ELECTIVE- III (A)**

**RECOMBINANT DNA TECHNOLOGY**

| Semester VI | Internal Marks: 25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB6MBE3A** | **Recombinant DNA Technology** | **Major Based Elective** | **75** | **5** | **-** | **5** |

**Preamble:** To acquaint the students to versatile tools and techniques employed in recombinant DNA technology. A sound knowledge on methodological repertoire allows students to innovatively apply these in basic and applied fields of biological research.

**Course Outcome:**

On the successful completion of the course, students will be able to

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO1 | Understand the role of enzymes in rDNA technology | K2 |
| CO2 | Sketch the basic techniques of vectors and its biology | K3 |
| CO3 | Illustrate the gene cloning strategies in recombinant DNA | K4 |
| CO4 | Explain the importance of rDNA techniques | K5 |
| CO5 | Summarize the applications of recombinant technology | K6 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S |
| **CO2** | S | S | S | M | S |
| **CO3** | S | S | M | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | M | S | S | S |

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

**Unit I: Introduction to rDNA Technology (18 hours)**

History and recent developments in rDNA technology, Enzymes used in rDNA technology – Restriction enzymes: types and importance of Type II restriction enzymes, DNA Ligases, DNA polymerase, Ribonucleases, Reverse transcriptase, Alkaline phosphatase, T4 Polynucleotide kinase, Terminal deoxynucleotidyl transferase,

Nucleases: S1Nuclease and DNase.

**Unit II: Cloning Vectors (15 hours)**

Cloning Vectors: properties and types. Plasmids – vectors for cloning in *E. coli*: pUC, pBR322 and pGEM3Z. Bacteriophage vectors: Lambda, M13, Phagemids and T7 promoter-based vector. Shuttle vectors: YACs, YEps, BACs. Animal viruses: SV40, Baculo and their use as vectors.

**Unit III: Gene Cloning Strategies (12 hours)**

Gene cloning strategies, Uses of adapters and linkers. Screening and selection of recombinant clones: Colony Hybridization techniques, lacZ complementation (Blue-white selection) and Immuno-screening. Construction of genomic DNA and cDNA libraries.

**Unit IV: rDNA Techniques (18 hours)**

Introduction to Gene sequencing methods: Sanger's termination, automated and next generation sequencing, Polymerase chain reaction and RT-PCR, DNA finger printing: RAPD and RFLP, Chromosome walking, Blotting techniques and Electrophoresis (Agarose Gel and SDS – PAGE). Brief introduction of CRISPR-Cas9 gene editing technology. Methods of gene transfer techniques in plants and animals: *Agrobacterium* mediated, electroporation and particle gun.

**Unit V: Applications of rDNA (12 hours)**

Transgenic animals - sheep and mice, Transgenic plant - BT brinjal, Molecular pharming, Brief introduction to Gene therapy, Corona vaccine and Human genome project. Merits and demerits of recombinant products. Hazards and safety regulations in r-DNA Technology.

**Text Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | T. A. Brown | Gene Cloning and DNA Analysis. An Introduction. (8th Edition) | Blackwell Publications | 2020 |
| 2. | Monika Jain | Recombinant DNA Techniques: A Text book | Narosa, India | 2020 |
| 3. | Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten | Molecular Biotechnology: Principles and Applications of Recombinant DNA. (5thEdition) | ASM Press | 2017 |
| 4. | Mukherjee, Siddhartha | The Gene: An Intimate History | Scribner Publication | 2017 |
| 5. | S.B. Primrose and R.M. Twyman | Principles of Gene manipulation and Genomics. (7th Edition) | Blackwell Scientific Publications, India | 2014 |

**Reference Books**

| S.No. | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Daniel L.Hartl | Analysis of Genes and Genomes. (9th Edition) | Jones & Bartlett Learning, US | 2019 |
| 2. | Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick | Lewin's genes XII | Jones and Bartlett Learning, US | 2018 |
| 3. | Fridos Alam Khan | Biotechnology Fundamentals (2nd Edition) | CRC Press | 2017 |
| 4. | T.A. Brown | Gene Cloning and DNA analysis. (7th Edition) | Blackwell Publication | 2016 |
| 5. | Chaudhuri, Keya | Recombinant DNA Technology | TERI, New Delhi | 2015 |

**Web links:**

1. https://physicscatalyst.com/biotechnology/recombinant-dna-technology.php
2. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod2.pdf
3. https://facultystaff.richmond.edu/~lrunyenj/bio554/lectnotes/chapter14.pdf
4. http://www.bio.brandeis.edu/classes/heredity/Lecture%20Powerpoints/Chapter_13_1.pdf
5. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/

**Pedagogy**

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

**MAJOR BASED ELECTIVE–III (B)**

**BIOLOGICAL TECHNIQUES**

| Semester VI | Internal Marks :25 | External Marks: 75 | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **19UMB6MBE3B** | **Biological Techniques** | **Major Based Elective** | **75** | **5** | **-** | **5** |

**Preamble:** To educate the students with the basic principles of microbial techniques so as to develop their research aptitude and career prospects.

**Course Outcome:**

| COs | CO Statement | Knowledge level |
|---|---|---|
| CO 1 | Recall microscopic techniques. | K1 |
| CO 2 | Apply the spectroscopic, Spectrophotometric methods & analytical techniques. | K3 |
| CO 3 | Critique knowledge about chromatographic techniques. | K5 |
| CO 4 | Revise about electrophoresis & its applications. | K6 |
| CO 5 | Combine view of molecular techniques. | K6 |

**Mapping with Programme Outcomes:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **S** | **M** | **S** |
| **CO2** | **S** | **M** | **S** | **M** | **S** |
| **CO3** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **M** | **S** | **M** | **S** |

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

**Syllabus:**

**UNIT-I: MICROSCOPIC TECHNIQUES (15 Hours)**

Basic principles, mechanisms and application of Bright Field, Dark field, Phase contrast, Polarization, Confocal laser scanning microscope, Fluorescence, Scanning Electron microscope & Transmission Electron Microscope (SEM & TEM) and Radio- frequency scanning tunneling microscopy, Atomic force microscopy. Preparation of microbial, animal and plant samples for microscopy.

**UNIT-II: SPECTROSCOPY & SPECTROPHOTOMETRY (15 Hours)**

Basic concepts and applications of Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy,UV/Visible spectrophotometry, Infrared spectroscopy, Fourier-transform infrared spectroscopy (FTIR), Nuclear Magnetic Resonance spectroscopy (NMR).

**UNIT III- CHROMATOGRAPHIC TECHNIQUES (13 Hours)**

Basic Principles and application of Bioautography, Thin-layer chromatography, Paper chromatography, Gel filtration chromatography, Ion- exchange chromatography, Affinity chromatography, Gas chromatography and High Performance Liquid chromatography.

**UNIT IV- CENTRIFUGATION & ELECTROPHORESIS (15 Hours)**

Basic principles and applications of Centrifuges - Preparative, analytical, high speed, low speed, ultracentrifuge, differential and density gradient.

Basic concepts and applications of Gel Electrophoresis- Agarose and acrylamide (native, denaturing and gradient), Isoelectric focusing, 2D Electrophoresis, Immunoelectrophoresis and Pulse field Electrophoresis.

**UNIT V- RADIOGRAPHY & MOLECULAR TECHNIQUES (17 Hours)**

Basic principles and application of Autoradiography. Liquid scintillation counting, phosphor imaging, Imatinib Resistance Mutation Analysis. Types of PCR- Real time PCR, Reverse Transcriptase PCR, Multiplex PCR, Nested PCR and In-situ PCR. Blotting (Southern, Western, Northern) Techniques, DNA Finger printing, RFLP, RAPD and AFLP application.

**Text Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | RaoD M | Instrumental Methods of Analysis | CBS publishers and distributors pvt ltd | 2020 |
| 2. | Gurdeep R. Chatwal | Instrumental Methods of Chemical Analysis | Himalaya publishing house | 2019 |
| 3. | Bhawana Pandey M.H. Fulekar | Bioinstrumentation | Dreamtech Press | 2019 |
| 4. | Gilbert H mitchell | Gel Electrophoresis: Types, Applications & Research | Nova Science Publishers | 2017 |
| 5. | Jessica carol | Textbook of Analytical Biochemistry | Syrawood Publishing House | 2016 |

**Reference Books**

| S.No | Authors Name | Title of the book | Publishers Name | Year |
|---|---|---|---|---|
| 1. | Ankita Jain, Haresh Kalasariya, Varsha Tailor, Nikunj B. Patel | Bioinstrumentation techniques-Basics and applications | Notion Press | 2020 |
| 2. | Gakhar, Monika Miglani, Ashwani Kumar | Molecular Biology: A Laboratory Manual | Dreamtech Press | 2019 |
| 3. | Almroth E. Wright | Principles of Microscopy: Being a Handbook to the Microscope | Forgotten Books | 2018 |
| 4. | *Andreas Hofmann and Samuel Clokie* | *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* | *Cambridge University Press* | 2018 |
| 5. | *Sanjay B Bari* | *Theory and Practice of Chromatographic Techniques* | *Pharma Med Press* | 2017 |

**Web links:**

1.http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf

**2.** https://research.ipmu.jp/seminar/sysimg/seminar/574.pdf

**3.**http://www-keeler.ch.cam.ac.uk/lectures/Irvine/

**4.** https://www.ccamp.res.in/sites/default/files/Basics%20of%20Chromatography_KR_C-CAMP.pdf

**5.** http://www.bdu.ac.in/schools/biotechnology-and-genetic-engineering/biomedical-science/docs/course_materials/Biotechniques/Electrophoresis.pdf

**6.**https://ehs.psu.edu/sites/ehs/files/lsc_theory_of_operation_part_1.pdf

**7.**https://www.youtube.com/watch?v=kOCcmJ3nVQ4

**Pedagogy**

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.