

MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL - 624 101
Tamil Nadu.



Curriculum Framework and Syllabus for
B.Sc. MICROBIOLOGY

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

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

Mother Teresa Women's University, Kodaikanal
Department of Biotechnology
Choice Based Credit System (CBCS)
(2021-2022 onwards)
B.Sc. Microbiology

1. About the Programme

Our B.Sc Microbiology is a 3 years undergraduate program and the syllabus is divided into six semesters offering a strong foundation of microbiological concepts. This program involves the study of microorganisms with particular emphasis on the biology of bacteria, viruses, fungi and protozoan parasites. It emphasizes on understanding microorganisms and their inter relationships with other organisms in nature. Students in the microbiology degree program study the background and current findings in the field of microbiology and also acquire the critical thinking skills and the hands-on laboratory and field skills required to succeed in science.

2. Programme Educational Objectives (PEOs)

PEO1: To communicate the basic knowledge in general microbiology with detailed subdivision of microbiology.

PEO2: To explain the advanced sections of microbiology like Immunology, Microbial genetics, food microbiology, medical microbiology, Environmental microbiology, industrial microbiology and bioinformatics

PEO3: To provide necessary theoretical and practical experience in all divisions of microbiology to become an effective professional.

PEO4: To develop microbiologist with professional ethics in order to address global and societal issues for sustainable development.

PEO5: To promote lifelong learning skills to meet the ever evolving professional demands

3. Eligibility *: +2 Pass with Science Subject

4. General Guidelines for UG Programme

- i. **Duration:** The programme shall extend through a period of 6 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.
- ii. **Medium of Instruction:** English
- iii. **Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

| Evaluation Pattern | Theory | | Practical | |
|--------------------|--------|-----|-----------|-----|
| | Min | Max | Min | Max |
| Internal | 10 | 25 | 10 | 25 |
| External | 30 | 75 | 30 | 75 |

- **Internal (Theory):** Test (15) + Assignment (5) + Seminar/Quiz(5) = 25
- **External Theory:** 75

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75**Time: 3 Hrs.**

| S.No. | Part | Type | Marks |
|-------------|------|---|-----------|
| 1 | A | 10*1 Marks=10 Multiple Choice Questions(MCQs): 2 questions from each Unit | 10 |
| 2 | B | 5*4=20 Two questions from each Unit with Internal Choice (either / or) | 20 |
| 3 | C | 3*15=45 Open Choice: Any three questions out of 5 : one question from each unit | 45 |
| Total Marks | | | 75 |

* **Minimum credits required to pass: 156**

- **Project Report**

A student should select a topic for the Project Work at the end of the third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman font with 1.5 line space.

- **Project Evaluation**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

5. Conversion of Marks to Grade Points and Letter Grade (Performance in a Course/ Paper)

| Range of Marks | Grade Points | Letter Grade | Description |
|----------------|--------------|--------------|--------------|
| 90 – 100 | 9.0 – 10.0 | O | Outstanding |
| 80-89 | 8.0 – 8.9 | D+ | Excellent |
| 75-79 | 7.5 – 7.9 | D | Distinction |
| 70-74 | 7.0 – 7.4 | A+ | Very Good |
| 60-69 | 6.0 – 6.9 | A | Good |
| 50-59 | 5.0 – 5.9 | B | Average |
| 40-49 | 4.0 – 4.9 | C | Satisfactory |
| 00-39 | 0.0 | U | Re-appear |
| ABSENT | 0.0 | AAA | ABSENT |

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance less than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

7. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

8. Any Other Information

In addition to the above mentioned regulations, any other common regulations pertaining to the UG Programmes are also applicable for this Programme.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

On completion of B.Sc Microbiology programme

| | |
|-------------|--|
| PSO1 | Problem Solving Skills: Students will be able to explain about various applications of Microbiology such as Environmental Microbiology, Industrial Microbiology, Food Microbiology, and Microbial Pathogenicity |
| PSO2 | Research Skills: Students will execute a short research project incorporating techniques of Basic and Advanced Microbiology |
| PSO3 | Successful career: Students will be able to take up a suitable position in academia or industry, and to pursue a career in research field. |
| PSO4 | Entrepreneurship: Students will be aware of the importance of entrepreneurship opportunities available in the society |
| PSO5 | Sustainable Development: Students will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics |

PROGRAMME OUTCOMES (POs):

On completion of B.Sc Microbiology, graduates will be able to

| | |
|------------|---|
| PO1 | Endorse them by understanding the impact of Microbiology in life. |
| PO2 | Cultivate practical skills in Microbiology to gain a strong notion for the job seeking sector. |
| PO3 | Employ themselves in the field of microbiology such as mushroom farming, biofertilizer preparation, dairy product preparation, and etc |
| PO4 | Apply their skills and techniques gained to reform the modern needs and make welfare for the society through the beneficial microbes. |
| PO5 | Establish the ability to work autonomously as an individual and will be highly adaptably within a team with effectiveness and responsibility |
| PO6 | Analyse and interpret results from a variety of microbiological methods |
| PO7 | Understand the relationship between science and society by recognizing and discussing logical, scientific and ethical issues in microbiology. |
| PO8 | Communicate and collaborate with other disciplines in written and oral format. |

**MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL**

**Framework of the Syllabus to be implemented from the Academic Year 2021-2022
Curriculum Framework and Syllabus for**

B.Sc. MICROBIOLOGY

(For the candidates to be admitted from the academic year 2020-2021 onwards)

| Course Code | Title of the Course | Credits | Hours | | Maximum Marks | | |
|-------------------------|---|-----------|-----------|-----------|---------------|------------|------------|
| | | | T | P | INT | EXT | Total |
| FIRST SEMESTER | | | | | | | |
| U21LTA11 | Part I -Tamil I | 3 | 6 | | 25 | 75 | 100 |
| U21LEN11 | Part II - English I | 3 | 6 | | 25 | 75 | 100 |
| U21MBT11 | Core I– Basic Microbiology | 4 | 5 | | 25 | 75 | 100 |
| U21MBP11 | Core II – Practical in Basic Microbiology | 4 | | 6 | 25 | 75 | 100 |
| U21MBA11 | Allied I –Physics for Biology | 4 | 5 | | 25 | 75 | 100 |
| U21EVS11 | Environmental studies | 2 | 2 | | 25 | 75 | 100 |
| U21PELS11 | Part III -Professional English | 4 | 6 | | 25 | 75 | 100 |
| | Total | 24 | | 36 | 175 | 525 | 700 |
| SECOND SEMESTER | | | | | | | |
| U21LTA22 | Part I -Tamil II | 3 | 6 | | 25 | 75 | 100 |
| U21LEN22 | Part II - English II | 3 | 6 | | 25 | 75 | 100 |
| U21MBT21 | Core III– Microbial Genetics & Molecular Biology | 4 | 5 | | 25 | 75 | 100 |
| U21MBT22 | Core IV –Microbial Diversity and Taxonomy | 4 | 5 | | 25 | 75 | 100 |
| U21MBA22 | Allied II- Statistics for biology | 4 | 5 | | 25 | 75 | 100 |
| U21VAE21 | Value education | 3 | 3 | | 25 | 75 | 100 |
| U21PELS22 | Part III -Professional English | 4 | 6 | | 25 | 75 | 100 |
| | Total | 25 | 36 | | 175 | 525 | 700 |
| THIRD SEMESTER | | | | | | | |
| U21LTA33 | Part I -Tamil III | 3 | 6 | | 25 | 75 | 100 |
| U21LEN33 | Part II - English III | 3 | 6 | | 25 | 75 | 100 |
| U21MBT31 | Core V– Microbial Physiology | 4 | 5 | | 25 | 75 | 100 |
| U21CHA33 | Allied III- Chemistry | 4 | 5 | | 25 | 75 | 100 |
| U21MBE311/ U21MBE312 | Elective-I Choice 1: General biology Choice 2: Human Physiology | 3 | 4 | | 25 | 75 | 100 |
| U21MBS311 | Skill Based Elective I-Managerial Skills | 2 | 2 | | 25 | 75 | 100 |

| | | | | | | | |
|-------------------------|---|-----------|-----------|---|------------|------------|------------|
| | Non-Major Elective – I | 2 | 2 | | 25 | 75 | 100 |
| | Total | 21 | 30 | | 175 | 525 | 700 |
| FOURTH SEMESTER | | | | | | | |
| U21LTA44 | Part I -Tamil IV | 3 | 6 | | 25 | 75 | 100 |
| U21LEN44 | Part II - English IV | 3 | 6 | | 25 | 75 | 100 |
| U21MBT41 | Core VI– Biochemistry | 4 | 4 | | 25 | 75 | 100 |
| U21MBP42 | Core VII – Practical in Biochemistry & Molecular Biology | 4 | | 4 | 25 | 75 | 100 |
| U21CHA44 | Allied IV – Chemistry Practical | 4 | | 4 | 25 | 75 | 100 |
| U21MBE421/ U21MBE422 | Elective-II Choice 1: Plant Anatomy and Physiology Choice 2: Plant Pathology | 3 | 3 | | 25 | 75 | 100 |
| U21CSS421 | Skill Based Elective II - Computer Skills for Office Management | 2 | 2 | | 25 | 75 | 100 |
| | Non -major Elective –II | 2 | 2 | | 25 | 75 | 100 |
| | Total | 25 | 31 | | 200 | 600 | 800 |
| FIFTH SEMESTER | | | | | | | |
| U21MBT51 | Core VIII- Agricultural & Environmental Microbiology | 4 | 5 | | 25 | 75 | 100 |
| U21MBT52 | Core IX– Food Microbiology | 4 | 5 | | 25 | 75 | 100 |
| U21MBT53 | Core X– General Virology | 4 | 5 | | 25 | 75 | 100 |
| U21MBT54 | Core XI– Bioinstrumentation | 4 | 5 | | 25 | 75 | 100 |
| U21MBP55 | Core XII – Practical in Agricultural & Environmental Microbiology, Food Microbiology and Virology | 4 | | 5 | 25 | 75 | 100 |
| U21MBE531/ U21MBE532 | Elective –III Choice 1: Nutritional Biochemistry Choice 2: Developmental Biology | 3 | 3 | | 25 | 75 | 100 |
| U21MBS531/ U21MBS532 | Skill Based Elective III Choice 1: Medical Lab Technology Choice 2: Clinical Biochemistry & Metabolic Disorders | 2 | 2 | | 25 | 75 | 100 |
| | Total | 25 | 30 | | 175 | 525 | 700 |
| SIXTH SEMESTER | | | | | | | |
| U21MBT61 | Core XIII – Medical Microbiology | 4 | 4 | | 25 | 75 | 100 |
| U21MBT62 | Core XIV – Industrial Microbiology | 4 | 5 | | 25 | 75 | 100 |
| U21MBT63 | Core XV- Microbial Biotechnology | 4 | 5 | | 25 | 75 | 100 |

| | | | | | | | |
|-------------------------|---|------------|------------|---|------------|------------|-------------|
| U21MBT64 | Core XVI – Immunology | 4 | 4 | | 25 | 75 | 100 |
| U21MBP65 | Core-XVII- Practical in Medical Microbiology, Industrial Microbiology, Microbial Biotechnology and Immunology | 4 | | 5 | 25 | 75 | 100 |
| U21MBE641/ U21MBE642 | Elective –IV Choice 1: Bioinformatics Choice 2: Mycology | 3 | 3 | | 25 | 75 | 100 |
| U21MBS641/ U21MBS642 | Skill Based Elective IV Choice 1: Vermicomposting Choice 2: Molecular Modeling and Drug Designing | 2 | 2 | | 25 | 75 | 100 |
| U21EAS61 | Extension Activities | 3 | 2 | | 100 | | 100 |
| Total | | 28 | 30 | | 175 | 525 | 800 |
| Grand Total | | 148 | 193 | | | | 4400 |

1. Online course - III Semester -U21MB031
2. Internship - IV Semester -U21MB141
3. Value added Course - Dairy Technology V Semester - U21MBV51

Each carries 2 Credits to be included as additional credit courses.

Non Major Elective - NME

NME – I : U21MBN31 - Applied Food Microbiology – III Semester

NME – II : U21MBN42 - Mushroom Cultivation – IV Semester

SEMESTER - I

| Course Code | U21MBT11 | Basic Microbiology | | | |
|--------------------------|---|--------------------|-----------|---|---|
| Core | I | L | T | P | C |
| Cognitive Level | K1: Recall | K2: Understand | K3: Apply | | |
| Course Objectives | <ul style="list-style-type: none"> To provide a wide knowledge on basic aspects of microbiology To learn the different types of microscope and their application To understand the organization of prokaryotic and eukaryotic cell To know about various sterilization techniques, culturing and storage of microbes. | | | | |
| Unit I | History of Microbiology: Contributions of Leeuwenhoek, John Needham, Spallanzani, Tyndall, Lister, Jenner, Pasteur, Robert Koch, Alexander Fleming and Elie Metchnikoff, Scope of Microbiology | | | | |
| Unit II | Prokaryotes -Structure and function of cell and cellular components – slime layer, capsule, pili, flagella, cell wall, cytoplasmic membrane and other cytoplasmic inclusions. | | | | |
| Unit III | Eukaryotes - Structure and function of cell and cellular components – cell wall, cilia, nucleus, mitochondria, chloroplast, endoplasmic reticulum, golgi apparatus, lysosomes. | | | | |
| Unit IV | Microscope - simple, compound – bright field and dark field, electron, phase contrast microscope, confocal and Fluorescence microscope, - parts and their functions, resolving power, aperture. | | | | |
| Unit V | Sterilization – Principle – dry heat, moist heat, filtration, radiation, disinfection techniques, antimicrobial agents. Types of media, micro and macro nutrients, aerobic and anaerobic culture technique and preservation of microbes. | | | | |
| Textbook | <ol style="list-style-type: none"> Pelczar.M.J, Schan.E.C and Kreig.N.R. Microbiology – An application based approach. 7th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi; 2020. Dubey.R.C. and Maheswari.D.K. A Text Book of Microbiology. 4th Edition, S. Chand and Company Ltd, NewDelhi; 2013. | | | | |
| References | <ol style="list-style-type: none"> Atlas, R.A. and Bartha, R. 2000. Microbial Ecology, Fundamentals A.J Salle. Fundamentals of bacteriology Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley and David A. Stahl. Brock Biology of Microorganisms, 15th Edition. Prentice Hall Inc; 2018. Pelczar.M.J, Schan.E.C and Kreig.N.R. Microbiology – An application based approach. 7th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi; 2020. Roger Y. Stanier, John L Ingraham, Mark L Wheelis, Rage R Painter. General Microbiology. 5th Edition. Macmillan, Hampshire & London; 1992. Joanne Willey, Linda Sherwood & Christopher J. Woolverton. Prescott's Microbiology. 10th Edition. McGraw-Hill; 2016. | | | | |
| E-references | <ol style="list-style-type: none"> https://microbenotes.com https://medicalaid.org | | | | |

| | | | |
|-----------------------|--|---|----|
| | 3. https://www.cliffsnotes.com 4. https://www.cdc.gov 5. https://www.aladdin-e.com | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | understand the microbiological inventions and inventors. | K1 |
| | CO2 | describe the prokaryotic and eukaryotic cell structure and function | K3 |
| | CO3 | compare the prokaryotic and eukaryotic cell structure and function | K3 |
| | CO4 | understand the types of microscope, parts of the microscope and its function. | K1 |
| | CO5 | gather knowledge on various sterilization techniques, types of media and its preservation | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | M | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | S |
| CO4 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | M | S | S | S | S | S | M | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark

| Course Code | U21MBP11 | Practical in Basic Microbiology | | | |
|--|--|--|---|-----------|----|
| Core | II | L | T | P | C |
| | | - | - | 6 | 4 |
| Cognitive Level | K1: Recall | K2: Understand | | K3: Apply | |
| Learning objective | <ul style="list-style-type: none"> To explore skill based knowledge in aseptic maintenance, handling microscopes and glassware. To gain knowledge on technical hands-on-training in preparation of selective and differential media, isolation and maintenance of pure culture To identify the morphological characteristics of microbes using various staining methods. | | | | |
| Experiments in Basic Microbiology | <ol style="list-style-type: none"> 1) Sterilization techniques 2) Preparation of Media 3) Preparation of Slant, Stab & Plating techniques. 4) Observation of bacterial colony morphology 5) Observation of cell shape & arrangement 6) Staining techniques <ol style="list-style-type: none"> a) Simple Staining b) Gram's Staining c) Spore Staining 7) Motility of Bacteria 8) Pure culture technique <ol style="list-style-type: none"> a) Spread plate technique b) Streak plate Method c) Pour plate technique 9) Microbial population count – viable count & haemocytometer count 10) Micrometry | | | | |
| Textbook | 1. Dariel Burdass, John Grainger & Janet Hurst. Basic Practical Microbiology: Manual. 3 rd Edition. Society for General Microbiology; 2003. | | | | |
| References | <ol style="list-style-type: none"> 1. Cappuccino, G. James and Natalie Sherman, Gram stain, Microbiology A Lab. Manual. 10th Edition. Pearson Benjamin Cummings publisher. 2013. 2. Atlas, M. Ronald, Alfred E. Brown and Lawrence C. Parks, Gram stain, Experimental Microbiology, St.Louis Mosby publisher.1995. 3. Handbook of Microbiological Media – HiMedia. 4th Edition. CRC press; 2010 4. Biochemical Methods – Wilson & Walker. 8th Edition. Cambridge University Press publisher; 2018 | | | | |
| E-references | 1. https://www.alibris.com | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | |
| | CO1 | apply the aseptic techniques and proper handling of glassware and equipment. | | | K3 |
| | CO2 | prepare various culture media for the cultivation of microbes. | | | K3 |

| | | | |
|--|-----|---|----|
| | CO3 | demonstrate pure culture isolation and maintenance. | K3 |
| | CO4 | use various staining techniques for morphological characterization of microbes. | K2 |
| | CO5 | know storage technique for bacteria and fungi | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | M | S | S | S | S | S | S | S | S | S | M | S | S |

Strongly Correlating

(S) - 3 marks

Moderately Correlating

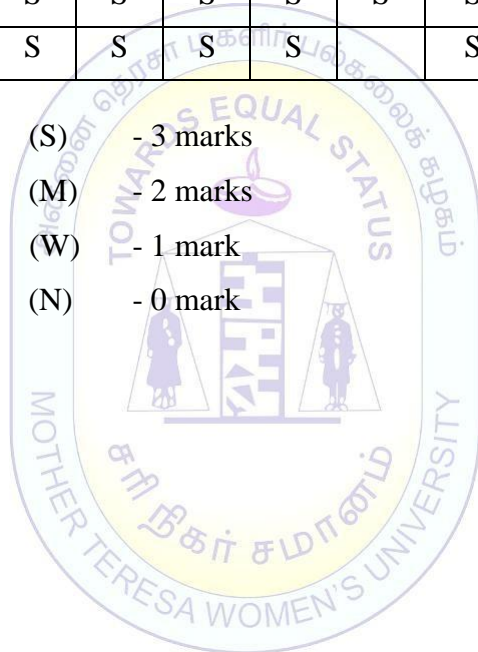
(M) - 2 marks

Weakly Correlating

(W) - 1 mark

No Correlation

(N) - 0 mark



| Course Code | U21MBA11 | Physics for Biology | L | T | P | C |
|---------------------------|---|---------------------|---|---|---|---|
| Allied | I | | 5 | - | - | 4 |
| Cognitive Level | K1: Recall K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the principles and applications of Spectroscopy To be trained in Principles of thermodynamics and their applications. To attain knowledge on Types of radioisotopes used in biology To have the ability to understand the fundamental of physics in Biological applications | | | | | |
| Unit I | Spectroscopy - Absorption spectroscopy – principle, instrumentation and applications of atomic absorption, UV visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy, NOSY, COSY and ROSY techniques. Electron Spin resonance. | | | | | |
| Unit II | Emission spectroscopy – introduction, principle, method and application of Flame photometry. Fluorimetry – principle, instrumentation and application. Mass spectroscopy – principle, instrumentation and application. Light scattering Raman Spectroscopy; principles, method, application with reference to biological macromolecules such as proteins and nucleic acids. | | | | | |
| Unit III | Principles of thermodynamics and their applications. Introduction, thermodynamics system, thermodynamic state functions, first and second laws of thermodynamics, concept of free energy, standard free energy, determination of G for a reaction, relation between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions. | | | | | |
| Unit IV | Radioisotopes: Types of radioisotopes used in biology, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid scintillation counting), nuclear emulsions used in biological studies (pre-mounted liquid and stripping). | | | | | |
| Unit V | Hazards and safety: Isotopes commonly used in biochemical studies – ³² P, ³⁵ S, ¹⁴ C and ³ H. Autoradiography, Biological hazards of radiation and safety measures in handling radioisotopes – Biological applications | | | | | |
| Textbook | 1. Pranav Kumar. Fundamentals and Techniques of Biophysics and Molecular Biology. 3 rd ed. Pathfinder publication ; 2016. ISBN -13 978-9380473154. | | | | | |
| References | <ol style="list-style-type: none"> 1. VanHolde K.E. Principles of Physical Biochemistry. 2nd ed. Pearson Prentice Hall Inc; 2005. ISBN-13 978-0130464279. 2. Upathayah. Biophysical Chemistry. Himalaya publishing house ; 2016. ISBN-13 978-9351422273. 3. Keith Wilson & John Walker. Practical Biochemistry – Principles and Techniques. 5th ed. Cambridge university press ; ISBN-13 978-0521799652. 4. David Friefelder. Biophysical Biochemistry. 2nd ed. W.H .Freeman & Co USA; 1983. ISBN-13 978-0716714446. | | | | | |
| E-references | 1. https://is.muni.cz/www/384/30618506/koncepty/Physics_in_Biology_and_Medicine_3rd_Edition.pdf | | | | | |

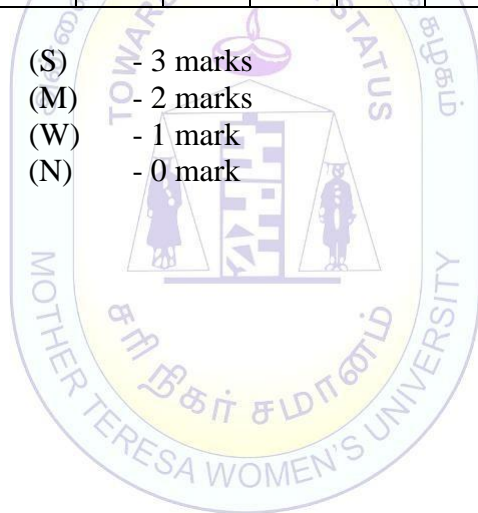
| Course outcome | Upon completion of this course, the students will be able to | | |
|----------------|--|--|----|
| | CO1 | analyse and understand the techniques of spectroscopy. | K3 |
| | CO2 | understand the basic principle of emission spectroscopy and mass spectroscopy. | K2 |
| | CO3 | recognise the principles of thermodynamics. | K2 |
| | CO4 | realise and learn the various types of radioisotopes | K2 |
| | CO5 | gather the knowledge on biological hazards of radiation and safety. | K1 |

Mapping of COs with POs & PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | S | M | S | S | S | S | S | M | S | M | S |
| CO2 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | S | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | M | S |

Strongly Correlating
Moderately Correlating
Weakly Correlating
No Correlation

(S) - 3 marks
(M) - 2 marks
(W) - 1 mark
(N) - 0 mark



SEMESTER - II

| Course Code | U21MBT21 | Microbial Genetics & Molecular Biology | L | T | P | C |
|---------------------------|--|--|----------------|---|-----------|---|
| Core | III | | 5 | - | - | 4 |
| Cognitive Level | K1: Recall | | K2: Understand | | K3: Apply | |
| Learning objective | <ul style="list-style-type: none"> To describe the principles of gene regulation in prokaryotic and eukaryotic cells To describe the consequences of different types of mutations and DNA-repair systems To focus on hereditary aspects of prokaryotic microbes To elucidate the various mechanisms of gene transfer in microorganism and extra chromosomal inheritance | | | | | |
| Unit I | Genetic material: Microbial Genetics Vs Mendelian Genetics- Structure of nucleic acids – Watson and Crick’s double helix structure, types of DNA, Structure of mRNA, t-RNA and r-RNA – Nucleic acid as genetic material – Experimental evidence – concept of gene and mutation – Fluctuation test and its significance – Cistron, Complementation of gene function. | | | | | |
| Unit II | Extrachromosomal inheritance: Plasmids – Types and curing. Transposons –structure, functions and types. Mechanism of antibiotic resistance. | | | | | |
| Unit III | Mutation – Definition and types. Mutagenesis – Spontaneous and Induced - Physical mutagen – UV, Chemical mutagen – NTG, HNO ₂ and Biological mutagen –transposons and their mutagenic action. Mutants – types and applications - Auxotroph and drug resistant mutants. DNA damage - types and repair mechanism – Excision and SOS. | | | | | |
| Unit IV | Genetic exchange in bacteria – transformation, transduction and conjugation – genetic maps – linkages – natural transformation – competence – DNA uptake – F factor in conjugation – Chromosome mobilization – HFr strain, Recombination. | | | | | |
| Unit V | Central Dogma of Life and gene expression: Replication – types and mechanism. Transcription in prokaryotes and eukaryotes. Translation – Genetic code – Wobble hypothesis, mechanism of translation in prokaryotes and Eukaryotes. Regulation of Gene expression – The operon model – Lac operon and catabolic repression, Trp operon (Repressible system) and attenuation | | | | | |
| Textbook | <ol style="list-style-type: none"> David Freifelder.D. Microbial Genetics. 18th Edition. Narosa Publishing House, New Delhi; 2008. David Freifelder. D Molecular Biology. Jones and Bartlett Publishers; 2004 | | | | | |
| References | <ol style="list-style-type: none"> Lewin. Gene VIII. pearson publisher. 2003. ISBN -13- 978-0131439818 James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Berkeley Richard Losick. Molecular Biology of the Genes. 7th Edition. Pearsons Education Inc; 2013. Arthur Kornberg & Tania A. Baker. DNA replication. 2nd Edition. University Science Books; 2005. Molecular Cell Biology. Harvey Lodish, Arnold Berk, Chris.A Kaiser, | | | | | |

| | | | |
|-----------------------|--|---|----|
| | Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh and Paul Matsudaira. 6 th Edition. W.H.Freeman publisher; 2007 | | |
| E-references | 1. https://www.biologydiscussion.com/dna/dna-damage-types-and-repair-mechanisms-withdiagram/16332#:~:text=DNA%20has%20many%20elaborate%20mechanisms,mismatched%20with%20the%20complementary%20str and. | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | understand the discovery of DNA by Watson and Crick and and gather information on the evidence for DNA and RNA as genetic material. | K2 |
| | CO2 | gain basic knowledge on extra chromosomal inheritance, plasmids, transposons and the mechanism of antibiotic resistance. | K2 |
| | CO3 | gain knowledge on various mutagens, transposons as mutagenic agent, DNA damage and repair mechanisms. | K2 |
| | CO4 | recognize the genetic exchange in bacteria by means of transformation, transduction and conjugation and understand the genetic maps and chromosome mobilization. | K2 |
| | CO5 | know and understand recombination, replication, transcription and translation with reference to genetic code, wobble hypothesis and information on types of operon. | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | S | S | M | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | M | S | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark

| Course Code | U21MBT22 | Microbial Diversity and Taxonomy | L | T | P | C |
|--------------------|---|----------------------------------|---|---|---|---|
| Core | IV | | 5 | - | - | 4 |
| Cognitive Level | K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> • To focus on the principles of microbial diversity and taxonomy • To learn about different classification system, characteristics, and phylogenetic relevance of diversified prokaryotes. • To provide special emphasis on morphology and reproduction of eukaryotic organism | | | | | |
| Unit I | Classification of Microorganisms: Introduction – Hacekel’s three Kingdom concept – Whittaker’s five Kingdom concept – three domain concept of Carl Woese. | | | | | |
| Unit II | Binomial nomenclature: Species concept – Kingdom, division, class, order, family, and genus. Phototrophs, Heterotrophs, Lithotrophs, Chemotrophs, and Organotrophs. Principles of classification – morphological, physiological biochemical basis of classification. Molecular basis of classification – chemotaxonomy & numerical taxonomy | | | | | |
| Unit III | Classification of bacteria: General characters of bacteria, archea and actinomycetes. Classification of bacteria – Bergey’s Manual (upto family level). Classification of Archaeobacteria (upto to family level). | | | | | |
| Unit IV | Classification of Algae and Fungi : Salient features, structures and reproduction of algae – <i>Nostoc</i> , and <i>Chlamydomonas</i> . Salient features, structures and reproduction of fungi – <i>Aspergillus</i> , <i>Rhizopus</i> , <i>Yeast</i> , <i>Agaricus</i> and <i>Pencillium</i> . | | | | | |
| Unit V | Classification of viruses and protozoa : Salient Features of Bacteriophages - T ₄ , Plant viruses - TMV and animal viruses - Adenovirus. Protozoa – Outline Classification – General characteristics of each group – Structure and reproduction of Amoeba, Plasmodium | | | | | |
| Textbook | <ol style="list-style-type: none"> 1. Pelczar.M.J, Schan.E.C and Kreig.N.R. Microbiology – An application based approach. 7th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi; 2020. 2. Dubey.R.C. and Maheswari.D.K. A Text Book of Microbiology. 4th Edition, S. Chand and Company Ltd, NewDelhi; 2013. | | | | | |
| References | <ol style="list-style-type: none"> 1. A.J Salle. Fundamentals of bacteriology. 7th Edition. Tata McGraw Hill Education; 1984. 2. Brock T.D Madigan M.T. Biology of Microorganisms, Prentice Hall Inc. 3. Pelczar M.J., Chan E.C.S., Kreig N.R. Microbiology, McGraw Hill. 4. Bergey’s Manual of Systematic Bacteriology – P.H Sneath, N.S Mair, M. Elizabeth. 5. Stanier R.Y., Ingharam J.L., Wheelis M.L., Painter P.R (1999). General Microbiology, Macmillan Education Ltd. London. 6. .N.A Logan – Bacterial Systematics. 1991. Blackwell Scientific Publications. | | | | | |

| | | | |
|----------------|--|---|----|
| E-references | 1. https://www.nature.com/subjects/microbiology#:~:text=Microbiology%20is%20the%20study%20of,host%20response%20to%20these%20agents. 2. https://www.moscmm.org/pdf/Ananthanarayan%20microbio.pdf | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | outline the classification of microorganisms. | K2 |
| | CO2 | understand the binomial nomenclature and the basis of molecular classification. | K2 |
| | CO3 | explain the Bergey's manual of classification of bacteria | K3 |
| | CO4 | discuss the common characteristics, structure and reproduction of algae and fungi. | K3 |
| | CO5 | acquire knowledge on the classification and salient features of virus and protozoa. | K2 |

Mapping of COs with POs & PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBA22 | Statistics For Biology | | | |
|---------------------------|---|------------------------|---|---|---|
| Allied | II | L | T | P | C |
| | | 5 | - | - | 4 |
| Cognitive Level | K1: Recall K2: Understand K3: Apply | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the collection of data To learn measures of central tendency. To understand symmetry, correlation and regression. To realise tests of significance. | | | | |
| Unit I | Statistics Introduction: Statistics Definition. Collection and organization of data. Representation of data. Sampling and Sampling Design. Tabulation, Diagrammatic and graphical representation | | | | |
| Unit II | Measures of Central Tendency – Mean, Median, Mode. Measures of Dispersion – Range, Mean Deviation, Standard Deviation and Variance – Problems and explanation. Probability – Distribution – Binomial, Poisson and normal | | | | |
| Unit III | Measures of symmetry - Skewness; Kurtosis a brief explanation - Measures of Skewness and Kurtosis. (Problems not necessary). | | | | |
| Unit IV | Correlation and regression – Explanation – Types of correlation – Positive and negative correlation – Methods of studying Correlation using Karl Pearsons Coefficient of correlation (Simple problems related to correlation and regression). | | | | |
| Unit V | Hypothetical analysis: Tests of statistical significance – Analysis of Variance – Chi square test. | | | | |
| Textbook | 1. Statistical Methods. M.Manoharan. 23 rd Edition. Palani Paramount Publications. | | | | |
| References | 1. Gupta SP. Statistical Methods. 45 th Edition. Publisher - Sultan Chand & Sons; 2017. 2. Bhaskar Rai T. 2001. Methods of Biostatistics. 3. Bliss C.I.K. Statistics in Biology. Vol I. McGraw Hill, New York. 1967. 4. Campbell R.C. 1974. Statistics for Biologists, Cambridge University Press | | | | |
| E-references | 1. http://www.biostathandbook.com/HandbookBioStatThird.pdf | | | | |

COURSE OUTCOMES

| Course outcome | Upon completion of this course, the students will be able to | | |
|----------------|--|--|----|
| CO1 | learn and understand the collection, organization, Representation of data. | | K1 |
| CO2 | gain knowledge on measures of central tendency and Probability problem solving | | K2 |
| CO3 | understand the measures of symmetry and skewness, kurtosis | | K2 |
| CO4 | distinguish types of Correlation and regression | | K1 |
| CO5 | analyse and understand the analysis of variance and chi square test. | | K3 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | M | S | S |
| CO4 | S | M | S | M | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | S | M | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark



SEMESTER - III

| Course Code | U21MBT31 | | L | T | P | C |
|---------------------------|--|--|---|----------------|----|---|
| Core | V | | 5 | - | - | 4 |
| | Microbial Physiology | | | | | |
| Cognitive Level | K1: Recall | | | K2: Understand | | |
| Learning objective | <ul style="list-style-type: none"> To understand the components of physiology of microbes To understand the bacterial respiration and bacterial photosynthesis To acquire knowledge on microbial physiology and metabolism of biomolecules | | | | | |
| Unit I | Physiological metabolism and growth of microorganism: Microbial Physiology – Metabolism concepts – anabolism, catabolism. Physiology of bacterial growth conditions – different phases – growth measurements – differentiation of bacterial cell – Sporulation and Germination. Synthesis of bacterial cell wall – peptidoglycon and teichoic acid. | | | | | |
| Unit II | Bacterial respiration and photosynthesis – Anaerobic and aerobic respiration – Respiratory pathway in Nitrobacter group and Methanogens. Bacterial photosynthesis – Carbondioxide fixation. | | | | | |
| Unit III | Carbohydrate metabolism and ATP generation: Carbohydrates-classification-Pathways of carbohydrate utilization – Glycolysis, ED and HMP pathway, Krebs's cycle. ETC, Oxidative Phosphorylation and Substrate level phosphorylation – ATP generation and utilization – fermentation pathways of pyruvate. | | | | | |
| Unit IV | Protein and Lipid Metabolism - Structures of protein, Pathways in aminoacid biosynthesis and degradation- Fatty acid synthesis and degradation | | | | | |
| Unit V | Nucleic Acid metabolism - Forms of DNA, Organelle DNA (mitochondria and chloroplast) and types of RNA. Nucleotide biosynthesis and degradation. | | | | | |
| Textbook | 1. Moat, A.G. and Foster, W. Microbial Physiology, 4 th Edition, John Wiley and Sons, New York; 2002. | | | | | |
| References | <ol style="list-style-type: none"> Caldwell D.H. Microbial Physiology and Metabolism. 2nd Edition. Win C Brown publishers. 1995. ISBN-13 : 978-0898632088 Moat.A.G. & Foster.J.W. Microbial Physiology, 4th Edition John Wiley and Sons Inc. 1999. Stanier.R.Y, Ingharam.J.L., Wheelis.M.L, Painter.P.L. General Microbiology.5th Edition. Publisher: Macmillan, Hampshire & London. 1992. ISBN 13: 9780333417683 Brock T.D, Madigan M.T. Biology of Microorganisms. 15th Edition. Prentice Hall Inc. 2018. ISBN 9781292235103 Pelczar.M.J, Schan.E.C and Kreig.N.R. Microbiology – An application based approach. 7th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi; 2020. | | | | | |
| E-references | 1. https://www.biotecharticles.com/Biology-Article/The-Process-of-Bacterial-Photosynthesis-and-its-Importance-671.html . | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | |
| | CO1 | learn and understand the metabolism, growth conditions | | | K1 | |

| | | | |
|--|-----|--|----|
| | | of bacteria and its different phases of growth, sporulation and germination. | |
| | CO2 | gain knowledge on bacterial respiration and photosynthesis. | K2 |
| | CO3 | recognize the carbohydrates classification and understand fermentation pathways of pyruvate. | K2 |
| | CO4 | learn the pathways in amino acid biosynthesis, fatty acid synthesis and degradation and cell wall synthesis. | K1 |
| | CO5 | acquire knowledge on the structure of nucleic acids. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | M | S | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark

| Course Code | U21CHA33 | CHEMISTRY | | | |
|--------------------|--|-----------|----------------|---|---|
| Allied | III | L | T | P | C |
| | | 5 | - | - | 4 |
| Semester | Semester-III | Credits:4 | Hours/weeks: 5 | | |
| Cognitive Level | K1: Recall K2: Understand | | | | |
| Learning Objective | <ul style="list-style-type: none"> To understand the handling of chemicals and errors in chemical analysis To get knowledge in chemical bonding and hybridization To acquire knowledge in volumetric analysis To understand the basic concept of Biomolecules | | | | |
| Unit I | Handling of chemicals and Data analysis : a) Storage and handling of chemicals: Handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedure. b) Errors in chemical analysis: Accuracy, precision. Types of error-absolute and relative errors. Methods of eliminating and minimizing errors. c) Separation techniques–Solvent extraction. Principle of adsorption and partition chromatography, column chromatography, thin layer chromatography (TLC), paper chromatography and their applications. | | | | |
| Unit II | Chemical bonding : a) Ionic Bond: Nature of Ionic bond. Structure of NaCl, KCl and CsCl. Factors influencing the formation of ionic bond. b) Covalent Bond: Nature of covalent bond. Structure of CH ₄ , NH ₃ , H ₂ O based on hybridisation. c) Coordinate Bond: Nature of coordinate bond. Coordination complexes. Werner's theory. Geometrical and optical isomerism in square planar and octahedral complexes. Mention of structure and functions of chlorophyll and hemoglobin d) Hydrogen Bond: Theory and importance of hydrogen bonding. Types of hydrogen bonding. Hydrogen bonding in carboxylic acids, alcohol, amides, polyamides, DNA and RNA. e) van der Waal's forces: Dipole – dipole and dipole - induced dipole interactions. | | | | |
| Unit III | Volumetric analysis : a) Methods of expressing concentration: normality, molarity, molality, ppm. b) Primary and secondary standards: preparation of standard solutions c) Principle of volumetric analysis: end point and equivalence points. d) Strong and weak acids and bases - Ionic product of water , pH, pKa, pKb. Buffer solutions - pH of buffer solutions. Mention of Henderson equation & its significance. | | | | |
| Unit IV | Chemical Kinetics: a) Chemical Kinetics: Rate, rate law, order and molecularity. Derivation of rate expressions for I and II order reactions. b) Catalysis-Homogeneous and heterogeneous catalysis. Enzyme catalysis, enzymes in biological system and in industry. | | | | |

| | | | |
|-------------------------|--|--|----|
| Unit V | Chemistry of biomolecules : a) Fats – Occurrence and composition. Hydrolysis of fats. b) Vitamins – Source, provitamin, properties and classification. Structure and function of vitamin A, C, D, K and E c) Hormones – Thyroxin, adrenaline and sex hormones (structure and functions only) | | |
| Text Book | 1. R. Gopalan, S. Sundaram, <i>Allied Chemistry</i> , Sultan Chand and Sons, 1995. | | |
| Reference Books: | 1. U. Sathyanarayana, <i>Biochemistry</i> , Books and allied (p) Ltd, 1999. 2. B.R.Puri and L.R.Sharma, <i>Principles of physical chemistry</i> , Shoban Lal Nagin Chand and Co. 33rd ed., 1992. | | |
| Course Outcomes | Upon completion of this course, the students will be able to | | |
| | CO1 | gain the knowledge on the handling of chemicals and errors in chemical analysis, | K1 |
| | CO2 | learn Chemical Bonding and Hybridization | K1 |
| | CO3 | learn the calculations of preparing standard solutions | K1 |
| | CO4 | understand and appreciate the advanced concepts and rate equations in chemical kinetics. | K2 |
| | CO5 | learn the importance of Biomolecules in chemistry | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | M | S | S | S | S | S | S | S | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark

| Course Code | U21MBE311 | General Biology | | | |
|---------------------------|---|-----------------|---|---|---|
| Elective | I | L | T | P | C |
| | | 4 | - | - | 3 |
| Cognitive Level | K2: Understand K3: Apply | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the basis of plant classification To acquire knowledge about the different characteristics of plants. To learn the basics of human body and its organization To know in detail about the structure and function of organs in the human body | | | | |
| Unit I | Basis of Classification – Bentham and Artificial, Natural Classification of plants. Morphology, Structure and reproduction in plants. Algae: General characters – <i>Sargassum</i> as an example – Economic importance of Sea weeds. Fungi: General characters – Yeast as an example. | | | | |
| Unit II | Bryophytes: General characters – <i>Funaria</i> as an example - alternation of generation. Pteridophytes: General characters – <i>Selaginella</i> as an example. Gymnosperm: General characters – <i>Pinus</i> – Economic uses of gymnosperms. Angiosperms – Monocot flower – <i>Allium cepa</i> ; Dicot flower – <i>Tribulus terrestris</i> . | | | | |
| Unit III | Invertebrates – General Characters and classification of invertebrates' upto class level with examples- Paramecium, Filarial and <i>Ascaris</i> - Structure, reproduction and life cycle. | | | | |
| Unit IV | Vertebrates - General Characters and classification of vertebrates' upto class level with examples- Frog and pigeon structure and reproduction. | | | | |
| Unit V | Structure and Function of human system: Digestion: Organization, movement and secretions of gastrointestinal tract. Respiration: respiratory organs– morphology and respiratory pigments. Circulation: Blood – composition of blood - General organization of circulatory systems. Nervous system – CNS – Autonomic nervous system – Endocrine system in man. Excretion system – excretory organs – general organization in man – muscular system – ultra structure of voluntary muscle. | | | | |
| Textbook | 1. Renato.A, Delna Pena, J.R.Daniel, Gracilla Christian. General Biology.1 st ed. JFS Publishing services ; 2016.ISBN 13 978-6214150137. | | | | |
| References | <ol style="list-style-type: none"> A.C.Dutta. Botany for degree students .Revised ed.Oxford publisher; 1998. ISBN -13 978-0195637489. G.M.Smith. Cryptogamic Botany Volume I & II .Mc Graw Hill publisher ; 1955. W.T.Taylor and R.J.Wehe . General Biology .2 nd ed. Van Nost Reinhold publisher;1968.ISBN -13 978-0442084097. Narayanaswamy – Outlines of Botany General Biology – Cambridge Press | | | | |

| | | | |
|-----------------------|--|--|----|
| E-references | 1. https://www.researchgate.net/publication/316588265_general_biology | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | recognise the classification of plants, and importance of algae, fungi and plants. | K2 |
| | CO2 | understand the bryophytes and gymnosperms. | K2 |
| | CO3 | understand the classification, structure and function of invertebrate | K2 |
| | CO4 | empathize on structure and reproduction of vertebrate | K2 |
| | CO5 | describe the structure and function of various human systems | K3 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | S | S | M | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | S | S | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | M | S | S | M | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBE312 | Human Physiology | L | T | P | C |
|---------------------------|--|------------------|---|---|---|---|
| Elective | I | | 4 | - | - | 3 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To learn fundamentals of anatomical structures and physiology of body organs. To describe the structure and functions of the blood & blood vessels To understand how the nervous system controls the body parts. To understand the structure and functions liver and pancreas, respiratory organs, urinary System, endocrine System | | | | | |
| Unit I | General Anatomy; Digestion in the mouth, stomach and intestines. Movements of the intestine; Role of Liver and Pancreas – Structure and Functions. | | | | | |
| Unit II | Respiratory System: Structure of Respiratory organs; Sub – divisions of lung air; Chemistry of Respiration. Physiology of the Urinary System- Structure of kidney and nephron; Formation of urine, Skin – Structure and functions, Regulations of body temperature | | | | | |
| Unit III | Endocrine System – Structure and functions of thyroid, pituitary, parathyroid, adrenals, islets of langerhans of pancreas b) Reproductive System – anatomy of the male and female reproductive organs; menstrual cycle; mammary glands; Fertilisation; Development of Embryo; Pregnancy and parturition | | | | | |
| Unit IV | Nervous System: General classification of nervous system ; Structure of nerve cell and Spinal cord; Basic Knowledge of different parts of the brain – anatomy and functions of cerebrum, cerebellum and medulla oblongata. Structure and function of eye and ear; taste, smell and cutaneous sensations. | | | | | |
| Unit V | Blood: Composition and Functions of blood; White Blood Cells – Types and function; Red Blood Cells – Structure and functions; Haemoglobin –Structure and functions, Blood coagulation, Blood group – ABO, Rh. Structure of heart and blood vessels; Properties of cardiac muscle; cardiac cycle; origin and conduction of heart beat; measurement of arterial blood pressure. | | | | | |
| Textbook | 1. Chatterjee C.C .Human Physiology Volume II.13 th ed.CBS publishers; 2020. ISBN 13 978-9388902717 . | | | | | |
| References | 1. Sembulingam, K. Essentials of Medical Physiology. 8 th ed. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi; 2019.ISBN -13 978- 9352706921. 2. Best and Taylor. The Physiological Basis for Medical Practice. 13 th ed. Wolters kluwer India Pvt Ltd; 2011.ISBN -13 978-8184731927. | | | | | |
| E-references | 1. https://www.researchgate.net/publication/311934098_introduction_to_human_physiology | | | | | |
| Course | Upon completion of this course, the students will be able to | | | | | |

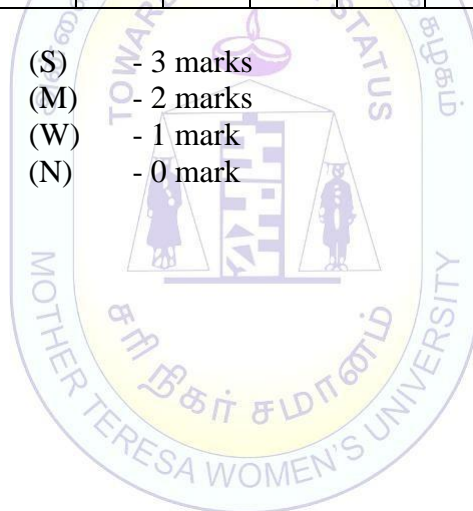
| outcome | | | |
|---------|---|----|--|
| CO1 | realise and understand the function of digestive system and the role of liver and pancreas. | K1 | |
| CO2 | acquire information on respiratory organs and its regulation. | K2 | |
| CO3 | recognise the importance of endocrine system. | K2 | |
| CO4 | understand the structure and function of nervous system. | K2 | |
| CO5 | empathize on composition and functions of blood. | K2 | |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | M | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | S | S |

Strongly Correlating
Moderately Correlating
Weakly Correlating
No Correlation

(S) - 3 marks
(M) - 2 marks
(W) - 1 mark
(N) - 0 mark



| Course Code | U21MBN31 | Applied Food Microbiology | L | T | P | C |
|---------------------------|---|---------------------------|---|---|---|---|
| NME | I | | 2 | - | - | 2 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To learn about the relationship of foods with microbes and its positive and negative roles in food processing, production and preservation in order to keep/ produce safe foods needed for a healthy society. To understand the method of food preservation techniques | | | | | |
| Unit I | Food fermentation :Food as a substrate for microorganisms - mold, yeast and bacteria - General characteristics and importance | | | | | |
| Unit II | Preservation of food: Principles of food preservation - Asepsis - Removal of microorganisms - Anaerobic conditions | | | | | |
| Unit III | Spoilage of food : Food spoilage - fruits - vegetables - meat - canned food - sources - control - spoilage problems | | | | | |
| Unit IV | Methods of Preservation: Preservation techniques - freezing and refrigeration - Heat - Vacuum packing - Addition of chemicals – Pasteurization | | | | | |
| Unit V | Intoxications of food: Food poisoning - Bacterial, viral, fungal, protozoa and other chemicals | | | | | |
| Textbook | <ol style="list-style-type: none"> Shakuntala Manay N and M. Shadaksharaswamy (2001) Foods – Facts and Principles, 2 nd edn, New Age International (P) Limited, Publishers, New Delhi. W. C. Frazier and D. C. Westhoff. 2003. Food Microbiology, 4th edition. | | | | | |
| References | <ol style="list-style-type: none"> Tripathy SN (2004) Food Biotechnology.1st edn, .Dominant Publishers and Distributors- New Delhi. Adams M. R and M. O. Moss (2003) Food Microbiology, 2nd edn, Panima Publishing Corporation, New Delhi. Paul P.C. and Palmer H.H. (1972) Food Theory and Applications, John Wiley and Sons, New York Jay. J.M (2010) Modern Food Microbiology CBS publishers Vijaya Ramesh K (2007) Food Microbiology MJP Publishers, Chennai | | | | | |

COURSE OUTCOME

| Course outcome | Upon completion of this course, the students will be able to | |
|----------------|--|--|
| | CO1 | outline the food fermentation techniques |
| CO2 | learn the preservation of food | K1 |
| CO3 | undersand the spoilage problems in the food | K2 |
| CO4 | gain knowledge on methods of preservation techniques | K2 |

| | | |
|-----|---------------------------------------|----|
| CO5 | have a knowledge on food intoxication | K2 |
|-----|---------------------------------------|----|

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | S | M | S | S | S | S | S | M | S | M | S |
| CO2 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | S | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | M | S |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark



SEMESTER - IV

| Course Code | U21MBT41 | Biochemistry | | | |
|---------------------------|---|--------------|---|---|---|
| Core | VI | L | T | P | C |
| | | 4 | - | - | 4 |
| Cognitive Level | K2: Understand K3: Apply | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the basic concepts of biomolecule structure and functions To learn about the concepts of enzymes and coenzymes To describe the most important functions of the cell, its microscopic structure and the structure and function of the different cell organelles, cell cycle and regulation To gain knowledge on cell structure, cell signalling and cellular function of biomolecules | | | | |
| Unit I | Cell structure: prokaryotic and eukaryotic (plant and animal cells – structural features – a brief comparative account). Plasma membrane – structure, models and functions. Protoplasm – chemistry and organization – microtubules and microfilaments. Structure and functions of eukaryotic cell organelles – plastid, mitochondria, lysosomes, ribosomes, nucleus, ER, golgi complex | | | | |
| Unit II | Cell cycle and regulation – Mitosis, Meiosis. Cell signalling, G- Proteins, Secondary messengers, signal transduction, hormones and receptors. Signalling pathways. | | | | |
| Unit III | Carbohydrates – Classification, Structure and biological functions of carbohydrates – mono, di and poly saccharides. Enzymes: Unit of activity, coenzymes and metal cofactors, temperature and pH effects, Michaelis-Menton kinetics, inhibitors and activators, active site and mechanism of enzyme action, Isoenzyme, allosteric enzyme. | | | | |
| Unit IV | Protein – Classification, structure and biological functions. Physical and chemical properties of aminoacids and polypeptides. Theoretical and experimental methods for determination of size of proteins. Physical nature of non-covalent interactions. Conformational properties of proteins, Ramachandran Plot, Secondary, Super Secondary, Tertiary and Quaternary structure of proteins. | | | | |
| Unit V | Lipid – Classification, structure and biological functions. Significance of sterols and steroids. Nucleic acid – Types, structure and biological functions. | | | | |
| Textbook | 1. Zeynep Gromley and Adam Gromley. Biochemistry, cell and molecular biology, and genetics . 1 st ed.Thieme Medical publishers ; 2021.ISBN 13 978-1626235359. | | | | |
| References | 1. Harvey Lodish. Molecular Cell Biology. 5 th ed.W.H.Freeman and Co Ltd 2003.ISBN 13 978-0716743668. 2. S.C Rastogi . Cell & Molecular Biology. 3 rd ed. New age Publishers; 2005 .ISBN 13 978-8122416886. 3. E.D.P De Robertis and E.M.F De Robertis. Cell & Molecular Biology.8 th ed.2017. ISBN 13 978- 8184734508. 4. P.S Verma & V.K Agarwal Cytology.Revised ed. Schand Publisher;1999.ISBN 13 978-8121908146. | | | | |
| E-references | 1. https://www.researchgate.net/publication/242096122_cell_biology_and_membrane_biochemistry | | | | |

| Course outcome | Upon completion of this course, the students will be able to | | |
|----------------|--|---|----|
| | CO1 | recognise and realise the structure and function of cell organelles. | K2 |
| | CO2 | analyse the cell structure and its function with understanding cell cycle and regulation. | K3 |
| | CO3 | understand the basic concepts of biomolecules. | K2 |
| | CO4 | accumulate knowledge on proteins and its conformational changes.. | K3 |
| | CO5 | acquire knowledge on lipid structure and function. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | M | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | S | M | S | S | S | M | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | M | S | S | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

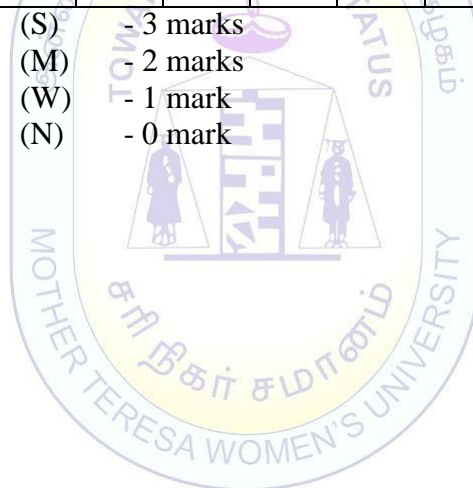
No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark



| Course Code | U21MBP42 | Practical in Biochemistry & Molecular Biology | L | T | P | C |
|--|--|---|---|---|---|----|
| Core | VII | | - | - | 4 | 4 |
| Cognitive Level | K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> To gain knowledge on microbial genetics through practical approach. To learn to perform molecular biology techniques To understand the principles and learn the bio chemical techniques of bacteria | | | | | |
| Experiments in Microbial Genetics & Molecular Biology | <ol style="list-style-type: none"> Preparation of buffers; phosphate and acetate buffer Qualitative test for Carbohydrates Qualitative test for lipids Qualitative test for amino acids and protein Separation of amino acids and sugars by thin layer chromatography or paper chromatography Biochemical tests for identification of bacteria IMViC test TSI test Catalase test Oxidase test Coagulase test Acid – gas production Starch & Protein hydrolysis Determination of growth phases of <i>E.coli</i> <ol style="list-style-type: none"> Calculation of generation time Relationship between OD and colony forming units Calculation of growth rate. | | | | | |
| Textbook | 1. Kallas, T. Experiments in Microbial Genetics. UW-Oshkosh; 2003. | | | | | |
| References | <ol style="list-style-type: none"> Cappuccino, G. James. and Natalie Sherman, Gram stain, Microbiology A Lab. Manual. 11th ed. Pearson publication ;2017. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks. Gram stain, Experimental Microbiology. Mosby – Year Book, Inc; 1990. HiMedia. Handbook of Microbiological Media. | | | | | |
| E-references | 1. https://microbiology.arizona.edu/sites/microbiology.arizona.edu/files/Lab%20Manual%20428L%202015%20copy.pdf | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | |
| | CO1 | realise and understand the importance of antibiotic resistance and lethal death by UV mutation. | | | | K2 |
| | CO2 | acquire information on auxotrophic mutant and transformation. | | | | K2 |
| | CO3 | recognise replica plating and gradient plating techniques. | | | | K2 |
| | CO4 | understand the growth phases of <i>E.coli</i> | | | | K2 |
| | CO5 | empathize on various biochemical techniques | | | | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | M | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | M | S | S | S | M | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



| Course Code | U21CHA44 | Chemistry Practical | | | |
|---------------------------|---|---|---|---|----|
| Allied | IV | L | T | P | C |
| | | - | - | 4 | 4 |
| Cognitive Level | K1: Recall K2: Understand | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand basics and gain knowledge on laboratory reagents and their uses in volumetric analysis. To enable the students to acquire knowledge in Organic Estimation To understand basics and gain knowledge in organic analysis | | | | |
| Experiments | <p>Acidimetry and alkalimetry: Titration acids used: hydrochloric acid, sulphuric Standard solutions prepared: sodium carbonate, sodium bicarbonate, oxalic acid.</p> <p>Oxidation and reduction titration: Oxidising agents: Potassium permanganate (permanganimetry) Reducing agents: Ferrous sulphate, ferrous ammonium Sulphate, oxalic acid</p> <p>Standard solutions prepared: Ferrous Sulphate, ferrous ammonium Sulphate and oxalic acid.</p> <p>Iodometry titrations: titrations of liberated iodine against sodium thiosulphate using acidified potassium permanganate, potassium dichromate and copper Sulphate solutions.</p> <p>Standard solutions: potassium dichromate, copper sulphate.</p> | | | | |
| Textbook | <ol style="list-style-type: none"> Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996. B.S. Furniss, A.J. Hannaford, P.W. G. Smith, A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry. 5th Edn., Pearson Education, 2005. | | | | |
| References | <ol style="list-style-type: none"> N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt., 1998. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004. | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | |
| | CO1 | learn the concept of Titration methods and various Titrations. | | | K1 |
| | CO2 | understand the Acidimetry and alkalimetry titrations | | | K2 |
| | CO3 | learn the preparation of standard solutions | | | K1 |
| | CO4 | learn the calculations of molarity, molality and normality of the solutions | | | K1 |
| | CO5 | understand the concept of Iodometry titrations | | | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | M | S | S | S | S | S | S | | S | S | M | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



| Course Title & Code | U21MBE421 | Plant Anatomy and Physiology | | | |
|---------------------------|---|------------------------------|---|---|---|
| Elective | II | L | T | P | C |
| | | 3 | - | - | 3 |
| Cognitive Level | K1: Recall K2: Understand K3: Apply | | | | |
| Learning objective | <ul style="list-style-type: none"> To develop skill to distinguish monocot and dicot plants To understand the structure of simple and complex tissues To learn the internal organization of different parts of plants To know the process of fertilization in plants | | | | |
| Unit I | Simple tissue: Structure, occurrence and function of Parenchyma, Collenchyma, Sclerenchyma. Complex tissues; Definition, Structure, Origin and function of Xylem & Phloem, Tracheary elements and Sieve elements. Secretory tissues, Types of Vascular bundles. | | | | |
| Unit II | Meristems: Classification, distribution, structure, function. Primary structure of monocot stem and root. Primary and secondary structure of dicot stem and root. Structure of Monocot and dicot leaves. Brief account on Nodal anatomy. Structure of mature anther and ovule. Embryo: types of embryogenesis in monocot and dicot embryos. | | | | |
| Unit III | Absorption of water and minerals: transpiration: types, mechanism of stomatal movement. Factors affecting transpiration. Gas exchange, guttation. Mineral nutrients: Role of macro elements (N, P, K, Mg, Ca) and micro elements (Zn, Mo, B). | | | | |
| Unit IV | Photosynthesis: Photophosphorylation. Calvin cycle (C ₃). Respiration: Aerobic and anaerobic respiration. Glycolysis, Krebs's cycle, electron transport system, oxidative phosphorylation. | | | | |
| Unit V | Nitrogen fixation: Biological nitrogen fixation; symbiotic and asymbiotic N ₂ fixation, symbionts, mechanism of biological N ₂ fixation. Physiological role of auxins, gibberellins, cytokinins, ethylene and abscissic acid. Phototropism and photoperiodism; Senescence. | | | | |
| Text books | <ol style="list-style-type: none"> Singh.V.Text Book of Botany: Anatomy and Embryology of Angiosperms .Rastogi Publication.2017. Pandey, B.P. Plant Anatomy. Chand & Co Ltd.2012. Singh,Pande and Jain.Text Book of Botany:Angiosperms, Rajpal and sons Publishing. 2010 Vashista, P.C.. A text Book of plant Anatomy, S.Negin & Co.2001. | | | | |
| Reference books | <ol style="list-style-type: none"> Dr. K. N. Dhumal, Dr. H. S. Patil , Dr. B. N. Zaware , Dr. B. P. Shinde /,Dr. K. S. Bhosale.A Book of Plant Anatomy & Embryology and Plant Biotechnology. Edition Paperback. Nirali Prakashan.2019. Bhojwani, S..S and Bhatnagar, S.P. The Embryology of Angiosperms,6th Edition Vikas Publishing House Pvt. Ltd., New Delhi. 2015. Vimala singh and Alok Abhisek, ,Plant Embryology and Experimental Biology, Educational Publishers and Distributors 291, Bank Enclave, Laxmi Nagar, Delhi – 2019 Esau, K. Plant Anatomy, Miley Eastern Private Limited. New Delhi.2006 | | | | |

| | | | |
|-----------------------|--|---|-----------|
| E-References | <ol style="list-style-type: none"> http://ndl.iitkgp.ac.in/document/aFR5ZURTaDRVRjdrSDdvdkhSRkVNbmJtOXNSYIJQNkpIa1dQUXJoR1ZMaz0 http://ndl.iitkgp.ac.in/document/ZMsMc3RMeFNtMDhVVk1vV2x1NTkMZjM4RmprYys5cHQrQ3hveDcyOHIRdz0 http://ndl.iitkgp.ac.in/document/MHdqSIQ2MDR4UXhKcDNQTXI0akFXdTdIY1ZuMMxER2tkV2VkreG5QTVTQTO http://ndl.iitkgp.ac.in/document/Sm0rdEpQN1Y1YU1UT0pEa3VvdktzY2xIUkM0MmFQVnlhbTQMV2V4Qjd0QTO | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | attain knowledge on different types and functions of simple and complex tissues | K2 |
| | CO2 | understand about meristems and internal structure of plant parts | K2 |
| | CO3 | acquire knowledge on transport of minerals and water | K1 |
| | CO4 | have clear knowledge on the photosynthesis and respiration | K2 |
| | CO5 | explain the nitrogen fixation process | K3 |

Mapping of COs With POs & PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | M | S | S | M | M | S | S | S | S | M | S |
| CO2 | S | S | M | S | S | S | S | S | S | S | S | M | S |
| CO3 | S | S | M | S | S | M | S | M | S | S | S | M | S |
| CO4 | S | S | M | S | S | S | S | M | S | S | S | M | S |
| CO5 | S | S | M | S | S | M | M | S | S | S | S | M | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBE422 | Plant Pathology | L | T | P | C |
|---------------------------|--|-----------------|---|---|---|---|
| Elective | II | | 3 | - | - | 3 |
| Cognitive Level | K1: Recall K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> To enrich the knowledge on Microorganisms To learn different types of bacteria and fungi and their nature To understand the pest management To know the control measures of plant diseases | | | | | |
| Unit I | Plant diseases: Classification of plant disease based on casual organisms such as Fungi, Bacteria, Viruses. Molecular basis of diagnosis, Microbial toxins. Bacterial diseases: Paddy blast and citrus canker | | | | | |
| Unit II | Fungi and fungal disease: Fungal diseases: Tikka disease of ground nut and red rot of sugarcane. Mechanism of infection and Dissemination of fungal diseases, Symptomology and Identification of fungal diseases. | | | | | |
| Unit III | Viruses and viral disease: Viral diseases -bunchy top of banana. Mechanism of Infection and Dissemination symptoms and Methods of Identification, Diseases caused, Symptoms, Method of infection. Diseases control methods (physical, chemical and biological) | | | | | |
| Unit IV | Introduction of Pests: General characters, Habitats, Damage, Economic Threshold Level, Natural enemies, Parasitoids and Predators. General description and morphology of the Insect | | | | | |
| Unit V | Biological control: Types of biocontrol agents. Techniques of biocontrol. Genetic control and area-wide management. | | | | | |
| Text books | <ol style="list-style-type: none"> Bauman, R. W. Microbiology: with diseases by body system 4th Edn. Pearson Education, Inc. 2015. Stanbury, P.F., Whitaker, A. & Hall, S.J. Principles of Fermentation Technology, Butterworth-Heinemann publications. 2016. Singh R.S. Introduction to Principles of Plant Pathology. 5th Edition. Medtech Publisher. 2017. Dube H.C. Modern Plant Pathology.3rd Edition, Agribios, New Delhi. 2014. Sharma, P. D, Plant Pathology. Rastogi Publishers New Delhi.2013. | | | | | |
| Reference books | <ol style="list-style-type: none"> Pommerville, J. C. Alcamo's Fundamentals of Microbiology, 11th Edition. Jones & Bartlett Learning. 2017. Madigan M. T., Bender K.S., Buckley D.H., Sattley W.M., & Stahl D.A. Brock Biology of Microorganisms. Pearson Education, Inc. 2017. Mehrotra R.S. Plant Pathology. 3rd Edition. McGraw Hill Education.2017. | | | | | |
| E-References | <ol style="list-style-type: none"> https://nptel.ac.in/courses/102/103/102103015/ https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf https://WWW.researchgate.net/publication/340660994_Plant_Pathology_at_a_Glance https://WWW.moscomm.org/pdf/Ananthanarayan%20microbio.pdf | | | | | |

| | | | |
|-----------------------|--|---|-----------|
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | have a knowledge on plant diseases | K1 |
| | CO2 | identify and describe the fungal diseases | K2 |
| | CO3 | know the mechanism of viral infection in plants | K2 |
| | CO4 | understand the pest management | K2 |
| | CO5 | gain knowledge on biological control | K3 |

Mapping of COs With POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | M | S | S | S | S | M | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | S | S | M | M | S | S | S | S | S |
| CO4 | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | M | S | S | M | S | M | S | S | S | M | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBN42 | Mushroom Cultivation | L | T | P | C |
|---------------------------|---|----------------------|--------------------------------|---|---|---|
| NME | II | | 2 | - | - | 2 |
| Cognitive Level | K1: Recall K3: Apply | | K2: Understand K4: Evaluate | | | |
| Learning objective | <ul style="list-style-type: none"> To provide the student with an understanding of preparation of mushroom. To evaluate the continuing roles played by mushroom in daily nutrition. | | | | | |
| Experiments | <ol style="list-style-type: none"> Mushroom – Nutritional value and Medicinal Values of Mushroom Life cycle of Mushroom Types of Mushroom – Edible and Poisonous Sterilization of substrate Fungal Nutritional habitat - Spawn preparation Casing and casing methods Cropping and harvesting. Mushroom disease and control measures | | | | | |
| Textbook | <ol style="list-style-type: none"> Nita Bahl - Handbook on Mushroom Science 2017 (4th Edition) ISBN 9788120413993 David. G. Spoerke and Barry H. Rumack - Handbook on Mushroom Poisoning (Diagnosis & Treatment) (1994) ISBN 0-8493-0194-7 Reeti singh, U.C.Singh - Modern Mushroom cultivation 2nd Edition (2011) ISBN(13): 978-81-7754-235-6 | | | | | |
| References | <ol style="list-style-type: none"> T.N. Kaul - Introduction to Mushroom Science (Systematics), (1997) Oxford ISBN-13:978-1886106956 K.R.Aneja - Experiment in Microbiology, Plant Pathology, Tissue culture | | | | | |

| | | | |
|-----------------------|--|---|----|
| | and Microbial Biotechnology, New age International publishers 2017 ISBN 81-224-1494-X 3. Stephen Russell - A complete guide to cultivating mushrooms (2014) ISBN 978-1-61212 | | |
| E-references | 1. http://nsdl.niscair.res.in/jspui/bitstream/123456789/599/1/mushroom%20cultivation%20-%20Formatted.pdf 2. https://en.wikipedia.org/wiki/Volvarella_volvacea 3. https://en.wikipedia.org/wiki/Shiitake 4. https://en.wikipedia.org/wiki/Pleurotus | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | Learn the importance of mushroom. | K1 |
| | CO2 | Know the types of mushroom. | K2 |
| | CO3 | Know the different aspects of mushroom preparation. | K2 |
| | CO4 | Acquire knowledge on spawn preparation. | K3 |
| | CO5 | Know the application of mushroom in the diet. | K2 |

Mapping of COs with POs & PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO4 | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | S | S | S | S | M | S | S | S | S |

Strongly Correlating
Moderately Correlating
Weakly Correlating
No Correlation

(S) - 3 marks
(M) - 2 marks
(W) - 1 mark
(N) - 0 mark

| Course Code | U21MBT51 | Agricultural & Environmental Microbiology | L | T | P | C |
|---------------------------|---|---|---|---|---|---|
| Core | VIII | | 5 | - | - | 4 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the isolation and determination of microorganisms in the environment; To gain knowledge on the role and relations of microorganisms to the environment To recognize factors influencing growth of microorganisms in the soil and the environment To understand the basic knowledge and techniques in agriculture and environmental microbiology | | | | | |
| Unit I | Microbial Interaction in Soil: Microbes in soil – Rhizosphere – Phyllosphere. Microbial Interaction – Symbiosis, Mutualism, Commensalism, Competition, Amensalism, Synergism and Parasitism. Plant microbe interaction. | | | | | |
| Unit II | Diseases caused by Bacteria, Fungi and Virus: Plant diseases caused by bacteria – <i>Xanthomonas</i> , <i>Mycoplasma</i> , <i>Spirodomas</i> . Fungi – <i>Pyricularia</i> , <i>Phytophthora</i> , <i>Fusarium</i> . Viruses – TMV, CMV. Viroids – mechanism of pathogen establishment and symptoms. Plant disease control measures. | | | | | |
| Unit III | Economic importance of agricultural microbes: Biofertilizers – preparation and application. Biological nitrogen fixation – mechanism of nitrogen fixation genes and regulation. Disease control – fungicide, bacterial disease control, insecticide, biopesticides, nematocide, herbicide and viral disease | | | | | |
| Unit IV | Environmental Microbiology introduction: Concepts -Soil Microbiology – microflora of soil and their role. Microbes in biogeochemical cycles – Carbon, Nitrogen, Phosphorus and Sulfur cycle. Biodegradation of xenobiotic – Bioaccumulation, Bio magnification, Biodegradation and Bioleaching. Air Microflora – Indoor and outdoor pollution. | | | | | |
| Unit V | Aquatic Microbiology: – zonation in lakes and ponds, ocean – Microbes in fresh and marine environment, Eutrophication — potability of water – microbial quality testing of water – water purification, water borne disease and preventive measures. Sewage water treatment – primary, secondary (Trickling filter and Activated Sludge process) and disinfection. Measurement of BOD & COD. Solid waste management using microbes (aerobic and anaerobic). | | | | | |
| Textbook | <ol style="list-style-type: none"> Ronald M. Atlas & Richard Bartha. Microbial Ecology, Fundamentals and application. 1998. N.S. Subba Rao .Soil Microorganisms and Plant growth.Science publishes ; 1999. ISBN 13 978-1578080700. N.S. Subba Rao . Biofertilizers in Agriculture and Forestry.4th ed.Medtech publisher; 2017.ISBN 13 978-9386800039 Chhatarpal Singh, Shashank Tiwari, Jay Shankar Singh,Ajar Nath Yadav. Microbes in Agriculture and Environmental Development. 1st ed.CRC | | | | | |

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|-----------------------|---|--|----|
| | Press ; 2020. ISBN 13 978-0367524135. | | |
| References | <ol style="list-style-type: none"> 1. Thomas D. Brock and M.T Madigan. Biology of Microorganisms.7th ed.Pearson Education ; 1993. ISBN 13 978-0130421692. 2. Alexander . Introduction to soil microorganisms and plant growth.2nd ed. John Wiley and sons; 1977. ISBN 13 978-0471021797. 3. Dasgupta M.K. Principles of Plant Pathology.Allied publishers; 1988. 4. George N. Agrios – Plant Pathology.5th ed.Academic press; 2005 . ISBN 13 978-0120445653. | | |
| E-references | 1. https://www.routledge.com/Microbiology-for-Sustainable-Agriculture-Soil-Health-and-Environmental/Verma/p/book/97817746 | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | realise and understand the importance of microbes in soil. | K1 |
| | CO2 | acquire information on plant diseases caused by bacteria and virus. | K2 |
| | CO3 | recognise and realise the economic importance of microbes as biofertilizer and as disease control agent. | K2 |
| | CO4 | understand the recognition of microbes in environment. | K2 |
| | CO5 | empathize microbiological knowledge in aquatics. | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | S | S | S | S | S | S | S | S |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark

| Course Code | U21MBT52 | Food Microbiology | L | T | P | C |
|---------------------------|--|-------------------|---|---|---|---|
| Core | IX | | 5 | - | - | 4 |
| Cognitive Level | K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the significance of food, its composition and microbes causing spoilage To understand the preservation procedures for different kinds of foods. To gain knowledge about fermented food products, food sanitation and regulatory bodies. | | | | | |
| Unit I | Food as a substrate for microorganisms: Microorganisms important in food Microbiology - bacteria, yeast, moulds, Factors influencing microbial growth in food, Contamination of foods, General principles underlying spoilage – chemical changes caused by microorganisms. | | | | | |
| Unit II | Contamination and Spoilage of different groups of Foods – Contamination and spoilage of Cereals and Cereal Products, Vegetables and fruits, Meat and Meat products, Eggs and Poultry, Fish, Canned Food. | | | | | |
| Unit III | Food borne diseases – Bacterial and Viral food borne diseases, food – borne important animal parasites, Mycotoxins, Indicators of food safety and Quality, Microbiological Criteria of foods and their significance, Role of microbes in fermented foods – beverages, Curd, Butter milk, Toddy foods and Traditional foods. | | | | | |
| Unit IV | Food Preservation – Physical Methods – Asepsis, drying, heat processing, Filtration, chilling and freezing, Radiation, Pasteurization, Desiccation, Anaerobiosis, Canning controlled Atmosphere. Chemical Preservatives – Salt, Sugar, Organic acid (Benzoic acid, Sorbic acid, Propionates, Acetic acid & Lactic acid), Nitrites, Nitrates, Sulphur dioxide, Ethylene dioxide, Propylene acid, Wood Smoker and Antibiotics. | | | | | |
| Unit V | Microbial fermentation –commercial production of fermented food products – yoghurt, cheese, pickles, bread, vinegar. Probiotics – concept and applications. Quality and safety assurance – food and diary industries, GMP, HACCP. | | | | | |
| Textbook | 1. Frazier WG and Westhoff Dc. Food Microbiology.5 th ed. Tata McGraw Hill Publishing Company; 2017.ISBN 13 978-1259062513. | | | | | |
| References | <ol style="list-style-type: none"> Adams M.R and Moss M.O. Food Microbiology. 4th ed. Royal Society of Chemistry Publication, Cambridge; 2015.ISBN 13 978-1849739603. Banwart GJ. Basic Food Microbiology.2nd ed. CBS publisher ;2004.ISBN 13 978-8123906461. Hobbs BC and Robert SD. Food Poisoning and Food Hygiene.7th ed.Hodder Arnold publisher; 2007.ISBN 13 978-0340905302. Robinson R.K. Dairy Microbiology.3rd ed.Wiley Interscience publisher ; 2002. ISBN 13 978-0471385967. Tortora GJ, Funke BR, and Case CL. Microbiology: An Introduction . 12 th edition . Pearson Education; 2008. ISBN 13 978- 0321929150. Jay JM, Loessner MJ and Golden DA. Modern Food Microbiology . 7 th edition. CBS Publishers and Distributors, Delhi, India; | | | | | |

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|-----------------------|--|--|----|
| | 2006.ISBN 13 978-0387231808. 7. Lund BM, Baird Parker AC, and Gould GW. The Microbiological Safety and Quality of Foods . Vol. 1-2. 20 th ed. Springer publication; 1999.ISBN 13 978-0834213234. | | |
| E-references | 1. http://nuristianah.lecture.ub.ac.id/files/2014/09/fundamental-food-microbiology.pdf | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | acquire knowledge on food and microbial interaction. | K2 |
| | CO2 | realise the facts of contamination and spoilage in food products.. | K2 |
| | CO3 | analyse and understand the basis of food borne diseases. | K3 |
| | CO4 | acquire knowledge on various food preservation methods. | K2 |
| | CO5 | identify and observe the various fermented food products using microbial source. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | M | S | M | S |
| CO2 | S | S | S | S | S | S | M | S | S | S | S | M | S |
| CO3 | S | S | S | M | S | S | S | S | S | S | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBT53 | General Virology | | | |
|---------------------------|---|--------------------|---|-------------------------|---|
| Core | X | L | T | P | C |
| | | 5 | - | - | 4 |
| Semester | Semester V | Credits : 4 | | Hours / Week : 5 | |
| Cognitive Level | K2: Understand K3: Apply | | | | |
| Learning objective | <ul style="list-style-type: none"> To know the basic concepts of viral structure, classification, gene expression and transmission. To understand the mechanisms involved in viral pathogenesis To know the relationships among viruses, between individual viruses and their hosts and those among viruses and subviral pathogens To describe general virus life cycle, predict replication strategy of viruses based on genome composition | | | | |
| Unit I | History and structure of Virus: Brief outline on discoveries of viruses. General structure of bacterial viruses – Helical, Icosahedral, Filamentous capsids, Nucleic acid types – envelopes & enzymes – Cultivation, purification and assay methods. | | | | |
| Unit II | Bacteriophages – General characteristics and Reproduction of Bacteriophages - Lytic and Lysogenic cycle. Life cycle of M13, P1, T4 and Lambda phage – One step growth – application of phages in bacterial genetics. | | | | |
| Unit III | Plant viruses: Structure and life cycle of TMV and CMV. Viroids, Virusoids, Satellite virus, Prions. Viruses of algae and fungi. | | | | |
| Unit IV | Animal viruses – Structure and life cycle of Rhabdo, Pox, Influenza, Herpes, Adeno, Hepatitis, Retro – HIV and Polio viruses, Coronaviridae-corona virus | | | | |
| Unit V | Prevention of Viral Disease: Viral infection and control - Etiology, Pathogenesis, symptoms, treatment and prophylaxis. Vaccines – Types of Viral vaccines – Interferons – types and mechanism of antiviral drugs. | | | | |
| Textbook | 1. Jane Flint, Vincent R. Racaniello, Glenn F. Rall, Theodora Hatziioannou. Principles of virology. volume 1.4 th ed. ASM Press ; 2020.ISBN 13 978-1555819514. | | | | |
| References | <ol style="list-style-type: none"> S.E.Luria. GeneralVirology. 3rd ed.John Wiley and sons;1978.ISBN 13 978-0471032878. Brock T.D Madigan M.T. Biology of Microorganisms.13th ed. Benjamin cummings pub co; 2010. ISBN 13 978-0321649638. Pelczar M.J., Chan E.C.S., Kreig N.R. Microbiology.5th ed. McGraw Hill; 2001. ISBN 13 978-0074623206. Morag C and Timbury MC. Medical Virology.11th ed. Churchill Livingston, London; 1997. ISBN 13 978-0443058455. Bernard N.Fields, David M.Knipe . Fundamentals of Virology. 2nd ed .Lippincott Williams and Wilkins; 1990. ISBN 13 978-0881676839. | | | | |
| E-references | 1. http://www.columbia.edu/itc/hs/medical/pathophys/id/2008/viralstructureNotes.pdf | | | | |

| | | | |
|-----------------------|--|---|----|
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | understand the basic structure of virus and its cultivation methods | K2 |
| | CO2 | analyse bacteriophages and understand its life cycle. | K3 |
| | CO3 | accumulate knowledge on plant virus. | K2 |
| | CO4 | realise the structure and lifecycle of animal virus. | K2 |
| | CO5 | understand about the viral diseases and its treatment | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | M | S | S | S |

Strongly Correlating
Moderately Correlating
Weakly Correlating
No Correlation

(S) - 3 marks
(M) - 2 marks
(W) - 1 mark
(N) - 0 mark

| Course Code | U21MBT54 | Bioinstrumentation | | | |
|---------------------------|--|--|---|---|----|
| Core | XI | L | T | P | C |
| | | 5 | - | - | 4 |
| Cognitive Level | K2: Understand K3: Apply | | | | |
| Learning objective | <ul style="list-style-type: none"> To know the fundamental principles and applications of basic instruments in biology To learn the types of electrophoresis and spectroscopy To understand, design and evaluate systems and devices that can measure, test and/or acquire biological information To apply advanced control theory to practical research problems. | | | | |
| Unit I | Microscopy – parts and their function, resolving power, aperture – simple, compound, light and dark field, fluorescent, phase contrast and electron microscopes– their applications. | | | | |
| Unit II | pH meter – buffers and standardization, and its applications. Colorimetry: components and their functions - Beer Lambert’s Law. Spectroscopy –NMR, IR, UV-Vis – principles and applications | | | | |
| Unit III | Chromatography techniques – Principles and types – paper, TLC, HPTLC, Column, GC, GC-MS and HPLC | | | | |
| Unit IV | Centrifugation techniques – principle, types and uses of centrifuges, separation methods. Ultracentrifugation – applications | | | | |
| Unit V | Electrophoretic techniques – principle, electrophoresis of proteins and nucleic acids. Capillary electrophoresis, Pulse field electrophoresis and 2 D gel electrophoresis | | | | |
| Textbook | 1. Alexander.J Ninfa. Fundamental Laboratory & Approach for Biochemistry & Biotechnology.2 nd ed.Wiley publisher;2009.ISBN - 13 978-0470087664 | | | | |
| References | 1. Keith Wilson and John Wilson. Practical Biochemistry. 7 th ed.Cambridge university press;2010.ISBN -13 978-0521516358. 2. Palanivelu.P. Analytical Biochemistry & Separation Techniques.6 th ed. Twenty first century publications;2000.ISBN -13 978-8190848909. 3. Alexander.J Ninfa . Fundamental Laboratory & Approach for Biochemistry & Biotechnology.2 nd ed.Wiley publisher;2009.ISBN - 13 978-0470087664. | | | | |
| E-references | 1. https://application.wiley-vch.de/books/sample/3527338802_c01.pdf | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | |
| | CO1 | expertise in the fundamentals of microscope and its working principle. | | | K2 |
| | CO2 | realise the use of calorimetry and spectroscopy. | | | K2 |
| | CO3 | recognise the importance of chromatographic techniques.. | | | K2 |
| | CO4 | acquire knowledge on centrifuge and its types. | | | K2 |
| | CO5 | empathize on electrophoretic techniques. | | | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | S | S | S | M | S | S | S | S | M | S | S |
| CO2 | S | S | S | S | S | S | M | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | S | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | M | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



| Course Code | U21MBP55 | Practical in Agricultural & Environmental Microbiology, Food Microbiology and Virology | L | T | P | C |
|---|--|--|-----------|---|---|----|
| Core | XII | | - | - | 5 | 4 |
| Cognitive Level | K2: Understand | | K3: Apply | | | |
| Learning objective | <ul style="list-style-type: none"> To train the students to know generation of microbial population in fruit juices and meat. To learn the technique to test milk quality To be trained in water analysis – sewage and drinking water in laboratory To develop skill in isolation, identification and enumeration of microbes | | | | | |
| Experiments in Agricultural & Environmental Microbiology | <ol style="list-style-type: none"> Isolation of <i>Rhizobium</i> Demonstration of Mycorrhizae in infected plant roots Cultivation of <i>Pleurotus sojar caju</i> Microbial quality of water – MPN & BOD | | | | | |
| Experiments in Food Microbiology | <ol style="list-style-type: none"> Enumeration of total microbial population in fruit juices, soft drinks, ice cream, pickles and meat. Milk quality testing – dye reduction test Preparation of yogurt, citric acid, wine | | | | | |
| Experiments in Virology | <ol style="list-style-type: none"> Determination of phage titre in a given stock Clear plaque observation | | | | | |
| Textbook | <ol style="list-style-type: none"> James G. Cappuccino and Natalie Sherman. Microbiology. 10th edition. The Benjamin/Cummings pub.co. California; 1996.ISBN 13 978-0321840226. Rajan S and Selvi Christy R. Experiments in Microbiology. Anjana Books House, Chennai; 2015. | | | | | |
| References | <ol style="list-style-type: none"> K.R Aneja. Experiment in Microbiology, Plant Pathology Tissue Culture and Mushroom Cultivation.5th ed. New Age International Ltd; 2017. ISBN 13 978-9386418302. Cappuccino, G. James. and Natalie Sherman. Microbiology A Lab. Manual.10th ed.Pearson Benjamin Cummings publisher; 2013. ISBN 13 978-0321840226. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks. Gram stain, Experimental Microbiology.Mosby – year Book ,Inc; 1990. Handbook of Microbiological Media – HiMedia. | | | | | |
| E-references | 1. https://www.alibris.com | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | |
| | CO1 | recognise the importance of water analysis and its treatment. | | | | K2 |
| | CO2 | understand and analyse the microbial population in various foods. | | | | K2 |
| | CO3 | identify and develop methods for the production of biofertilizer. | | | | K2 |
| | CO4 | understand and observe the growth of mushroom and mycorrhizae. | | | | K2 |
| | CO5 | acquire knowledge on clear plaque isolation and observation. | | | | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | S | M | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | M | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | M | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | M | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



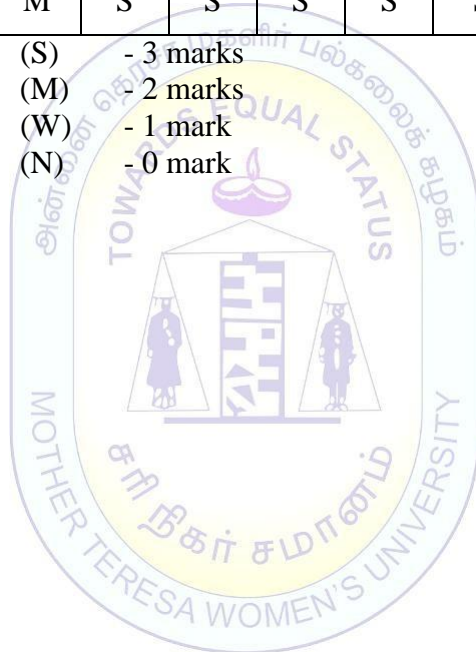
| Course Code | U21MBE531 | Nutritional Biochemistry | | | |
|---------------------------|--|---|---|---|----|
| Elective | III | L | T | P | C |
| | | 3 | - | - | 3 |
| Cognitive Level | K1: Recall K2: Understand | | | | |
| Learning objective | <ul style="list-style-type: none"> To explain mechanisms of digestion and absorption. To learn the factors influencing bioavailability of nutrients To describe the biochemical and physiological functions of the nutrient To explain the mechanisms of nutrient homeostasis in the body. To attain knowledge in Physiological role and nutritional significance of carbohydrates, lipids, vitamins | | | | |
| Unit I | Food and its nutrition: Introduction and definition of food and nutrition. Basic food groups; Basic concepts of energy expenditure, unit of energy, measurements of food Stuffs by bomb calorimeter | | | | |
| Unit II | Value of Nutrition: Nutritive value of proteins; essential amino acids. Single cell proteins. Protein malnutrition and under nutrition, their preventive and curative measures. | | | | |
| Unit III | Hyperglycemia & hypoglycemia - Diabetes mellitus - definition, types, features, gestation diabetes mellitus, glucose tolerance test, glycosurias, Hypoglycemia & its causes | | | | |
| Unit IV | Balanced diet: Composition of balanced diet and RDA for infants, children, adolescent, adult male and female, pregnant lactating woman and old age. | | | | |
| Unit V | Significance of nutrients: Physiological role and nutritional significance of carbohydrates, lipids, vitamins (water and fat soluble) and minerals. | | | | |
| Textbook | <ol style="list-style-type: none"> Victor Rodwell, David Bender, & Kathleen Botham. Harper's Illustrated Biochemistry. 31st Edition. McGraw-Hill Education; 2018. Dr. M Swaminathan. Text Book On Food & Nutrition. The Bangalore Press. | | | | |
| References | <ol style="list-style-type: none"> B. R. Mackenna & Robin Callander. Illustrated Physiology. 6th Edition. Churchill Livingstone; 1996. White, Abraham; Handler, Philip; Smith, Emil L. Principles of biochemistry. 3rd Edition McGraw - Hill; 1964. John E. Hall . Guyton and Hall Textbook of Medical Physiology. 13th Edition. Saunders; 2015. | | | | |
| E-references | <ol style="list-style-type: none"> https://www.otsuka.co.jp/en/nutraceutical/about/nutrition/functions/ https://www1.health.gov.au/internet/publications/publishing.nsf/Content/canteen-mgr-tr1~nutrients#:~:text=Nutrients%20are%20compounds%20in%20foods,%20Vitamins%20Minerals%20Water. | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | |
| | CO1 | gather information on food and its nutrition. | | | K1 |
| | CO2 | know the nutrients value and its importance in prevention of disease. | | | K1 |
| | CO3 | acquire knowledge on diabetes mellitus and its effect in our | | | K2 |

| | | | |
|--|-----|---|----|
| | | body. | |
| | CO4 | recognise the importance of balanced diet. | K2 |
| | CO5 | realise the facts behind the significance of nutrients. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | M | S |
| CO3 | S | S | M | S | S | S | S | S | S | M | S | S | M |
| CO4 | S | M | S | M | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



| Course Code | U21MBE532 | Developmental Biology | | | |
|---------------------------|--|-----------------------|---|---|---|
| Elective | III | L | T | P | C |
| | | 3 | - | - | 3 |
| Cognitive Level | K1: Recall K2: Understand | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the mechanisms of development from genes to the formation of an organism. To understand how evolutionary processes have shaped life in its varied forms. To explore selected areas of developmental biology in depth. To apply concepts in developmental biology to your development as a biologist. | | | | |
| Unit I | Gametogenesis: Definition-primordial germ cells-origin-spermatogenesis-physiological ripening of sperm- oogenesis- previtellogenesis- vitellogenesis. | | | | |
| Unit II | Embryo development –Egg size, shape, egg membranes,tertiary membranes,organization of the egg yolk, pigments, egg cortex, polarity, origin of polarity, types of eggs. Cleavage-Definition, morula, blastula, types of blastula, molecular changes, planes of cleavages, types of cleavage, factors affecting cleavage, cleavage laws, adhesion of blastomeres during cleavage, nuclei of cleaving cells, cytoplasm of cleaving cells. | | | | |
| Unit III | Gastrulation: Definition, exogastrulation, metabolism and molecular changes during gastrulation, gene activities during gastrulation. Morphogenic movements- Definition, types epiboly, emboly mechanism of morphogenic movements | | | | |
| Unit IV | Organogenesis: Definition, tabulation, neurogenesis, spermatogenesis, growth and differentiation derivatives of ectoderm and mesoderm. | | | | |
| Unit V | Regeneration: Definition – Types, Human Reproduction puberty, Menstrual cycle. Menopause, Pregnancy and related problems parturition and lactation. | | | | |
| Textbook | 1. Scott Gilbert. Developmental Biology. 11 th ed.Sinauer Associates Inc; 2016. ISBN 13 978-1605356044. | | | | |
| References | <ol style="list-style-type: none"> Verma.S and Agarwal V.K. Chordate Embryology.1st ed. S.Chand & Co. New Delhi; 2010.ISBN -13 978-8121902618. Berrill.N.J. Developmental Biology .Mc.Graw Hill, New Delhi;1971.ISBN -13 978-0070050204. Patten, B.M. Foundations of Embryology.6th ed. Mc.Graw Hill, New Delhi; 2014. ISBN -13 978-9339205348. Saunders.J.W. Developmental Biology – Pattern and Principles.Macmillan New York; 1982. ISBN -13 978-0024063700. Principles of Embryology Waddington. . Principles of Embryology. 2021.ISBN -13 9781138956995. | | | | |
| E-references | 1. https://www.e-libraryme.com/2019/12/developmental-biology.html | | | | |
| Course | Upon completion of this course, the students will be able to | | | | |

| outcome | | | |
|---------|-----|---|----|
| | CO1 | gather knowledge on gametogenesis. | K1 |
| | CO2 | acquire information on egg and cleavage. | K2 |
| | CO3 | recognise the importance of gastrulation. | K2 |
| | CO4 | understand the process of oranogenesis. | K2 |
| | CO5 | empathize on regeneration and human reproduction. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | M | S | S | S | S | M | S | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

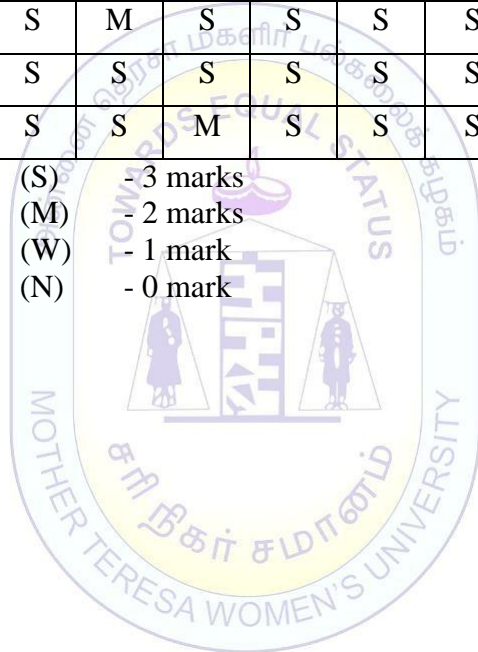
No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark



| Course Code | U21MBS531 | Medical Lab Technology | L | T | P | C |
|--------------------|---|------------------------|---|---|---|---|
| SBE | III | | 2 | - | - | 2 |
| Cognitive Level | K1: Recall K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand laboratory investigations relating to diagnosis, treatment and prevention of disease. To analyze body fluids, tissues, blood typing, microorganism screening, chemical analyses and cell counts of human body for the diseased. To perform technique such as collecting information, sampling, testing, reporting, documenting and maintaining confidentially of the medical investigations To acquire knowledge and practical skills of laboratory investigation analysis of all biochemical and microbiological diagnosis and documenting the investigated results | | | | | |
| Unit I | Body Systems: Structure and Functions of body Systems & their Function Tests - Digestive System - Respiratory System - Circulatory System - Central Nervous System - Urinary System- Endocrine System | | | | | |
| Unit II | Haematology: Blood – Constituents, Normal and Abnormal RBC, WBC and Platelets, Bleeding and Clotting Mechanism. Haemoglobin - Structures, Synthesis and Degradation, Anaemia – Classification and Clinical Features, Leukaemia – Types and Classification Histopathology – Fixation, Tissue Preparation and Processing, Infiltration, Impregnation, Embedding, Sectioning, Mounting and Staining (H & E, PAP, PAS, AFB), Cytopathology - Cytology of Fluids and Cervical Cytology | | | | | |
| Unit III | Serology and Blood Banking: Principles of Serodiagnostic Tests- Collection and Processing of Blood for Transfusion - Routine Laboratory Procedures in Blood Bank - Transfusion Reactions and Haemolytic Disease of Newborn | | | | | |
| Unit IV | Lab Principles and Procedures: Organization of the Clinical Laboratory and Role of Laboratory Technicians, Clinical Laboratory Records – Reporting and Recording procedures, Ethics of Laboratory Confidentiality and logical aspects of Record keeping, Laboratory Safety, Common Lab Accidents, Prevention and First Aid, Quality Control of Laboratory Findings | | | | | |
| Unit V | Clinical Microbiology: Bacteriology - Morphology, Pathogenesis and laboratory diagnosis of <i>Staphylococci</i> , <i>Streptococci</i> , <i>Bacillus</i> , <i>Anthrax</i> , <i>Corynebacterium</i> , <i>Clostridium tetani</i> , <i>Mycobacterium</i> , <i>E. coli</i> , <i>Salmonella</i> , <i>Shigella</i> , <i>Pseudomonas</i> , <i>Vibrio cholera</i> . Parasitology - Morphology, Pathogenesis and laboratory diagnosis of Protozoa, <i>E. histolytica</i> , <i>Plasmodium</i> , <i>Giardia</i> , <i>Platyhelminths</i> , <i>Taeniasolium</i> , <i>Nematihelminthes</i> , <i>Ascaris</i> .. Mycology -Classification, superficial mycosis, Dermatophytes, <i>Aspergillus</i> . | | | | | |
| Textbook | 1. Praful B. Godkar and Darshan p. Godkar. Textbook of Medical laboratory technology. 3 rd ed. Bhalani publishing house; 2020. ISBN 13 978-9381496190. 2. Text book of Medical Biochemistry - M.N. Chatterjee Rana Shinde. | | | | | |

| | | | |
|-----------------------|---|---|----|
| | Text book of Medical Biochemistry.8 th ed.JPB publisher; 2012. ISBN 13 978-9350254844. | | |
| References | <ol style="list-style-type: none"> 1. Ronald A. Sachner. Widmann's Clinical interpretation of laboratory tests 10th edition . 2. Kanai Mukherjee. Medical Laboratory technology Volume I – III .3rd ed.McGraw Hill Education;2017.ISBN -13 978-9352606801. 3. Alan H. Gowenlock. Varley's Clinical Biochemistry.Cbs publisher;2002.ISBN -13 978-8123904276. 4. Dr. C.C. Chatterjee. Human physiology Volume II.11th ed. Cbs publishers; 5. Histology - Ray C. Henrikson. Histology.1st ed.Lippincott Williams and Wilkins publishers;1997.ISBN -13 978-0683230246. | | |
| E-references | 1. https://idp.my.vccs.edu/authenticationendpoint.com | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | analyse , realise and understand the working of human body | K3 |
| | CO2 | gather information regarding blood sample and tissue sample methods | K2 |
| | CO3 | accumulate knowledge on serology & blood banking | K2 |
| | CO4 | understand how to write the reports and maintain the records | K2 |
| | CO5 | gain knowledge about the microbial disease and its diagnosis | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | S | M | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBS532 | Clinical Biochemistry & Metabolic Disorders | | L | T | P | C |
|---------------------------|---|---|--|---|---|---|----|
| SBE | III | | | 2 | - | - | 2 |
| Cognitive Level | K1: Recall K2: Understand | | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the lifestyle disease due to imbalance To know the fundamental principles and disease causing by hormonal imbalance and nutritional deficiency | | | | | | |
| Unit I | Inborn errors of metabolism - Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders | | | | | | |
| Unit II | Nutritional deficiency based diseases -Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease. | | | | | | |
| Unit III | Lifestyles disease -Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD). | | | | | | |
| Unit IV | Hormonal Imbalances - Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism. | | | | | | |
| Unit V | Diseases caused due to misfolded proteins - Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalassemia. | | | | | | |
| Textbook | 1. Devlin, T.M. Textbook of Biochemistry with Clinical Correlations. 7 th ed. John Wiley & Sons, Inc; (New York); 2010. ISBN: 978 – 0470281734. | | | | | | |
| References | 1. Coico, R and Sunshine, G. Immunology. 6th ed .John Wiley& sons, Inc (New Jersey); 2009. ISBN: 978-0-470-08158-7 2. Berg, J.M., Tymoczko, J.L. and Stryer, L. Biochemistry. 7th ed. W.H Freeman and Company (New York); 2012 . ISBN: 13:978-1-4292-7635-1. 3. Snustad D.P. and Simmons.Genetics.6 th ed. M.J., John Wiley & Sons (Singapore); 2012. ISBN: 978-1-118-09242-2. | | | | | | |
| E-references | 1. https://en.wikipedia.org/wiki/Hormone | | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | | |
| | CO1 | realise and understand the inborn errors of metabolism. | | | | | K1 |
| | CO2 | acquire information on nutritionally deficiency disease and its importance. | | | | | K2 |
| | CO3 | recognise the importance of diet in lifestyle disease. | | | | | K2 |
| | CO4 | understand the disorders related to hormonal imbalance. | | | | | K2 |
| | CO5 | empathize on genetics in disease and its inheritance. | | | | | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | S | M | S | S | S | S | S | S | M | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | M | S | S | S | S | S | S | S | S | S | S | S | M |
| CO4 | S | S | S | S | S | S | M | S | M | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | S | S |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark



| Course Code | U21MBT61 | Medical Microbiology | L | T | P | C |
|---------------------------|---|----------------------|---|---|---|---|
| Core | XIII | | 4 | - | - | 4 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the basic principles of medical microbiology and infectious disease. To gain knowledge on the relevant clinical examples of bacterial, viral, fungal, and parasitic pathogens and the diseases they cause. To understand pathogenic microorganisms and the mechanisms by which they cause disease in the human body. To develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases. | | | | | |
| Unit I | Medical Microbiology: Introduction, Normal flora of the human, Nosocomial Infection. General approach to clinical specimen – collection and transport, microbiological examination, transport media for isolation. General principle – isolation techniques involved for anaerobic bacteria. | | | | | |
| Unit II | Medical Bacteriology: Morphology, infection, pathogenesis, laboratory diagnosis, treatment and prophylaxis of bacterial diseases - Staphylococci, <i>Bacillus anthrax</i> , <i>Corynebacterium</i> , <i>Clostridium</i> , <i>Streptococci</i> , <i>Mycobacterium</i> , <i>E.coli</i> , <i>Salmonella</i> , <i>Shigella</i> , <i>Pseudomonas</i> , and <i>Vibrio cholerae</i> . | | | | | |
| Unit III | Medical Mycology: Morphology, infection, pathogenesis, laboratory diagnosis, treatment and prophylaxis of fungal diseases - superficial mycosis - <i>Dermatophytes</i> , <i>rhinosporidiosis</i> , <i>Candidiosis</i> and <i>Aspergillosis</i> . Medical Virology - Morphology, infection, pathogenesis, laboratory diagnosis, treatment and prophylaxis of viral diseases – Polio, Rabies, Dengue, AIDS, Influenza, Japanese encephalitis. | | | | | |
| Unit IV | Medical Parasitology: Morphology, infection, pathogenesis, laboratory diagnosis, treatment and prophylaxis of parasitic infections - <i>E.histolytica</i> , <i>Plasmodium</i> (life cycle), <i>Giardia</i> , <i>Taenia solium</i> , <i>Ascaris</i> | | | | | |
| Unit V | Antimicrobial chemotherapy: Development of chemotherapy – general characteristics of antimicrobial activity – mechanism of action of antimicrobial drugs – sulfonamides and sulfa drugs – penicillin, cephalosporin and tetracycline – factors influencing the effectiveness of antimicrobial drugs- Drug resistance: mechanism of drug resistance – the origin and transmission of drug resistance – MIC and MLC – Antimicrobial susceptibility testing – tube and agar dilutions – disc diffusion tests – Antiparasitic drugs – mechanism and action., | | | | | |
| Textbook | 1. Ananthanarayan R and Paniker C.K.J. Textbook of Microbiology. 11th edition. University Press Publication; 2020. | | | | | |
| References | 1. Chatterjee K.D. Parasitology and Helminthology. 13 th ed.CBS Publishers and Distributers PVT LTD ; 2017.ISBN -13 978-8123918105. 2. Jawetz and Melnick and Adelbergs. Review of medical Microbiology.28 th ed.MCGraw –Hill Education;2019.ISBN -13 9781260012026. | | | | | |

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|-----------------------|--|--|----|
| E-references | 1. https://www.pdfdrive.com/medical-microbiology-e18737002.html | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | acquire knowledge in the field of medical microbiology. | K1 |
| | CO2 | gain information and knowledge on bacteriology. | K2 |
| | CO3 | recognise the importance of mycology and viral diseases. | K2 |
| | CO4 | understand the basis of medical parasitology. | K2 |
| | CO5 | empathize on chemotherapy and its action. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | S | M | S |
| CO3 | S | S | S | S | M | S | S | S | S | M | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | M | S | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

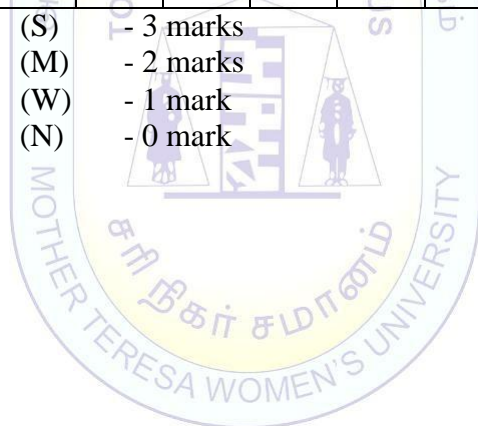
No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark



| Course Code | U21MBT62 | Industrial Microbiology | L | T | P | C |
|---------------------------|---|-------------------------|---|---|---|---|
| Core | XIV | | 5 | - | - | 4 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the isolation, screening and strain improvement of industrially important microorganisms To understand the concepts and principles of fermentation processes media for industrial fermentation, sterilization, inoculum preparation. To attain knowledge in applications of industrial microbes and Microbial products To know that microorganisms are important in the production of many useful products | | | | | |
| Unit I | Industrially important microbes and fermentation media – Isolation, screening of microorganism and strain development strategies. Inoculum development - fermentation media, raw material used in media production, antifoaming agents, buffers. Immobilization. | | | | | |
| Unit II | Industrial Fermentation – Types of fermentation and its uses - single, batch, continuous, multiple, surface, submerged and solid state. Fermentor - design, types of Fermentors. Sterilization of fermentation media. Upstream and down stream processing. | | | | | |
| Unit III | Industrial alcoholic beverages, biofuel and enzymes production – production of beer and wine. Biofuels - ethanol, methane. Biogas, MFC (Microbial Fuel Cells) – Principle and applications. Production of Enzymes (amylase, protease & lipase). | | | | | |
| Unit IV | Organic acid and amino acid production: Industrial production of organic acids (citric acid & acetic acid); amino acids (glutamic acid & lysine); vitamins B2, B12 and ascorbic acid. Antibiotics -production of penicillin and streptomycin, hormones, Interferons, vaccines and toxoids | | | | | |
| Unit V | Industrial Quality and Standards – product quality and safety, manufacturing and environment safety analysis. | | | | | |
| Textbook | <ol style="list-style-type: none"> L E Casida, J R. Industrial Microbiology. 2nd ed New Age International Publishers; 2015. ISBN -13 978-8122438024 Agarwal and Parihar. Industrial Microbiology. Agrobiosis (India); 2006. ISBN 13 978-8177542332. | | | | | |
| References | <ol style="list-style-type: none"> Whitaker and Stanbury. Principles of Fermentation Technology. 3rd ed. Butterworth Heinemann; 2016. ISBN -13 978-0080999531. L E Casida, J R. Industrial Microbiology. 2nd ed New Age International Publishers; 2015. ISBN -13 978-8122438024. Wulf Cruger. Biotechnology: A textbook of Industrial Microbiology. 3rd ed. Sinauer Associates Inc., U.S.; 1991. ISBN -13 978 – 087893135X. McNeil and Harvey. Fermentation – A practical approach. Wiley Publisher; 2008. ISBN -13 978 – 0470014349. Michael J. Waites, Neil L. Morgan, John S. Rockey and Gary Higton. Industrial microbiology: An Introduction 2001- Blackwell Science | | | | | |

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|-----------------------|--|---|----|
| | Ltd. | | |
| E-references | 1. https://bioprocessing.weebly.com/upstream-processing.html | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | gain the importance of strain development and fermentation. | K1 |
| | CO2 | acquire knowledge on the types of fermentor and fermentation. | K2 |
| | CO3 | recognise and understand the production of beverages, enzymes | K2 |
| | CO4 | realise the production and importance of organic acids, vitamins and antibiotics. | K2 |
| | CO5 | accumulate knowledge on quality control. | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | M | S | S | S | M | S | M | S | S | S |
| CO4 | S | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | M | S | S | S | S | M | S | S | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

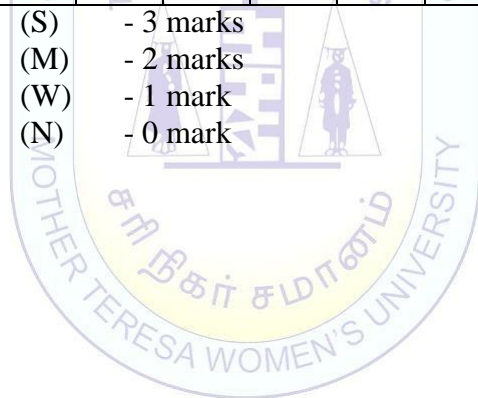
No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark



| Course Code | U21MBT63 | Microbial Biotechnology | L | T | P | C |
|---------------------------|--|-------------------------|---|---|---|---|
| Core | XV | | 5 | - | - | 4 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the molecular cloning- tools and strategies and methods in molecular cloning To learn the methods of DNA sequencing in prokaryotic and eukaryotic genomes To learn the construction and screening of genomic libraries To gain theoretical knowledge in rDNA technology tools | | | | | |
| Unit I | Gene manipulation: Introduction to gene manipulation – restriction enzymes – nomenclature, properties and applications. | | | | | |
| Unit II | Cloning vectors - plasmids, cosmids, prokaryotic and eukaryotic expression vectors – broad host range and shuttle vectors, Cloning Strategies – Cloning in E.coli and Bacillus. | | | | | |
| Unit III | Methods in Biotechnology- Construction and screening of genomic library and DNA library – PCR – Site Directed Mutagenesis – Blotting, Techniques- Southern, Northern, Western and Eastern, Polymerase chain reaction – types, methods, application, DNA sequencing methods, RFLP, RAPD | | | | | |
| Unit IV | Post modifications: Post transcriptional (RNA splicing) and post translational (protein folding) modifications of expressed gene products. | | | | | |
| Unit V | Applications of recombinant DNA technology in agriculture – Ti plasmids and their uses in pharmaceuticals, Insulin, Aminoacids, protein engineering and drug design – transgenic plants, animals and microbes – biohazards and biosafety. | | | | | |
| Textbook | 1. Robert F. Weaver and Philip W. Hedrick. Genetics. 3 rd Edition.1997. | | | | | |
| References | <ol style="list-style-type: none"> Primrose S.B. Twyman.R.M. and Old R.W. Principles of Gene Manipulation. 6th Edition. Publisher - Wiley–Blackwell; 2001. Winnacker E.L. From genes to Clone. Panima Publishing Corporation; 1987. James D.Watson, Amy A.Caudy, Richards M.Myers and Jan A.Witkowski. Recombinant DNA. 3rd Edition. W.H.Freeman Publisher; 2007. Brown T.A. Gene Cloning & DNA Analysis– An Introduction. 8th Edition. Publisher - Wiley-Blackwell; 2020. Glick, Bernard R, Pasternak, Jack J & Patten, Cheryl L. Molecular Biotechnology : Principles And Applications Of Recombinant DNA. 4th Edition. Washington, DC : ASM Press; 2010. Robert F. Weaver and Philip W. Hedrick. Genetics. 3rd Edition.1997. Michael R. Green & Joseph Sambrook. Molecular Cloning A Laboratory Manual. 4th Edition. Cold Spring Harbor Laboratory Press, New York; 2012 | | | | | |
| E- | 1. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf | | | | | |

| | | | |
|-----------------------|--|---|----|
| references | | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | gain the basic information on gene manipulation, properties and application. | K1 |
| | CO2 | expertise in cloning vectors and strategies. | K2 |
| | CO3 | familiarize the various techniques in biotechnology | K1 |
| | CO4 | know and understand post transcriptional and post translational modifications | K2 |
| | CO5 | receive elaborate knowledge on various applications of recombinant DNA technology and transgenic. | K1 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | S | S | M | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | S | S | S | S |
| CO3 | S | S | M | S | M | S | S | S | S | S | M | S | S | M |
| CO4 | M | S | S | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | S | S | M | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

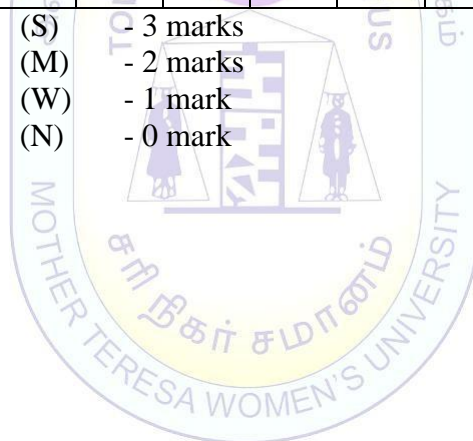
No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark



| Course Code | U21MBT64 | Immunology | | | |
|---------------------------|---|------------|---|---|---|
| Core | XVI | L | T | P | C |
| | | 4 | - | - | 4 |
| Cognitive Level | K2: Understand | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand the molecular and cellular interactions and principles of the immune system. To gain knowledge on how the immune system works and principles of auto immunity To understand the types and development of vaccines . To provide a basic knowledge of the immune response and its involvement in health and disease | | | | |
| Unit I | History and Development of immunology and Immune system: Development of immunology – Immunity – types –Organs of immune system – Hematopoiesis – Cells of immune system – blood grouping ABO and Rh systems – Blood transfusion. | | | | |
| Unit II | Antigens and Antibody: Antigen properties and types – Haptens and adjuvants. Antibodies: structure, classes and biological functions- Generation of antibody diversity, Immunogenicity, Hybridoma and monoclonals | | | | |
| Unit III | Antigen antibody reaction: Precipitation, Agglutination, Complement fixation, Electrophoresis, ELISA and RIA. Host response – humoral and cell mediated immunity. Complement - pathways of complement activation, MHC. | | | | |
| Unit IV | Disease occurrence with antigen and antibody: Hypersensitivity, Immune tolerance, Transplantation immunity, Auto immune diseases - SCID, DiGeorge syndrome, Chediak – Higashi syndrome, Leukocyte adhesion deficiency | | | | |
| Unit V | Immunodeficiency: Immunology of infectious diseases - microbial infection (bacterial, protozoan, viral infection). Toxoid. Vaccines – types and development. | | | | |
| Textbook | <ol style="list-style-type: none"> Abul K. Abbas, MBBS, Andrew H. Lichtman, MD, PhD and Shiv Pillai, MBBS, PhD. Cellular and Molecular Immunology. 9th Edition. Elsevier press; 2017. Eli Benjamini, Richard Coico & Geoffrey Sunshine. Immunology. 4th Revised edition. Wiley–Blackwell; 2000. | | | | |
| References | <ol style="list-style-type: none"> Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. Roitt's Essential Immunology. 13th Edition. Wiley-Blackwell; 2016. Robert M. Coleman & William E. Paul. Fundamentals of Immunology. 3rd Edition. Lippincott Williams and Wilkins; 1993. Jenni Punt, Sharon Stranford, Patricia Jones & Judy Owen. Kuby Immunology. 8th Edition. W.H Freeman; 2002. Julius M. Cruse. Illustrated dictionary of Immunology. 3rd Edition. CRC Press; 2009. Abul K. Abbas, MBBS, Andrew H. Lichtman, MD, PhD and Shiv Pillai, MBBS, PhD. Cellular and Molecular Immunology. 9th Edition. Elsevier press; 2017. | | | | |

| | | | |
|-----------------------|--|---|----|
| E-references | 1. http://www.sacema.org/uploads/Introduction-to-Medical-Immunology.pdf 2. http://dl.mehrsys.ir/pdfbooks/Roitt_s%20Essential%20Immunology%20Thirteenth%20Edition(www.myuptodate.com).pdf | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | upgrade the knowledge in development of immunology, types of immunity, blood groups and haematopoiesis. | K2 |
| | CO2 | recognize the information on antigens, antibodies and its function. | K2 |
| | CO3 | understand the reactions of antigen and antibody and the importance of complement pathway. | K2 |
| | CO4 | acquire knowledge in hypersensitivity. | K2 |
| | CO5 | empathize on vaccines and auto immune diseases | K2 |

Mapping of COs with POs & PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | M | S | S | S | S | M | S | S |
| CO3 | S | S | S | S | M | S | S | S | S | S | S | S | M |
| CO4 | S | M | S | S | S | S | S | S | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

| Course Code | U21MBP65 | Practical in Medical Microbiology, Industrial Microbiology, Microbial Biotechnology and Immunology | L | T | P | C |
|---|--|--|---|---|---|---|
| Core | XVI | | - | - | 5 | 4 |
| Cognitive Level | K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To be trained in distinguish the clinical pathogenic analysis To understand the techniques of blood counting To be skilled in isolation techniques of nucleic acid To develop the skills in molecular biology techniques to apply in microbes | | | | | |
| Experiments in Medical Microbiology | <ol style="list-style-type: none"> Blood collection Blood cell counting Clinical analysis of the following bacteria <ol style="list-style-type: none"> Staphylococcus Streptococcus Salmonella Pseudomonas Antibiotic sensitivity assay – Disc diffusion MIC and MLC of drugs against pathogens. | | | | | |
| Experiments in Industrial microbiology | <ol style="list-style-type: none"> 1) Isolation of industrially important microbes Immobilization of yeast using sodium alginate Wine production | | | | | |
| Experiments in microbial Biotechnology | <ol style="list-style-type: none"> Blotting Techniques PCR Restriction digestion of E. CorI and Isolation of restricted fragments. PCR Isolation and Gel electrophoresis <ol style="list-style-type: none"> Plasmid Protein | | | | | |
| Experiments in Immunology | <ol style="list-style-type: none"> Blood grouping Precipitation method <ol style="list-style-type: none"> Immunodiffusion Immuno electrophoresis Widal test Western Blot VDRL test CRP test RA test ASO test ELISA | | | | | |
| Textbook | <ol style="list-style-type: none"> Cappuccino, G. James. and Natalie Sherman, Gram stain, Microbiology A Lab. Manual. 11th ed. Pearson publication ;2017. Hudson. L., Hay F.C., 1989 Practical Immunology, 3rd ed., Blackwell Publishing, London. | | | | | |

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|-----------------------|---|---|----|
| | 3. Delves, P.J., Martin, S.J., Burton D.R., Roitt, I.M. 2011. Roitt's Essential Immunology. XIIth edition. Wiley-Blackwell, Oxford, UK. | | |
| References | 1. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks. Gram stain, Experimental Microbiology. Mosby – Year Book, Inc; 1990. 2. HiMedia. Handbook of Microbiological Media. | | |
| E-references | 1. https://www.ncbi.nlm.nih.gov/books/NBK20261/ | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | expertise in clinical microbiology. | K2 |
| | CO2 | acquire knowledge in gene transfer and restriction digestion. | K2 |
| | CO3 | understand the role of drugs against microbes.. | K2 |
| | CO4 | acquire knowledge on PCR technique | K2 |
| | CO5 | understand the immunological techniques | K2 |

Mapping of COs with POs & PSOs:

| CO | POs | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | M | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | S | S | S |
| CO3 | S | S | S | S | S | M | S | S | S | S | M | S | M |
| CO4 | S | S | S | S | S | S | M | S | S | S | S | S | S |
| CO5 | M | S | S | M | S | S | S | S | S | S | S | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

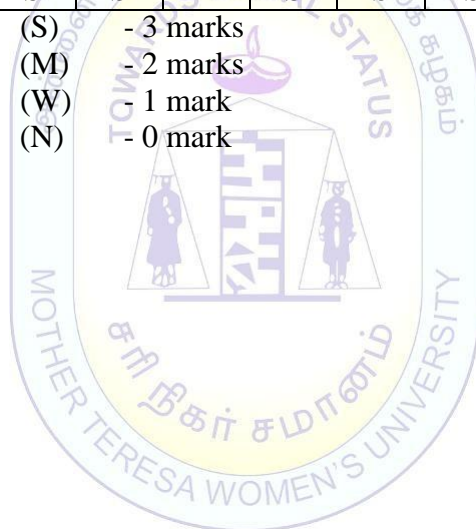
| Course Code | U21MBE641 | Bioinformatics | L | T | P | C |
|---------------------------|---|----------------|---|---|---|---|
| Elective | IV | | 3 | - | - | 3 |
| Cognitive Level | K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To learn the History, development and types of computers To learn basic tools on bioinformatics and biological databases To understand the construction phylogenetic trees for evolutionary analysis and apply theoretical skill to practical application To develop the skill about the bioinformatics tools, database for genomic and proteomics | | | | | |
| Unit I | Introduction to bioinformatics: Bioinformatics - Definition, application and significance of bioinformatics in life sciences. Database- introduction, types and classification, internet, World Wide Web | | | | | |
| Unit II | Biological Database: Nucleic acid sequence database - genbank, EMBL, DDBJ - Protein sequence database - PIR, SWISS PROT, protein structural database – PDB. | | | | | |
| Unit III | Sequence analysis and Alignment tools: Sequence analysis – need and importance – pairwise alignment – dynamic programming – Global (Needleman – Wunsch) and Local (Smith Waterman) Alignment concepts – Database searching tools – Entrez, BLAST, FASTA – multiple alignment – Clustal – Construction of Phylogenetic trees. | | | | | |
| Unit IV | 3 D structure analysis using database: Use of nucleic acid and protein data banks – NCBI, EMBL, DDBJ, SWISSPORT. 3D structural analysis of biomolecules – molecular visualization tools – RasMol. | | | | | |
| Unit V | Evolutionary analysis- Distance – Clustering methods – Rooted and Unrooted tree representation – Bootstrapping strategies. Neural Networks | | | | | |
| Textbook | 1. A. Fielding. Computing for biologists. Benjamin/Cuming Publ.Co ; 1985.ISBN -13 978-0201145748. | | | | | |
| References | <ol style="list-style-type: none"> TIBITE. Bioinformatics – Principles and potential of a new multidisciplinary tool. 1996. Fielding. A Computing for biologists. Benjamin/Cuming Publ.Co ; 1985.ISBN -13 978-0201145748. G.Von Heijne. Sequence Analysis in molecular Biology. A pioneer , Devereux and Gtribskov. Sequence analysis. Introduction of Bioinformatics – Attwood T and Parry D. Introduction of Bioinformatics. Pearson Education Asia; 2009. | | | | | |
| E-references | 1. https://www.ncbi.nlm.nih.gov/books/NBK20261/ | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | |

| | | | |
|--|-----|--|----|
| | CO1 | acquire knowledge on the application of bioinformatics in life sciences. | K2 |
| | CO2 | realise the importance and application of biological database. | K2 |
| | CO3 | understand and determine the sequence of unknown sample through various e resources. | K2 |
| | CO4 | understand the importance of data banks and visualization tools. | K2 |
| | CO5 | empathize evolutionary analysis by phylogenetic tree | K2 |

Mapping of COs with POs &PSOs:

| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | M | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | M | S | S | M | S | S | S | S | S | M | S | S | M |
| CO4 | S | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | M | S | S | S | S | S | M | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



| Course Code | U21MBE642 | Mycology | L | T | P | C |
|--------------------|--|----------|---|---|---|---|
| Elective | IV | | 3 | - | - | 3 |
| Cognitive Level | K1: Recall K2: Understand | | | | | |
| Learning objective | <ul style="list-style-type: none"> To understand general characteristics and classification of fungi To understand the culturing techniques for fungi To acquire knowledge on human mycology | | | | | |
| Unit I | General Characteristics: substrate relationship in fungi; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, sexual & asexual); life cycle patterns: heterothallism; heterokaryosis; parasexuality. | | | | | |
| Unit II | Classification: Recent trends (Alexopoulos). General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; Fungi in industry, medicine and as food; fungal diseases in plants and human; mycorrhizae; as biocontrol agents. Contributions of Indian Mycologists. | | | | | |
| Unit III | Study of morphology and reproductive features of following Fungi: Albigo, Aspergillus, Peziza, Polyporus, Puccinia, Colletotrichum, Fusarium | | | | | |
| Unit IV | Fungal cultures: Different types of media, optimization of media, inoculation methods - fungi and mushrooms. Spore culture, maintaining of culture and specimen, identification and observation of culture, Culture repositories. | | | | | |
| Unit V | Human Mycology: Human Fungi - morphology and reproduction. Classification of fungi . Opportunistic fungi. Superficial mycotic infection. Fungi causing subcutaneous mycoses. Fungi causing systemic infections. Laboratory diagnosis of fungal infections. | | | | | |
| Textbook | 1. Alexopoulos, C.J. and Mims, M. Blackwel. 1996. Introductory Mycology. John Wiley & Sons Inc. | | | | | |
| References | 1. Mehrotra, RS. & Aneja, RS. 1998. An Introduction to Mycology. New Age International Press. 2. Rangaswamy, G. and A. Mahadevan. 1999. Disease of Crop Plants in India (4th Edition). Prentice Hall of India Pvt. Ltd., New Delhi. 3. Webster, J. 1985. Introduction to Fungi. Cambridge University Press. | | | | | |
| E-references | 1. https://www.pdfdrive.com/genitourinary-pathology-a-volume-in-foundations-in-diagnostic-pathology-series-high-yield-e176374227.html 2. https://www.pdfdrive.com/harsh-mohan-textbook-of-pathology-e52206258.html 3. https://www.pdfdrive.com/fundamentals-of-pathology-pathoma-2018-e185838619.html 4. https://www.pdfdrive.com/pathology-usmle-step-1-volume-1-basic-pathology-e187109588.html | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | |

| | | | |
|--|-----|---|----|
| | CO1 | learn general characteristics of fungi | K1 |
| | CO2 | understand the classification of fungi | K2 |
| | CO3 | know about the reproductive features of fungi | K1 |
| | CO4 | Understand the culturing techniques for fungi | K2 |
| | CO5 | have an idea on human mycology | K1 |

Mapping of COs with POs &PSOs:

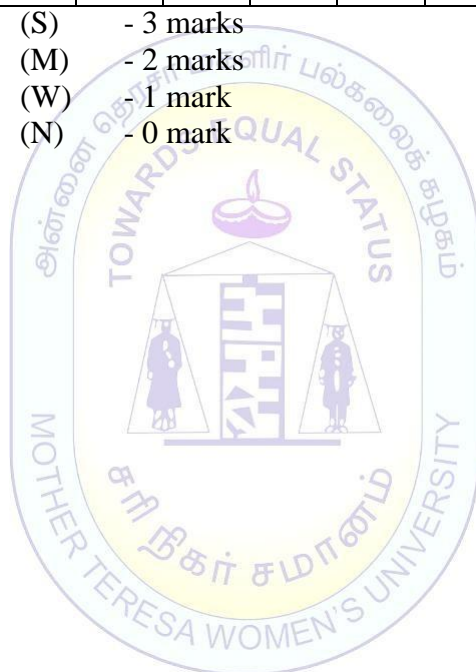
| CO | POs | | | | | | | | PSOs | | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | |
| CO1 | S | M | S | S | S | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | M | S | S | S | S | S | S | S | S | S | S |
| CO3 | S | M | S | S | M | S | S | S | S | M | S | S | M | |
| CO4 | S | S | S | S | S | S | M | S | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | M | S | S | S | S | M | S | S | |

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark



| Course Code | U21MBS641 | VERMICOMPOSTING | L | T | P | C |
|---------------------------|---|-----------------|---|---|---|---|
| SBE | IV | | 2 | - | - | 2 |
| Cognitive Level | K1: Recall K2: Understand K3: Apply | | | | | |
| Learning objective | <ul style="list-style-type: none"> ➤ To get the thorough knowledge on making vermicompost and vermiculture. ➤ To learn about South Indian and North Indian species used in Vermicomposting and Culture techniques of earthworms ➤ To study the vermicompost production ➤ To encourage the self employment practice and save the human being by the way of minimizing the use of chemical fertilizers. ➤ To understand the interaction of earthworms with other organisms | | | | | |
| Unit I | Earthworm Basics: taxonomy – Morphological and anatomical – Classification of earthworms – Food habits – Digestive system – Excretion – Reproduction and Life cycle – Earthworm as farmer's friend. | | | | | |
| Unit II | Types of earthworm: Exotic and native species – South Indian and North Indian species used in Vermicomposting – Collection and Preservation of earthworms for vermicomposting – Culture techniques of earthworms | | | | | |
| Unit III | Vermicompost production: Requirements – Different methods of Vermicomposting – Heap method – Pot method and Tray method – changes during Vermicomposting. | | | | | |
| Unit IV | Role of Earthworms: Earthworm in soil fertility – Use of Vermicompost for crop production – Use of earthworms in land improvement and land reclamation – Economics of Vermicompost and vermiwash production. Earthworms as animal feed – Medicinal value of earthworm meal – Role of Earthworms in Solid Waste, Sewage and faecal waste management and Vermifilters. Earthworms as bioreactors. | | | | | |
| Unit V | Interaction of earthworms with other organisms : Influence of chemical inputs on earthworm activities – Large scale manufacture of Vermicompost, packaging of vermicompost and its marketing – Financial supporting – Government and NGOs for vermiculture work | | | | | |

| | | | |
|------------------------|--|---|-----------|
| Text Books | <ol style="list-style-type: none"> 1. Sreenivasan Ettammal, Handbook of Vermicomposting Technology the Western India Plywoods Ltd, 2018. 2. A.K.Sharma A Hand book of Organic farming –.Agrobios publication. 2008. 3. Ismail, S.A Vermitech: Worm powered technology, Council for Advancement of People's Action and Rural Technology, New Delhi, India. 40 pp. 1997. 4. Vermicology: The Biology of Earthworms, (Ismail, S.A.) Orient Longman. 92pp. 1997. 5. Ismail, S.A Mannpuzhu: Valarppum, Tozhilnutpamum, Payankalum. Orient Longman. 115pp. 2001. 6. Alvares,C., Shiva,V., Ismail, S.A., Vijayalakshmi, K., Mathen, K., and Declercq, B The Organic Farming Reader, ARISE and Other India Press, India. 1999. 298 pp. 7. Ismail, S.A The Earthworm Book, Other India Press, Goa. 2005. | | |
| Reference Books | <ol style="list-style-type: none"> 1. Talashikar.S.C. and A A K Dosani, Earthworms in Agriculture ISBN 10: 8177542494 / ISBN 13: 9788177542493, Agrobios, Jodhpur, 2005 2. S.C. Talashikar and Dosani, Earthworm in Agriculture –, Agrobios Publications, Near Nasarani Cinema, Jodhpur, 342 002. 2010. 3. Ismail. SA , "Vermicology: Biology of Earthworms", Orient Longman Ltd, Chennai, India. 1997.Hall Publication. | | |
| E-Reference | <ol style="list-style-type: none"> 1. https://clarkcountycomposts.org/images/class_3_-_red_worm_composting.pdf 2. https://www.free-ebooks.net/academic-science/Handbook-of-Vermicomposting/pdf?dl&preview 3. file:///C:/Users/ACER/Downloads/5c55d33672e19.pdf 4. https://www.uvm.edu/sites/default/files/Extension-Master-Gardener/compostingwithworms.pdf 5. https://ag.tennessee.edu/EPP/Redbook/Apiculture%20(Beekeeping).pdf 6. https://drive.google.com/file/d/1rpz8Qhqqy6UoOOVpLjIVDZP3ZXqjNBte/view 7. http://studymaterial.unipune.ac.in:8080/jspui/bitstream/123456789/7420/1/Apiculture.pdf | | |
| Course outcome | Upon completion of this course, the students will be able to | | |
| | CO1 | gain knowledge about taxonomy of earthworms | K2 |
| | CO2 | know the types of earthworms and species used in vermicomposting | K2 |
| | CO3 | understand and analyse the different methods of vermicomposting | K3 |
| | CO4 | apply the knowledge on earthworms in soil fertility. | K3 |
| | CO5 | gather information about influence of chemical inputs on earthworm activities and Large scale manufacture of Vermicompost | K1 |

Mapping of COs with POs &PSOs:

| CO | Pos | | | | | | | | PSOs | | | | |
|-----|-----|---|---|---|---|---|---|---|------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | S | S | S | M | M | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | S | S | S | S | S | M | S |
| CO3 | S | S | S | S | S | S | S | M | S | M | S | S | S |
| CO4 | S | S | S | S | S | S | M | S | S | S | S | S | M |
| CO5 | S | S | S | S | S | M | S | S | S | M | S | S | S |

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark



| Course Code | U21MBS642 | Molecular Modelling and Drug Designing | L | T | P | C | |
|--------------------|---|--|---|---|---|----|--|
| Elective | IV | | 2 | - | - | 2 | |
| Cognitive Level | K2: Understand K3: Apply K4: Analyze | | | | | | |
| Learning Objective | <ul style="list-style-type: none"> Outline preliminary concepts in molecular modeling using molecular dynamics Utilize basic modeling techniques to explore biological phenomena at the molecular level Perceive knowledge in protein-ligand interaction study by docking and visualization tools for molecular dynamics. | | | | | | |
| Unit I | Quantum mechanics & concepts in molecular modeling: Coordinate systems, potential energy surfaces. Introduction to quantum mechanics. Force Fields - Bond stretching; angle bending. torsional terms; non-bonded interactions; electrostatic interactions; Vander Waals interactions | | | | | | |
| Unit II | Molecular Dynamics and Monte Carlo simulation: Design constraints, Potentials in MD simulation, Molecular dynamics algorithms. | | | | | | |
| Unit III | Analysis and Properties - Geometry optimization, Vibrational frequencies: potential energy surface, harmonic vs. fundamental frequencies, zero-point vibrational energies. | | | | | | |
| Unit IV | Modeling :Homology modeling, Ab initio, Protein Threading. Drug design - Structure-based methods to identify lead compounds: finding lead compounds by searching 3D databases; de novo ligand design. | | | | | | |
| Unit V | Molecular Docking : Docking - molecular modeling in drug design – structure-based drug design – pharmacophores -QSAR. | | | | | | |
| References | <ol style="list-style-type: none"> Leach AR (2010) Molecular Modeling, Principles & Applications, (Dorling Kindersley(India) (P)Ltd with Pearson education Ltd, UK. Arjun S (2103) Drug Discovery, Design & Development Lambert Academic publishing. Clark T, Thurston DE, and Banting L (2012) Drug Design Strategies: Computational Techniques & Applications Royal society of chemistry | | | | | | |
| E-Reference links | <ol style="list-style-type: none"> https://www.mdpi.com/books/pdfview/book/1187 https://www.kobo.com/us/en/ebook/molecular-modelling-and-drug-design https://faculty.psau.edu.sa/filedownload/doc-3-pdf/e1490523b8cd2c130b29656613850cf8-original.pdf | | | | | | |
| Course outcome | Upon completion of this course, the students will be able to | | | | | | |
| | CO1 | illustrate the concepts of Molecular modeling using Molecular Dynamics | | | | K2 | |
| | CO2 | Perform experiment with protein-ligand interaction study by docking | | | | K3 | |

| | | | |
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| | CO3 | translate the understanding of visualization tools for molecular dynamics | K3 |
| | CO4 | Apply the information gained in various chemistry and biochemistry courses toward solving problems pertinent to drug designing | K3 |
| | CO5 | Demonstrate the relative importance of molecular modeling and drug designing | K4 |

Mapping of COs with POs &PSOs:

| CO | PO | | | | | | | | PSO | | | | |
|-----|----|---|---|---|---|---|---|---|-----|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 |
| CO1 | S | S | M | S | S | S | M | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | M | S | S | S | S | S | S |
| CO3 | S | S | M | S | S | S | S | S | S | S | S | S | S |
| CO4 | S | S | S | S | S | S | M | S | S | S | S | S | S |
| CO5 | S | S | S | S | S | S | S | S | S | S | S | S | S |

Strongly Correlating

Moderately Correlating

Weakly Correlating

No Correlation

(S) - 3 marks

(M) - 2 marks

(W) - 1 mark

(N) - 0 mark

