



SOURASHTRA COLLEGE, MADURAI – 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

B.Sc. MICROBIOLOGY – SYLLABUS

(Under CBCS based on OBE) (with effect from 2021 – 2022)

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UNDERGRADUATE (UG) PROGRAMME OUTCOMES (POs)

Undergraduate (B.A., B.Sc., B.Com., B.C.A., B.B.A., etc.) is a 3-year degree Programme with 6 semesters consisting the following Programme Outcomes (POs) under various criteria including critical thinking, problem solving, effective communication, societal/ citizenship/ ethical credibility, sustainable growth and employable abilities.

| | |
|-------------|--|
| PO 1 | Critical Thinking: Intellectual exploration of knowledge towards actions in clear and rational manner by understanding the logical connections between ideas and decisions. |
| PO 2 | Problem Solving: Understanding the task/ problem followed by planning and narrow execution strategy that effectively provides the solution. |
| PO 3 | Effective Communication: Knowledge dissemination by oral and verbal mechanisms to the various components of our society. |
| PO 4 | Societal/ Citizenship/ Ethical Credibility: Realization of various value systems/ moral dimensions and demonstrate the empathetic social concern as well as equity in all the decisions, executions and actions. |
| PO 5 | Environmental Concern and Sustainable Growth: Understanding the emerging environmental challenges and provide the possible contribution in sustainable development that integrates environment, economy and employment. |
| PO 6 | Skill Development and Employable Abilities: Adequate training in relevant skill sector and creating employable abilities among the under graduates. |



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PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of **B.Sc. Microbiology programme**, the students are expected to

| | |
|--------------|--|
| PSO 1 | explore the biological diversity of microbial forms and various aspects of basic microbiology and able to address broad range of fields such as microbial taxonomy, microbial genetics, molecular biology, biocontrol, biochemistry, food and industrial microbiology and systems biology. |
| PSO 2 | understand the microbial metabolism, concepts of molecular biology, microbial pathogenicity, the role of microorganisms in the human welfare and helps to address the specific solutions for the problems associated with human society. |
| PSO 3 | develop high proficiency in good laboratory practices in microbiological laboratory and able to explain the theoretical basis and practical skills of the tools and techniques common to microbiology. |
| PSO 4 | develop the skills necessary for effective communication of experimental results and scientific principles with the community related to microbiology field and non-microbiology fields. |
| PSO 5 | acquire skills, assess and approach with ethical principles in the current social health issues and the ability to participate in a team. |
| PSO 6 | develop employability skills in the various fields of microbiology and ability to engage in life-long learning on life skills. |



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B.Sc. MICROBIOLOGY – COURSE STRUCTURE

SEMESTER – I

| S. No. | Sub. Code | Subject Title | Hrs./ Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|-----------|--|------------|-------------|----|----|-------------|-----------|
| 1. | 21UACT11 | Part – I: Tamil – கவிதையும் சிறுகதையும் | 6 | 3 | 25 | 75 | 100 | 3 |
| | 21UACH11 | Hindi – Hindi – I | | | | | | |
| | 21UACS11 | Sanskrit – Sanskrit – I | | | | | | |
| 2. | 21UACE11 | Part – II: English – I – English For Enrichment – I | 6 | 3 | 25 | 75 | 100 | 3 |
| 3. | 21UMBC11 | Part – III : Core: General Microbiology | 5 | 3 | 25 | 75 | 100 | 4 |
| 4. | 21UMBA11 | Part – III: Allied: Allied Chemistry for Life Sciences I | 4 | 3 | 25 | 75 | 100 | 4 |
| 5. | | Part – III: Core: Core Practical I* | 3 | – | – | – | – | – |
| 6. | | Part – III: Allied: Titrimetric Analysis* | 2 | – | – | – | – | – |
| 7. | 21UMBS11 | Part – III: SBS: Microbial Techniques | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21UACVE1 | Part – IV: Value Education | 2 | 3 | 25 | 75 | 100 | 2 |
| | | TOTAL | 30 | | | | 600 | 18 |

*Practical Examinations at the end of the II Semester

SEMESTER – II

| S. No. | Sub. Code | Subject Title | Hrs./ Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|-----------|---|------------|-------------|----|----|-------------|-----------|
| 1. | 21UACT21 | Part – I: Tamil – செய்யுளும் புதினமும் | 6 | 3 | 25 | 75 | 100 | 3 |
| | 21UACH21 | Hindi – Hindi – II | | | | | | |
| | 21UACS21 | Sanskrit – Sanskrit –II | | | | | | |
| 2. | 21UACE21 | Part – II: English – II English For Enrichment – II | 6 | 3 | 25 | 75 | 100 | 3 |
| 3. | 21UMBC21 | Part – III: Core: Microbial Physiology & Taxonomy | 5 | 3 | 25 | 75 | 100 | 4 |
| 4. | 21UMBA21 | Part – III: Allied: Allied Chemistry for Life Sciences II | 4 | 3 | 25 | 75 | 100 | 4 |
| 5. | 21UMBCP1 | Part – III : Core: Core Practical I | 3 | 3 | 40 | 60 | 100 | 2 |
| 6. | 21UMBAP1 | Part – III : Allied: Titrimetric Analysis | 2 | 3 | 40 | 60 | 100 | 2 |
| 7. | 21UMBS21 | Part – III: SBS: Diagnostic Microbiology and Haematology | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21UACES1 | Part – IV: Environmental Studies | 2 | 3 | 25 | 75 | 100 | 2 |
| | | TOTAL | 30 | | | | 800 | 22 |



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SEMESTER – III

| S. No. | Subject Code | Subject Title | Hrs. / Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|--------------|--|-------------|-------------|----|----|-------------|-----------|
| 1. | 21UACT31 | Part – I: Tamil – காப்பியமும் நாடகமும் | 6 | 3 | 25 | 75 | 100 | 3 |
| | 21UACH31 | Hindi – Hindi – III | | | | | | |
| | 21UACS31 | Sanskrit – Sanskrit – III | | | | | | |
| 2. | 21UACE31 | Part – II: English – English For Enrichment – III | 6 | 3 | 25 | 75 | 100 | 3 |
| 3. | 21UMBC31 | Part – III: Core – 3: Molecular Microbiology | 5 | 3 | 25 | 75 | 100 | 5 |
| 4. | 21UMBCP2 | Part – III: Core – 4: Practical – II: Core Practical – II* | 3 | – | – | – | – | – |
| 5. | 21UMBA31 | Part – III: Allied – 3 T: Cell Biology | 4 | 3 | 25 | 75 | 100 | 4 |
| 6. | 21UMBAP2 | Part – III: Allied – 3 Practical: Allied Biology Practical * | 2 | – | – | – | – | – |
| 7. | 21UMBS31 | Part – III: SBS – 3: Mushroom Technology | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21UMBN31 | Part – IV: NME–1: Food and Dairy Technology | 2 | 3 | 25 | 75 | 100 | 2 |
| | | TOTAL | 30 | | | | 600 | 19 |

*Practical examinations at the end of the IV semester

SEMESTER – IV

| S. No. | Subject Code | Subject Title | Hrs. / Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|--------------|--|-------------|-------------|----|----|-------------|-----------|
| 1. | 21UACT41 | Part – I: Tamil – சங்க இலக்கியமும் அற இலக்கியமும் | 6 | 3 | 25 | 75 | 100 | 3 |
| | 21UACH41 | Hindi – Hindi – IV | | | | | | |
| | 21UACS41 | Sanskrit – Sanskrit – IV | | | | | | |
| 2. | 21UACE41 | Part – II: English – English For Enrichment – IV | 6 | 3 | 25 | 75 | 100 | 3 |
| 3. | 21UMBC41 | Part – III: Core – 5 : Microbial Genetics | 5 | 3 | 25 | 75 | 100 | 5 |
| 4. | 21UMBCP2 | Part – III: Core – 4: Practical – II: Core Practical – II | 3 | 3 | 40 | 60 | 100 | 2 |
| 5. | 21UMBA41 | Part – III: Allied – 4 T : Biodiversity and Biostatistics | 4 | 3 | 25 | 75 | 100 | 4 |
| 6. | 21UMBAP2 | Part – III: Allied – 4 Practical: Allied Biology Practical | 2 | 3 | 40 | 60 | 100 | 2 |
| 7. | 21UMBS41 | Part – IV: SBS – 4 : Cosmetic Microbiology | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21UMBN41 | Part – IV: NME – 2: Microbes in Human Health | 2 | 3 | 25 | 75 | 100 | 2 |
| 9. | | Part – V: Extension Activities | – | – | – | – | 100 | 1 |
| | | TOTAL | 30 | | | | 900 | 24 |



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SEMESTER – V

| S. No. | Subject Code | Subject Title | Hrs./ Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|----------------------------------|---|------------|-------------|----|----|-------------|-----------|
| 1. | 21UMBC51 | Part – III: Core – 6: Clinical Microbiology | 5 | 3 | 25 | 75 | 100 | 5 |
| 2. | 21UMBC52 | Part – III: Core – 7: Agricultural and Environmental Microbiology | 4 | 3 | 25 | 75 | 100 | 4 |
| 3. | 21UMBC53 | Part – III: Core – 8: Immunology | 5 | 3 | 25 | 75 | 100 | 4 |
| 4. | 21UMBC54 | Part – III: Core – 9: Food and Industrial Microbiology | 4 | 3 | 25 | 75 | 100 | 4 |
| 5. | 21UMBCP3 | Part – III: Core – 10 Practical – III: Core Practical – III | 5 | 3 | 40 | 60 | 100 | 4 |
| 6. | Part – III: Elective – 1: | | 5 | 3 | 25 | 75 | 100 | 5 |
| | 21UMBE51 | Computer Applications in Biology | | | | | | |
| | 21UMBE52 | Bioremediation | | | | | | |
| | 21UMBE53 | Fermentation and Bioprocess Technology | | | | | | |
| 7. | 21UMBS51 | Part – IV: SBS – 5: Biocontrol | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21USSY51 | Soft Skills (Self-Study) | – | – | – | – | 100 | – |
| | | TOTAL | 30 | | | | 800 | 28 |

*One elective course to be chosen from THREE courses



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SEMESTER – VI

| S. No. | Subject Code | Subject Title | Hrs./ Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|----------------------------------|--|------------|-------------|----|----|-------------|-----------|
| 1. | 21UMBC61 | Part – III: Core – 11: Virology | 5 | 3 | 25 | 75 | 100 | 5 |
| 2. | 21UMBC62 | Part – III: Core – 12: Biochemistry and Enzymology | 4 | 3 | 25 | 75 | 100 | 4 |
| 3. | 21UMBC63 | Part – III: Core – 13: rDNA Technology | 4 | 3 | 25 | 75 | 100 | 4 |
| 4. | 21UMBCP4 | Part – III: Core – 14: Practical – IV: Core Practical – IV | 5 | 3 | 40 | 60 | 100 | 4 |
| 5. | Part – III: Elective – 2: | | 5 | 3 | 25 | 75 | 100 | 5 |
| | 21UMBE61 | Bioinformatics | | | | | | |
| | 21UMBE62 | Biotechnology | | | | | | |
| | 21UMBE63 | IPR, Bioethics and Biosafety | | | | | | |
| 6. | Part – III: Elective – 3: | | 5 | 3 | 25 | 75 | 100 | 5 |
| | 21UMBE64 | Analytical Microbiology | | | | | | |
| | 21UMBE65 | Mycology | | | | | | |
| | 21UMBE66 | Parasitology | | | | | | |
| 7. | 21UMBS61 | Part – IV: SBS – 6: Pharmaceutical Microbiology | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21UGKY61 | General Knowledge (Self-Study) | – | – | – | – | 100 | – |
| | | TOTAL | 30 | | | | 800 | 29 |

***One elective course to be chosen from THREE courses**



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COURSE STRUCTURE – V SEMESTER

| S. No. | Subject Code | Subject Title | Hrs./ Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|----------------------------------|--|------------|-------------|----|----|-------------|-----------|
| 1. | 21UMBC51 | Part – III: Core – 6: Clinical Microbiology | 5 | 3 | 25 | 75 | 100 | 5 |
| 2. | 21UMBC52 | Part – III: Core – 7: Agricultural and Environmental Microbiology | 4 | 3 | 25 | 75 | 100 | 4 |
| 3. | 21UMBC53 | Part – III: Core – 8: Immunology | 5 | 3 | 25 | 75 | 100 | 4 |
| 4. | 21UMBC54 | Part – III: Core – 9: Food and industrial Microbiology | 4 | 3 | 25 | 75 | 100 | 4 |
| 5. | 21UMBCP3 | Part – III: Core – 10: Practical – III: Core Practical – III | 5 | 3 | 40 | 60 | 100 | 4 |
| 6. | Part – III: Elective – 1: | | 5 | 3 | 25 | 75 | 100 | 5 |
| | 21UMBE51 | Computer Applications in Biology | | | | | | |
| | 21UMBE52 | Bioremediation | | | | | | |
| | 21UMBE53 | Fermentation and Bioprocess Technology | | | | | | |
| 7. | 21UMBS51 | Part – IV: SBS – 5: Biocontrol | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21USSY51 | Soft Skills (Self-Study) | – | – | – | – | 100 | – |
| | | TOTAL | 30 | | | | 800 | 28 |

***One elective course to be chosen from THREE courses**

CA – Class Assessment (Internal)

SE – Summative Examination

SBS – Skill Based Subject

T – Theory

P – Practical



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|-----------------------|----------|---|---|---------|
| 21UMBC51 | CLINICAL MICROBIOLOGY | CORE – 6 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|
|------------------|---|---|---|

COURSE DESCRIPTION:

The Clinical microbiology course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body. It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.

COURSE OBJECTIVES:

To enable the students

- learn basics of infection and the epidemiology of infectious diseases.
- gain an in-depth knowledge on clinical sample processing.
- get diagnostic skills and interpretation of laboratory tests in the diagnosis of infectious diseases.
- acquire basic knowledge about the morphology, pathogenicity and laboratory diagnosis of microbial pathogens.
- attain the knowledge on Anti-microbial chemotherapy and drug resistance.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | gain the basic knowledge about Infectious diseases, Human-microbe interactions, Host defence mechanisms. | Upto K3 |
| CO 2 | understand the pathogenicity of bacterial pathogens. | Upto K3 |
| CO 3 | comprehend the pathogenicity of viral pathogens. | Upto K3 |
| CO 4 | recognize the pathogenicity of fungal pathogens and protozoan parasites. | Upto K3 |
| CO 5 | gain the basic knowledge about Anti-microbial chemotherapy and drug resistance mechanisms. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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CLINICAL MICROBIOLOGY

UNIT– I: Historical Aspects of Infectious Diseases

Koch's postulates. Human–microbe Interactions, Virulence factors – Adhesins, Aggresins, Invasins and Impedins, Host defence mechanisms.

UNIT– II: Bacteriology

Transmission, Diagnosis, Clinical symptoms, Control, Treatment and Prophylaxes of bacterial member's – Staphylococcus, Streptococcus, E. coli, Salmonella, Bacillus, Vibrio & Mycobacteria.

UNIT– III: Virology

Etiology, Prophylaxis, Clinical symptoms and Treatment for Human Viral Diseases– SARS, Corona virus disease (COVID–19), Rabies, Hepatitis & AIDS, Dengue, Viruses and Cancer.

UNIT– IV: Mycology & Protozoan Diseases

Classification of Mycoses with example– Superficial, Cutaneous, Systemic & Opportunistic types– Life cycle of Candidiasis. Life cycle, Diagnosis and Treatment of Protozoan diseases – Amoebiasis & Malaria.

UNIT– V: Anti–microbial Chemotherapy

Antibacterial – Penicillin, Streptomycin, Antifungal –Nystatin and Antiviral drugs – Azidothymidine, Modes of action with examples – Drug resistance – Multiple drug resistance (MDR), Extensive drug resistance (XDR), Extreme drug resistance (XXDR) and Pan drug resistance (PDR), Mechanisms of Drug Resistance – Enzymatic, Chemical, Multiple drug resistance Pumps, Metabolic Bypass and R–Plasmids.

TEXT BOOKS:

1. Murray, Rosenthal and Pfaller, (2021). *Medical Microbiology*, 9thEd., Elsevier Publications, Philadelphia.
2. Kenneth J. Ryan *et al.*, (2022). *Sherris and Ryan's Medical Microbiology*, 8th Ed., McGraw Hill Publications, Australia.
3. David Greenwood, Richard C B Slack, Michael R. Barer, Will L Irving, (2012). *Medical Microbiology*, 18th Ed., Elsevier Publications, New York.
4. Vasanthakumari R. (2016). *Textbook of Microbiology*, 3rd Ed., Wolters Kluwer Pvt. Ltd, Gurgaon.
5. Rajan S. (2017). *Medical Microbiology*, MJP Publishers, Chennai.

REFERENCE BOOKS:

1. Paniker, C. K. J., (2017). *Ananthanarayanan and Paniker's Textbook of Microbiology*, 10th Ed., Orient Longman Publications, India.
2. Mackie and McCartney, (1994). *Medical Microbiology*, 14thEd., Churchill Livingstone publishers, London.
3. Bailey and Scotts, (1994). *Diagnostic Microbiology*, 9thEd, Baron and Fine gold CV Mosby Publications, Missouri.
4. Jawetz E Melnic JL and Adelberg EA, (1998). *Review of Medical Microbiology*, Lange Medical Publications, USA.
5. Joanne Willey, Kathleen Sandman and Dorothy Wood, (2020). *Prescott's Microbiology*, 11th Ed, McGraw Hill Publications, Australia.



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DIGITAL TOOLS:

1. <https://www.microrao.com/mypgnotes.htm>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4922927/>
3. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_occupational_health_students/medicalbacteriology.pdf
4. https://www.ipinnovative.com/media/books/Contents_5.pdf
5. https://www.brainkart.com/subject/Medical-Microbiology_252/

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 3 | 2 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. A. R. SARANYADEVI



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|---|----------|---|---|---------|
| 21UMBC52 | AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY | CORE – 7 | 4 | – | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

This course exposes the use of microorganisms in Agricultural and environmental applications.

COURSE OBJECTIVES:

To help the students

- understand the role of beneficial microorganisms in environment.
- acquire knowledge related to harmful plant pathogens
- have a basic knowledge of bio fertilizers
- comprehend the role of microbes in biogeochemical cycles.
- get expose the students to the concepts of sewage and waste management process.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | summarise the beneficial role of microbes | Upto K3 |
| CO 2 | explain the harmful plant pathogen interactions | Upto K3 |
| CO 3 | list the microbes that can be used as biofertilizers | Upto K3 |
| CO 4 | outline the biogeochemical cycles. | Upto K3 |
| CO 5 | understand the waste management process. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

UNIT– I: Plant, Soil and Microbial Interactions

Bacteria, Fungi and Actinomycetes (Distribution), Microbe–microbe Interaction – Mutualism, Amensalism and Commensalism; Microbe–plant interactions – Phylloplane – Phyllosphere –Rhizosphere and Mycorrhizae

UNIT– II: Plant Microbe Interactions (Harmful)

Symptoms, Characters of pathogens and control measures: Bacterial diseases – Citrus canker, Blight of rice. Fungal diseases – Red rot of sugarcane, Tikka leaf spot of ground nut. Viral diseases –TMV, CMV, Vein clearing disease of Bhendi (*Abelmoschus esculentus*).

UNIT– III: Applications of Microorganisms in Crop Production

Plant growth promoting *Rhizobacteria* (PGPR) – *Pseudomonas fluorescens* and Siderophores. Biofertilizers – Bacterial (*Rhizobium*) & Fungal (Vesicular Arbuscular Mycorrhiza) – Production and Methods of Application –Biopesticides – Bacterial (*Bacillus thuringiensis*), Fungal (*Beauveria bassiana*) and Viral (Nuclear Polyhedrosis Virus) – Microbial Nematicides and Microbial Herbicides – Biotechnology in Agriculture – Bt Cotton and herbicide tolerant plants. EM solution. Centres of Agriculture in India.

UNIT– IV: Microbes and their Role in the Environment

N₂–cycle, P–cycle and C–cycle, Aquatic Microbiology – Microbes in fresh water & Marine water. Air Microbiology.

UNIT– V: Role of Microorganisms in Pollution Management

Biodegradation of Xenobiotics (Chlorinated Pesticides) – Microbial enhanced oil recovery (MEOR) – Bioleaching of Metals (Copper and Gold). Bioremediation–Microbes in Waste treatment – Solid waste (Sanitary land fill and Composting) and liquid waste – Sewage treatment –Biological Oxygen Demand (BOD), Pollution indicating microbes.

TEXT BOOKS:

1. Joanne Willey, Kathleen Sandman and Dorothy Wood, (2020). *Prescott's Microbiology*, 11th Ed., McGraw Hill Publications, Australia.
2. Subba Rao NS. (2020). *Soil Microbiology*, 4th Ed., Oxford & IBH Publishing Co., New Delhi.
3. Satyanarayana, U. (2020). *Biotechnology*, India: Books and Allied (p) Limited., India
4. Charles P. Gerba, Ian L. Pepper, Terry J. Gentry, (2014). *Environmental Microbiology*, 4th Ed., Elsevier Science, Netherlands.
5. Pandey, B. P. (2018). *Plant pathology (Pathogen and Plant disease)*, S. Chand & Co Pvt Ltd, New Delhi.



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REFERENCE BOOKS:

1. Bagyaraj, D. J., Rangaswami, G. (2004). *Agricultural Microbiology*, PHI learning Pvt. Ltd., India
2. Atlas, R. M., Bartha, R., Atlas, D. (1998). *Microbial ecology: fundamentals and Applications*, 4th Ed., Benjamin/Cummings, India.
3. Pareek R.P., Navneet Pareek (2019). *Agricultural Microbiology*, Scientific Publishers, India.
4. Paniker, C. K. J., (2017). *Ananthanarayanan and Paniker's Textbook of Microbiology*, 10th Ed., Orient Longman Publications, India.
5. Vijaya Ramesh K. (2019). *Environmental Microbiology*, MJP publishers, Chennai.

DIGITAL TOOLS:

1. <http://eagri.org/eagri50/AMBE101/lec16.html>
2. <http://eagri.org/eagri50/AMBE101/lec29.html>
3. <https://www.slideshare.net/isurupriyaranga/pgpr-plant-growth-promoting-rhizobacteria>
4. <https://www.biologydiscussion.com/microbiology-2/bioremediation/xenobiotic-compounds-meaning-hazards-and-biodegradation/55625>
5. <https://www.researchgate.net/publication/233795004>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 2 | 3 | 2 | 3 | 2 | 1 |
| CO2 | 3 | 2 | 2 | 1 | 3 | 3 |
| CO3 | 3 | 1 | 3 | 2 | 1 | 2 |
| CO4 | 2 | 3 | 2 | 1 | 2 | 3 |
| CO5 | 2 | 1 | 3 | 1 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. K. RAGHAVAN



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B.Sc. MICROBIOLOGY – SYLLABUS

(Under CBCS based on OBE) (with effect from 2021 – 2022)

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| COURSECODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|------------|--------------|----------|---|---|---------|
| 21UMBC53 | IMMUNOLOGY | CORE – 8 | 5 | – | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|
|------------------|---|---|---|

COURSE DESCRIPTION:

This course explores the cells and molecules of the immune system and pathways work together and fight various infections. In addition, basic concepts of transplantation, tumor immunity, immune system deficiencies, autoimmunity and vaccination are examined. The course also emphasizes the antigen–antibody reactions, the mechanism of graft rejection and immune response to tumors, immunotherapy for cancer.

COURSE OBJECTIVES:

To help the students

- develop knowledge and skills related to health and disease and role of immune system.
- develop understanding of the functioning of the immune system,
- develop understanding of the molecular and cellular components and pathways that protect an organism from infectious agents.
- develop the skills and diagnose the presence of antigens and antibodies
- conceptualize the transplantation and tumor.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|--|
| CO 1 | become familiar with the historical perspective, cellular and molecular aspects of the immunesystem and the immune response. | Upto K3 |
| CO 2 | understand the characteristics of antigen, antibody and its types. | Upto K3 |
| CO3 | examine the basic mechanism of hypersensitivity, development of immune cells and their activation and differentiation. | Upto K3 |
| CO 4 | understand the principle and application of various immune techniques. | Upto K3 |
| CO 5 | comprehend the strategies essential for generating or suppressing immune responses as required in hypersensitivity reactions, transplantation, autoimmune diseases and cancer. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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IMMUNOLOGY

UNIT – I:

Contributions of following scientists to the development of field of immunology – Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Jules Bordet, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne and Rodney Porter. Cells and organs of the system–Stem cells, Lymphocytes, Macrophages, Granulocytes, Mast cells, Dendritic cells. Concept of Innate and Adaptive immunity; Primary and Secondary immune response. Cell mediated and humoral immune response. Immunisation schedule, Mission Indradhanush.

UNIT– II:

Characteristics of an antigen (Foreignness, Molecular size, Chemical complexity and Heterogeneity); Haptens; Epitopes, Paratopes; T-dependent and T-independent antigens; super antigens; Adjuvants. Antibodies– Structure, Types and Functions, Production of Monoclonal Antibodies (a brief account). Complement System –Components; Activation pathways (Classical, Alternative and Lectin pathways).

UNIT– III:

Hypersensitivity– Types, mechanism and examples; Major Histocompatibility Complex – Organization of MHC locus (Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways). T and B cell– Development, Activation and Differentiation. Immunotolerance.

UNIT– IV:

Autoimmunity–mechanism; Autoimmune diseases–Hashimoto's Thyroiditis, Myasthenia gravis, Rheumatoid arthritis, SLE; Immunodeficiency diseases –Primary–DiGeorge's syndrome, Selective immunoglobulin deficiencies, X-linked agammaglobulinemia, SCID, Chediak–Higashi syndrome, CGD–Secondary–acquired–HIV–AIDS.

Antigen–Antibody reaction– Precipitation– Single and Double Immuno diffusion (Ouchterlony method); Agglutination; Immunoelectrophoresis; Complement fixation test

UNIT– V:

Transplantation and types of graft; Graft Rejection– types and mechanism–GVHD; HLA typing; Clinical transplantation of kidney and Bone marrow, Kidney transplantation approved centres– IKDRC; Tumor Immunity– Tumor antigens– types; Immune response to tumors; Immunotherapy for Cancer (include FDA approved therapies). Vaccines– Types–Killed, Attenuated, Toxoid, Combination, DNA, Edible, Recombinant Vaccines.

TEXT BOOKS:

1. Travers. J., *Immunobiology, The Immune System in Health and Disease*, 3rd Ed., 1997–Garland publishers, NY.
2. Abul. K. Abbas, A. H. Lichtman, Shiv Pillai, *Cellular and Molecular Immunology*, 9th Ed., 2018. Elsevier.
3. C. V. Rao., *Immunology–A Text Book*, 3rd Edition., 2007, Narosa Publishing House, New Delhi
4. David Male, *Immunology– An Illustrated Outline*. 6th Ed., CRC Press.
5. SK Mohanty, K Sai Leela, *Textbook of Immunology*, 2013. 2nd edition. Jaypee Brothers Publications PVT Ltd.



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REFERENCE BOOKS:

1. Roitt, I.M., *Essentials of Immunology*, 1998, Blackwell scientific Publication.
2. William E. Paul, *Fundamentals of Immunology*, 2008. 6TH Ed., Lippincott Williams & Wilkins.
3. Kuby, *Immunology*, 1997, 2nd Ed., W, H. Freeman and company, NY.
4. J. H. L. Playfair, B. M. Chain., *Immunology at a Glance*, 2012, 10th Ed., Wiley Black publishers.
5. Klasus, E. and Elegert, *Immunology Understanding the Immune System*, 1996, Wiley Liss, NY.

DIGITAL TOOLS:

- NPTEL– <https://youtu.be/-bXcy5f1hPs>
- <https://www.cdc.gov/vaccines/vac-gen/immunity-types.html>
- <https://www.onlinebiologynotes.com/autoimmune-disease-mechanism-of-autoimmunity-types-and-examples/>
- <https://microbenotes.com/t-cell-t-lymphocyte/>
- <https://www.immunology.org/policy-and-public-affairs/briefings-and-position-statements/transplant-immunology>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 2 | 2 | 1 | 2 | 2 | 1 |
| CO2 | 2 | 2 | 1 | 1 | 1 | 1 |
| CO3 | 1 | 1 | 3 | 2 | 1 | 3 |
| CO4 | 1 | 1 | 3 | 2 | 3 | 3 |
| CO5 | 1 | 1 | 3 | 3 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. N. B. SHARMILA



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|----------------------------------|----------|---|---|---------|
| 21UMBC54 | FOOD AND INDUSTRIAL MICROBIOLOGY | CORE – 9 | 4 | – | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| | | | |
|------------------|--|--|---|
| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|

COURSE DESCRIPTION:

Food and Industrial microbiology help to understand the need of microbes in food processing as well as in fermentation foods and large-scale production of essential metabolites, antibiotics, etc.

COURSE OBJECTIVES:

To enable the students

- have basic knowledge on role of microbes in food processing
- acquire knowledge about food preservation techniques
- understand the design and working mechanism of bioreactor
- comprehend some of the production process of commercially important products using large scale fermentation.
- learn the biosafety level and good laboratory practices for quality management

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|--|
| CO 1 | understand the role of microbes in food processing | Upto K3 |
| CO 2 | summarise various food preservation techniques | Upto K3 |
| CO 3 | highlight the design and working mechanism of bioreactor | Upto K3 |
| CO 4 | outline the commercially important products production process in large scale | Upto K3 |
| CO 5 | define the biosafety level and good laboratory practices for quality management | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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FOOD AND INDUSTRIAL MICROBIOLOGY

UNIT– I: Importance of Food Microbiology

Intrinsic and Extrinsic Factors affecting microbial growth in food, Features of Food Spoilage in Vegetables, Cereals and Milk.

UNIT– II: Food Preservation Techniques

Asepsis, Low temperature, High temperature and Irradiation – Radicidation, Radappertization and Radurization, Chemicals, Food Borne Infections –Botulism, Food borne intoxications – Mycotoxicosis, Fermented foods – Sauerkraut – A brief account.

UNIT– III: Fermentor

Basic design and parts –types – Air lift, CSTR, tower and packed bed bioreactors. Upstream process – inoculum preparation – buildup production – Fermentation types – batch, fed batch and continuous, Downstream process.

UNIT– IV: Microbial Synthesis of Industrial products

Antibiotic (Penicillin) Amino acids (Glutamic Acid) Vitamin (Vitamin B12), Solvent (Ethanol) organic acid (Citric Acid). Detection and Assay of Fermentation products (Biological Assay).

UNIT– V: Biosafety and Regulations

BioSafety levels, Guidelines and Regulations and FSSAI. Quality Assurance and Quality Control of Fermented Products–HACCP.

TEXT BOOKS:

1. Frazier, W. C., Westhoff, D. C. (2014). *Food Microbiology*. 5th edition India: Tata McGraw–Hill.
2. James M. Jay. (2012). *Modern Food Microbiology*. Netherlands: Springer Netherlands.
3. K Vijaya Ramesh · (2019). *Food Microbiology*. N.p., MJP Publisher.
4. Adams, M. R., Moss, M. O., & Moss, M. O. (2000). *Food Microbiology*. 2nd Edition Royal society of chemistry.
5. Sukesh, K. (2010). 1st Edition. *An Introduction to Industrial Microbiology*. S. Chand Publishing., India.

REFERENCE BOOKS:

1. Waites, M. J., Rockey, J. S., Higton, G., Morgan, N. L. (2013). *Industrial Microbiology: An Introduction*. Germany: Wiley.
2. Crueger, W., Crueger, A. (2017). *Crueger's Biotechnology: A Textbook of Industrial Microbiology*. India: MedTech.
3. Jay, J. M., Loessner, M. J., & Golden, D. A. (2008). 7th edition *Modern Food Microbiology*. Springer Science & Business Media.
4. Lee, S. Y., Nielsen, J., & Stephanopoulos, G. (2016). *Industrial Biotechnology: Products and Processes*. Volume 4. John Wiley & Sons.
5. Rahman, M. S. (Ed.). (2007). *Handbook of Food Preservation*. 2nd Edition CRC press.



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DIGITAL TOOLS:

1. <https://www.slideshare.net/davidmbwiga1990/lecture-3-intrinsic-and-extrinsic-factors>
2. <https://www.onlinebiologynotes.com/food-preservation-from-microbial-spoilage-principle-and-methods/>
3. https://www.brainkart.com/article/Fermentors_41001/
4. <https://www.slideshare.net/AbhijitDebnath143/production-of-penicillin-citric-acid-vit-b12-glutamic-acid-griseofluvin>
5. <https://microbiologynote.com/citric-acid-production/>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 2 | 3 | 1 | 3 | 2 |
| CO2 | 3 | 2 | 1 | 3 | 2 | 2 |
| CO3 | 2 | 3 | 2 | 3 | 1 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 |
| CO5 | 2 | 3 | 2 | 1 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. K. RAGHAVAN



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| COURSE CODE | COURSE TITLE | ATEGORY | T | P | REDITS |
|-------------|--------------------|-----------------------|---|---|--------|
| 21UMBCP3 | CORE PRACTICAL–III | CORE – 10 PRATICAL | – | 5 | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 40 | 60 | 100 |

| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|
|------------------|---|---|---|

COURSE DESCRIPTION:

The Core practical–III provides practical training to the students in the fields of Medical Microbiology, Immunology, Soil and Agricultural Microbiology.

COURSE OBJECTIVES:

To enable the students

- learn the practical concept on isolation and identification of organisms.
- portray the process of sterilization and antibiotics sensitivity tests.
- outline the role of bacteria, its quantification and methods in isolation.
- emphasize the importance of Nitrogen fixing bacteria and phosphate solubilising bacteria by its isolation from leguminous plants and soil.
- competently perform serological diagnostic tests and identify blood groups.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | acquire technical skills on identification of pathogenic bacteria and antibiotics sensitivity tests. | Upto K3 |
| CO 2 | understand the practical concept on isolation and classification of significant soil microbes. | Upto K3 |
| CO 3 | be aware of various immune cells and enumerate them. | Upto K3 |
| CO 4 | knowledgeably execute serological diagnostic assays. | Upto K3 |
| CO 5 | obtain technical skills on Food and Industrial Microbiology. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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CORE PRACTICAL – III

MEDICAL MICROBIOLOGY

1. Antibiotic susceptibility test: Kirby Bauer Disc Diffusion method
2. Isolation of pathogenic bacteria from clinical specimens: Staphylococcus, Streptococcus, Salmonella, Vibrio

SOIL AND AGRICULTURAL MICROBIOLOGY

1. Isolation and enumeration of soil microbes.
2. Identification of bacterial pathogen in paddy and vegetable crops (field study)
3. Isolation of nitrogen fixing bacteria–Rhizobium, Azotobacter
4. Isolation of phosphate solubilizing bacteria– Pseudomonas
5. Examination of mycorrhizae–VAM
6. Potability testing of water(MPN test)

IMMUNOLOGY

7. Lymphoid organs in experimental animals–mouse/rat/rabbit – Theoretical explanation only.
8. Bleeding techniques – Capillary puncture and Vein puncture.
9. Separation of serum/plasma
10. Erythrocyte Sedimentation Rate (ESR)
11. Blood cell count: RBC count, WBC count–total and differential
12. Blood typing: ABO, Rh
13. Agglutination tests: Widal test
14. Precipitation: Ouchterlony Double Immune Diffusion

FOOD AND INDUSTRIAL MICROBIOLOGY

15. Examination of different food samples.
16. Methylene blue reduction test (MBRT).
17. Alcohol (Ethanol) production using Vitis vinifera.
18. Immobilization of Yeast

TEXT BOOKS:

1. **James G. Cappuccino, Natalie Sherman.** (2013). *Microbiology: A Laboratory Manual*, 10th Ed., Pearson Benjamin Cummings publications, San Francisco.
2. **William Claus. G.W.** (1989). *Understanding Microbes – A Laboratory textbook for Microbiology*, W.H. Freeman and Co., New York.
3. **Dubey, R.C. & D.K. Maheshwari.**(2010). *Practical Microbiology*, S. Chand & Co Pvt Ltd, New Delhi.
4. **Aneja K.R.**(2003). *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*, New Age International Publishers, New Delhi.
5. **Anuradha** (2020). *Practical and Applied Microbiology*, 5th Ed., CBS Publishers & Distributors Pvt. Ltd, India.



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REFERENCE BOOKS:

1. Rangasamy, G and Bagyaraj, D.J. (1993). *Agricultural Microbiology*, 2nd Ed., Prentice–Hall Publications, India.
2. Hleyn Bicknell and Gilstrap.(2001). *Microbiological Experiments: A Health Science perspective*, McGraw–Hill Inc., USA.
3. Kannan. N (2002). *Laboratory Manual in General Microbiology*, Palani Paramount Publications, Palani.
4. Rajan. S and Selvi Christy. (2018). *Experimental Procedures in Life Sciences*, CBS Publishers & Distributors Pvt. Ltd, India.
5. Atlas R.M. (1987). *Microbiology– Fundamentals and Applications*, Macmillan Publishing Company, New York.

DIGITAL TOOLS:

1. <https://in.coursera.org/lecture/antimicrobial-resistance/lecture-7-antimicrobial-susceptibility-testing-SDQ3D>
2. <https://www.youtube.com/watch?v=m9FzmL0Zs3A>
3. <https://www.youtube.com/watch?v=KYSRjtYjiHA>
4. <https://www.youtube.com/watch?v=JzGW9PovzGg>
5. <https://youtu.be/f4MiHUIi2k>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 2 | 1 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. A. R. SARANYADEVI



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|---------------------------------|--------------|---|---|---------|
| 21UMBE51 | COMPUTER APPLICATION IN BIOLOGY | ELECTIVE – 1 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| | | | |
|------------------|---|---|---|
| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|

COURSE DESCRIPTION:

Computer application in biology involves in the application of computational modeling techniques. It is the fundamental theory and programming in the context of problem solving in biology. This course teaches the basic operating system of a computer which help to understand the key concept of bioinformatics.

COURSE OBJECTIVES:

The goal of this study is to make the students

- learn how to operate a computer with basic knowledge.
- understand the Hardware, Software and languages of computer.
- gain the basic knowledge about internet bioinformatics related tools and gene sequences.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | acquire the knowledge on the basic of computer – History, components and devices of a computer. | Upto K3 |
| CO 2 | understand and operate the computer –Word, Excel, Power point and accesses internet. | Upto K3 |
| CO 3 | gain the knowledge about the basic and recent languages of computer–BASIC– FORTRAN | Upto K3 |
| CO 4 | know about the application of computer in biology using phylogenetic tree construction and its methods | Upto K3 |
| CO 5 | understand about the sequence analysis using different software packages– BLAST–FASTA | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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COMPUTER APPLICATION IN BIOLOGY

UNIT– I: Introduction to Computer

History and Generation of computer, Components of computer, Block diagram of computer – Binary number system of computer – Input and output devices of computer – storage devices of computer – Types of computer.

UNIT– II: Operating System

Layers of OS – Types and function of OS. Applications of computer – Word, Excel, Power point & Photoshop. Network Topology – LAN, WAN, MAN. Web browsers – Search Engines, Internet connections, Web pages and E-mail.

UNIT– III: Computer Languages

BASIC, COBOL, JAVA, FORTRAN and ALGOL (Definition and applications only), Applications of Software – Algorithms. Python, Machine learning in Microbiology (A brief account).

UNIT– IV: Phylogenetic Analysis

Steps in Phylogenetic analysis – Phylogenetic Tree Construction Methodologies – Distance Matrix and Character Based Methods – Types – Definition Only

– Structural Prediction – Software for Biomolecular Structure Prediction – MFOLD, ViennaRNA Package – Methods of Structure Prediction – Chou – Fasman Method, GOR Method, Neural Networks and PhD – Brief descriptions only, Digital Biostatistical analysis – Basic, Intermediate and Advance level Biostatistical Packages – examples.

UNIT– V: Similarity Search

Introduction, Sequence Alignment – Pairwise and Multiple Alignments, Global Vs. Local Alignments, Sequence Comparison – Database Search – BLAST, PSI-BLAST, BLAST–N, BLAST–P and WU-BLAST, FASTA and SPLASH –Brief descriptions only.

TEXT BOOKS:

1. Peter Norton, *Introduction to Computers*, 6th Ed., Tata McGraw Hill Publications.
2. Robert Ransom, Raymond J. Matela, *Computer Graphics in Biology*, 2012. British library cataloging in publication data
3. P. K. Singh, *Computer Fundamentals*. 2015. V K Global Publications.
4. Ignacimuthu. S, *Basic Bioinformatics*, 2005, Narosa Publishing House Pvt. Ltd.
5. Attwood. T. K and Parry Smith. D.J. 1999. *Introduction to Bioinformatics*, Pearson Education Asia



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REFERENCE BOOKS:

1. Rajadurai M., *Bioinformatics – A Practical Manual*, PSB Book Enterprises.
2. Martin J. Bishop, *Genetics Databases*, II Ed. Academic Press Publications
3. *Mapping And Sequencing*, The Human Genome National Research Council, Division On Earth And Life Studies, Commission On Life Sciences · 1988. National Academic Press.
4. *Computer Programming in Fortran*, V. Rajaraman. 4th Edition. Printice Hall Of India Pvt. Ltd.
5. *Developing Bioinformatics Computer Skills*. Cynthia Gibas, Per Jambeck, Lorrie Lejeune · 2001. O'Reilley & Associates

DIGITAL TOOLS:

1. https://www.tutorialspoint.com/basics_of_computers/basics_of_computers_introduction.html
2. <https://www.genscript.com/tools.html>
3. <https://bip.weizmann.ac.il/education/course/introbioinfo/03/lect12/phylogenetics.pdf>
4. <https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/development-computer-languages-and-programmers>
5. <https://synbio-tech.com/bioinformatics-tool/>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 1 | 2 | 1 | 3 | 2 | 2 |
| CO2 | 2 | 2 | 1 | 2 | 2 | 3 |
| CO3 | 1 | 1 | 3 | 2 | 2 | 3 |
| CO4 | 3 | 1 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 2 | 2 | 2 | 1 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. V. SELVI



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| COURSECODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|------------|----------------|--------------|---|---|---------|
| 21UMBE52 | BIOREMEDIATION | ELECTIVE – 1 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| | | | |
|------------------|---|---|---|
| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|

COURSE DESCRIPTION:

This course will help the students to gain the knowledge about the environment and the basic microbiological information. It also helps to reduce the pollution and toxic free environment and remove or utilizing the pollutants from the environment. The main *objective* of this course was to gain knowledge about the benefits of bioremediation include lower costs and less disruption of the contaminated environment.

COURSE OBJECTIVES:

To enable the students

- reduce toxicity in the environment.
- receive scientific information about bioremediation and hazardous waste in water and soil environment.
- gain the basic knowledge of different types of pollution occur in the environment and prevent the environment from pollutants.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | receive knowledge of bioremediation and technologies. | Upto K3 |
| CO 2 | gain expertise on different types of pollutions. | Upto K3 |
| CO 3 | gain knowledge on the accumulation of various gaseous in the environment. | Upto K3 |
| CO 4 | explain about the major environmental contaminants– Organic and industrial Waste | Upto K3 |
| CO 5 | explain the importance of waste water treatment and impact of using microbes in treatment. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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BIOREMEDIATION

UNIT– I: Bioremediation

Biodegradation – Biotransformation– Definition. Application and advantages of bioremediation. Bioremediation constraints and priorities. Factors affecting bioremediation.

UNIT– II: Pollutions

Types of pollutants – Water (Fresh and marine water), Soil and Air – Sources of pollution and their impact on environment.

UNIT– III: Environmental Pollution (Air and Water) and Contaminants

Recalcitrant compounds and pollutant – Categorization of contaminants– Carbon, Hydrogen and Sulphur content and density effects on the environment.

UNIT– IV: Bioremediation of Contaminants

a) Organic waste – Nature and decomposition – Mineralization and Immobilization – Microbes involved – Anaerobic decomposition of organic Matter.

B) Waste water – Environmental Impact

C) Industrial waste water – Types and component, Effects, Conventional strategies for waste water management.

UNIT– V: Treatment and Disposal of Waste Waters

Domestic sewage –Primary, Secondary and Tertiary treatment – Microbes in waste water treatment.

TEXT BOOKS:

1. Rajendran. P and Gunasekaran P, 2006. *Microbial Bioremediation*.
2. Amitava Rakshit, Manoj Parihar, Binoy Sarkar, *Bioremediation Science: From Theory to Practice*, 2021. CRC PRESS.
3. Ram Chandra, *Advances in Biodegradation and Bioremediation of Industry*, 2015. CRC PRESS.
4. Ram Naresh Bharagava *Environmental Pollutants and their Bioremediation Approaches*, 2017. CRC PRESS
5. Naofumi Shiomi, *Advances in Bioremediation of Wastewater and Polluted Soil*, 2015. CRC PRESS

REFERENCE BOOKS:

1. Atlas. R and Bartha R 2003, *Microbiology Ecology*, 2nd Ed., Pearson Education Publications.
2. *Microbial Bioremediation & Biodegradation*, Maulin P. Shah, 2020. Springer Nature Singapore PVT Ltd.
3. *Environmental Pollution*, S.M. Shafi · 2005. Atlantic Publishers and Distributors
4. *The Science of Environmental Pollution*, Frank R. Spellman · 2021. Library of Congress Cataloging in Publication Data
5. *Handbook of Water and Wastewater Treatment Technologies*, Nicholas P Cheremisinoff · 2002. Butterworth and Heinemann



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DIGITAL TOOLS:

1. <https://www.renewableresourcescoalition.org/pollution-causes-effects/>
2. <https://microbiologynote.com/bioremediation/>
3. <https://www.intechopen.com/books/wastewater-treatment-engineering/biological-and-chemical-wastewater-treatment-processes>
4. <https://www.epa.gov/sites/default/files/2019-02/documents/emerging-tech-wastewater-treatment-management.pdf>
5. <https://pubs.acs.org/doi/abs/10.1021/acs.est.5b00715>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 1 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 3 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | 1 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. V. SELVI



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|--|--------------|---|---|---------|
| 21UMBE53 | FERMENTATION AND BIOPROCESS TECHNOLOGY | ELECTIVE – 1 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| | | | |
|------------------|---|---|---|
| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|

COURSE DESCRIPTION:

This course emphasizes the fermentation and bioprocess technologies. It's the scientific study of the fundamentals, development, implementation and the operation of bioprocesses in the production process in large scale industries. The Primary and Secondary metabolites of various substance produced during the mass cell production. Control of biomass production using computer enrich the knowledge of computer application in the industries.

COURSE OBJECTIVES:

- To make the students learn the fermentation process and bioreactors
- To make the students understand the basic knowledge of production process techniques
- To make the students gain the basic knowledge to operate a computer in the control of biomassproduction in large scale industries

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|-----|---|---|
| CO1 | outline the concept of fermentation methods and its modes. | Upto K3 |
| CO2 | understand the knowledge of basic fermenter designs and its types. | Upto K3 |
| CO3 | explain the production process using the microorganisms | Upto K3 |
| CO4 | know about the application of commercially important Primary and Secondary metabolites process. | Upto K3 |
| CO5 | get educated to control the bioprocess using computer application skills. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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FERMENTATION AND BIOPROCESS TECHNOLOGY

UNIT– I: Fermentation Methods

Advantages and modes of fermentation techniques –Batch, Fed batch and continuous fermentation

UNIT– II: Bioreactors

Designs –Types of bioreactors – Airlift, CSTR, and Bubble column bioreactor.

UNIT– III: Industrial Fermentation Production Process

Antibiotic (Penicillin), Vitamins (VitaminB12), Solvent (Ethanol).

UNIT– IV: Biomass Production

Steps in bioprocess, Primary and Secondary metabolites, Enzymes and microbial cells production.

UNIT– V: Uses of Computer in Bioprocess

Instrumentation and control of bioprocess, Computer application in the control of bioprocess, Advantage and disadvantage of bioprocess techniques.

TEXT BOOKS:

1. Patel A.H.1985. *Industrial Microbiology*, Macmillan India Pvt. Ltd.Cassida, 1994.
2. **Aydin Berenjian**, 2019. Springer Nature Switzerland PVT Ltd.
3. *Principles and Applications of Fermentation Technology*, Vinay Sharma, Arindam Kuila · 2018. Scrivener publishing.
4. *Fermentation Technology*, Ray Medina, 2019. ED–TECH Press
5. *Bioreactors: Sustainable Design and Industrial Applications*, Lakhveer Singh, Abu Yousuf, Durga Madhab Mahapatra, 2020. Library of Congress Cataloging in Publication Data

REFERENCE BOOKS:

1. Young M.M.2004. *Comprehensive Biotechnology, Principles and Applications and Regulations of Biotechnology in industry, Agriculture and Medicine*, Vol – 1,2,3 and 4. Reed Elsevier Pvt. Ltd.
2. Stanbury, P.F., Whitaker, A and Hall, S.J. 1995. *Principles of Fermentation Technology*.2nd Ed., Elsevier India Pvt. Ltd.
3. *Principles of Fermentation Technology* Peter F. Stanbury, Allan Whitaker, Stephen J. Hall · 2013. library cataloging in publication data.
4. *Fermentation Microbiology and Biotechnology*, Second Edition, E. M. T. El-Mansi, C. F. A. Bryce, Arnold L. Demain · 2006. Taylor & Francis.
5. *Microbial Technology: Fermentation Technology*, H. J. Peppler, D Perlman· 2014. 2nd vol. Academic Press.

DIGITAL TOOLS:

1. <https://www.sartorius.com/en/products/fermentation-bioreactors>
2. <http://www.biologydiscussion.com/biotechnology/bioprocess-technology/primary-metabolites-secondary-metabolites-and-bioconversions/10126>
3. <https://www.learninsta.com/industrial-production-of-penicillin/>
4. <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/>
5. <https://www.masterclass.com/articles/what-is-fermentation-learn-about-the-3-different-types-of-fermentation-and-6-tips-for-homemade-fermentation>



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Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 2 | 3 | 3 | 2 | 3 |
| CO2 | 1 | 2 | 3 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 1 | 3 | 2 | 3 |
| CO4 | 1 | 2 | 2 | 2 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 2 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. V. SELVI



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| COURSECODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|------------|--------------|----------|---|---|---------|
| 21UMBS51 | BIOCONTROL | SBS – 5 | 2 | – | 2 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | V | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

This course highlights the concepts of biological control of insects, mites and weeds in natural and managed ecosystems. Biocontrol reduces the pest population and their impacts on the environment. Bio fertilizers can be expected to reduce the use of synthetic fertilizers and pesticides. Introducing of natural enemies to the environment are capable of sustaining themselves, often by reducing whatever pest population they are supposed to manage.

COURSE OBJECTIVES:

- To explain IPM and biopesticides
- To express the ecological, physiological and biochemical process involved in biological control.
- To outline the bacterial, fungal and viral biopesticides.
- To educate the students about the advantages of biocontrol and its applications.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|--|
| CO 1 | understand the basic strategies for biological pest control agents. | Upto K3 |
| CO 2 | know about the biological interaction of predation and predators. | Upto K3 |
| CO 3 | gain the knowledge of bacteria and fungi used as a biopesticides with examples. | Upto K3 |
| CO 4 | explain about the viral biopesticides. | Upto K3 |
| CO 5 | outline natural control methods of weeds and plant extracts. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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BIOCONTROL

UNIT– I: Pest Management

Principles of IPM, Integrated pest management – Rodent pest management – Biocontrol agents with examples, Advantages and application of biocontrol agents– Synthetic and chemical pesticides (comparison), Organic farming.

UNIT– II: Biology and Ecology of Organisms for Biocontrol

Predators, parasites and parasitoids– Nematodes.

UNIT– III: Biopesticides

Bacterial biopesticides – *Bacillus thuringensis*, *B. sphaericus*, and *Pseudomonas chlororaphis*. Fungal biopesticides, *Metarizyum Verticillium*, *Trichoderma* and *Beauveria bassiana* – potentials and limitations.

UNIT– IV: Viral Biopesticides

Nuclear Polyhedro virus, Granulosis virus, CPV and Endomopox virus– potentials and limitations.

UNIT– V: Biological Control of Weeds

Weeds management and methods of weed control– Advantages and disadvantages of biocontrol weeds – *Mycoherbicides* and *Phytophthora palmivora*. Plant extracts – Neem , Onion, Tobacco and Pudina.

TEXT BOOKS:

1. Roy G. Van Driesche and Bellows Jr. TS., *Biological Control – Guide to its applications*, Springer (1996).
2. *Hand Book of Biological Control. Principles and Application of Biological Control*. 1999. Thomas S. Bellows and T.W. Fisher
3. Kumerasan, *Biotechnology*, Saras Publication
4. *Handbook of Biological Control: Principles and Applications*. T. W. Fisher, Thomas S. Bellows, L. E. Caltagirone · 1999. Academic Press
5. *Integrated Pest Management: Current Concepts and Ecological Perspective*. Dharam P Abrol · 2013. Academic Press

REFERENCE BOOKS:

1. Helmut Fritz Van Embden and Service MW, *Pest and Vector Control*, Cambridge University Press (2004).
2. Martin. *Biological Control of Insect Pests Using Egg Parasitoids Hardcover* – 26 Aug 2013 by S. Sithanantham (Editor), Chandish R. Ballal (Editor)
3. Atlas R and Bartha R 1987. *Microbial Ecology*. 2nd Edition, Benjami Cummings Publications.
4. Sudisha Jogaiah, *Biocontrol Agents and Secondary Metabolites: Applications* , 2020. library cataloging in publication data
5. *Biopesticides: Volume 2: Advances in Bio-inoculants* Amitava Rakshit, Vijay Singh Meena, P.C. Abhilash · 2021. Woodhead publishing



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DIGITAL TOOLS:

1. <https://www.farmbiosecurity.com.au/what-is-integrated-pest-management/>
2. <https://www.frontiersin.org/articles/10.3389/fsufs.2021.619058/full>
3. https://agritech.tnau.ac.in/agriculture/agri_weedmgt_biologymethod.html
4. <https://ipm.ucanr.edu/what-is-ipm/>
5. <https://www.intechopen.com/chapters/44118>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 2 | 1 | 3 | 3 | 3 | 3 |
| CO2 | 1 | 2 | 2 | 3 | 2 | 2 |
| CO3 | 1 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 3 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. V. SELVI



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COURSE STRUCTURE – VI SEMESTER

| S. No. | Subject Code | Subject Title | Hrs./ Week | Exam (Hrs.) | CA | SE | Total Marks | Credits |
|--------|----------------------------------|--|------------|-------------|----|----|-------------|-----------|
| 1. | 21UMBC61 | Part – III: Core – 11: Virology | 5 | 3 | 25 | 75 | 100 | 5 |
| 2. | 21UMBC62 | Part – III: Core – 12: Biochemistry and Enzymology | 4 | 3 | 25 | 75 | 100 | 4 |
| 3. | 21UMBC63 | Part – III: Core – 13: rDNA Technology | 4 | 3 | 25 | 75 | 100 | 4 |
| 4. | 21UMBCP4 | Part – III: Core – 14: Practical – IV: Core Practical – IV | 5 | 3 | 40 | 60 | 100 | 4 |
| 5. | Part – III: Elective – 2: | | 5 | 3 | 25 | 75 | 100 | 5 |
| | 21UMBE61 | Bioinformatics | | | | | | |
| | 21UMBE62 | Biotechnology | | | | | | |
| | 21UMBE63 | IPR, Bioethics and Biosafety | | | | | | |
| 6. | Part – III: Elective – 3: | | 5 | 3 | 25 | 75 | 100 | 5 |
| | 21UMBE64 | Analytical Microbiology | | | | | | |
| | 21UMBE65 | Mycology | | | | | | |
| | 21UMBE66 | Parasitology | | | | | | |
| 7. | 21UMBS61 | Part – IV: SBS – 6: Pharmaceutical Microbiology | 2 | 3 | 25 | 75 | 100 | 2 |
| 8. | 21UGKY61 | General Knowledge (Self-Study) | – | – | – | – | 100 | – |
| | | TOTAL | 30 | | | | 800 | 29 |

*One elective course to be chosen from THREE courses

CA – Class Assessment (Internal)

SE – Summative Examination

SBS – Skill Based Subject

T – Theory

P – Practical



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| COURSE CODE | COURSE TITLE | ATEGORY | T | P | REDITS |
|-------------|--------------|-----------|---|---|--------|
| 21UMBC61 | VIROLOGY | CORE – 11 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|
|------------------|---|---|---|

COURSE DESCRIPTION:

The Virology course offers an overview of important virus families, their replication strategies and mechanisms for development of viral infectious diseases.

COURSE OBJECTIVES:

- To provide the students an understanding of virus architecture and replication strategies.
- To help them elucidate pathogenesis of diseases caused by viruses.
- To make them gain knowledge on clinical aspects and related implications of viral diseases.
- To describe the general method of viral lifecycle to the students
- To enable them acquire knowledge on viral vaccines and antiviral drugs.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | understand the historical development and basics of virology & assay of viruses. | Upto K3 |
| CO 2 | learn the reproductive pathway of phages. | Upto K3 |
| CO 3 | receive the knowledge about replication strategy animal viruses. | Upto K3 |
| CO 4 | analyse of the replication strategy of plant viruses. | Upto K3 |
| CO 5 | acquire knowledge about human viral infections and antiviral therapies. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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VIROLOGY

UNIT– I:

Introduction – History, Structure & Composition of Viruses, Cultivation of Viruses – Methods, Assay and Purification Methods.

UNIT– II:

Bacteriophages – Replication, One Step Growth Curve, Lytic (T4 and Lambda), and Lysogenic (P1 & Lambda) replication of bacteriophages. Filamentous phages – M13 and Q β , Structure, Replication and applications.

UNIT– III:

Animal viruses –Structure and Replication of Simion Virus 40, Herpes Simplex Virus, Adenoviruses, Poxviruses and Retroviruses.

UNIT– IV:

Plant viruses –Structure and Replication of Tobacco Mosaic Virus , Cauliflower Mosaic Virus and Cucumber Mosaic Virus, Prions and Viroids.

UNIT– V:

Human viral infections – Symptoms and Pathogenesis of Common cold, Influenza, Zika fever, Rubella, Mumps, Measles, and Chicken pox. Antiviral drugs, Interferons and Phage therapy.

TEXT BOOKS:

1. Dimmock, N. J., Easton, A.J and Leppard, K. N. (2016). *Introduction to Modern Virology*, 7th Ed., Blackwell Scientific Publications. Oxford.
2. Luria, S.E., Darnel, J.E., Jr., Baltimore, D. and Campbell. A, (1978), *General Virology*, 3rd Ed., John Wiley & Sons, New York.
3. Greenwood, D., Slack, R.B., and Peutherer, J.F (2007). *Medical Microbiology*, 17th Ed., Churchill Livingstone publishers, London.
4. Morag C. and Timbury M.C. (1994). *Medical Virology*, 10th Ed., Churchill Livingstone publishers, London.
5. Conrat, HF, Kimball, PC and Levy JA, (1994). *Virology*, 12th Ed., Prentice Hall, Englewood Cliff. New Jersey.

REFERENCE BOOKS:

1. Joanne Willey, Kathleen Sandman and Dorothy Wood, (2020). *Prescott's Microbiology*, 11th Ed, McGraw Hill Publications, Australia.
2. Alan J. Cann, (2015). *Principles of Molecular Virology*, 6th Ed., Academic Press, USA.
3. John Carter, (2007). *Virology: Principles and Applications*, 1st Ed., Wiley Publications, USA.
4. Nicholas H. Acheson, (2011). *Fundamentals of Molecular Virology*, 2nd Ed., John Wiley & Sons Inc., New York.
5. Balasubramanian, A. and Senthil kumar, P.K, (2017). *Medical Microbiology*, Darshan Publication, Rasipuram.



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DIGITAL TOOLS:

1. <https://microbenotes.com/category/virology/>
2. <https://www2.nau.edu/~fpm/bio205/Sp-08/Chapter-06.pdf>
3. <https://paramedicsworld.com/microbiology-notes/virology-notes/medical-paramedical-studynotes>
4. <https://www.ncbi.nlm.nih.gov/books/NBK8098/>
5. <https://microbiologynotes.org/virology-introduction-virus-classification-and-viral-diseases/>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 1 | 1 |
| CO3 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. A. R. SARANYADEVI



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|-----------------------------|-----------|---|---|---------|
| 21UMBC62 | BIOCHEMISTRY AND ENZYMOLOGY | CORE – 12 | 4 | – | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

This course gives knowledge about the basic biochemistry concepts and metabolic pathways.

COURSE OBJECTIVES:

To make the students

- study the structure and composition of biomolecules
- acquire knowledge in carbohydrate and fat metabolism
- understand the structure of proteins
- comprehend the nomenclature and function of enzymes
- explore the applications of enzymes in large scale

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|---|
| CO 1 | understand structure and composition of biomolecules | Upto K3 |
| CO 2 | outline the carbohydrate and fat metabolism | Upto K3 |
| CO 3 | summarise the structure of proteins | Upto K3 |
| CO 4 | differentiate enzymes based on their function | Upto K3 |
| CO 5 | highlight the use of enzymes in industrial sector | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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BIOCHEMISTRY AND ENZYMOLOGY

UNIT– I: Bioenergetics

Water and Life – pH and Buffers; Laws of Thermodynamics, Oxidation and Reduction reactions – Redox potential, Free energy – Exothermic and Endothermic reactions.

UNIT– II: Carbohydrates and Lipids

Carbohydrates – Classification and Physical and Chemical properties (brief); Carbohydrates pathway – Glycolysis, TCA Cycle, Oxidative Phosphorylation; Lipids and Fatty acids – Classification – Physical and Chemical properties (brief), Fatty acid Biosynthesis and Oxidation (β -Oxidation), Normal values of Blood glucose level.

UNIT– III: Amino Acids and Proteins

Amino acids – Classification – Properties – Biosynthesis (Glutamic acid and Lysine); Proteins – Classification and Structure – Primary, Secondary, Tertiary and Quaternary, Normal values of Urea and Creatinine.

UNIT– IV: Enzyme Kinetics

Enzymes – Nomenclature, Classification and Properties, Steady State Kinetics and derivation of Michaelis–Menten equation and Lineweaver Burk Equation plot. Mechanism and action of enzymes–Lock and Key model.

UNIT– V: Regulatory Enzymes

Allosteric enzymes –Aspartate transcarbamylase – Multienzyme Complex – Pyruvate Dehydrogenase, Extraction and Purification of Enzymes, Applications of Enzymes (Clinical & Industrial).

TEXT BOOKS:

1. Lehninger, A. L., Nelson, D. L., Cox, M. M. (2013). *Lehninger principles of biochemistry*. 6th Edition, United Kingdom: W. H. Freeman.
2. Berg, J. M., Gatto, G. J., Stryer, L., Tymoczko, J. L. (2015). *Biochemistry*. United States: W. H. Freeman.
3. Satyanarayana, U. (2021). *Biochemistry*, 6e–E–book. Elsevier Health Sciences.
4. Branden, C. I., & Tooze, J. (2012). *Introduction to protein structure*. 2nd Edition Garland Science.
5. Jain, J. L. (2018). *Fundamentals of biochemistry*. 7th Edition, S. Chand Publishing.

REFERENCE BOOKS:

1. Palanivelu, P. (2000). *Analytical Biochemistry and Separation Techniques*, 3rd Ed., 21st Century Publications.
2. Kennelly, P. J., Botham, K. M., McGuinness, O., Rodwell, V. W., & Weil, P. A. (2022). *Harper's illustrated biochemistry*. 31st Edition, McGraw Hill Professional.
3. Okotore, R. O. (2015). *Essentials of Enzymology*. 1st Edition, Xlibris Corporation.
4. Voet, D., & Voet, J. G. (2010). *Biochemistry*. 4th Edition, John Wiley & Sons.
5. Lundblad, R. L., & Macdonald, F. (Eds.). (2018). *Handbook of Biochemistry and Molecular Biology*. 5th Edition CRC press.



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DIGITAL TOOLS:

1. <https://www.sfu.ca/~mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf>
2. <https://www.osmosis.org/learn/Glycolysis>
3. <https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch450-and-ch451-biochemistry-defining-life-at-the-molecular-level/chapter-2-protein-structure/>
4. <https://microbenotes.com/enzymes-properties-classification-and-significance/>
5. <https://www.docsity.com/en/allosteric-enzymes-biochemistry-lecture-slides/721578/>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 2 | 3 | 1 |
| CO3 | 3 | 2 | 3 | 3 | 1 | 2 |
| CO4 | 2 | 3 | 2 | 1 | 2 | 3 |
| CO5 | 1 | 1 | 2 | 1 | 2 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. K. RAGHAVAN



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|-----------------|-----------|---|---|---------|
| 21UMBC63 | rDNA TECHNOLOGY | CORE – 13 | 4 | – | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| | | | |
|------------------|---|---|---|
| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|

COURSE DESCRIPTION:

This course offers tools and techniques employed in rDNA Technology.

COURSE OBJECTIVES:

To enable the students

- understand the use of tools and techniques for manipulation and analysis of genes.
- gain the knowledge of the different types of vectors
- understand the construction of libraries
- comprehend the different techniques for the screening of clones.
- get exposed to the applications of recombinant technology.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|--|
| CO 1 | understand the principles, methods and tools associated with recombinant technology. | Upto K3 |
| CO 2 | characterize the events in cloning. | Upto K3 |
| CO 3 | perceive the methods of the construction of libraries | Upto K3 |
| CO 4 | understand the different techniques for the selection of clones | Upto K3 |
| CO 5 | learn the various applications of recombinant DNA technology. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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rDNA TECHNOLOGY

UNIT – I: Introduction to Gene Manipulation

Common Steps involved in rDNA technology; Restriction– Modification System– Types of Restriction Endonucleases– Properties and Applications–Nomenclature. Recognition sequences; Cleavage Patterns; DNA manipulative enzymes– Nucleases, Ligases, Polymerases, Manipulative enzymes– Alkaline phosphatase, Polynucleotide kinase, Terminal transferase. Linkers and Adaptors

UNIT – II: Cloning Vectors

Characteristics of an ideal vector–Plasmids – pBR 322 and pUC vectors, Cosmids, Bacteriophages– λ Bacteriophage– Insertion vectors– λ gt10, Replacement vectors–EMBL4, Prokaryotic Expression Vectors, Broad–Host Range and Shuttle vectors, Eukaryotic vectors – YAC vectors.

UNIT – III: Cloning and Strategies

Cloning in *Escherichia coli* and *Bacillus*. DNA Amplification–PCR and DNA sequencing– Sanger method and Maxam–Gilbert method; Construction and Screening of Genomic library and cDNA library.

UNIT – IV: Methods for Clone Identification

Recombinant Selection– Blue/White, Blotting – Southern, Colony and Plaque Hybridization and Immunological detection method.

UNIT – V: Applications of Recombinant DNA Technology

A) Agricultural – Ti Plasmid and their uses B) Pharmaceutical Industries: Production of Insulin, Interferon, Growth Hormone and Blood Clotting factors from microorganisms. C) Protein Engineering D) Drug discovery and Drug development (a brief account) and E) Transgenic Plants (Insect resistant) and animals (Sheep). Biohazards and Biosafety (a brief account).

TEXT BOOKS:

1. Brown, T.A. (2010), *Gene Cloning and DNA Analysis–An Introduction*, 6th edn. Blackwell Science
2. Sandy B. Primrose and Richard Twyman, 2006. *Principles of Gene Manipulation and Genomics*, 7th Ed, 2006, Blackwell Publishing.
3. Sathyanarayana U., 2008, *Biotechnology*, 2nd Ed., Arunabha Sen Books and allied Publications Limited.
4. Desmond S.T. Nicholl, *An Introduction to Genetic Engineering*, 3rd Edition, Cambridge University Press, 2012.
5. K.Rajagopal, *Recombinant DNA Technology and Genetic Engineering*, TATA McGraw Hill, 2012.

REFERENCE BOOKS:

1. Bourgaize jewell. Buiser. *Biotechnology–Demystifying the Concepts*– Pearson Education.
2. Helen kraizer and Adrienne Massey– *Recombinant DNA Technology– A Guide for Teachers*. 2nd Ed.
3. Glick B.R and Pasternak. J.J *Molecular Biotechnology*, 2nd Ed, 2003. ASM press.
4. William J. Thieman Michael A.Palladino, *Introduction to Biotechnology* 3rd Edition, 2014, Pearson Education Ltd.
5. Jermy W. Dale and Malcolm Won Schantz, *From Gene to Genomes, Concepts and Application of DNA Technology*, 2007, John Wiley & Sons Ltd.



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DIGITAL TOOLS:

1. <https://bio.libretexts.org/Bookshelves/Genetics>
2. Blue white screening– <https://youtu.be/VocpyyrmVpA>
3. <https://youtu.be/3oGrVSTJa8I>
4. <https://www.biologydiscussion.com/genetics/construction-of-genomic-library-genetics/71924>
5. cDNA library– <https://youtu.be/FtNreXY7poA>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 2 | 1 | 2 | 3 |
| CO2 | 3 | 2 | 1 | 1 | 2 | 3 |
| CO3 | 2 | 2 | 2 | 1 | 3 | 3 |
| CO4 | 1 | 2 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 3 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. N. B. SHARMILA



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|---------------------|---------------------|---|---|---------|
| 21UMBCP4 | CORE PRACTICAL – IV | CORE – 14 PRACTICAL | – | 5 | 4 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 40 | 60 | 100 |

| | | | |
|------------------|---|---|---|
| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|

COURSE DESCRIPTION:

The Core Practical – IV *course* provides practical training to the students in the fields of Biochemistry, rDNA technology and Virology.

COURSE OBJECTIVES:

- To facilitate students in viral culturing techniques.
- To make the students analyze bio–molecules by separation techniques.
- To help them get expertise in estimation of various bio–molecules.
- To make them acquire knowledge about isolation and identification of DNA.
- To teach the essentials of Bioinformatics.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|--|
| CO 1 | understand evaluation of bio–molecules. | Upto K3 |
| CO 2 | analyse bio–molecules by partition techniques. | Upto K3 |
| CO 3 | obtain vital knowledge on rDNA technology. | Upto K3 |
| CO 4 | acquire knowledge about viral culturing techniques. | Upto K3 |
| CO 5 | receive information about basics of Bioinformatics and its application in research. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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CORE PRACTICAL – IV

1. Estimation of Carbohydrates – 3, 5–Dinitrosalicylic acid (DNSA) Method.
2. Estimation of Proteins – Lowry's Method.
3. Separation of amino acids by Paper Chromatography.
4. Bacterial Transformation (Blue/White Selection).
5. Restriction Digestion Analysis
6. Biological Databases – GenBank and PIR – Demonstration only.
7. Egg Inoculation Technique – Demonstration only.
8. Isolation and separation of plasmid DNA

TEXT BOOKS:

1. Palanivelu, P. (2019). *Analytical Biochemistry and Separation Techniques*, 6th Ed., Twenty first Century Publications, Punjab.
2. Jeffrey H. Miller. (1992). *A Short Course in Bacterial Genetics*, Cold Spring Harbour Laboratory Press, New York
3. Arthur M. Lesk (2019). *Introduction to Bioinformatics*, 5th Ed., Oxford University Press.
4. Alan J. Cann, (2015). *Principles of Molecular Virology*, 6th Ed., Academic Press, USA.
5. Rajan. S and Selvi Christy. (2018). *Experimental Procedures in Life Sciences*, CBS Publishers & Distributors Pvt. Ltd, India.

REFERENCE BOOKS:

1. Tiwari, G. S., Hoondal, (2005). *Laboratory Techniques in Microbiology & Biotechnology*, Swastik publishers, India.
2. Wilson. K and Goulding. K.H, (1986). *A Biologists Guide to Principles and Techniques of Practical Biochemistry*, ELBS, London.
3. K. R. Aneja, (2018). *Laboratory Manual of Microbiology and Biotechnology*, Ed-tech Pvt. Ltd, India.
4. Click. B.R. and–Pasternak J.J. (2002). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, ASM press. Washington DC.
5. Rastogi S.C, (2019). *Bioinformatics: Concepts Skills and Applications*, 2nd Ed., CBS Publishers, New Delhi.

DIGITAL TOOLS:

1. <https://www.youtube.com/watch?v=tDaKxskUwA0>
2. <https://www.youtube.com/watch?v=k2xx7jIW3E8>
3. <https://www.youtube.com/watch?v=k-v-cjGyaxM>
4. <https://www.youtube.com/watch?v=Eg9JIq9HvMg>
5. <https://www.youtube.com/watch?v=WZbAfQ58eCw>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 2 | 3 | 3 | 2 | 2 | 3 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 1 | 3 | 1 |
| CO5 | 3 | 3 | 1 | 2 | 1 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. A. R. SARANYADEVI



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| COURSECODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|------------|----------------|--------------|---|---|---------|
| 21UMBE61 | BIOINFORMATICS | ELECTIVE – 2 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|
|------------------|---|---|---|

COURSE DESCRIPTION:

Bioinformatics is an interdisciplinary field of Science that deals with biological information. It is the computer aided study of biological data. This course helps to develop research and development skill. It also focuses the application of computational methods of biological data analysis and usage of software. Students can obtain the essential qualities necessary for success in a rapidly changing technological environment.

COURSE OBJECTIVES:

- To enhance the students' knowledge of the basic principles and concepts of biology, computer science and mathematics.
- To help them identify and apply logic skills of gene sequence molecular modeling and determine their function.
- To introduce the various scientific journals which help them augment their thirst for research interest.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | know about the basics of Bioinformatics and data information. | Upto K3 |
| CO 2 | know about sequence analysis , similarities using different software | Upto K3 |
| CO 3 | strongly understand the data storage methods and drug discovery. | Upto K3 |
| CO 4 | receive updated information about the recent journals enhance the quality of students | Upto K3 |
| CO 5 | enlarge the knowledge on the application of computer. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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BIOINFORMATICS

UNIT–I: Introduction to Bioinformatics

Scope of Bioinformatics – Biological Databases– Types of Databases– Primary (EMBL), Secondary (PDB) and composite databases, Protein sequence databases (SWISS PROT) – Application of Bioinformatics.

UNIT–II: Sequence Analysis

Basic concepts of sequence similarity, identity and homology (Definition only) – Gene prediction method, RNA fold analysis – GEN BANK, CLUSTALW

UNIT–III: Data Storage

File format, Data Transfer, 3D structure visualize structure – RASMOL – Molecular modeling, Ramachandran Plot.

UNIT–IV: Biological Websites

PubMed, Medline, Science daily, Microbiology online, Science Journals, Google scholar, Reference Manager, Science direct, Springer – ISSN, ISBN and Impact factor.

UNIT–V: Accessing Information Through Internet

Bionet Newsgroups– WWW Software –HTTP and HTML. Plagiarism and paraphyses Tools.

TEXT BOOKS:

1. Hooman H. Rashidi and Lukas K. Buehler, *Bioinformatics Basics – Applications in Biological Science and Medicine*, CRC Press, Washington D. C.
2. Ignacimuthu. S 2005, *Basic Bioinformatics*, Narosa Publishing house, Pvt. Ltd.
3. Attwood T. K and Parry Smith. D.J. 1999. *Introduction to Bioinformatics*, Pearson Education Asia.
4. Andreas D. Baxevanis, B. F. Francis Ouellette, *Bioinformatics: A Practical Guide to the Analysis of Genes*. 2004. Vol-3. Second Edition. Wiley Publication.
5. Supratim Choudhuri, *Bioinformatics for Beginners: Genes, Genomes, Molecular*, 2014. Academic Press

REFERENCE BOOKS:

1. Jin Xiong, *Essential Bioinformatics*, Cambridge Publications.
2. Arthur M. Lesk, *Introduction to Bioinformatics*, Oxford University Press.
3. Arthur M. Lesk, *Introduction to Bioinformatics*. Oxford University Press–2003.
4. Prakash S. Lohar. *Bioinformatics*. 2009 MJP Publications.
5. S. Harisha *Fundamentals of Bioinformatics*. 2013. International Publication Data.

DIGITAL TOOLS:

1. <https://www.ck12.org/computer-fundamentals/block-diagram-of-computer-system/>
2. <https://www.ncbi.nlm.nih.gov/pubmed/>
3. <https://onlinelibrary.wiley.com/>
4. <https://www.geeksforgeeks.org/types-of-biological-database-in-bioinformatics/>
5. <https://thebiologynotes.com/biological-databases-types-and-importance/>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 1 | 2 | 3 | 2 | 3 | 3 |
| CO2 | 2 | 2 | 3 | 1 | 3 | 2 |
| CO3 | 2 | 1 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 3 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. V. SELVI



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|---------------|--------------|---|---|---------|
| 21UMBE62 | BIOTECHNOLOGY | ELECTIVE – 2 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| | | | |
|------------------|--|--|---|
| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|

COURSE DESCRIPTION:

This course will explore the principles and applications of recombinant DNA technology.

COURSE OBJECTIVES:

- To describe the methods and tools in biotechnology
- To elucidate the methods involved in animal and plant biotechnology.
- To make the students acquire the knowledge on various applications of Biotechnology.
- To guide the students learn to define the various forms of intellectual property and the organisations involved.
- To make the students learn the biosafety levels and good laboratory practices for qualitymanagement

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|---|
| CO 1 | understand the different tools and methods are employed in the laboratory for manipulation of DNA | Upto K3 |
| CO 2 | become familiar with various cloning strategies in prokaryotes and eukaryotes | Upto K3 |
| CO 3 | become familiar with the methods of Plant and Animal Tissue Culture and their applications and highlight the design and working mechanism of bioreactor | Upto K3 |
| CO 4 | become aware of the various biological applications for Human Welfare. | Upto K3 |
| CO 5 | understand the importance of IPR, the social and ethical issues concerning biological materials. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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BIOTECHNOLOGY

UNIT-I: Introduction to Genetic Engineering

DNA manipulative and modification enzymes; Cloning and Expression vectors; Gene Cloning strategies.

UNIT-II: Animal Biotechnology

Animal cell culture, culture media – Primary culture and Cell Lines, Tissue Engineering. Transgenic animals and their applications – Knockout mice, Transgenic cattle, Transgenic sheep.

UNIT-III: Plant Biotechnology

Plant tissue culture – media – applications, gene transfer mechanism. Transgenic plants – insect resistance, virus resistance, herbicide resistance.

UNIT-IV: Biotechnology for Human Welfare

Medical Biotechnology – Gene Therapy, Diagnosis and Medical Forensics, Pharmaceutical products, Recombinant vaccines, Monoclonal Antibodies.

UNIT-V: Intellectual Property Rights

GATT and IPR, different forms of IPR, IPR in India, patent co-operation treaty, forms of patents, process of patenting, Indian and international agencies involved in patenting, patenting biological materials. Biosafety – Biosafety cabinets and their types. Bioethics – Bioethical issues and conflicts in developing the GMOs.

TEXT BOOKS:

1. Dubey, R. C. (2007). *A Text book of Biotechnology*, 5th edition. New Delhi: S.Chand & Company Ltd.
2. Satyanarayana, U. (2010). *Biotechnology*, 1st edition. Kolkata: Books and Allied (P)Ltd.
3. Ashish S. Verma, Anchal Singh, *Animal Biotechnology: Models in Discovery and Translation*, 2020. Library of Congress in Publication Data.
4. Birbal Singh, Gorakh Mal, Sanjeev K. Gautam, *Advances in Animal Biotechnology*, 2019. Springer.
5. Mitchell L. Gaynor, MD, *The Gene Therapy Plan*: Penguin Books, 2016.

REFERENCE BOOKS:

1. Brown T.A., *Gene Cloning and DNA Analysis*. 2nd Edition, ASM press. (2004).
2. Sandy Primrose. *Principles of Gene Manipulation and Genomics*. 7th Ed., Blackwell Publishers. (2006).
3. Glick B.R and Pasternak. J.J, *Molecular Biotechnology*, 2nd Ed. ASM press. (2003).
4. C. Neal Stewart, Jr. *Plant Biotechnology and Genetics*, 2016. John Wiley and Sons. 2016.
5. Desmond S. T. Nicholl, *An Introduction to Genetic Engineering*, 2nd Ed., Cambridge University Press, 2002.

DIGITAL TOOLS:

1. Blue white screening– <https://youtu.be/VocpyrmVpA>
2. <https://youtu.be/3oGrVSTJa8I>
3. <https://www.biologydiscussion.com/genetics/construction-of-genomic-library-genetics/71924>
4. cDNA library– <https://youtu.be/FtNreXY7poA>
5. <https://patienteducation.asgct.org/gene-therapy-101/gene-therapy-basics>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 1 | 2 | 3 | 1 | 3 | 2 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO3 | 2 | 3 | 2 | 3 | 1 | 3 |
| CO4 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO5 | 2 | 3 | 2 | 1 | 2 | 3 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level
COURSE DESIGNER: Prof. N. B. SHARMILA



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|------------------------------|--------------|---|---|---------|
| 21UMBE63 | IPR, BIOSAFETY AND BIOETHICS | ELECTIVE – 2 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

This course exposes the importance of the Intellectual Property Rights, Biosafety and Bioethics of the GMOs.

COURSE OBJECTIVES:

To enable the students

- understand the need for protection of the genetically modified organisms and product development.
- understand the different norms such as patents, trade secrets, copy rights and industrial design rights which are collectively called as intellectual property rights (IPR).
- analyse the importance of the role of biological containment in research, production and release of GMO's.
- understand and implement the containment by Biosafety cabinets of which there are various levels each specific for particular functions.
- acquire the knowledge on bioethical issues in various biological fields.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|--|
| CO 1 | acquire knowledge on intellectual property rights and their implications in biological research and product development. | Upto K3 |
| CO 2 | understand the role of regulatory agencies for the protection of biological products. | Upto K3 |
| CO 3 | acquire knowledge on Patents and filing procedures | Upto K3 |
| CO 4 | understand the implementing of Biosafety cabinets and their levels. | Upto K3 |
| CO 5 | become aware of the ethical issues involving biological organisms, biological cells, organs and materials. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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IPR, BIOSAFETY AND BIOETHICS

UNIT – I: Introduction to Intellectual Property Rights

Concepts, Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications– importance of IPR – patentable and non – patentables – patenting life – legal protection of biotechnological inventions.

UNIT – II: Patent System

History, Indian Patent Act 1970, International Conventions and Treaties, World Intellectual Property Rights Organization (WIPO) World Intellectual Property Organization (WIPO), World Trade Organization (WTO), Paris Convention (for the protection of industrial property), Patent Cooperation Treaty (PCT), Budapest Treaty.

UNIT – III: Grant of Patent and Patenting Authorities

Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement – meaning, scope, litigation, case studies, Rights and Duties of patent owner.

UNIT – IV: Biosafety

Introduction; Biosafety Issues in Biotechnology; Biological Safety Cabinets & their types; Biosafety Levels of Specific Microorganisms. Biosafety Guidelines: and regulations (National and International); GMOs – Concerns and Challenges; Role of Institutional Biosafety Committees for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment.

UNIT – V: Bioethics

Bioethical issues and conflicts in the development of GMOs, Bioethical issues in Agriculture and Health care, stem cell research, Protection of Environment and Biodiversity

TEXT BOOKS:

1. By Deepa Goel, Shomini Parashar (2013), IPR, *Biosafety and Bioethics* 1st Ed., Pearson Education, India.
2. Dubey, R. C. (2007). *A Text book of Biotechnology*, 5th edition. New Delhi: S.Chand & Company Ltd.
3. Satyanarayana, U. (2010). *Biotechnology*, 1st edition. Kolkata: Books and Allied (p)Ltd.
4. *Intellectual Property Rights*, Rajagopalan, Dr. R Radhakrishnan and Dr.S. Balasubramanian, Excel Books, 2008.
5. Karen B. Byers, Dawn P. Wooley, *Biological Safety: Principles and Practices*, 2020 Library of Congress in Publication Data.



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REFERENCE BOOKS:

1. Glick B.R and Pasternak. J.J, *Molecular Biotechnology*, 2nd Ed. ASM press. (2003).
2. Neeraj Pandey, Khushdeep Dharni, *Intellectual Property Rights*, PHI Learning PVT LTD, 2014
3. Laboratory Biosafety Manual: Third Edition, *World health organisation staff, World Health Organization*, 2004, Library Cataloging in Publication Data.
4. M. K. Sateesh, *Bioethics and Biosafety*, Library of Congress in Publication Data, 2013
5. N. S. Sreenivasulu, *Biotechnology and Patent Law: Patenting Living Beings*, 2008 First Edition, Manupatra International Solutions.

DIGITAL TOOLS:

1. https://ris.org.in/sites/default/files/article1_v7n2.pdf
2. <https://ibkp.dbtindia.gov.in/Content/FlashPDF/IBSC%20Handbook.pdf>
3. <https://dbtindia.gov.in/guidelines-biosafety>
4. <https://www.longdom.org/scholarly/bioethics-and-biosafety-journals-articles-ppts-list-1965.html>
5. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB1615.pdf

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 1 | 2 | 1 | 2 | 2 | 3 |
| CO2 | 1 | 2 | 3 | 2 | 3 | 2 |
| CO3 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 2 | 3 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: N. B. SHARMILA



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|-------------------------|--------------|---|---|---------|
| 21UMBE64 | ANALYTICAL MICROBIOLOGY | ELECTIVE – 3 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

To study Analytical Microbiology is help to analyse and understand the innovative rapid methods available with the help of various instruments. Perform laboratory experiments using instruments is support to demonstrate and understand the basic separation techniques and its help to learning scientific and writing skills through reporting. Analytical instrumentation in microbiological research and application which includes Chromatography, Centrifuge, HPLC etc., help to analysis chemical markers used in the identification of Amino acids and Proteins etc.,

COURSE OBJECTIVES:

To enable the students

- acquire knowledge the basic separation techniques.
- gain knowledge about the pharmaceutical quality tests.
- analyse the different types of instruments which is help to separate the DNA, RNA and Proteins.
- understand the working principle and application of the instruments.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|--|
| CO 1 | understand the basic knowledge of separation techniques of centrifuge. | Upto K3 |
| CO 2 | gain the knowledge of separation of Nucleic acids and purification techniques of DNA. | Upto K3 |
| CO 3 | acquire the knowledge on various separation techniques –SDS PAGE. | Upto K3 |
| CO 4 | understand the different types of chromatography techniques. | Upto K3 |
| CO 5 | find out the different types of pharmaceutical quality tests | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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ANALYTICAL MICROBIOLOGY

UNIT– I: Separation Techniques

Centrifuge– Part of Centrifuge –Working Principle, Types of Centrifuge and applications.

UNIT– II: Separation of Nucleic acids

DNA, RNA – Agarose Gel Electrophoresis, Principles, Methods and Application. DNA purification techniques.

UNIT– III: Protein Separation Techniques

SDS PAGE, NATIVE PAGE – Principles, Methodology and applications.

UNIT– IV: Chromatography Techniques

Thin Layer Chromatography, Paper Chromatography, High Liquid Performance Chromatography (HPLC), GCMS, FTIR

UNIT– V: Pharmaceutical Quality Tests

Pyrogen test, sterility test, Microbial Limit Test (MLT), Minimum Inhibitory Concentration (MLC), Automated Biochemical Test.

TEXT BOOKS:

1. Dube R.C. 1999. *Text book of Biotechnology*, S. Chand and company.
2. Palanivelu P. 2004. *Analytical Biochemistry and Separation Technology*.
3. Elsa Lundanes, Léon Reubsaet, Tyge Greibrokk, *Chromatography*, 2013. Wiley Publications.
4. Concepts and Contrasts James M. Miller, *Chromatography*, 2005. Wiley Publications.
5. Michal Holcapek, Wm. Craig Byrdwell, *Handbook of Advanced Chromatography/Mass Spectrometry*, 2017. Academic Press.

REFERENCE BOOKS:

1. Keith Wilson and John Walker, 1994. *Practical Biochemistry – Principles and Techniques*, 4th Ed., Cambridge University Press.
2. Hans Peter Schmauder, *Methods in Biotechnology*, 2003, Taylor and Francis.
3. Reiner Westermeier, *Electrophoresis in Practice: A Guide to Methods*, 2016. Fifth Edition. Wiley.
4. Dr Robin Martin, *Gel Electrophoresis: Nucleic Acids*, 2020. Taylor & Francis
5. Wallace Woon-Fong Leung, *Centrifugal Separations in Biotechnology*, 2020. Second Edition. Library of Congress Cataloging in Publication Data

DIGITAL TOOLS:

1. <https://druckerdiagnostics.com/knowledge/how-a-centrifuge-works/>
2. <https://www.thermofisher.com/blog/ask-a-scientist/what-is-chromatography/>
3. <https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/gel-electrophoresis>
4. <https://apps.who.int/iris/handle/10665/39594>
5. <https://www.britannica.com/science/chromatography>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 3 | 2 |
| CO3 | 2 | 1 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. V. SELVI



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|--------------|--------------|---|---|---------|
| 21UMBE65 | MYCOLOGY | ELECTIVE – 3 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

This course provides an understanding of general concepts of Mycology, major groups of fungi and their associations, Life cycle, Clinical manifestations, Laboratory Diagnosis and Treatment and Economic Importance of Fungi.

COURSE OBJECTIVES:

- To provide a background on the characteristics of fungi, Heterothallism and Para – sexuality.
- To make the students understand the various classes of fungi and the morphology, life cycle and the mode of transmission of various plant pathogenic fungi.
- To make the students recognize the basics of infections and epidemiology of various mycoses.
- To make the students acquire the diagnostic skills and the interpretation of tests and the treatment for different mycoses.
- To make the students gain an in – depth knowledge on the importance of fungi in Agriculture and Biotechnology.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|--|
| CO 1 | gain the basic knowledge on the classification of fungi, characteristics of important group of fungi, and their associations with algae. | Upto K3 |
| CO 2 | understand the life cycle of various plant pathogenic fungi, their mode of transmission and disease life cycle. | Upto K3 |
| CO 3 | correlate a particular fungal infection with their clinical manifestations. | Upto K3 |
| CO 4 | identify mycoses with the help of laboratory diagnosis and able to give appropriate treatment. | Upto K3 |
| CO 5 | understand the importance of various fungi in the field of agriculture and biotechnology. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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MYCOLOGY

UNIT – I: Mycology

Characteristics, classification (Alexopoulos and Mim's) of fungi. General features of different fungi group – Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. General account and importance of lichens. Heterothallism and Para – sexuality. Sex hormones in fungi.

UNIT – II: General Features of Important Plant Pathogenic Fungi and their Disease Life Cycle

Mucor, Saccharomyces, Neurospora, Agaricus, Fusarium, Alternaria and Cladosporium. Important plant diseases caused by fungi – symptoms, disease cycles and control Late blight of potato – Phytophthora infestans; Ergot of rye – Claviceps purpurea; Black stem rust of wheat – Puccinia graminis, Wilt of tomato – Fusarium oxysporum Red rot of sugarcane – Colletotrichum falcatum.

UNIT – III: Classification of Mycoses

Epidemiology, Clinical manifestations, Laboratory diagnosis and Treatment of Important diseases caused by fungi in various systems – Respiratory system – Blastomycosis, Histoplasmosis, Nervous system – Cryptococcosis, Digestive system – Claviceps purpurea, Reproductive system – Candidiasis, Skin and Nails – Cutaneous mycoses, Subcutaneous mycoses.

UNIT – IV: Role of Fungi in Biotechnology

Application of fungi in food industry (Fermentation, Baking, Organic acids, Enzymes); Secondary metabolites (Pharmaceutical preparations – Antibiotics)

UNIT – V: Role of Fungi in Agriculture

Biofertilization, Biostimulation, Bioinsecticides: Biofertilizers–symbiotic (Bradyrhizobium, Rhizobium, Frankia), Non – Symbiotic (Azospirillum, Azotobacter, Mycorrhizae, Phosphate solubilizers), PGPRs; Biological control (Mycofungicides) and Mushroom.

TEXT BOOKS:

1. Constantine J.Alexopolous (1993), *An Introduction to Mycology*, 3rd Ed., H.S.Poplai for Wiley Eastern LTD.
2. Mehrotra, R.S. and K.R.Aneja *An Introduction to Mycology*. New Age International
3. Webster, J. **Introduction to Fungi**. Cambridge University Press. Cambridge, U.K. 1985.
4. Mahendra Rai I.K , *Advances in Fungal Biotechnology, 2009*, International Publishing House Pvt. Ltd.
5. R. S. Mehrotra, K. R. Aneja, *An Introduction to Mycology*, 1990, New Age International Publishers,1990



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REFERENCE BOOKS:

1. Casida LE, *Industrial Microbiology*, 1968, J. Wiley.
2. Pelczar, MJ Chan ECS and Krieg NR, *Microbiology*, 7th Ed., 2008, McGraw – Hill.
3. Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's *Microbiology*, McGraw – Hill publication
4. Tortora, Funke, Case. *Microbiology*, Pearson Benjamin Cummings.
5. Jacquelyn G. Black. *Microbiology Principles and Explorations*. John Wiley & Sons, Inc.

DIGITAL TOOLS:

1. <https://www.earth.com/earthpedia-articles/a-beginners-guide-to-mycology/>
2. <https://www.frontiersin.org/articles/560315>
3. <https://pubmed.ncbi.nlm.nih.gov/12898399/>
4. <https://www.frontiersin.org/articles/10.3389/fpls.2019.01068/full>
5. <https://bsppjournals.onlinelibrary.wiley.com/doi/10.1111/j.1364-3703.2011.00783.x>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 3 | 2 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. N. B. SHARMILA



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|--------------|--------------|---|---|---------|
| 21UMBE66 | PARASITOLOGY | ELECTIVE – 3 | 5 | – | 5 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input type="checkbox"/> | Skill Oriented <input checked="" type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|--|--|---|
|------------------|--|--|---|

COURSE DESCRIPTION:

This course provides an understanding of general concepts of parasitology, major groups of parasites, life cycle, Clinical manifestations, Laboratory diagnosis and Treatment.

COURSE OBJECTIVES:

- To provide a background on the concepts, terminologies, types of parasites and their life cycle.
- To make the students understand the various classes of parasites, their morphology, life cycle and the mode of transmission.
- To make the students recognize the basics of infections of various parasites.
- To make the students understand the different methods of collection of samples and their processing.
- To make the students acquire the diagnostic skills and the interpretation of tests

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|--|--|
| CO 1 | understand the concept of parasitism, their associations, life cycle and transmission | Upto K3 |
| CO 2 | categorize various parasites | Upto K3 |
| CO 3 | understand the life cycle of various parasites and their mode of transmission. | Upto K3 |
| CO 4 | correlate a particular parasitic infection with their clinical manifestations | Upto K3 |
| CO 5 | identify parasites with the help of laboratory diagnosis and able to give appropriate treatment. | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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PARASITOLOGY

UNIT – I: Introduction

Parasitism, Parasite – Types, Host – Types, Host – Parasite Relationship, Life – cycle of Parasites, Sources of Infection, Pathogenesis

UNIT – II: Protozoan infections

Amoeba – Intestinal Amoeba – *Entamoeba histolytica* – Morphological form – Life cycle – Clinical manifestations – Laboratory diagnosis and Treatment, *Leishmania donovani* – Clinical manifestations – Laboratory diagnosis and Treatment, Malarial parasite – Life cycle – Clinical manifestations – Laboratory diagnosis and Treatment.

UNIT – III: Helminthic infections

Cestodes – Cysticercosis – Life cycle – Laboratory diagnosis and Treatment, Trematodes – *Schistosoma*, *Fasciola* – Life cycle – Laboratory diagnosis and Treatment.

UNIT – IV: Intestinal Nematodes

Ascaris lumbricoides, *Ancylostoma duodenale*, *Necator americanus*, *Wuchereria bancrofti* – Clinical Manifestations – Laboratory diagnosis and Treatment.

UNIT – V: Laboratory diagnosis of parasitic diseases

Examination of Stool – Collection, Microscopic and Macroscopic Examination, Egg counting method, Examination of blood, Immunodiagnostic methods and Antibody Detection tests. Treatment of parasitic diseases.

TEXT BOOKS:

1. Paul G. Engelkirk, Janet Duben – Engelkirk ***Burton's Microbiology for the Health Sciences***, 2015, 10th Ed., Wolters Kluwer Health, USA
2. Apurba S Sastry, Sandhya Bhat (2021), ***Essentials of Medical Microbiology***, 2021, 1st Ed., Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
3. Jayaram Paniker, ***Textbook of Medical Parasitology*** 2013, 7th Ed., Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
4. Conor R. Caffrey, ***Parasitic Helminths: Targets, Screens, Drugs and Vaccines***, 2012, Vol –3, Wiley Blackwell Publications.
5. Donald L Lee, ***The Biology of Nematode***, 2002, CRC Press, 2002

REFERENCE BOOKS:

1. Larry s. Roberts John Janovy (2009), ***Foundations of Parasitology***, 8th Ed. Mac Graw Hill Higher Education.
2. Lynne Shore Garcia , ***Diagnostic Medical Parasitology***, 6th Edition, 2020, Wiley Publication .
3. Alan Gunn, Sarah J. Pitt, ***Parasitology: An Integrated Approach***, 2012, Wiley Publication.
4. Elizabeth Zeibig , ***Clinical Parasitology: A Practical Approach***, 2012, 2nd Ed., Elsevier.
5. Mark F Wiser, ***Protozoa and Human Disease***, 2010, Garland Science and Publications.



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DIGITAL TOOLS:

1. <https://www.cambridge.org/core/journals/parasitology>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2276811/>
3. <https://www.britannica.com/animal/nematode>
4. <https://www.hindawi.com/journals/ipid/2009/278246/>
5. [https://www.mayoclinicproceedings.org/article/S0025-6196\(12\)61099-4/fulltext](https://www.mayoclinicproceedings.org/article/S0025-6196(12)61099-4/fulltext)

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 3 | 2 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. N. B. SHARMILA



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| COURSE CODE | COURSE TITLE | CATEGORY | T | P | CREDITS |
|-------------|-----------------------------|----------|---|---|---------|
| 21UMBS61 | PHARMACUETICAL MICROBIOLOGY | SBS – 6 | 2 | – | 2 |

| YEAR | SEMESTER | INTERNAL | EXTERNAL | TOTAL |
|------|----------|----------|----------|-------|
| III | VI | 25 | 75 | 100 |

| NATURE OF COURSE | Employability <input checked="" type="checkbox"/> | Skill Oriented <input type="checkbox"/> | Entrepreneurship <input type="checkbox"/> |
|------------------|---|---|---|
|------------------|---|---|---|

COURSE DESCRIPTION:

The course describes the importance of pharmaceutical microbiology, products of microbial origin, therapeutic uses of various drugs, their mode of action and toxicity.

COURSE OBJECTIVES:

To enable the students

1. understand the drug actions on microorganisms.
2. understand the antibiotics and their mode of action.
3. gain the knowledge in the aspect of mechanism of pharmacological agents on various infectious microorganisms.
4. understand good practices and regulations involved in the pharmaceutical industries.

COURSE OUTCOMES (COs):

After the completion of the course, the students will be able to

| No. | Course Outcomes | Knowledge Level (According to Bloom's Taxonomy) |
|------|---|--|
| CO 1 | gain the basic knowledge of pharmaceutical microbiology | Upto K3 |
| CO 2 | explore the different microbial products used in pharmaceutical applications | Upto K3 |
| CO 3 | understand the therapeutic uses, mode of action and toxicity of various drugs | Upto K3 |
| CO 4 | develop the skills of the evaluation of pharmaceutical products | Upto K3 |
| CO 5 | gain information about the good laboratory practices and regulations for utilizing microbial product in pharmaceutical applications | Upto K3 |

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY



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PHARMACUETICALMICROBIOLOGY

UNIT – I: Drug

definition and properties of ideal drug – Drug Absorption, Bioavailability and Routes of Administration–distribution– oral, topical, sublingual, inhalation and injection (definitions only). Action and Elimination (a brief account), Route of drug administration: Phase I and Phase II – Role of cytochrome P450 in drug metabolism.

UNIT–II: Antibiotics

definition and classification of antibiotics. Structure of antibiotics (Penicillin, Streptomycin, Chloramphenicol and Tetracycline) and polypeptide antibiotics (Bacitracin and Actinomycin D). Mode of action of penicillin G.

UNIT – III: Chemotherapy

therapeutic uses, mode of action and toxicity – antiprotozoal infections– Amphotericin, Metronidazole– anti–helminthic agents–Mebendazole, Diethylcarbamazine.

UNIT – IV: Antimicrobial Agents

Mechanism– Sulfonamides, Penicillin, Cephalosporins–antifungal agents– Imidazole, Ketoconazole, Fluconazole– Antiviral agents– Acyclovir, Amantidine, Osteltamivir.

UNIT – V: Quality Assurance

Good manufacturing practice (GMP) – Good Laboratory Practice (GLP)

Quality Evaluation: sterility test, antibiotic assay, microbial limit tests and preservative efficacy test.

TEXT BOOKS:

1. Hugo, W B., & Russell, A D. (2016). *Pharmaceutical Microbiology*, 8th edition. Oxford: Blackwell Science.
2. *Pharmaceutical Biotechnology: Concepts and Applications*, Gary Walsh, First Edition, Wiley Publications, 2007
3. *Pharmaceutical Biotechnology*, Chandrakant Kokare, First Edition, Nirali Prakashan – Advancement of Knowledge, 2019.
4. *Pharmaceutical Quality Assurance*, Anusuya R. Kashi, Bindu Sukumaran and Veena P, Nirali Prakashan – Advancement of Knowledge, 2020.
5. *Handbook of Cancer Chemotherapy*, Roland T. Skeel, Samir N. Khleif, Eighth Edition, Lippincott Williams & Wilkins, 2011

REFERENCE BOOKS:

1. Prescott, Harley & Klein, (2008). *Microbiology*, 7th edition. New York: The McGraw–Hill companies.
2. Patrick, & Murray, R. (2007). *Medical Microbiology*, 4th edition. Missouri: The C.V. Mosby Company.
3. Fifth Edition, Dann J.A. Crommelin, Robert D.S. Sindelar and Bernd Meibohm, *Pharmaceutical Biotechnology: Fundamentals & Applications*, 2002, Springer.
4. David Roesti, Marcel Goverde, *Pharmaceutical Microbiological Quality Assurance and Control*, 2020, Wiley Publication.
5. Geoff Hanlon, Norman A. Hodges, *Essential Microbiology for Pharmacy and Pharmaceutical Science*, 2012, Wiley BlackWell.



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DIGITAL TOOLS:

1. <https://www.knowledgedose.com/routes-of-drug-administration/>
2. <https://www.britannica.com/science/antibiotic>
3. <https://emedicine.medscape.com/article/999282-medication>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/>
5. <https://www.who.int/teams/health-product-policy-and-standards/standards-and-specifications/gmp>

Mapping of CO with PSO

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|-----|------|------|------|------|------|------|
| CO1 | 3 | 3 | 2 | 2 | 1 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 2 | 3 | 2 | 2 |

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. N. B. SHARMILA