# B. Sc.,
# Microbiology
## (Programme Code – UMB)

# Programme outcome – PO (Aligned with Graduate Attributes)
# Bachelor of Science (B. Sc.,)

## Scientific Knowledge and Critical Thinking

Apply the knowledge of Life Science, Physical and Chemical Science, Mathematics, statistics, Computer science and humanities for the attainment of solutions to the problems that come across in our day-to-day life/activities.

## Problem Solving

Identify and analyze the problem and formulate solutions for problems using the principles of mathematics, natural sciences with appropriate consideration for the public health, safety and environmental considerations.,

## Communication and Computer Literacy

Communicate the fundamental and advanced concepts of their discipline in written and oral form. Able to make appropriate and effective use of information and information technology relevant to their discipline

## Life-Long Learning

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Ethical, Social and Professional Understanding

Commitment to principles, codes of conduct and social responsibility in order to behave consistently with personal respect. Acquire the responsibility to contribute for the personal development and for the development of the community. Respect the ethical values, social responsibilities and diversity.

## Innovative, Leadership and Entrepreneur Skill Development

Function as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving, and intellectual skills.

# THIAGARAJAR COLLEGE, MADURAI – 9.

**(Re-Accredited with "A++" Grade by NAAC)**

**Department of –Zoology and Microbiology**

## Vision

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

## Mission

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching Positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary learning.

## Programme Educational Objectives (PEO)

The objectives of this programme is to equip/prepare the students

| | |
|---|---|
| **PEO1** | To prepare a new generation of microbiologists, capable of excelling in careers of their choosing. |
| **PEO2** | To equip the students to apply knowledge of prokaryotic and eukaryotic cellular processes, classification, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms |
| **PEO3** | To undertake research studies, collect relevant literature, design experiment, use experimental techniques, analysis the results statistically, report and publish the findings |
| **PEO4** | Job opportunities in pharmaceutical, food and bioprocess industries |
| **PEO5** | Basics and current updates in the areas of Microbiology, Biochemistry, Molecular Biology, Immunology, Genetic Engineering, Industrial Microbiology, Medical Microbiology, Agriculture & Environmental Microbiology are included to train the students and also sensitize them to scope for research. |

## Programme specific outcomes- B.Sc., Microbiology

On the successful completion of B.Sc., Microbiology the students will

| | |
|---|---|
| **PSO1** | Comprehend the core concepts, methods & practices in life sciences especially Microbiology, Biotechnology etc., |
| **PSO2** | Isolate, identify and characterize different types of microorganisms and their metabolites |
| **PSO3** | Interpret the etiology of infectious diseases, their transmission, treatment, control and prevention methods. |
| **PSO4** | Acquire theoretical basis and practical skills in the use of basic tools, technologies and methods common to different disciplines of life sciences. |
| **PSO5** | Be proficient in the fundamental knowledge and recent trends/updates of different disciplines in microbiology. |

# THIAGARAJAR COLLEGE, MADURAI – 9.

**(Re-Accredited with "A++" Grade by NAAC)**
**Department of –Zoology and Microbiology**
**Bachelor of Science (B. Sc.,) Microbiology (w. e. f. 2020 batch onwards)**
**Programme Code-UMB**

## Semester – I

| Course | Code No | Subject | Hrs/ Week | Credit | Total Hrs | Max Marks CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part I | U20 TM11 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II | U20 EN11 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 1 | UMB20 C11 | General Microbiology | 4 | 4 | 60 | 25 | 75 | 100 |
| Core 2 | UMB20 C12 | Bioinstrumentation | 4 | 4 | 60 | 25 | 75 | 100 |
| Core lab 1 | UMB20 CL11 | Lab in Microbiology | 2 | 1 | 30 | 40 | 60 | 100 |
| Generic Elective | UCH20 GE11Z | General Chemistry I | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab | UCH20 GL21Z | Anc. Chemistry lab | 2 | - | 30 | - | - | - |
| EVS | U20 ES11 | Environmental Studies | 2 | 2 | 30 | 15 | 35 | 50 |
| **TOTAL** | | | **30** | **21** | | | | |

## Semester – II

| Course | Code No | Subject | Hrs/ Week | Credit | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part I | U20 TM21 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II | U20 EN21 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 3 | UMB20 C21 | Biochemistry | 4 | 4 | 60 | 25 | 75 | 100 |
| Core 4 | UMB20 C22 | Cell Biology | 4 | 4 | 60 | 25 | 75 | 100 |
| Core lab 2 | UMB20 CL21 | Lab in Biochemistry and Cell Biology | 2 | 1 | 30 | 40 | 60 | 100 |
| Generic Elective | UCH20 GE21Z | General Chemistry II | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab | UCH20GL 21Z | Chemistry Lab | 2 | 2 | 30 | 40 | 60 | 100 |
| | U20VE21 | Value Education | 2 | 1 | 30 | 15 | 35 | 50 |
| **TOTAL** | | | **30** | **22** | | | | |

## Semester –III

| Course | Code No | Subject | Hrs/ Week | Credit | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part I | U20 TM31 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II | U20 EN31 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 5 | UMB20 C31 | Molecular Biology | 4 | 4 | 60 | 25 | 75 | 100 |
| Core 6 | UMB20 C32 | Microbial Physiology and Metabolism | 4 | 4 | 60 | 25 | 75 | 100 |
| Core lab 3 | UMB20 CL32 | Lab in Molecular Biology | 2 | 1 | 30 | 40 | 60 | 100 |
| Generic Elective | UMB20 G31Z | Agricultural Microbiology | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab | UMB20 GL31Z | Lab in Agricultural Microbiology | 2 | 1 | 30 | 40 | 60 | 100 |
| NME1 | UMB20 NE31 | Health Awareness | 2 | 2 | 30 | 15 | 35 | 50 |
| **TOTAL** | | | **30** | **22** | | | | |

## Semester – IV

| Course | Code No | Subject | Hrs/ Week | Credit | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part I | U20 TM41 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II | U20 EN41 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 7 | UMB20 C41 | Microbial Genetics | 4 | 4 | 60 | 25 | 75 | 100 |
| Core 8 | UMB20C 42 | Medical Bacteriology and Virology | 4 | 4 | 60 | 25 | 75 | 100 |
| Core lab 4 | UMB20 CL41 | Lab in Microbial Genetics | 2 | 1 | 30 | 40 | 60 | 100 |
| Generic Elective | UMB20 G41Z | Environmental Microbiology | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab | UMB20 GL41Z | Lab in Environmental Microbiology | 2 | 1 | 30 | 40 | 60 | 100 |
| NME2 | UMB20 NE41 | Clinical Lab Technology | 2 | 2 | 30 | 15 | 35 | 50 |
| **TOTAL** | | | **30** | **22** | | | | |

**Internship***

## Semester --V

| Course | Code No | Subject | Hrs/ Week | Credit | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core 9 | UMB20C51 | Mycology and Parasitology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 10 | UMB20C52 | Food Microbiology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 11 | UMB20C53 | Clinical Lab Technology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 12 | UMB20C54 | Nanobiology | 2 | 1 | 30 | 15 | 35 | 50 |
| Core lab 5 | UMB20CL51 | Lab in Mycology and Parasitology | 2 | 1 | 30 | 40 | 60 | 100 |
| Core lab 6 | UMB20CL52 | Lab in Food Microbiology | 2 | 1 | 30 | 40 | 60 | 100 |
| Core lab 7 | UMB20CL53 | Lab in Clinical Lab Technology | 2 | 1 | 30 | 40 | 60 | 100 |
| Core Elective | UMB20CE51 A / B | Epidemiology / Pharmacology | 5 | 5 | 75 | 25 | 75 | 100 |
| SBE I | UMB20SE51 A/B | Bioethics and Biosafety / Bioenergy | 2 | 2 | 30 | 15 | 35 | 50 |
| **TOTAL** | | | **30** | **26** | | | | |
| | UMB20IN | Internship | - | 2 | - | 15 | 35 | 50 |

## Semester-VI

| Course | Code No | Subject | Hrs/ Week | Credit | Total Hrs | Max Mark CA | Max Marks SA | Total |
|---|---|---|---|---|---|---|---|---|
| Core 12 | UMB20C61 | Immunology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 13 | UMB20C62 | Industrial Microbiology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 14 | UMB20C63 | Genetic Engineeringand Biotechnology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 15 | UMB20C64 | IPR | 2 | 1 | 30 | 15 | 35 | 50 |
| Core lab 8 | UMB20CL61 | Lab in Immunology | 2 | 1 | 30 | 40 | 60 | 100 |
| Core lab 9 | UMB20CL62 | Lab in Industrial Microbiology | 2 | 1 | 30 | 40 | 60 | 100 |
| Core Lab 10 | UMB20CL63 | Lab in Genetic Engineering and Biotechnology | 2 | 1 | 30 | 40 | 60 | 100 |
| Core Elective II | UMB20CE61 A / B | Biostatistics and Bioinformatics / Microbial Genomics | 5 | 5 | 75 | 25 | 75 | 100 |
| SBE II | UMB20SE61 A / B | Stem Cell Biology/ Forensic Science | 2 | 2 | 30 | 15 | 35 | 50 |
| **TOTAL** | | | **30** | **26** | | | | |
| **Part V** | - | | - | 1 | | 75 | 25 | 100 |

## A) Consolidation of contact hours and credits: UG

| Semester | Contact Hrs/ Week | Credits |
|---|---|---|
| I | 30 hrs | 21 |
| II | 30 hrs | 22 |
| III | 30 hrs | 22 |
| IV | 30 hrs | 22 |
| V | 30 hrs | 26 |
| VI | 30 hrs | 26 |
| Part - V | - | 01 |
| Total | 180 hrs | 140 |
| V | Internship | 2 |

## B) Curriculum Credits: Part wise

| | | No of papers | Credits per paper | Total credits |
|---|---|---|---|---|
| **Part I** | **Tamil** | **4** | **3** | **12** |
| **Part II** | **English** | **4** | **3** | **12** |
| | | | | |
| **Part III** | **Core Theory** | **8+6** | **4/5** | **62** |
| | **Core lab** | **10** | **1** | **10** |
| | **Core Elective** | **2** | **5** | **10** |
| | **Generic Elective Theory** | **4** | **4** | **16** |
| | **Generic Elective Lab** | **2** | **2** | **4** |
| **Part IV** | **AECC** | **2** | **2** | **4** |
| | **NME** | **2** | **2** | **4** |
| | **SEC** | **2** | **2** | **4** |
| | **VE** | **1** | **1** | **1** |
| | | | | |
| **Part V (NSS / NCC / Physical Education)** | | | | **1** |
| **Grand total** | | | | **140** |

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C51 | Mycology and Parasitology | Core 9 | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 25 | 75 | 100 |

## Preamble

Course provides an in-depth knowledge in identifying, differentiating, culturing the fungal and parasitic pathogens. Elaborate the stages of pathogen life cycle, diagnosis and prevention.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Outlinethe basic concepts of structure, cultivation and storage of fungi | 75 | 70 |
| CO2 | Explain the identification protocols and diagnosis of fungi from samples | 70 | 60 |
| CO3 | Exemplify fungal disease classification and antifungal chemotherapy | 70 | 65 |
| CO4 | Illustrate the life cycle of Protozoan parasites | 75 | 60 |
| CO5 | Identify the diagnostic methods for protozoan diseases. | 75 | 65 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | M | M | - | L | - | S |
| CO2 | M | S | - | M | - | S |
| CO3 | M | S | - | S | - | L |
| CO4 | M | S | - | L | - | L |
| CO5 | M | S | - | S | - | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | S | S | L | S | S |
| CO2 | S | S | S | S | S |
| CO3 | S | M | S | M | S |
| CO4 | S | S | S | L | S |
| CO5 | S | L | S | M | S |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Mycology and Parasitology

**Unit I**

Fungi – Morphological features – Cell structure, reproduction, growth and nutrition – mycotoxins – Fungal dimorphism, types of fungal medium, Fungal slide culture, maintenance of fungal cultures – Molecular tools for the fungal identification, Normal fungal flora of the human body.

**Unit II:**

Fungal Pathogenesis – fungal infections –skin, hair, nail, sputum and CSF. Collection, storage and transport of fungal samples for diagnosis, Molecular diagnosis. Identification of fungal staining KOH, wet mount (lactophenol cotton blue staining) and Tetraethyl ammonium hydroxide preparations.

**Unit III:**

Classification of Mycoses – Superficial – Dermatophytosis, Surface Infections – Tinea and Piedra, Cutaneous and Subcutaneous Infections – Candidiasis; Systemic and Opportunistic Infections. Antifungal chemotherapy: Cell wall Synthesis Inhibitors, Glucan Synthase Inhibitors – Echinocandins, Chitin Synthase Inhibitors – Polyoxin, Cell membrane permeability disruptors – Amphotericin B, Ergosterol Synthesis inhibitors – Fluconazole and Itraconazole, Nuclear Division Inhibitors – Griseofulvin, Nucleic acid synthesis inhibitors – 5-fluorocytosine.

**Unit IV:**

Introduction to parasitic diseases, Parasitology – Morphology, life cycle, pathology, prophylaxis and treatment of *Entamoeba*, *Plasmodium, Ascaris*, *Giardia* and *Trichomonas.*

**Unit V:**

Diagnostic methods and molecular diagnosis in parasitology – examination of stool and blood, Antiprotozoal chemotherapy: Piperazine, Niclosamide and quinine (Cinchona bark).

## Text Books:


1. Paniker, C. K. J. and Ghosh, S. 2013. Paniker's Textbook of Medical Parasitology, Seventh Edition, Jaypee Brothers Medical Publishers, India.
2. Reiss, E., Shedomy, H. J. and Lion III G. M. 2012. Fundamental Medical Mycology, John Wiley and Sons Inc., Publications, Canada.


## References:


1. Kibbler, C. C., Barton, R., Gow N. A. R., Howell, S., MacCallum, D. M. and Manuel R.J. 2017. Oxford Textbook of Medical Mycology, Oxford University Press, UK.
2. Bogitsh, B. J., Carter, C. E. and Oeltmann, T. N. 2017. Human Parasitology, Fourth Edition, Academic press, US.
3. Brandt, M. E., Lockhart, S. R. and Warnock, D. W. 2011.Essentials of Clinical Mycology, Second Edition, Springer-Verlag, New York, US.

4. Roberts, Jr. L. and Janovy, J. 2008. Foundations of Parasitology, Eighth Edition, McGraw-Hill, New York, US.
5. Marr, J. J., Nilson, W. T. and Komuniecki, W. R. 2003. Molecular Medical Parasitology, Academic Press, Elsevier Science, UK.

**Web Resources:**

1. Introduction to Clinical Mycology -https://www.youtube.com/watch?v=zCvG35jKgUY
2. Medical Mycology - http://www.sbs.utexas.edu/mycology/bio329/bio329_links.htm
3. Parasites A-Z Index -https://www.cdc.gov/dpdx/az.html

**Course Designers:**

1. Dr. B. Samuel Raj
2. Dr. B. Singaravelan

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B.Sc. Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C52 | Food Microbiology | Core 10 | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 25 | 75 | 100 |

## Preamble

The course imparts the role of microbes in fermented food industry. Emphasistheidentification of food borne pathogen, preservation methods and quality control.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Summarize the history, scope and factors influencing growth of microbes in food. | 80 | 75 |
| **CO2** | Illustrate the mechanism of microbial food spoilage | 85 | 80 |
| **CO3** | Classify the physical and chemical methods of food preservation | 75 | 70 |
| **CO4** | Explain the microbial quality control of food products and safety | 90 | 75 |
| **CO5** | Discover the role of microbial fermentation in food | 90 | 80 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **M** | **--** | **--** | **M** | **--** | **L** |
| **CO2** | **S** | **M** | -- | **S** | **--** | **S** |
| **CO3** | **M** | **M** | -- | **M** | **M** | **S** |
| **CO4** | **M** | **L** | -- | **M** | **S** | **S** |
| **CO5** | **L** | **--** | -- | **L** | **L** | **S** |

**Strong (S), Medium (M), Low (L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **--** | **M** | **M** |
| **CO2** | **M** | **S** | **--** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **--** | **S** | **S** |
| **CO5** | **M** | **S** | **--** | **S** | **S** |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Food Microbiology

**Unit I**

History of fermented foods. Scope in food industry. Factors (intrinsic and extrinsic) influencing growth of microbes in food. Microorganisms associated with food. Microbes as food: probiotics, prebiotics and Single cell protein (SCP) – applications.

**Unit II**

Microbial food spoilage - butter, cheese, beer, wine, vegetables, fruits, meat & canned food. Food borne disease: Indicators of pathogens associated with food - faecal coliforms, faecal streptococcal forms, *Salmonella*, *Staphylococcus*. Food poisoning by mold -*Aspergillus flavus*, bacteria - *Clostridium botulinum* and yeast – *Kluyveromyces* sp.

**Unit III**

Preservation methods: Physical- Asepsis, filtration, centrifugation, pasteurization (low, high, vacuum, flash, ultra), desiccation, radiation, pascalization, freezing, canning. Chemical-traditional (Salt, Sugar, wood smoke), acidulants - benzoic acid, sorbic acid, propionates, acetic acid & lactic acid; gaseous agents - nitrates, nitrites, sulfur dioxide, ethylene dioxide, propylene oxide; antibacterial (Nisin), antifungal (Natamycin); antioxidants -butylated hydroxy toluene (BHT) and butylated hydroxy anisole (BHA). Modification of atmosphere for storage.

**Unit IV**

Microbial Indicators for food quality: Quality and Criteria – sampling schemes, control at source, Codes of Good Manufacturing Practice, Hazard Analysis and Critical Control Point (HACCP); Quality Systems: AGMARK symbol BS 5750 and ISO 22000 series. Risk Analysis.

**Unit V**

Fermented dairy products: Buttermilk, Sour cream, Yoghurt & Cheese. Fermented vegetables: kimchi, sauerkraut, table olives, soy sauce, apple cider vinegar, idli batter, & bread; alcoholic beverages - beer, wine, sake, distilled liquors. Fermentation of seed – coffee, cocoa. Fermented meat products – sausage, ham and bacon, Microbial food cultures (Flavors and colours).

## Text Books:


1. Frazier, W.C.and Westoff, D.C. 2017. Food Microbiology,Fifth Edition, Tata McGraw Hill Publishing Co. Ltd. Fuller. New Delhi, India
2. Jay, J.M., Loessner, M.J. and Golden, D.A. 2008. Modern Food Microbiology. Springer Science & Business Media, Heidelberg, Germany


## References:


1. Hutkins, R.W. 2018. Microbiology and Technology of Fermented Foods. John Wiley & Sons, New Jersey, US.
2. Kuila, A. and Sharma, V. 2018. Principles and Applications of Fermentation Technology. John Wiley & Sons, New Jersey, US.
3. Erkmen, O. and Bozoglu, T.F. 2016. Food Microbiology, vol (2), Principles into Practice. John Wiley & Sons, New Jersey, US.

4. Adams, M. R. and Moss, M. O. 2014. Food Microbiology. FourthEdition, New Age International (P) Limited Publishers, New Delhi, India
5. Tamang, J.P. and Kailasapathy, K. 2010. Fermented Foods and Beverages of the World. CRC press, Florida, US.

**Web Resources:**

1. Food Safety and Standards Authority of India - https://www.fssai.gov.in/
2. Food and Agriculture Organization of the United Nations - https://www.fao.org/home/en
3. International commission on Microbiological Specifications for Foods (ICMSF) - www.ICMSF.org

**Course Designers:**

1. Dr. E. Kaarunya
2. Dr. B. Singaravelan

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C53 | Clinical Lab Technology | Core 11 | 5 | - | - | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 25 | 75 | 100 |

## Preamble

The course imparts the knowledge of the collection, transport and analyses of clinical specimens for diagnosis. Comprehensive understanding on the different techniques related to clinical laboratory methods and analysis of body fluids.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Outline the code of conduct and SOP, safety measures and precautions of clinical laboratory. | 70 | 75 |
| CO2 | Infer the safe clinical laboratory practices to be followed for collection, transport and analysis of blood samples. | 65 | 70 |
| CO3 | Explain the different clinical laboratory techniques for physical, chemical and microscopical analysis of urine sample. | 60 | 65 |
| CO4 | Elaborate the technical skills of chemical and microscopical analysis of stool samples. | 70 | 75 |
| CO5 | Outline the common respiratory disorders and chemical and microscopical examination of sputum and semen analyses. | 60 | 65 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | S | M | - | S | - | S |
| CO2 | M | S | - | S | - | S |
| CO3 | M | S | - | M | - | S |
| CO4 | M | S | - | M | - | S |
| CO5 | M | S | - | M | - | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | S | - | - | S | - |
| CO2 | S | S | S | S | S |
| CO3 | S | S | S | S | S |

| | | | | | |
|---|---|---|---|---|---|
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** |

**Blooms taxonomy**

| | CA | | End of Semester |
|---|---|---|---|
| | **First** | **Second** | |
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Clinical Lab Technology

**Unit I**

Laboratory designing, Code of conduct for Clinical Laboratory, SOP. National and International GLP and GMP- Biosafety levels. Accidents-types and safety measures. First Aid in laboratory and Precautions.Collection and processing – Blood, Urine, Stool, Sputum, Semen, CSF and Pus cells.

**Unit II:**

Blood sample analysis:Anti-coagulants. Determination of TC, DC, ESR, Hb, Bleeding time and clotting time. Blood film and Bone marrow examination. ABO Blood grouping. Blood transfusion and Compatibility testing. Determination of blood glucose, Urea, Cholesterol and Bilirubin. VDRL and WIDAL test. Blood culture and antibiotic sensitivity.

**Unit III:**

Urine sample analysis: Gross examination of Urine. Chemical examination of urine – protein, albumin, glucose – benedict's test, ketone bodies, bile salts, bile pigments and blood in urine. Microscopic Examination of Urine – Cast Crystals and Cells. Pregnancy Test- slide test for pregnancy. Urine culture and antibiotic sensitivity.

**Unit IV:**

Stool sample analysis: Physical examination of feces. Chemical and Microscopic examination of stool samples. Stool Culture and antibiotic sensitivity. Occult blood and its clinical significance. Stool concentration methods – Flotation concentration methods and Sedimentation concentration methods.

**Unit V:**

Sputum sample analysisMacroscopic and Microscopic examination of sputum. Cytologic examination in malignancy. AFB staining. Sputum culture and sensitivity. Semen analysis: Gross examination and microscopic examination of semen, motility, total count and abnormality. Chemical examination of semen and antibodies to spermatozoa.

**Text Books:**


1. Lieberman, M. A. and Peet, A. 2017. Marks' Basic Medical Biochemistry: A Clinical Approach, Fifth Edition, Lippincott Williams & Wilkins, US.
2. Sood, R. 2010, Medical Laboratory Technology – Methods and interpretations, Seventh Edition, Jaypee Publishers, NewDelhi.


**References:**


1. Provan, D. 2018. Oxford Handbook of Clinical and Laboratory Investigation, Fourth Edition, Oxford University Press, US.
2. Weidmann, M., Silmann, N., Butaye, P. and Elschner, M. 2017. Working in Biosafety Level 3 and 4 Laboratories: A Practical Introduction, Wiley-Blackwell, US.

3. Ochei, J. and Kolkatkar, A. 2017. Medical Laboratory Science – Theory and Practice. Seventeenth Edition, Tata Mc Graw – Hill Publishing Company Ltd., New Delhi,India.
4. Burtis, C. A. and Bruns, D. E. 2014. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, Seventh Edition, Elsevier Saunders, US.
5. Mukherjee, L.K. 2010. Medical Laboratory Technology, 3 volumes, Second Edition, Hill Publishing Ltd., NewDelhi.

**Web Resources:**

1. Laboratory Safety - https://www.youtube.com/watch?v=acRXhnCi3dc -
2. First Aid in Science Lab - https://www.youtube.com/watch?v=Gn2pxZoxCaQ-
3. Blood Glucose Estimation- https://www.youtube.com/watch?v=SwzN0rqIFcA&t=39s

**Course Designers:**

1. Dr. C. M. Archana
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C54 | Nanobiology | Core 12 | 2 | - | - | 1 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 15 | 35 | 50 |

## Preamble

Course imparts knowledge on the classification, types, synthesis of nanoparticles and their use as implants, sensors, delivering drugs to the specific target sites.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Outline the fundamental concepts and scope of Nanobiology | 90 | 85 |
| **CO2** | Explain the different types of nanoparticles | 80 | 75 |
| **CO3** | Apply the techniques learnt in the field of Nanobiology. | 80 | 75 |
| **CO4** | Make use of different techniques for the characterization of nanoparticles | 80 | 75 |
| **CO5** | Demonstrate the applications of nanostructures in biomedical sciences | 80 | 75 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **S** | **-** | **-** | **-** | **-** | **-** |
| **CO2** | **-** | **-** | **-** | **-** | **-** | **M** |
| **CO3** | **L** | **L** | **-** | **L** | **-** | **S** |
| **CO4** | **L** | **L** | **-** | **L** | **-** | **S** |
| **CO5** | **L** | **-** | **-** | **-** | **-** | **S** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **-** | **-** | **S** | S |
| **CO2** | **S** | **-** | - | **S** | **S** |
| **CO3** | **S** | **-** | - | **S** | **S** |
| **CO4** | **S** | **-** | - | **S** | **S** |
| **CO5** | **S** | **-** | **S** | **S** | **S** |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Nanobiology

**Unit I:**

Nanobiology: Fundamental concepts, importance and historical background. Classification of nanostructures – Nanomaterials, Nanocomposites, Nanocapsules, Nanopores and Nanoconjugates.Types of nanoparticles: Metallic nanoparticles (Gold and silver), Non-metallic nanoparticles (carbon and silicon). Synthesis of Nanoparticles and Nanostructures-Synthesis methods- physical (ball milling), Chemical (reduction method using sodium borohydride, sodium citrate), Biological (microorganisms and, plants). Characterization of nanoparticles: UV-visible, FTIR, AFM, SEM, TEM and XRD.

**Unit II:**

Biomedical applications of nanoparticles: Targeted drug delivery- liposomes, nano-shells and hydrogels; Imaging technique-quantum dots and magnetic nanoparticles, Implants-orthopaedic and vascular, Bionanosensors based detection of mutations and its application on cancer treatments.

## Text Books:


1. Anal, A. K. 2018. Bionanotechnology: Principles and Applications. CRC Press, Taylor & Francis Group, New York.
2. Hornyak, G. L., Moore, J. J., Tibbals, H. F. and Dutta, J. 2009. Fundamentals of Nanotechnology. CRC Press, Taylor & Francis Group, New York.


## References:


1. Neves, A. R. and Reis, S. 2018. Nanoparticles in Life Sciences and Biomedicine, Pan Stanford Publishing, Singapore.
2. Kulkarni S. K. 2015. Nanotechnology: Principles and Practices, Third Edition, Springer Publishing, US.
3. Kodoloc, V. I., Zaikov, G. E.and Haghi, A. K. 2014. Nanostructures, Nanomaterials, and Nanotechnologies to Nanoindustry. Apple Academic Press, Canada.
4. Oashby, M. F., Ferreira, P. J. and Schodek, D. L. 2009. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and architects. Butterworth-Heinemann, UK.
5. Goodsell, D. S. 2004. Bionanotechnology: Lessons from Nature. Wiley-Liss, Inc., New Jersey, US.


## Web Resources:

1. Exploring Nanotechnology - https://www.youtube.com/watch?v=-bYaFqubQDw
2. Nanotechnology:A New Frontier-https://www.youtube.com/watch?v=OLa8DQkKlyU

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CL51 | Lab in Mycology and Parasitology | Core lab 5 | -- | -- | 2 | 1 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 40 | 60 | 100 |

## Preamble

Impart hands on training in the field of Mycology and Parasitology to isolate and identify the pathogenic fungi and parasites.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Explain the precaution and safety protocol to be maintain in the Mycology and Parasitology lab | 80 | 85 |
| CO2 | Isolate, identify and culture pathogenic fungi | 90 | 90 |
| CO3 | Differentiate yeast and mold by staining procedure | 90 | 90 |
| CO4 | Interpret the infective lifecycle of parasites causing disease in human | 85 | 95 |
| CO5 | Show the parasites and their dormant state in human sample and waste water | 85 | 90 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | L | M | -- | -- | -- | M |
| CO2 | -- | M | -- | L | -- | S |
| CO3 | L | L | -- | L | -- | S |
| CO4 | L | S | -- | L | -- | S |
| CO5 | L | S | -- | L | -- | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | S | -- | -- | -- | L |
| CO2 | S | S | S | M | L |
| CO3 | S | S | M | S | M |
| CO4 | S | S | S | S | M |
| CO5 | S | S | S | S | M |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Lab in Mycology and Parasitology

1. Laboratory safety of Mycology and Parasitology Lab
2. Isolation of fungi from human skin -- cotton swab
3. Fungal slide culture technique
4. Lactophenol cotton blue staining
5. Identification of mould and yeast
6. Observation of cysts and ova in stools
7. Isolation of microorganisms from stoolsample
8. Virtual demonstration of various stages of malarial parasite in RBCs
9. Identification of Malarial parasitesby Giemsa staining
10. Observation of Parasites in waste water
11. Isolation of Microorganisms from sputum

## References:


1. Dahms, T. E. S. and Czymmek,K.J. 2015. Advanced Microscopy in Mycology, Springer International Publishing, Switzerland.
2. Campbell, C. K., Johnson, E. M. and Warnock, D. W. 2013. Identification of Pathogenic Fungi, Second Edition, John Wiley & Sons Ltd., UK.
3. Ridley, J. W. 2011. Parasitology for Medical and Clinical Laboratory Professionals, Cengage Learning, US.
4. Garcia, L, S. 2007. Diagnostic Medical Parasitology, Fifth Edition, ASM Press, US.
5. Kavanagh,K. 2006. Medical Mycology: Cellular and Molecular Techniques, John Wiley & Sons Ltd., UK.


## Web Resources:

1. Slide culture technique - https://www.youtube.com/watch?v=y1Fc-5OxGl0
2. Malaria life cycle: Human host - https://www.youtube.com/watch?v=1v55yg0RfoY
3. Malaria life cycle: Mosquito host - https://www.youtube.com/watch?v=MxiWp8vkRFI

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)
**Programme Code-UMB**

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CL52 | Lab in Food Microbiology | Core Lab 6 | - | - | 2 | 1 |

L - Lecture T - Tutorial P – Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 40 | 60 | 100 |

## Preamble

The course provides hands on skill in screening of microorganism in food products. Understanding the significance of food preservation.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Enumerate the microorganism associated with food | 80 | 80 |
| **CO2** | Demonstrate the microbial enzymes activities | 90 | 90 |
| **CO3** | Understand the principles of microorganisms during various food-processing and preservation steps | 70 | 80 |
| **CO4** | Distinguish types of microbial spoilage based on shelf-life period | 75 | 80 |
| **CO5** | Recall improper food storage and contamination | 75 | 70 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **L** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **--** | **S** | **M** | **S** |
| **CO3** | **S** | **M** | **--** | **S** | **--** | **S** |
| **CO4** | **S** | **M** | **M** | **M** | **--** | **M** |
| **CO5** | **S** | **--** | **--** | **M** | **--** | **M** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **M** |
| **CO2** | **S** | **S** | **M** | **S** | **M** |
| **CO3** | **S** | **S** | **M** | **S** | **M** |
| **CO4** | **S** | **L** | **M** | **S** | **M** |
| **CO5** | **M** | **M** | **L** | **S** | **S** |

## Blooms Taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Lab in Food Microbiology

1. Enumeration of microbes from spoiled bread (bacteria and fungi)
2. Isolation of microbes from packed/canned food
3. Determination of milk quality Methylene Blue ReductaseTest
4. Estimation of alkaline phosphataseactivity
5. Screening of Lactic acid bacteria for probiotic characters
6. Estimation of cellulase activity
7. Determination of vitamin C assay
8. Changes in protein conformation due to Physical factors (pH and temperature) by observingUV-spectra
9. Changes in protein conformation due to chemical factors (ionic concentration) by observingUV-spectra
10. Effect of food grade preservatives to prevent microbial spoilage in food.

## References:


1. Nielsen, S.S. 2019. Food analysis laboratory manual, Third Edition, Springer International, Switzerland.
2. Cappuccino, J. G. and Welsh, C. T. 2018.Microbiology – A Laboratory Manual, Eleventh Edition,Pearson Education Ltd., Global Edition. UK.
3. Da Silva, N., Taniwaki, M.H., Junqueira, V.C.A., Silveria, F. de.A., Okazaki, M.M. and Gomes, R.A.R. 2018. Microbiological examination methods of food and water: a laboratory manual, Second Edition, CRC Press, US.
4. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2012. Molecular Cloning- A Laboratory Manual, Fourth Edition, Cold Spring Laboratory Press, US.
5. Spencer, J.F. T. and de Spencer, A.L.R. 2001. Food Microbiology Protocols, Methods in Biotechnology-vol.14, Humana Press, Totawa, New Jersey, US.


## Web Resources:

1. Cellulose degrading bacteria - https://www.youtube.com/watch?v=J4mrxq-G2XY
2. Methylene blue reductase test - https://www.youtube.com/watch?v=0XXIntGsBog

## Course Designer:

1. Dr. E. Kaarunya
2. Dr. B. Singaravelan

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)
**Programme Code-UMB**

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CL53 | Lab in Clinical Lab Technology | Core lab 7 | - | - | 2 | 1 |

L - Lecture T - Tutorial P - Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 40 | 60 | 100 |

## Preamble

Provides hands on training to the students on the collection, transport and analyses of clinical samples. The course work demonstrates technical skills, quality control parameters and other health related methods required for clinical lab technician.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Enumerate the total and differential count of blood cells | 80 | 85 |
| **CO2** | Determine the bleeding and clotting time of blood sample. | 85 | 90 |
| **CO3** | Estimate the different clinical laboratory techniques for collection and analysis of blood sample. | 80 | 85 |
| **CO4** | Infer the presence of microbial growth and antibiotic sensitivity of clinical samples. | 80 | 85 |
| **CO5** | Choose to work or establish a clinical laboratory. | 80 | 85 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **M** | **S** | **S** | **S** |
| **CO3** | **S** | **L** | **L** | **M** | **L** | **S** |
| **CO4** | **S** | **S** | **M** | **S** | **M** | **S** |
| **CO5** | **S** | **L** | **M** | **M** | **M** | **S** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **---** | **S** | **S** | **M** |
| **CO2** | **M** | **M** | **S** | **S** | **M** |
| **CO3** | **M** | **M** | **M** | **S** | **M** |
| **CO4** | **M** | **S** | **S** | **S** | **M** |
| **CO5** | **M** | **M** | **S** | **M** | **M** |

## Blooms Taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Lab in Clinical Lab Technology

1. Urine – Microbial Culture andSensitivity.
2. Microscopic and culturing examination of sputum sample.
3. Total W.B.C. & R.B.C.count.
4. Differential leukocyte count.
5. Determination of Bleeding & Clottingtime.
6. Determination ofESR.
7. Estimation of Haemoglobin (sahli'smethod).
8. Estimation of Blood Sugar (O Toluidinemethod).
9. Estimation of blood Urea (DAMmethod).
10. Estimation of serumCholesterol (Zak'smethod).
11. Urine sample analysis to detect sugar, Albumin, Ketone bodies and bilesalts.
12. Separation of Serum protein byelectrophoresis.

## References:


1. Ranjan Kumar De, 2018. Diagnostic Microbiology, (For DMLT Students), Second Edition,Jaypee Brothers publishing, India.
2. Jorgensen, J. H. and Pfaller, M. A. 2015. Manual of Clinical Microbiology, Eleventh Edition, ASM Press, US.
3. Chandrasekar, M. and Mishra, N. 2014. Practical Physiology Book, Second Edition, Jaypee Brothers Medical Publishers, India.
4. Collee, J.G., Fraser, A. G., Marmion, B. P. and Simmons, A. 2007. Mackie and McCartney Practical Medical Microbiology, Fourteenth Edition, Churchill Livingstone, New York, US.
5. Ashok, R. 2000.Antimicrobials in Laboratory Medicine, ChurchillLivingstonePvt. Ltd. India.


## Web Resources:

1. Differential Count - https://www.youtube.com/watch?v=VFKm_kMTf50&t=68s
2. Haemoglobin estimation - https://www.youtube.com/watch?v=-TDL9Jp0dg4&t=336s
3. Blood urea estimation - https://www.youtube.com/watch?v=y4mMP8rmp3M

## Course Designer:

1. Dr. C. M. Archana
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B.Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CE51A | Epidemiology | Core Elective | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 25 | 75 | 100 |

## Preamble

Highlight the elemental principles of epidemiology. To demonstrate the descriptive, analytical and interventional study designs in context to the health system monitoring.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Outline the definition, concepts, history and role of epidemiology in public health | 80 | 80 |
| **CO2** | Illustrate the dynamics of disease, modes of transmission and emerging diseases. | 75 | 80 |
| **CO3** | Demonstrate the tools used to measure disease frequency, their association and impact | 90 | 80 |
| **CO4** | Classify types of epidemiological study designs, basic principles and analysis | 75 | 80 |
| **CO5** | Compare the significance of modern epidemiology designs and review the case studies. | 80 | 80 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **--** | **M** | **L** | **--** |
| **CO2** | **S** | **M** | **--** | **S** | **--** | **--** |
| **CO3** | **--** | **M** | **M** | **S** | **L** | **--** |
| **CO4** | **--** | **L** | **--** | **S** | **--** | **M** |
| **CO5** | **--** | **L** | **--** | **S** | **M** | **M** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | M | -- | S | M | M |
| **CO2** | M | -- | S | M | S |
| **CO3** | M | -- | S | M | L |

| | | | | | |
|---|---|---|---|---|---|
| **CO4** | L | -- | M | M | M |
| **CO5** | L | -- | M | L | S |

**Blooms taxonomy**

| | CA | | End of Semester |
|---|---|---|---|
| | **First** | **Second** | |
| *Knowledge* | 30% | 30% | 30% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 30% | 30% | 30% |

## Epidemiology

**Unit: I**

Fundamentals of epidemiology - Definitions, Basic concepts and applications - History and evolution of epidemiologic methods. Natural history of a disease and its application in disease control, Levels of prevention and modes of intervention.

**Unit: II**

Concepts of Endemic, epidemic, pandemic and sporadic diseases; mortality/ morbidity rates, incidence and prevalence; Communicable and non-communicable diseases; Modes of transmission of infections; Emerging and re-emerging diseases (bacterial, viral, fungal, and parasite diseases).

**Unit: III**

Formulation and Importance of a case definition. Development of a case definition over time. Types of epidemiological measures: Measuring disease frequency (prevalence, incidence), survey methodology (data collection – reliability and validity, sensitivity, specificity and predictive values); Measurement of association and potential impact (relative risk, attributable risk, population attributable risk).

**Unit: IV**

Epidemiological study designs: Overview of study design. Types - Descriptive studies Ecological studies, Case control, cohort studies, Randomized control trials, estimating risks.

**Unit: V**

Analysis of data: Systematic review and meta-analysis – Hybrid designs in epidemiology – Community based epidemiologic studies.

**Text Books:**


1. Celentano, D. D. and Szklo, M. 2019. Gordis Epidemiology, Sixth Edition, Elsevier Health Sciences, US.
2. Nelson, K.E. and Williams, C.M. 2014. Infectious Disease Epidemiology: Theory and Practice, Third Edition, Jones and Bartlett Publishers, US.


**References:**


1. Legach, E.I. and Sharov, K.S. 2021. SARS-CoV-2 and Corona Crisis: Epidemiological Challenges, Social Policies and Administrative Strategies. Springer Nature, Germany.
2. Friis, R.H., Sellers, T. and Sellers, T. A. 2020. Epidemiology for public health practice, Sixth Edition, Jones & Bartlett Learning, US.
3. Merrill, R.M. 2016. Introduction to Epidemiology, Seventh Edition, Jones & Bartlett Publishers, US.

4. Ahrens, W., Krickberg, K. and Pigeot, I. 2014. Handbook of epidemiology, Second Edition,Springer-Verlag New York, Germany.
5. Rothman, K.J., Greenland, S. and Lash, T.L., 2008. Modern epidemiology, Third Edition, Wolters Kluwer Health/Lippincott Williams & Wilkins, US.

**Web Resources:**

1. Epidemiology of COVID19 Article - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7364648/
2. COVID 19 Epidemiology – https://www.cdc.gov/coronavirus/2019-ncov/science/about-epidemiology/index.html
3. ICMR: EpidemiologyOutbreak - https://www.nie.gov.in/resource/outbreak-sciences

**Course Designers:**

1. Dr.E. Kaarunya
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CE51B | Pharmacology | Core Elective | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 25 | 75 | 100 |

## Preamble

The course demonstrates the fundamentals techniques in pharmacology. Illustrates the elemental procedure in drug identification, processing, toxicity analysis and clinical trials.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Outline basic scientific concepts and principles of the pharmacology | 80 | 75 |
| **CO2** | Explain the pharmacokinetic parameters of drug | 75 | 80 |
| **CO3** | Distinguish the types of drugs and their interactions | 80 | 75 |
| **CO4** | Illustrate the chemical structure, dosage regimen, stability and storage of commonly used drugs | 75 | 80 |
| **CO5** | Summarize the basic principles of toxicology and clinical trials | 80 | 80 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **--** | **S** | **M** | **M** |
| **CO2** | **--** | **M** | **--** | **M** | **M** | **--** |
| **CO3** | **S** | **M** | **--** | **S** | **M** | **S** |
| **CO4** | **M** | **--** | **--** | **S** | **M** | **M** |
| **CO5** | **--** | **L** | **--** | **S** | **L** | **M** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **--** | **M** | **L** | **S** |
| **CO2** | **S** | **M** | **S** | **M** | **S** |
| **CO3** | **L** | **--** | **S** | **M** | **M** |
| **CO4** | **M** | **--** | **--** | **M** | **M** |
| **CO5** | **M** | **--** | **M** | **M** | **M** |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 30% | 30% | 30% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 30% | 30% | 30% |

## Pharmacology

**Unit: I**

Introduction and scope of Pharmacology, Various routes of drug administration -Drug absorption - types, factors affecting drug absorption. Bioavailability and the factors affecting bioavailability. Drug distribution - factors affecting drug distribution. Biotransformation of drugs - Definition, types of biotransformation reactions, factors influencing drug metabolisms, Excretion of drugs - routes of drug excretion

**Unit: II**

Pharmacokinetics - Sites of drug action, Structure Activity Relationship (SAR), dose-response relationship, Adverse Drug Reactions (ADR) and manifestations of ADR, Drug allergy, treatment of acute drug poisoning; Factors modifying drug action.

**Unit: III**

Principles of drug prescription – P drug concept, Essential drugs, orphan drugs, factors modifying the effects of a drug and drug interactions.

**Unit: IV**

Definition, classification, pharmacological actions, dose, indications, and contraindications of Drugs Acting on the Peripheral Nervous System - Neuromuscular blocking agents, Non-Steroidal Anti-Inflammatory drugs (NSAIDs); Drugs Acting on the Central Nervous System Anti-depressant drugs, Anti-psychotics; Drugs acting on cardiovascular system - Anti-arrhythmic drugs, Congestive heart failure.

**Unit: V**

Toxicity studies – ADME (absorption, distribution, metabolism, and excretion), teratogenicity, mutagenicity and carcinogenicity. Clinical Trails – Animal Studies, Phases – I, II, III & IV. Randomized control studies.

## Text Books:


1. Satoskar, R. S., Nirmala, R. and Bhandarkar, S. D. 2020.Pharmacology and Pharmacotherapeutics, Twenty Fourth Edition, Elsevier, India.
2. Tripathi, K.D., 2013. Essentials of Medical Pharmacology. Jaypee Brothers Medical Publications, India.


## References:


1. Ritter, J., Flower, R., Henderson, G., Loke, Y. K., MacEwan, D. and Rang. H. 2019. Rang & Dale's Pharmacology, Ninth Edition, Elsevier Health Sciences, UK.
2. Whalen, K. 2018. Lippincott's illustrated reviews: Pharmacology, Seventh Edition, Wolters Kluwer Health, India.
3. Golan, D.E., Armstrong, E.J. and Armstrong, A. W. 2016. Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy, Fourth Edition, Lippincott Williams & Wilkins, US.

4. Katzung, B. G. and Trevor, A. J. 2014. Basic and Clinical Pharmacology, Thirteenth Edition, McGraw Hill Education, US.
5. Helms, R. A., Quan, D. J., Herfindal, E.T. and Gourley, D.R. 2006. Textbook of Therapeutics: Drug and Disease Management,Eighth Edition, Lippincott Williams and Wilkins, US.

**Web Resources:**

1. Drug action - https://cdsco.gov.in/opencms/opencms/en/Drugs/New-Drugs/
2. Toxicology - https://libguides.utoledo.edu/toxicology/internet
3. Clinical trial guidelines in India -https://clinregs.niaid.nih.gov/country/india
4. Drugs approved - https://www.fda.gov/drugs

**Course Designers:**

1. Dr.E. Kaarunya
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20SE41B | Bioethics and Biosafety | SBE - 2 | 2 | - | - | 2 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 15 | 35 | 50 |

## Preamble

The course provides the basic knowledge on the moral values of handling experimental animals and biosafety in laboratory

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | List the fundamental concepts of Bioethics and Biosafety. | 75 | 75 |
| CO2 | Explain the pre-symptomatic genetic diseases and its importance in healthcare. | 70 | 75 |
| CO3 | Summarize the importance of biological hazard and level of biosafety. | 80 | 80 |
| CO4 | Outline the theoretical basis of Institutional Animal Ethical Committee (IAEC) and Institutional Biosafety Committee (IBSC). | 75 | 75 |
| CO5 | Illustrate the genetically modified organisms and their implications in environment. | 75 | 70 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | L | S | - | - | M | L |
| CO2 | M | M | - | M | - | - |
| CO3 | S | S | - | L | - | L |
| CO4 | L | L | - | - | S | L |
| CO5 | M | M | - | M | - | - |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | - | - | - | - | - |
| CO2 | M | - | S | M | M |
| CO3 | - | - | - | - | - |
| CO4 | - | - | - | - | - |
| CO5 | M | - | S | M | M |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Bioethics and Biosafety

**Unit I**

Introduction to Bioethics: Moral values on experimental animals, Human Genome Project and its ethical issues. Detection of pre-symptomatic genetic diseases and its importance in healthcare, Ethical implication of biotechnological product and techniques, Institutional Animal Ethical Committee (IAEC), patents and copyrights.

**Unit II:**

Introduction to biosafety: Guidelines and regulation. Biosafety in laboratory: Laboratory associated infection and other hazards, Decontamination and disposal in the microbiology laboratory -biomedical waste and their management, Assessment of biological hazard and level of biosafety. Use of genetically modified organisms and their release in environment. Institutional Biosafety Committee (IBSC).

## Text Books:


1. Joshi, R. 2006. Biosafety and Bioethics, Gyan Publishing House, New Delhi, India
2. Fleming, D. A. and Hunt, D. L.2001. Biological Safety Principles &Practices. Third Edition, ASM Press, Washington, US.


## References:


1. Chadwick, R.F. and Schuklenk. U. 2020. This is Bioethics: An Introduction. John Wiley and sons, New Jersey, US.
2. Wooley, D. and Byers, K. 2017. Biological Safety: Principles and Practices, Fifth Edition, ASM Press, US.
3. Goel, D. and Parashar, S. 2013. IPR, Biosafety and Bioethics. Dorling Kindersley Pvt. Ltd. India.
4. Talbot, M. 2012. Bioethics: An Introduction, Cambridge university Press, UK.
5. Sateesh, M.K. 2008. Bioethics and Biosafety. I. K. International publishing House Pvt. Ltd., New Delhi India.


## Web Resources:

1. Transgenic organisms -https://www.youtube.com/watch?v=6-YI7nG0CVc
2. Biological safety cabinet -https://www.youtube.com/watch?v=96-aZLom340
3. Biological safety -https://www.youtube.com/watch?v=YGtrh6Lw5PE

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20SE41C | Bioenergy | SBE - 3 | 2 | - | - | 2 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Fifth | 15 | 35 | 50 |

## Preamble

The course elaborates on renewable and non-renewable energy sources, focuses on Bioenergy and in particular on the exploitation of biomass and biomass waste for energy recovery.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | List the basic principle and application of bioenergy systems | 75 | 70 |
| CO2 | Explain the fundamental concepts in bioconversion of biomass to energy | 70 | 70 |
| CO3 | Explain the fundamental concepts in biofuel production | 70 | 60 |
| CO4 | Develop designs for bioenergy conversion and scale up | 70 | 65 |
| CO5 | Apply the skills in the development of microbial fuel cells | 75 | 60 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | M | L | - | M | - | L |
| CO2 | M | L | - | M | - | L |
| CO3 | M | - | - | L | - | M |
| CO4 | | - | - | - | - | S |
| CO5 | L | - | - | - | - | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | - | - | - | L | - |
| CO2 | - | - | - | L | - |
| CO3 | - | - | - | L | - |
| CO4 | M | - | - | S | - |
| CO5 | S | - | - | S | M |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Bioenergy

**Unit I**

Introduction to Renewable and non-renewableenergy; Biomass as a source of energy and its classifications; Trans esterification and combustion of biomass. Biofuels: Definition and Type – Ethanol & Methanol production using bagasse, Biodiesel from *Jatropha curcas*- Advantages and limitations

**Unit II:**

Microbial oil production from oleaginous microorganisms (Algae & Fungi) Advantages and Limitations. Microbial biogas production: methane& hydrogen – Process design and Applications; Microbial Fuel Cell - Process design and Applications; National Biofuel Policy

## Text Books:


1. Rai, G.D. 2007. Non-conventional energy sources, Khanna Publishers, New Delhi, India.
2. Maheswari R. C. and Chaturvedi. P. 1997. Bio Energy for Rural Energisation, Concept Publishing Co. India.


## References:


1. Drapcho, C. M.,Nhuan, N. P. and Walker, T. H. 2020. Biofuels Engineering Process Technology, Second Edition, The McGraw-Hill Companies, US.
2. Lee, S. and Shah, Y. T. 2013. Biofuels and Bioenergy: Processes and Technologies, CRC Press, US.
3. Calle, F. R., de Groot, P., Hemstock, S.L. and Woods, J. 2007. The Biomass Assessment Handbook: Bioenergy for a sustainable environment, Routledge, UK.
4. Viswanathan, B. 2006. An Introduction to Energy Sources- Indian Institute of Technology, Madras, India.
5. Ravindranath, N. H. and Hall, D.O. 1995. Biomass, Energy and Environment: A Developing Country: Perspective from India, Oxford University Press, UK.


## Web Resources:

1. Renewable energy - https://www.youtube.com/watch?v=nVl17JLn_u0
2. Problem with biofuels- https://www.youtube.com/watch?v=OpEB6hCpIGM
3. Biogas - https://www.youtube.com/watch?v=3UafRz3QeO8

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. C. M. Archana

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C61 | Immunology | Core-12 | 5 | - | - | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 25 | 75 | 100 |

## Preamble

The course elaborates on principles and molecular, cellular interactions of the immune system. Provide detailed description of the immune response to foreign antigens, vaccines, HLA testing, auto immune disorders and immunodeficiency.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Define the immunobiological basis of the cellular and molecular responsiveness of immunity. | 65 | 75 |
| CO2 | Outline the characterization and functions of antibody isotypes. | 60 | 70 |
| CO3 | Exemplify the adverse effect of hypersensitivity and autoimmunity of the immune system | 65 | 70 |
| CO4 | Recall the stages of various transplantation procedures and immunodiagnostics. | 70 | 75 |
| CO5 | Elucidate the reasons for immunization and different vaccination | 70 | 75 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | S | M | L | S | - | M |
| CO2 | S | S | M | S | - | S |
| CO3 | M | M | L | M | - | M |
| CO4 | M | S | L | M | M | M |
| CO5 | S | S | L | S | M | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | S | S | S | S | M |
| CO2 | S | L | S | S | M |
| CO3 | S | M | M | M | M |
| CO4 | S | S | M | M | M |
| CO5 | S | S | S | S | S |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Immunology

**Unit I**

History of Immunology: Contributions of Edward Jenner –Louis Pasteur – Elie Metchnikoff Types of immunity: Innate-anatomic, physiologic, phagocytic, and inflammatory. Acquired or Adaptive–antigenic specificity – diversity- Immunologic memory–self/nonself recognition. Cells: Lymphocytes (T& B) – Macrophages, NK cells – APCs - Role. Humoral–Cell-mediated immunity - Clonal selection theory. Organs of immune system: Primary- Thymus & Bone marrow; Secondary – spleen –lymph nodes – GALT & MALT.

**Unit II:**

Antigens: Immunogenicity Versus Antigenicity - Factors Influence Immunogenicity – Adjuvant – Epitopes – Haptens and the Study of Antigenicity; Antibodies: Immunoglobulins – Domain structure – classes – IgG, IgA, IgM, IgD, IgE Characteristics; Isotypes– Allotypes-Idiotypes. Hybridoma Technology – Monoclonal Antibodies –Applications. Antigen–Antibody interactions: Primary interaction, Secondary phenomena – Cross reactivity, Agglutination, Precipitation- Radio immune assay- ELISA- Immunofluorescence.

**Unit III:**

Complement factors – Classical – Alternate Pathways-Lectin pathway-biological functions Cell mediated immunity – Cytokines – types – Network – Role in immune regulation. Hypersensitivity reaction – Type I, II, III, IV. Tolerance: definition – types; Autoimmunity: organ specific – Grave's disease -Myasthenia gravis - Hashimoto's thyroiditis. Systemic-Rheumatoid Arthritis - Multiple sclerosis - Systemic lupus erythematosus (SLE).

**Unit IV:**

Transplantation antigens-Erythrocyte antigens - MHC – HLA – Class I & Class II Antigens – Immunologic Basis of Graft Rejection - Allograft rejection — Graft Versus Host Disease – Prevention of graft rejection. Xenotransplantation. Tumor Antigens: Oncofetal tumor antigens, tumor-associated transplantation antigens on human melanomas –Immunity to tumor - Tumor evasion mechanisms - Immunodiagnosis – Tumor immuno therapy.

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**Unit V:**

Immunodeficiencies - Primary – B & T Cell deficiencies, combined – secondary- acquired – HIV – AIDS. Experimental Models of immunodeficiency include genetically altered animals - Nude (Athymic) mice and the SCID mouse. Vaccines: Types- Attenuated – Killed – Purified proteins (Toxoid) – Recombinant vector Vaccines, DNA vaccines and Multivalent subunit vaccines. Immunization schedule, Active & Passive immunization.

**Text Books:**


1. Coico, R., Sunshine, G., Benjamini, E. 2021. Immunology: A Short Course, Eighthedition. Wiley- Blackwell, NewYork, US.
2. Punt, J., Stranford, S., Jones, P. and Owen, J. A. 2019. Kuby Immunology. Eighth Edition, W.H. Freeman and Company, NewYork, US.


**References:**


1. Murphy, K., Travers, P., Walport, M., and Janeway, C. 2022. Janeway's Immunobiology. Tenth Edition, Garland Science, New York, US.
2. Shetty, N. 2021. Immunology – Introductory Text Book, Wiley Eastern Limited, NewDelhi, India.
3. Roitt, I., Brostoff, J., Male, D., Roth, D. and Male, V. 2020. Immunology, Ninth Edition, Elsevier Publications, US.
4. Delves, P. J., Martin, S. J., burton, D. R. and Roitt, I. M. 2017. Roitt's Essential Immunology, Thirteenth Edition, Wiley-Blackwell, US.
5. Abbas, A.K., Lichtmann, A.H. and Psober, y. S. 2016. Cellular and Molecular Immunology, Ninth Edition, W.B. Saunders company,London.


**Web Resources:**

1. Immune system - https://www.youtube.com/watch?v=lxC-3MpIMUo
2. Hybridoma technology - https://www.youtube.com/watch?v=cCeze8tA_XI
3. Vaccine production - https://www.youtube.com/watch?v=34UWTlxK6Ks

**Course Designers:**

1. Dr. C. M. Archana
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C62 | Industrial Microbiology | Core 13 | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 25 | 75 | 100 |

## Preamble

Summaries the applications of microorganisms in fermentation process. Emphasis on upstream and downstream processes of fermentation, process optimization and product development.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Recollectknowledge on industrially important microbes from different sources. | 75 | 80 |
| **CO2** | Illustrate the types of fermenters, operation methods and kinetics | 85 | 80 |
| **CO3** | Explain the fermentation media, process parameters, control and kinetics of mass production | 90 | 80 |
| **CO4** | Explain the process of industrially important biotransformed and recombinant products and emphasis on product development regulation and safety | 75 | 80 |
| **CO5** | Illustrate the types and importance of downstream processing | 80 | 80 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **M** | **--** | **--** | **S** | **--** | **S** |
| **CO2** | **--** | **--** | **M** | **S** | **--** | **M** |
| **CO3** | **--** | **--** | **M** | **S** | **--** | **S** |
| **CO4** | **S** | **M** | **L** | **S** | **M** | **S** |
| **CO5** | **M** | **M** | **M** | **S** | **M** | **S** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **--** | **M** | **M** |
| **CO2** | **M** | **S** | **--** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **--** | **S** | **S** |
| **CO5** | **M** | **S** | **--** | **S** | **S** |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 30% | 30% | 30% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 30% | 30% | 30% |

## Industrial Microbiology

**Unit I**

Definitions, history and scope of industrial microbiology. Isolation of industrially important strains: Sources for sample collection, screening techniques: primary screening crowded plate technique, Auxanography, enrichment technique, dye indicator and secondary screening. Strain development- mutation, selection of auxotroph, protoplast fusion, and parasexual reproduction. Strain Maintenance.

**Unit II**

Design configurations and components of fermenter. Types of fermentation process - solid state fermentation and submerged fermentation, Modes of fermentation operation- batch, fed-batch, continuous fermentation. Types of bioreactor/fermentors - airlift, fluidized bed, tower, photo bioreactor, disposable bioreactor.

**Unit III**

Upstream processing: Fermentation media- chemical composition, types of media: industrial wastes, molasses, corn steep liquor, sulphite waste liquor, whey, yeast extract, and synthetic media - protein hydrolysates. Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration; computer automation. Media optimization and methods. Modelling the kinetics of biological activity in fermentation systems (batch fermentation).

**Unit IV**

Downstream processing: Cell disruption-physical and chemical methods; Separation-Precipitation, filtration, centrifugation, solid liquid extraction, liquid-liquid extraction; Purification- chromatography, solvent extraction; Preservation – drying (spray & freeze) and crystallization.

**Unit V**

Industrial process and products developed – microbial enzymes- amylase, antibiotic-penicillin, fuels – ethanol, chemicals – amino acid glutamic acid, vitamins –riboflavin, food supplements – citric acid, biomass production – SCP, Recombinant products– interferon, hormones, vaccines; Product development, regulation and safety.

## Text Books:


1. Crueger, W. and A. Crueger, 2003. Biotechnology: A Test Book of Industrial Microbiology, Second Edition, Panima Publishing Corporation, New Delhi, India.
2. Patel, A.H. 1996. Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi, India.

## References:


1. Okafor, N. 2007. Modern Industrial Microbiology and Biotechnology, Science Publishers, US.
2. Waites, M.J., Morgan, N.L., Rockey,J.S. and Higton,G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, UK.
3. Stanbury, P.F., Whitaker, A.and Hall, S. J. 1999. Principles of Fermentation Technology, Second Edition, Aditya Book (p) Ltd., New Delhi, India.
4. Glaze A.N. and Nikaido H. 1995. Microbial Biotechnology: Fundamentals of Applied Microbiology, W.H. Freeman and Company, US.
5. Casida, L.E., 1991. Industrial Microbiology, Fifth Edition,New Age International Private Limited, India.


## Web Resources:

1. Bioreactors - https://www.biocon.com/products/key-therapeutic-areas/
2. Serum institute of India -https://www.seruminstitute.com/research_devlopment.php
3. Bharat biotech -https://www.bharatbiotech.com/clinical_research.html
4. Biocon - https://www.biocon.com/products/key-therapeutic-areas/

## Course Designers:

1. Dr.E. Kaarunya
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C63 | Genetic Engineering and Biotechnology | Core | 5 | - | - | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 25 | 75 | 100 |

## Preamble

Course provides theoretical basis to properties and applications of versatile DNA modifying enzymes, cloning strategies and vector types. Illustrate the fundamental steps in gene cloning, transformation and culturing in organisms.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Elaborate the various tools, techniques and vectors of Recombinant DNA technology. | 75 | 70 |
| CO2 | Explain various gene cloning strategies, transformation in various organisms and screening of the recombinants. | 75 | 65 |
| CO3 | Illustrate the different types of animal cell culture techniques and their applications. | 75 | 65 |
| CO4 | Outline the different types of plant cell culture techniques and their applications. | 75 | 65 |
| CO5 | Strategize the principlesunderlying DNA amplification and analysis. | 75 | 60 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | L | L | - | M | - | S |
| CO2 | L | L | - | M | - | S |
| CO3 | L | L | - | M | - | M |
| CO4 | L | L | - | M | - | M |
| CO5 | M | S | - | S | - | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | S | M | L | S | S |
| CO2 | S | M | L | S | S |
| CO3 | S | - | - | S | S |
| CO4 | S | - | - | S | S |
| CO5 | S | S | S | S | S |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Genetic Engineering and Biotechnology

**Unit I**

Tools for Genetic engineering –restriction endonucleases, alkaline phosphatase, S1 Nuclease, Polynucleotide kinase, TdT,Ligase. Structure and Properties of cloning vectors- Plasmids (PBR322, PUC18), Ti plasmids, bacteriophages (lambda phage) – Hybrid vectors (Cosmids, phagemids). Expression vectors (*E.coli*lac and T7 promoter-based vectors, yeast YIp, YEp and YCpvectors).

**Unit II**

Gene cloning strategies: Selection of desired DNA fragments, linkers and adapters,homopolymer tailing, TA cloning.Transformation (heatshock, electroporation, microinjection) and transfection. Indirect transformation in plants (Ti plasmid)liposome and viral mediated delivery. Screening of recombinants (reporter genes, colony hybridization, antibiotics,α-complementation). Construction of genomic and cDNA libraries.

**Unit III**

Animal cell culture: Primary and Continuous Cell culture, adherent and suspension cultures; functional characteristics of cultured cells. Composition of animal cell culture media. Cryopreservation of animal cells, Applications of animal cell culture - Animal cloning (Dolly – nuclear transfer method).

**Unit IV**

Plant cell and tissue culture (PTC), culture media, Types of plant tissue cultures (Callus, suspension, protoplast, anther & ovule cultures, somatic embryos and meristem cultures). Micropropagation and somatic embryogenesis. Applications of PTC: Massive plant production, virus free plants, Embryo rescue of endangered plants, Germplasm collection and seed conservation.

**Unit V**

PCR- Principle and its application. Types of PCR: Reverse transcription PCR, quantitative real time PCR, multiplex PCR. DNA finger printing (RAPD and RFLP), DNA sequencing methods- Maxam Gilbert, Sanger's, Automated and NGS: pyrosequencing, Ion torrent Illumina. Phage display, Microarray, CRISPR and its applications. Transgenic animals (Sheep and fish) and Plants (Bt cotton, drought resistant plants and its applications. Animal bioreactors and molecular farming.

## Text Books:


1. Dubey R.C. 2018. A text book of Biotechnology. S. Chand & Company, New Delhi, India.
2. Brown, T.A. 2016. Gene Cloning & DNA Analysis: An introduction, Seventh Edition, John Wiley & Sons Ltd., UK.

**References:**


1. Satyanarayana U. 2020 Biotechnology. Books and Allied (P) Ltd., India.
2. Griffiths, A. J. F., Wessler, S. R., Carroll, S.B. and Doebley, J. 2015. An Introduction to Genetic Analysis. Eleventh Edition, W.H. Freeman and Company, New York, US.
3. Thieman, W. J. and Palladino, M. A. 2012. Introduction to Biotechnology, Third Edition, Pearson Education, US.
4. Glick, B. R., Pasternak, J. J. and Patten, C.L. 2010. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Fourth Edition,ASM Press, US.
5. Primrose, S.B. and Twyman, R. M. 2006. Principles of Gene Manipulation and Genomics, Seventh Edition, Blackwell Publishing, US.


**Web Resources:**

1. Dolly Sheep Legacy - https://www.youtube.com/watch?v=QO2yyS0CMQw
2. RT-PCR - https://www.youtube.com/watch?v=DH7o9Df5_50
3. CRISPR System - https://www.youtube.com/watch?v=VtOZdThI6dM

**Course Designers:**

1. Dr. B. Samuel Raj
2. Dr. B. Singaravelan

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20C64 | Intellectual Property Rights | Core 15 | 2 | - | - | 1 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 15 | 35 | 50 |

## Preamble

The course explains the basic concepts, patent, copyright and trademark on the biological materials.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Explain the awareness of acquiring the patent and copyright for their innovative works. | 90 | 90 |
| CO2 | Apply intellectual property rights and principles to day-to-day life real problems. | 95 | 90 |
| CO3 | Analyze professional issues which arise in the intellectual property right context. | 95 | 85 |
| CO4 | Explain the Procedure for patent application and patent granting procedure. | 90 | 90 |
| CO5 | Outline the Indian Patent Act 1970, Copyright Act 1957 and Trademark Act 1999. | 90 | 80 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | S | - | - | L | M | M |
| CO2 | S | - | - | - | L | M |
| CO3 | M | - | - | L | L | M |
| CO4 | S | - | - | L | L | S |
| CO5 | S | - | - | - | M | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | - | - | - | L | - |
| CO2 | - | - | - | M | - |
| CO3 | - | - | - | M | - |
| CO4 | - | - | - | M | - |
| CO5 | - | - | - | L | - |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Intellectual Property Rights

**Unit I**

Intellectual Property Rights: concept, scope and economic importance.Types of intellectual property: origin and development. Patent: Patent Law, Patent Act 1970 and its amendment. Procedure for patent application and patent granting. Copyright: Indian Copyright Act 1957 and its amendment; Ownership and duration of copyright; Needs for the protection of industrial design.

**Unit II:**

Trademark: Need for protection of trademarks, Indian Trademark Act 1999. Geographical indications. Patents of Biological materials in India: Protection of plant varieties and farmers rights. Patenting - microbes, genes, traits, techniques. Plant and animal genetic protection right and implication of protection. WIPO, GATT, TRIPS.

## Text Books:


1. e-book: www.icsi.edu. 2014. Intellectual Property Rights-Law and Practices, Published by The Institute of Company Secretaries of India. New Delhi, India.
2. Miller, R. and Davis, M.H. 2000. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers, US.


## References:


1. Satyanarayana U. 2020 Biotechnology. Books and Allied (P) Ltd., India.
2. Arezzo, E. and Ghidini, G. 2011. Biotechnology and Software Patent Law: A Comparative Review on New Developments. The Editors and Contributors Severally, UK.
3. Singh, K. 2010. Intellectual Property rights on Biotechnology, BCIL, New Delhi, India.
4. Stanley, S. A. 2008. Bioethics, Wisdom educational service, Chennai, India.
5. Acharya, N. K. 2001. Textbook on intellectual property rights, Asia Law House, India.


## Web Resources:

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. E.Kaarunya

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)
**Programme Code-UMB**

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CL61 | Lab in Immunology | Core lab 8 | - | - | 2 | 1 |

L - Lecture T - Tutorial P - Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 40 | 60 | 100 |

## Preamble

The students will be able to describe the basic principles, procedures and develop skills in basic immunological techniques. Provides hands on training on basic diagnosis and therapy.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Demonstrate and display the various lymphoid organs | 80 | 90 |
| **CO2** | Perform blood collection and serum separation | 80 | 90 |
| **CO3** | Distinguish various blood cells and their importance | 85 | 90 |
| **CO4** | Perform agglutination assays | 80 | 85 |
| **CO5** | Demonstrate animal handling techniques | 80 | 85 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | -- | **S** | **M** | **S** | -- | **S** |
| **CO2** | -- | **M** | **M** | **S** | -- | **S** |
| **CO3** | -- | **L** | **L** | **M** | -- | **S** |
| **CO4** | -- | **S** | **M** | **S** | -- | **S** |
| **CO5** | -- | **L** | **M** | **M** | -- | **M** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **S** |
| **CO3** | **S** | **M** | **S** | **M** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **L** | **L** | **S** | **M** |

## Blooms Taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Lab in Immunology

1. ABO blood grouping.
2. Reverse blood grouping.
3. WBC differential count.
4. Preparation of soluble, particulate and cellularantigens.
5. Separation of serum and plasma from blood.
6. Natural resistance by bacterial killing using unimmunizedserum
7. Immunoelectrophoresis.
8. Immunodiffusion test.
9. Bacterial agglutinationassay
10. Isolation and enumeration of T lymphocytes
11. Widal test
12. Virtual dissection and onscreen display of lymphoid organs of chick andmouse
13. Virtual demonstration of repetitive bleeding technique and injection routes in mouse, rat andrabbit.

## References:


1. Hay, F.C. and Westwood, M.R. 2008. Practical Immunology, Fourth Edition, Blackwell Publishing Company, UK.
2. Talwar, G.P. and Gupta, S.K. 2008. A Handbook of practical and Clinical Immunology, Second Edition, Vol- I, CBS, New Delhi, India.
3. Chakravarthy, A.K. 2006. Immunology and Immunotechnology. Oxford University Press, New Delhi, India.


## Web Resources:

1. Lymphoid organs in mice - https://www.youtube.com/watch?v=Mcmo8Z2u28s
2. Routes of immunization in mice - https://www.youtube.com/watch?v=s9skgg7dHIA
3. Haemagglutination assay - https://www.youtube.com/watch?v=HMg48a2W_6o

## Course Designer:

1. Dr. C. M. Archana
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)
**Programme Code-UMB**

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CL62 | Lab in Industrial Microbiology | Core Lab 9 | - | - | 2 | 1 |

L - Lecture T - Tutorial P – Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | sixth | 40 | 60 | 100 |

## Preamble

The course provides knowledge on principle of bioreactors. Highlights the screening of industrially important microbes, their mass production and downstream processing.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Identify the instruments and elaborate on the techniques associated with Industrial microbiology | 90 | 85 |
| **CO2** | Isolation and screening of economically importantmicrobes for mass production | 90 | 90 |
| **CO3** | Distinguish between the different types and stages of fermentation process | 85 | 85 |
| **CO4** | Production of alcohol and enzymes from bacteria or yeast | 90 | 80 |
| **CO5** | Analyze the problem associated with fermentation process. | 80 | 75 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | -- | -- | **M** | **S** | -- | **M** |
| **CO2** | **M** | **M** | -- | **S** | -- | **S** |
| **CO3** | -- | -- | -- | **S** | -- | -- |
| **CO4** | **M** | **M** | -- | **S** | **L** | **M** |
| **CO5** | -- | **S** | **M** | **M** | -- | **S** |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | -- | -- | **S** | **M** |
| **CO2** | **S** | **S** | -- | **S** | **S** |
| **CO3** | **S** | -- | -- | **S** | **S** |
| **CO4** | **S** | **S** | **M** | **S** | **S** |
| **CO5** | **S** | **S** | **M** | **S** | **S** |

## Blooms Taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Lab in Industrial Microbiology

1. Introduction to fermentors and their components.
2. Screening of antibiotic production from bacteria and fungi
3. Identification of bacteria for lipase production.
4. Identification of bacteria for amylase enzyme production.
5. Production of protease by *Bacillus subtilis*
6. Production of Citric acid by *Aspergillus niger* by Solid State fermentation.
7. Yeast cell Immobilization by Calcium Alginate method
8. Wine fermentation by *Saccharomyces cerevisiae*.
9. Estimation of alcohol using Potassium di-chromate method
10. Determination of cell separation (bacteria &yeast) by sonication
11. Determination of cell separation (bacteria & yeast) by Centrifugation and Filtration
12. Demonstration of fermentation using Kuhne's fermentation vessel.
13. Solid state fermentation – Mushroom production

## References:


1. Cappuccino, J. G. and Welsh, C. T. 2018.Microbiology – A Laboratory Manual, Eleventh Edition,Pearson Education Ltd., Global Edition. UK.
2. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2012. Molecular Cloning- A Laboratory Manual, Fourth Edition, Cold Spring Laboratory Press, US.
3. Rana, A. K. 2012. Downstream Processing Techniques in Biotechnology. Global Academic Publishers, NewDelhi, India.
4. Murugan, P., Nithya, R. and Fredinose, M. 2012. Experimental Procedure in Bioprocess Technology and Downstream Processing.Anjana Book House, India.
5. Kulanthaivel, S. and Janarthanan, S. 2012. Practical Manual on Fermentation Technology. I.K. International Publishing House, NewDelhi, India.


## Web Resources:

1. Mushroom production- https://onlinecourses.swayam2.ac.in/nos21_ge07/preview
2. Amylase enzyme activity - https://www.youtube.com/watch?v=Eqe7jC737Hs
3. Fermentation in yeast - https://www.youtube.com/watch?v=uN9POjK_iBE

## Course Designer:

1. Dr. E. Kaarunya
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CL63 | Lab in Genetic Engineering and Biotechnology | Core Lab 10 | -- | -- | 2 | 1 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 40 | 60 | 100 |

## Preamble

Provide hands on training and develop computer knowledge to impart in the field of Biology. Acquire knowledge of using tools to modify, amplify and identifying the genetic materials and protein.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Retrieve the genetic and protein information from the databases | 80 | 85 |
| CO2 | Identify and differentiate between two or multiple genome sequences | 85 | 90 |
| CO3 | Prepare primers and analyze the primers *in silico* | 95 | 90 |
| CO4 | Isolate the genetic material and analyze by electrophoresis | 95 | 90 |
| CO5 | Estimate the amount of genetic material in the given sample | 95 | 95 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | -- | L | S | M | -- | M |
| CO2 | -- | M | S | M | -- | M |
| CO3 | -- | S | S | M | -- | S |
| CO4 | -- | M | -- | -- | -- | S |
| CO5 | -- | M | -- | -- | -- | M |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | S | S | S | S | S |
| CO2 | S | S | S | S | S |
| CO3 | S | S | S | S | S |
| CO4 | S | M | S | S | M |
| CO5 | S | L | L | S | M |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Lab in Genetic Engineering and Biotechnology

1. Isolation of Genomic DNA from *Escherichia coli*
2. Isolation of Plasmid DNA from alkaline lysis method
3. Restriction digestion analysis
4. Agarose gel electrophoresis of DNA
5. SDS-PAGE
6. Demonstration of cloning
7. Western blotting - demonstration
8. Estimation of DNA by DPA method
9. Estimation of RNA by orcinol method
10. Pairwise sequence alignment (BLAST)
11. Multiple sequence alignment (CLUSTAL –W)
12. Restriction digestion *insilico*
13. Primer designing and *insilico* PCR
14. Phylogenetic tree

## References:


1. Baxevanis, A. D. and Ouellette, B. F. F. 2020. Bioinformatics: A Practical Guide to the Analysis of Genes and proteins, Fourth Edition, Wiley-Intern Science Publication, New York, US.
2. Chaitanya. K. V. 2013. Cell and Molecular Biology, A Lab manual, PHI learning Pvt. Ltd., India.
3. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2012. Molecular Cloning- A Laboratory Manual, Fourth Edition, Cold Spring Laboratory Press, US.
4. Jeyaraman, J., 2011. Lab. Manual in Biochemistry, Second Edition, Wiley Eastern Ltd, New Delhi, India.
5. Palanivelu. P. 2009 Analytical Biochemistry and Separation Techniques. Twenty First Century Publications, Madurai.


## Web Resources:

1. Blotting Techniques - https://www.youtube.com/watch?v=RvbzjYM_Ok0
2. Agarose Gel Electrophoresis - https://www.youtube.com/watch?v=dSFQHt-zIQs
3. SDS PAGE - https://www.youtube.com/watch?v=On_ZotdZexI

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CE61A | Biostatistics and Bioinformatics | Core Elective II | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 25 | 75 | 100 |

## Preamble

Provides ability to integrate theory and practice across biological and computing disciplines. Course emphasize the basic concepts of microorganism lineage, differentiating between organisms and evaluation of biological data statistically.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Collect, organize, analyze the data in the form of diagram or chart. Measure the central tendency and dispersion of the data. | 85 | 90 |
| CO2 | Evaluate and analyze the association between two or more variables | 80 | 85 |
| CO3 | Interpret the results of biological experiments based on statistical analyses. | 90 | 80 |
| CO4 | Differentiate between databases, tools, repositories and be able to use each one to extract specific information. | 85 | 80 |
| CO5 | Explore the evolutionary relatedness among genetically related organisms. | 90 | 85 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | L | L | -- | M | -- | M |
| CO2 | L | L | -- | M | -- | M |
| CO3 | L | L | -- | M | -- | M |
| CO4 | -- | S | S | L | -- | M |
| CO5 | -- | S | S | L | -- | M |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | -- | -- | -- | S | L |
| CO2 | -- | -- | -- | S | L |
| CO3 | -- | -- | -- | S | L |
| CO4 | M | S | L | S | M |
| CO5 | M | S | L | S | M |
| | | | | | |

## Blooms taxonomy

| | CA | End of |
|---|---|---|

| | First | Second | Semester |
|---|---|---|---|
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Biostatistics and Bioinformatics

**Unit: I**

Data: Types, Collection, Organization,Presentation and Tabulation of Data. Table: types and components.Graphs:Graphs and Graphs of frequency distribution.Diagram: Types. Measures of central tendency: Mean, Median, Mode (Individual, discrete and continuous observations). Measures of Dispersion – Range, quartile deviation, Standard deviation, variance, Coefficient of variation

**Unit: II**

Probability Theorems; Distribution- types Correlation-types, Karl Pearson's coefficient of correlation and Rank correlation; Regression equations.

**Unit III**

Hypothesis Testing- Level of Significance, types of errors, region of acceptance and rejection-Chi-square test,Student "t" test. Anova-one way. Application of MS-Excel for statistical analysis.

**Unit IV**

Scope and applications of Bioinformatics. Biological databases: DNA and protein- primary, secondary, specialized and structural databases. Similarity search, pairwise alignment- FASTA, BLAST: Conserved region-Motif. Multiple sequence alignment- Local and global- clustal omega.

**Unit V**

Phylogenetic analysis- Phylogenetic Trees, types. Neighbour Joining method, Maximum parsimony. 3D structure prediction -Homology modelling, Principles and steps in evaluation Tool- SPDB viewer. Structure validation-Ramachandran plot-SAVES.

## Text Books:


1. Gupta, S.P., 2014, Statistical Methods, Thirty Third Edition, Sulton Chand and Sons Publishers, New Delhi, India.
2. Mount, W.2004. Bioinformatics sequence and genome analysis, Second Edition, Cold Spring harbour Laboratory Press, New York, US.


## References:


1. Baxevanis, A. D. and Ouellette, B. F. F. 2020. Bioinformatics. A Practical Guide to the Analysis of Genes and Proteins, Fourth Edition, Wiley-Intern Science Publication, New York, US.
2. Pandey, M. 2015 Biostatistics: Basic and Advanced. Viva Books Pvt. Ltd., India.
3. Pevsner, J. 2015. Bioinformatics and Functional Genomics, Third Edition, Wiley - Blackwell, US.
4. Das.N. G. 2009. Statistical methods. Tata McGraw Hill Publishing Company Limited, India.
5. Twyman, R.H. 2003. Instant notes on Bioinformatics. Viva Books Pvt. Ltd., India.

**Web Resources:**

1. NCBI BLAST - https://www.youtube.com/watch?v=HXEpBnUbAMo
2. Protein 3D - https://www.youtube.com/watch?v=qBRFIMcxZNM

**Course Designers:**

1. Dr. B. Singaravelan
2. Dr. E. Kaarunya

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20CE61B | Microbial Genomics | Core Elective II | 5 | -- | -- | 5 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 25 | 75 | 100 |

## Preamble

Course insights on the genome structure, mapping and sequencing of the microbial system, Emphasis on the aid of computer analysis of the genome and the gene expression and protein profiling.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Outline the genome mapping and genome sequencing strategies | 80 | 75 |
| CO2 | Elaborates the aid of computer analysis in genome comparison and gene identification | 75 | 80 |
| CO3 | Explains the microbial genome organization, genome rearrangements and pathogenicity islands. | 85 | 80 |
| CO4 | Explains the components of transcriptome and proteome | 85 | 75 |
| CO5 | Discuss the principles and strategy for culture independent studies of microorganisms | 90 | 80 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | - | - | - | M | - | S |
| CO2 | - | - | - | M | - | S |
| CO3 | - | M | - | M | - | S |
| CO4 | - | - | - | M | - | L |
| CO5 | - | M | - | M | - | S |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | M | S | S | S | S |
| CO2 | S | S | S | S | S |
| CO3 | S | S | S | S | S |
| CO4 | M | L | M | S | S |
| CO5 | S | S | M | S | S |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | **40%** | **40%** | **40%** |
| *Understand* | **40%** | **40%** | **40%** |
| *Apply* | **20%** | **20%** | **20%** |

## Microbial Genomics

**Unit I**

Sequences as biological information: DNA, RNA and protein as informative molecules. Genome mapping: physical and genetic mapping, shotgun method, Genetic markers. Genome sequencing:First generation – Next generation – third and fourth generation sequencing.

**Unit II**

Bioinformatics for biologists: sequence comparison and identifying phylogenetic relationship. Genome Annotation: Computer analysis, Analysis by gene transcripts, Genome wide RNA mapping. Identification of gene function: computer analysis, gene inactivation and overexpression.

**Unit III**

Comparative Genomics: Microbial Genome size, structure, organization, base composition and elements of microbial genomes.DNA, RNA and proteome comparison, Genome evolution, genome rearrangements, horizontal gene transfer, pathogenicity islands.

**Unit IV**

Functional Genomics: components of transcriptome, microarray analysis, gene chips, SAGE, RNA sequencing, protein profiling, protein interactions, differential gene expression, comparing gene and protein expression.

**Unit V**

Environmental genomics, Metagenomics: Principles and applications, culture independent studies ofmicroorganisms, metagenome construction, Examples of metagenomic studies, human microbiomics.

## Text Books:


1. Brown, T.A. 2018. Genomes, FourthEdition,Garland Science, Taylor & Francis Group, LLC New York, US.
2. Ussery, D. W., Wassenaar, T. M. and Borini. S. 2009. Computing for comparative Microbial Genomics. Springer, London, UK.


## References:


1. Hartwell, L. H., Goldberg, M. L., Fischer, J. A. and Hood. L. 2018. Genetics: from Genes to Genomes, Sixth Edition, McGraw-Hill Education, New York, US.
2. Pevsner. J. 2015. Bioinformatics and Functional Genomics, Third Edition, John Wiley and Sons, Ltd. UK
3. Glick, B. R., Pasternak, J. J. and Patten, C.L. 2010. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Fourth Edition, ASM Press, US.

4. Primrose, S.B and Twyman, R. M. 2006. Principles of Gene Manipulation and Genomics, Seventh Edition, Blackwell Publishing, US.
5. Fraser, C.M., Read, T.D. and Nelson, K. 2004. Microbial Genomes. Humana Press,New Jersey, USA.

**Web Resources:**

1. NGS: Illumina - https://www.youtube.com/watch?v=CZeN-IgjYCo
2. Phylogenetic Trees - https://www.youtube.com/watch?v=6_XMKmFQ_w8
3. Metagenomics Principles -https://www.youtube.com/watch?v=RcYXTpNS_XU
4. Metagenomics for Researches - https://www.youtube.com/watch?v=TnWeVUx5ERU

**Course Designers:**

1. Dr. B. Singaravelan
2. Dr. B. Samuel Raj

**Thiagarajar College (Autonomous):: Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20SE61B | Stem Cell Biology | SBE - 2 | 2 | - | - | 2 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 15 | 35 | 50 |

## Preamble

Course emphasize the importance of stem cells and their application in therapeutic purpose. Elaborate the different types of stem cells and their properties.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | Define the concepts of stem cells | 75 | 70 |
| CO2 | Differentiate theoretically the adult and embryonic stem cells | 70 | 75 |
| CO3 | Illustrates the ethics and conflicts in stem cell application | 70 | 70 |
| CO4 | Outline the procedure for stem cell isolation, differentiation and maintenance | 75 | 60 |
| CO5 | Analyze the case studies associated with stem cell therapy | 70 | 60 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | L | - | - | L | - | - |
| CO2 | - | - | - | L | - | M |
| CO3 | - | M | - | L | - | L |
| CO4 | - | M | - | M | - | M |
| CO5 | L | S | - | M | - | - |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | M | - | - | - | - |
| CO2 | M | - | - | - | - |
| CO3 | L | - | - | - | L |
| CO4 | M | - | L | L | M |
| CO5 | M | - | S | L | M |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Stem Cell Biology

**Unit I**

Definitions of stem cells, Pluripotency, Stem-cell plasticity, Regulators of pluripotency, Differences between adult and embryonic stem cells, Stem Cell Niche and Microenvironment, primordial germ cells as stem cells, common markers to identify stem cells, protocol for embryonic stem cells isolation. Epigenetics

**Unit II**

Clinical applications of hematopoietic stem cells, Stem cells and aging, Correlation between stem cells and cancer, Tissue regeneration, Stem cell bank, case study (spinal cord injury, cancer), Merits ad demerits on human embryonic stem cell research.

## Text Books:


1. Regad, T., Sayers, T. J. and Rees, R. C. 2015. Principles of Stem Cell Biology and Cancer. Future Applications and Therapeutics. Wiley Blackwell, UK.
2. Lonza, R., Gearhart, J., Hogan, B., Melton, D., Pederson, R., Thomas, E. D., Thomson, J. and Wilmut, I. 2009. Essentials of Stem Cell Biology, Second Edition, Academic Press, US.


## References:


1. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H. *et al*., 2021. Molecular Cell Biology, Ninth Edition, Macmillan Learning, NewYork, US.
2. Rodrigues, G. and Roelen, B. A. J. 2020. Concepts and Applications of Stem Cell Biology: A Guide for Students. Learning Materials in Biosciences, Springer, Switzerland.
3. Slack, J. M. W. 2018. The Science of Stem Cells. Wiley Blackwell, US.
4. Lanza, R. and Atala, A. 2014. Essentials of Stem Cell Biology, Third Edition, Academic Press US.
5. Meshorer, E. and Plath, K. 2010. The Cell Biology of Stem Cells. Springer Science and Landes Bioscience, US.


## Web Resources:

1. Stem Cells - https://www.youtube.com/watch?v=i2pyDBMglfM
2. Stem Cell Therapy - https://www.youtube.com/watch?v=3KDsB7Rjaaw

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. C. M. Archana

**Thiagarajar College (Autonomous)::Madurai – 625 009**
**Department of Zoology and Microbiology**
(For those joined B. Sc., Microbiology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UMB20SE61C | Forensic Science | SBE - 3 | 2 | - | - | 2 |

L - Lecture T - Tutorial P - Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Third | Sixth | 15 | 35 | 50 |

## Preamble

The course explains the various concepts and importance of forensic science. Demonstrate knowledge and understanding the links between forensic science and the legal system.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| CO1 | List the history and development of forensic science. | 75 | 70 |
| CO2 | Define the principles, types and significance of fingerprints in crime investigation. | 70 | 65 |
| CO3 | Explain the basic principles and application of forensic science. | 70 | 70 |
| CO4 | Explain the fundamental concepts in physical, chemical and biological methods of crime investigation. | 75 | 70 |
| CO5 | Make use of biological evidence for crime investigation. | 70 | 65 |

## Mapping of COs with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - |
| CO2 | - | - | - | - | - | - |
| CO3 | L | - | - | L | - | L |
| CO4 | L | - | - | L | - | M |
| CO5 | M | - | - | - | - | M |

**Strong(S), Medium(M), Low(L)**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | - | - | - | - | L |
| CO2 | - | - | - | - | L |
| CO3 | - | - | - | M | - |
| CO4 | L | - | L | M | M |
| CO5 | M | - | L | S | M |

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| *Knowledge* | 40% | 40% | 40% |
| *Understand* | 40% | 40% | 40% |
| *Apply* | 20% | 20% | 20% |

## Forensic Science

**UNIT I**

Introduction to forensic Science –Development of Forensic science in India - Organization and functions of Forensic laboratory; Physical evidences - their classification and significance - Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation of physical evidence for laboratory examinations. Fundamentals of crime scene photography. Tool marks - identification - restoration of field off/erased marks.

**Unit II**

Foot and tyre impressions - examination of foot and tyre prints. Finger prints - Finger print patterns and classification – Toxicology - classification and mode of action of Poisons - narcotic drugs - alcoholic beverages - Examination of biological fluids - blood, seminal and saliva stains - forensic characterization of the above stains - stain patterns of the blood, Examination of fibres, hair, bones, teeth and skull - Fundamental of DNA typing.

## Text Books:


1. Harris H.A. and Lee H. C. 2019. Introduction to Forensic Science and Criminalistics, Second Edition, CRC Press, US.
2. Nanda, B. B. and Tiwari, R. K. 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi, India.


## References:


1. Saferstein, R. 2015. Criminalistics: An Introduction to Forensic Science. Pearson Publishers, UK.
2. Reddy, K. S. N. and Murty O. P. 2015. The Essentials of Forensic Medicine and Toxicology, Jaypee Brothers Medical Publishers, India.
3. Houck, M. M. and Siegel, J. A. 2015. Fundamentals of Forensic Science, Third Edition, Academic Press, US.
4. James, S.H., Nordby, J. J. and Bell S. 2014. Forensic Science: An Introduction to Scientific and Investigative Techniques, Fourth Edition, CRC Press, US.
5. Tilstone, W. J., Hastrup, M. L. and Hald, C. 2013. Fisher's Techniques of Crime Scene Investigation, CRC Press, US.


## Web Resources:

1. Real Science of Forensics - https://www.youtube.com/watch?v=h3-Pj-zbEq8
2. Why fingerprints unique? -https://www.youtube.com/watch?v=iCRy8voU5dE
3. Forensic DNA profiling - https://www.youtube.com/watch?v=C8QoMKHIEo8

## Course Designers:

1. Dr. B. Singaravelan
2. Dr. B. Samuel Raj

# M.Sc.,Microbiology

## ProgrammeCode:PMB

# Programme Outcome - PO (Aligned with Graduate Attributes) - Master of Science(M. Sc.,)

## Knowledge

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

## Complementary skills

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;

## Applied learning

Students will be able to apply disciplinary or interdisciplinarylearning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate.

## Communication

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentation by oral and/or written form.

## Problem solving

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

## Environment and sustainability

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

## Teamwork, collaborative and management skills

Recognize the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

**THIAGARAJAR COLLEGE, MADURAI - 9**

**An autonomous institution affiliated by Madurai Kamaraj University**

**(Re-Accredited with "A++" Grade by NAAC)**

**Vision**

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

**Mission**

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students
- To prepare the students for entry – level research and teaching positions in biological sciences
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students
- To create a holistic understanding of the allied subjects through interdisciplinary learning

**Programme Educational Objectives (PEO)**

**The Objectives of this programme is to equip/ prepare the students**

| | |
|---|---|
| **PEO1** | Adopt for careers in the food/agriculture/ pharmaceutical industry, agriculture, and applied research |
| **PEO2** | To compete in competitive exams like NET, SET and civil services |
| **PEO3** | Analyze and interpret scientific data collected with microbiological laboratory techniques and safety procedures |
| **PEO4** | To utilize the scientific literature effectively for the successful completion of research projects related to microbiology |
| **PEO5** | A proficient microbiological quality analyst in a reputed company or will be an entrepreneur in the field concerned |

**Programme Specific Outcome (PSO)**

**On the successful completion of M. Sc Microbiology, the students will**

| | |
|---|---|
| **PSO1** | Comprehend the core theories, concepts, practices and methods related to the different disciplines in microbiology |
| **PSO2** | Analyze the scientific information related to microbial processes and their role in ecosystem functioning and health issues |
| **PSO3** | Plan and execute safely a series of food, environment and medical microbiological experiments |
| **PSO4** | Be equipped with interdisciplinary skills, computational tools and techniques related to microbiology |
| **PSO5** | Exhibit their ideas/knowledge through their involvement in research/internship activities, association club and outreach activities specific to microbiology |

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
**CURRICULUM STRUCTURE - M.Sc., Microbiology (w.e.f. 2020 - 2021 batch onwards)**

| Semester | Category | No. of Courses | Credit Distribution |
|---|---|---|---|
| I | Core | - | 18 |
| | Elective | 1 | 5 |
| II | Core | - | 18 |
| | Elective | 1 | 5 |
| III | Core | - | 18 |
| | Elective | 1 | 5 |
| IV | Core | - | 18 |
| | Elective | 1 | 3 |
| **Total credits** | | | **90** |

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COURSE STRUCTURE- M.Sc., Microbiology (w.e.f. 2021 batch onwards)
Programme Code: PMB

**Semester – I & II**

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core 1 | PMB21 C11 | General Microbiology | 4+1 | 4 | 75 | 25 | 75 | 100 |
| Core 2 | PMB21 C12 | Microbial Biochemistry and Physiology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core 3 | PMB21 C13 | Environmental Microbiology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core Elective1 | PMB20 CE11 | Elective 1 (Options Given) | 5 | 5 | 75 | 25 | 75 | 100 |
| Lab 1 | PMB21 CL11 | Lab in General Microbiology | 4 | 2 | 75 | 40 | 60 | 100 |
| Lab 2 | PMB21 CL12 | Lab in Microbial Biochemistry and Physiology | 4 | 2 | 75 | 40 | 60 | 100 |
| Lab 3 | PMB21 CL13 | Lab in Environmental Microbiology | 4 | 2 | 75 | 40 | 60 | 100 |
| | **Total** | | **30** | **23** | | | | |

**Semester – II**

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core 4 | PMB21 C21 | Immunobiology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core 5 | PMB21 C22 | Molecular Biology and Microbial Genetics | 5+1 | 4+1 | 75 | 25 | 75 | 100 |
| Core 6 | PMB21 C23 | Applied Microbiological Techniques | 5+1 | 4+1 | 75 | 25 | 75 | 100 |
| Core Elective 2 | PMB21 CE21 | Elective 2 (Options Given) | 5 | 5 | 75 | 25 | 75 | 100 |
| Lab 4 | PMB21 CL21 | Lab in Immunobiology | 4 | 2 | 75 | 40 | 60 | 100 |
| Lab 5 | PMB21 CL22 | Lab in Molecular Biology and Microbial Genetics | 4 | 2 | 75 | 40 | 60 | 100 |
| | **Total** | | **30** | **23** | | | | |

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COURSE STRUCTURE- M.Sc., Microbiology (w.e.f. 2020 batch onwards)
Programme Code: PMB

**Semester – III & IV**

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core 7 | PMB21 C31 | Medical Microbiology | 4+1 | 4 | 75 | 25 | 75 | 100 |
| Core 8 | PMB21 C32 | Clinical Lab Technology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core 9 | PMB21 C33 | rDNA Technology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core Elective 3 | PMB21 CE31 | Elective 3 (Options Given) | 5 | 5 | 75 | 25 | 75 | 100 |
| Lab 5 | PMB21 CL31 | Lab in Medical Microbiology | 4 | 2 | 75 | 40 | 60 | 100 |
| Lab 6 | PMB21 CL32 | Lab in Clinical Lab Technology | 4 | 2 | 75 | 40 | 60 | 100 |
| Lab 7 | PMB21 CL33 | Lab in rDNA Technology | 4 | 2 | 75 | 40 | 60 | 100 |
| | **Total** | | 30 | 23 | | | | |

**Semester –IV**

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total Hrs | Max Mark CA | Max Marks SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core 10 | PMB21 C41 | Fermentation Technology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core 11 | PMB21 C42 | Food and Agriculture Microbiology | 5 | 4+1 | 75 | 25 | 75 | 100 |
| Core 12 | PMB21 C43 | Research Methodology | 5+1 | 4+1 | 75 | 25 | 75 | 100 |
| Core Elective 4 | PMB21 PJ41 | Elective Project | 6 | 3 | 75 | 25 | 75 | 100 |
| Lab 8 | PMB21 CL41 | Lab in Fermentation Technology | 4 | 2 | 75 | 40 | 60 | 100 |
| Lab 9 | PMB21 CL42 | Lab in Food, Agriculture and Environmental Microbiology | 4 | 2 | 75 | 40 | 60 | 100 |
| | **Total** | | 30 | 21 | | | | |

1. **Consolidation of Contact Hours and Credits: PGMicrobiology**

| Semester | Contact Hrs/Week | Credits |
|---|---|---|
| I | 30 | 23 |
| II | 30 | 23 |
| III | 30 | 23 |
| IV | 30 | 21 |
| **Total** | **120** | **90** |

2. **Curriculum Credits**

Core - 78
Elective - 18

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**Total 90**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)

Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **PMB21C31** | **MedicalMicrobiology** | Core-7 | 4 | 1 | - | 4 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Third | 25 | 75 | 100 |

## Preamble

Medical microbiology imparts in-depth understanding on the route cause of various microbial diseases and its diagnostics procedures. The mode of actions of different antibiotics used in its treatment.

## Prerequisite

Basic understanding of medically important pathogens.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Outline the general characteristics, laboratory diagnosis and control measures of bacteria | 70 | 70 |
| **CO2** | Appraise the diagnosis, prevention, treatment and epidemiology of infectious diseases including the impact of bacterial infectious agents on the human body | 70 | 70 |
| **CO3** | Explain the general characteristics, pathogenesis and laboratory diagnosis of fungi, parasites | 65 | 70 |
| **CO4** | Apprise the different microbiological methods for viral diagnosis | 65 | 70 |
| **CO5** | Classify various antibiotics based on their mode of actions | 60 | 70 |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **L** | **M** | **S** | **L** |
| **CO2** | **S** | **M** | **M** | **-** | **M** | **S** | **M** |
| **CO3** | **S** | **S** | **M** | **-** | **L** | **S** | **S** |
| **CO4** | **S** | **M** | **M** | **L** | **M** | **S** | **S** |
| **CO5** | **S** | **M** | **M** | **-** | **S** | **S** | **L** |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | L |
| **CO2** | S | S | M | M | L |
| **CO3** | S | S | M | M | L |
| **CO4** | S | S | S | M | L |
| **CO5** | S | M | L | - | M |

**S: Strong M: Medium L: Low**

## Blooms Taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15% (9) | 15% (9) | 15% (20) |
| Understand -K2 | 15% (9) | 15% (9) | 15% (20) |
| Apply-K3 | 30% (18) | 30% (18) | 30% (40) |
| Analyze-K4 | 20% (12) | 20% (12) | 20% (25) |
| Evaluate-K5 | 20% (12) | 20% (12) | 20% (25) |
| Total Marks | **60** | **60** | **130** |

## Title of the paper: Medical Microbiology

**Unit I**

History and overview of medical Microbiology. Pathogenesis of microbial infections. Mechanism of antibiotic resistance. General characters, virulence factors, antigenic structures, mode of transmission, pathogenesis, diagnosis, epidemiology and control measures of: Gram positive aerobic bacteria– *Staphylococci, Streptococci, Corynebacteria, Bacillus. A*naerobic bacteria: *Clostridium.* Acid fast bacteria – *M. tuberculosis, M. leprae,* sexually transmitted diseases – *Treponema pallidum,* Spirochaetes –*Leptospira.* Normal microbial flora of human system.

**Unit II**

General characters, antigenic structures, pathogenesis, diagnosis, mode of transmission, epidemiology control measures of: Gram negative non-spore forming bacilli: Aerobic (*Bordetella,Haemophilus), Yersinia,* Enterobacteriaceae *(Vibrio, E. coli, Klebsiella pneumoniae, Shigella, Salmonella)*Aerobic cocobacilli- *Neisseria gonorrhoeae,* Cell wall less bacteria: *Mycoplasma pneumoniae, Ureaplasmaurealyticum*

**Unit III**

General characters, pathogenesis, diagnosis, control measures of superficial mycosis-*Tinea versicolor*. Systemic Mycoses – *Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans,* Opportunistic mycoses: Candidiasis. Fungal Allergies, Mycotoxins. Morphology, life cycle, pathogenesis, laboratory diagnosis and treatment of Amobea-*Entamoebahistolytica*, Flagellates-*Trichomonas vaginalis*, Apicomplexa-*Plasmodium flaciparum, Toxoplasma gondii*, Ciliate-*Balantidium coli, Ascaris lumbricoides, Ancylostoma duodenale, Taneia.*

**Unit IV**

Principles and Pathogenesis of viral Disease.Morphology, pathogenesis, diagnosis and treatment of: *Ebola virus, Poxviruses, Epstein Barr Virus, Herpes simplex virus, Hepatitis B virus. Flavi virus* (dengue), Retrovirus -HIV. Viral zoonosis - *Japaneseencephalitis, Rabies, Corona virus*, Oncogenic virus.

**Unit V**

Classification of antibiotics based on mode of action: antibacterial (Penicillin and Streptomycin), antiviral (Amantidine and Zidovudine), antifungal (Amphotericin and Nystatin) antiparasitic drugs (Quinine and Metranidazole) and anticancer drugs (Methotrexate and L asparaginase). Emerging and re-emerging infections (MRSA, NDMS), Beta lactamase and types, Antifungal resistance (CDR and ERG), Superbugs, National programs in prevention of infectious diseases.

**Reference Books:**


- Barer, M. R. and Irving, W. 2018. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Investigation and Control,Nineth edition, Elsevier Health Sciences, Leicester.
- Ananthanarayanan,R. and JeyaramPaniker,C.K. 2020. Text Book of Microbiology, Eleventh Edition, Universities Press, India.
- Riedel, S., Hobden, J.A., Miller, S., Morse, S.A.,Mietzner, T.A., Detrick, B., Mitchell, T.G.,Sakanari, J.A.,Hotez, P. and Mejia R. 2019. Jawetz, Melnick, &Adelberg's Medical Microbiology, 28 edition. McGraw Hill., New York.
- Carroll, K.C.,Pfaller, M.A, Landry, M.L., McAdam, A.J., Patel, R., M.D., Richter, S.S.and Warnock, D.W. 2019. Manual of clinical Microbiology, Twelfth edition, ASM Press, Washington.
- Collee, J.G., Fraser,A.G., Marmion, B.P. and Simmons,A. 2007. Mackie and McCartney, Practical Medical Microbiology, Fourteenth Edition, Churchill

Livingstone, London.

## ICT Tutorial:

- Antibiotics - https://www.youtube.com/watch?v=Cj9UADDIidI
- ELISA-https://www.youtube.com/watch?v=CWkrQrq0yxQ
- Mantox test- https://www.youtube.com/watch?v=9O0yDUktaLk

## Course Designers:

1. **Dr. M. Vijayasarathy- Assistant Professor**
2. **Dr. K. Renugadevi- Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **PMB21CL31** | **Lab in MedicalMicrobiology** | Core Lab - 5 | - | - | 4 | 2 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Second | Third | 40 | 60 | 100 |

## Preamble

Provide hands on exposure to processing of clinical specimens and laboratory diagnosis of microorganisms using different techniques

## Prerequisite

Develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Identify microorganisms of relevance to health care and the pharmaceutical industry and their sources | 60 | 70 |
| **CO2** | Perform microbiological laboratory procedures according to appropriate safety standards | 70 | 70 |
| **CO3** | Evaluate microbial content testing and sterility testing | 60 | 70 |
| **CO4** | Compare and contrast different microbial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis | 70 | 60 |
| **CO5** | I Illustrate the therapeutic treatments for microbial infections, and distinguish when a | 70 | 60 |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **S** | **L** | **M** | **L** | **-** |
| **CO2** | **S** | **M** | **M** | **L** | **M** | **L** | **-** |
| **CO3** | **S** | **M** | **M** | **-** | **M** | **-** | **-** |
| **CO4** | **S** | **S** | **M** | **L** | **S** | **L** | **L** |
| **CO5** | **S** | **S** | **M** | **L** | **S** | **L** | **L** |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **M** | **L** | **M** |
| **CO2** | **S** | **S** | **M** | **L** | **M** |
| **CO3** | **S** | **S** | **L** | **-** | **M** |
| **CO4** | **S** | **L** | **M** | **L** | **L** |
| **CO5** | **S** | **M** | **M** | **L** | **L** |

**S: Strong M: Medium L: Low**

## Title of the paper: Lab in Medical Microbiology

1. Staining techniques- Simple, Negative, Gram's, capsule, Spores
2. Staining of Acidfast Bacilli by Ziehl Nelson staining (Virtual).
3. Isolation and identification of pyogenic microorganisms.
4. Identification of *Staphylococci* and *Streptococci sp.* by hemolysis (α, β and γhaemolysis)
5. Differentiation of *Streptococci sp.* by Bile solubility test.
6. Differentiation of *Staphylococci sp.* by coagulase test
7. Isolation and identification of microorganisms from urine sample
8. Biochemical tests for identification of unknown bacteria (IMViC, Urease, TSI, Catalase & oxidase test)
9. Isolation and identification of Dermatophytic fungus (*Microsporum, Epidermophyton, Trichophyton)*
10. Lactophenol cotton blue staining and KOH mount for fungi *(Aspergillus, Mucor, Rhizopus, Penicillium).*
11. Germ tube test for identification of *Candida albicans*
12. Preparation of dried filter paper discs for susceptibility assay.
13. Antimicrobialactivity by Kirby – Bauer disc diffusion technique.
14. Determination of MIC & MBC
15. Antimicrobial susceptibility test against filamentous and non- filamentous fungi.
16. Detection of β lactamase producing organisms
17. Detection of Azole resistance in *Candida albicans*

## Reference Books:


- Procop, G.W., Church, D.L., Hall, G.S., Janda, W.M., Koneman, E.W., Schreckenberger, P.C. and Woods, G.L. 2017. Koneman's Color Atlas and Text book of Diagnostic Microbiology, Seventh Edition, Lippincott, Williams & Wilkins, Philadelphia.
- Betty, A.F., Daniel, F.S., Alice, S. 2006. Bailey & Scott's Diagnostic Microbiology, Twelfth edition Diagnostic Microbiology, Mosby publisher, Maryland Heights, Missouri.
- Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. 1996. Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.

- Mahon, C.R. and Lehman, D. C. 2018. Textbook of Diagnostic Microbiology, Sixth edition, Saunders publishers, St. Louis, Missouri.


**ICT tools:**

- Antibiotic resistance- Beta lactamase:https://www.youtube.com/watch?v=byLV2bESY4k
- Azole resistance *Candida albicans*:https://www.youtube.com/watch?v=6GT11CiOykM
- Determination of MIC and MBC: https://www.youtube.com/watch?v=jCShFlXPcmg

**Course Designer:**

**1. M. Vijayasarathy – Assistant Professor**

**THIAGARAJAR COLLEGE, MADURAI:: 9**
**An Autonomous Institution affiliated by Madurai Kamaraj University**
**(Re-Accredited with 'A$^{++}$' Grade by NAAC)**
**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21C32 | Clinical Lab Technology | Core-8 | 4 | - | - | 4 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Second | Third | 25 | 75 | 100 |

## Preamble

The course provides an overview of diagnostic procedures required for performing clinical laboratory techniques. The course work demonstrates technical skills, quality control parameters and other health related settings required for clinical lab technician.

## Prerequisite

Basic knowledge on microbiology and biochemistry

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Define the basic lab safety methods and different clinical lab techniques | 80 | 70 |
| **CO2** | Summarize theoretical knowledge on blood sample analysis and grouping | 70 | 70 |
| **CO3** | Emphasize the scientific knowledge on urine sample processing and analysis | 70 | 60 |
| **CO4** | Interpret the importance of microscopic, macroscopic and culture sensitivity analyses of stool samples | 70 | 80 |
| **CO5** | Appraise scientific knowledge on specimen collection and examination of sputum and semen sample analyses | 70 | 60 |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **S** | **-** | **L** | **-** | **L** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO2** | **L** | **M** | **S** | **L** | **L** | **-** | **M** |
| **CO3** | **S** | **M** | **S** | **L** | **L** | **-** | **M** |
| **CO4** | **L** | **M** | **S** | **L** | **L** | **-** | **M** |
| **CO5** | **L** | **M** | **S** | **L** | **L** | **-** | **M** |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **L** | **M** | **-** | **S** |
| **CO2** | **L** | **S** | **L** | **L** | **M** |
| **CO3** | **S** | **L** | **-** | **M** | |
| **CO4** | **L** | **S** | **L** | **-** | **M** |
| **CO5** | **L** | **S** | **L** | **-** | **M** |

**S: Strong M: Medium L: Low**

## Blooms taxonomy

| Blooms Taxanomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15% (9) | 15% (9) | 15% (20) |
| Understand -K2 | 15% (9) | 15% (9) | 15% (20) |
| Apply-K3 | 30% (18) | 30% ( 18) | 30% (40) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (25) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20% (25) |
| Total Marks | **60** | **60** | **130** |

## Title of the paper – Clinical Lab Technology

### Unit I

Laboratory management – Biosafety in containment laboratory - Personal hygiene for Laboratory Technologists, National and International GLP and GMP, Accidents - types and safety measures. Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections. Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA. Biomedical waste management

### Unit II

Collection and processing of blood sample. Staining techniques for blood samples. ABO Blood group system- Slide and tube method, RH system. Antihuman globulin test (Direct and Indirect methods), Coombs test. Determination of TC, DC, Platelets, ESR, Hb, BT & CT, Prothrombin time, Thromboplastin time, Blood disorder diseases. Blood transfusion and Compatibility testing. Determination of blood glucose, Urea, Cholesterol, Creatinine and Bilirubin. Rheumatoid arthritis, VDRL and WIDAL test. Blood culture and sensitivity.

**Unit III**

Collection, transport and Storage of Urine sample. Physical properties of Urine. Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies, specific gravity, amino acids. Microscopic Examination of Urine – Cast Crystals and Cells. Automation urine analysis, Special urine test, Pregnancy Test (slide test and ELISA). Urine culture and sensitivity.

**Unit IV**

Collection and transport cerebrospinal fluid sample. Lumbar Puncture (Spinal Tap), CSF Pressure, Color and appearance, Microscopic examination of cells. Synovial fluid test, Peritoneal fluid test. Collection and transport of stool sample. Macroscopic and Microscopic examination of stool. Chemical examination of stool. Stool Culture and sensitivity. Occult blood and its clinical significance

**Unit V**

Collection and transport of sputum specimen. Macroscopic and Microscopic examination of sputum. AFB staining. Sputum culture and sensitivity. Collection of semen. Semen analysis – motility, total count and abnormality, Chemical examination of semen. Skin test- Tuberculin test, Schick test

## Reference Books


- Sood, R, 2010. Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.
- Mukherjee, L.K. 2010. Medical Laboratory Technology – 3 volumes – Second edition, Hill Publishing Ltd., New Delhi.
- Ochei, J and Kolkatkar, A. 2019. Medical Laboratory Science – Theory and Practice, Seventeenth edition, Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.
- Alex, C., Sonnenwirth, 1998. Gradwohl's Clinical Laboratory Methods and Diagnosis, Vol. 1&2, Eighth edition, B.I. Publications Ltd., New Delhi.
- David, S. Jacobs, W. R. Demott, Paul R. F, 1994. Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.


## ICT Tools

- VDRL Test - https://www.youtube.com/watch?v=cFRk6CoupDs
- Urine analysis - https://www.youtube.com/watch?v=d8w5SICzzxc
- Analysis of Blood cells - https://www.youtube.com/watch?v=yKWQ_oLSXI8

## Course Designers


1. **Dr. A. Kanakalakshmi- Assistant Professor**
2. **M. Vijaysarathy- Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CL32 | Lab in Clinical Lab Technology | Core Lab - 6 | - | - | 4 | 2 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Third | 40 | 60 | 100 |

## Preamble

Provides hands on training to the students on the collection, transport and analyses of clinical specimens.

## Prerequisite

Knowledge on the mechanism and diagnosis of diseases in clinical specimens

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Apply different clinical laboratory techniques for collection and analysis of body fluids | 60 | 70 |
| **CO2** | E Exhibit technical skills in clinical sample analyze according to pre-established laboratory standards | 70 | 70 |
| **CO3** | List and adhere to safety rules and regulations prescribed for sample acquisition, handling and test to be adopted for analyses. | 70 | 60 |
| **CO4** | Choose to work or establish a clinical laboratory | 70 | 60 |
| **CO5** | Explain methods for microbial culture, evaluate microbial content testing and sterility testing | 70 | 60 |

## Mapping of COS with POs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **-** | **M** | **M** | **L** |
| **CO2** | **S** | **S** | **M** | **L** | **M** | **M** | **-** |
| **CO3** | **S** | **M** | **M** | **-** | **L** | **M** | **-** |
| **CO4** | **S** | **L** | **M** | **L** | **M** | **L** | **L** |
| **CO5** | **S** | **S** | **M** | **L** | **L** | **L** | **-** |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | **S** | **-** | **S** | **S** | **-** |
| **CO2** | **S** | **M** | **S** | **S** | **M** |
| **CO3** | **S** | **M** | **S** | **M** | **M** |
| **CO4** | **S** | **L** | **L** | **L** | **-** |
| **CO5** | **S** | **M** | **M** | **L** | **L** |

**S: Strong M: Medium L: Low**

## Title of the paper: Lab in Clinical Lab Technology

1. Collection and processing of clinical specimen for microbiological examination.
2. Coombs test
3. Determination of ESR
4. Estimation of Haemoglobin
5. Estimation of Blood Sugar
6. Estimation of blood Urea
7. Estimation of serum Cholesterol
8. Estimation of serum bilirubin
9. Urine analysis
10. Urine sample analysis to detect sugar, protein, Albumin, Ketone bodies, bile salts and bile pigments
11. Sero-diagnosis of bacterial infection using WIDAL& RPR, RA Test
12. Staining techniques for Amoeba / Intestinal protozoa / Malarial parasites – Leishman'sstain, Giemsa stain.
13. Semen analysis – Motility and Total count.
14. Chemical analysis of semen
15. Virtual lab on Tuberculin test and Schick test.
16. Visit to clinical lab

## Reference Books:


- Collee, J.G, Fraser, A.G, Marmion, B.P and Simmons, A. 2007. Mackie and McCartney Practical medical Microbiology, Fourteenth edition, Elsiever, New York.
- Ranjan Kumar De, 2007. Diagnostic Microbiology, (For DMLT Students), Second Edition, Jaypee Brothers publishing, New Delhi.
- Betty A.F, Daniel F.S, Alice S. B& Scott's 2006. Diagnostic Microbiology,Twelth Edition,Elsiever, Mosby, Missouri, United States.

- Winn, W.C, Allen S.D, Janda W. M, Koneman E.W. 2007. Color Atlas an Textbook of Diagnostic Microbiology, Sixth Edition, Lippincott Williams & Wilkins, Pennsylvania.
- Collee, J.C, Duguid, J.P, Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edition. Churchill Livingstone, London.


**ICT Tools:**

- Schick test:https://www.youtube.com/watch?v=ToXXdTIB5cs
- **S**emen analysis: https://www.youtube.com/watch?v=gIDMLjZgj8g
- Rheumatoid arthritis: https://www.youtube.com/watch?v=Yc-9dfem3lM

**Course Designer:**

1. **M. Vijayasarathy – Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| CourseCode | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21C33 | rDNA Technology | Core-9 | 4 | - | - | 4 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Third | 25 | 75 | 100 |

## Preamble

Provide the principles of elemental concepts, various methods of gene manipulation and its implementation in multiple sectors of modern biotechnology

## Prerequisite

Be aware of the principles behind the methods of rDNA technology

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Explain to the history, principles behind the restriction and modification methods | 70 | 80 |
| **CO2** | Recall and make use of various cloning methodologies, genomic library construction and blotting techniques | 60 | 70 |
| **CO3** | List an in-depth knowledge of PCR and sequencing methods | 70 | 60 |
| **CO4** | Interpret and defend the cloning techniques of various bacteria and yeast | 60 | 70 |
| **CO5** | Explain the importance of transposition, plant genetic engineering and gene silencing | 60 | 70 |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | M | S | M | S |
| **CO2** | S | M | S | M | M | - | M |
| **CO3** | S | S | S | M | S | L | M |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO4** | S | S | S | M | M | L | - |
| **CO5** | S | M | M | M | S | S | L |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | S | M | M | M | M |
| **CO2** | S | M | S | M | S |
| **CO3** | S | S | S | M | M |
| **CO4** | S | M | L | - | L |
| **CO5** | S | M | S | M | - |

**S: Strong M: Medium L: Low**

## Blooms taxonomy

| Blooms Taxanomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15% (9) | 15% (9) | 15% (20) |
| Understand -K2 | 15% (9) | 15% (9) | 15% (20) |
| Apply-K3 | 30% (18) | 30% ( 18) | 30% (40) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (25) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20% (25) |
| Total Marks | **60** | **60** | **130** |

## Title of the paper – rDNA Technology

### Unit I

History and scope of rDNA technology. Restriction enzymes – nomenclature, classification and applications. DNA modifying enzymes– nucleases – T4/T7 DNA polymerases, Ligases, Reverse Transcriptase, Terminal Transferases, T4 Polynucleotide kinases & Alkaline phosphatase. Cloning vectors – Plasmids, Cosmids, Phasmids, Phagemids, Plasmid vectors –pBR322 and pUC18, Expression vectors-YAC, BAC vectors,M13 vectors, Hybrid vectors.Adenoviral and Adenovirus associated viral vectors.

### Unit II

Cloning methodologies – sticky and blunt end cloning, homopolymeric tailing and use of adapters & linkers. Cloning from mRNA – synthesis of cDNA, cloning cDNA in plasmid and phage vectors, cDNA libraries. Cloning from genomic DNA – genomic library. Shot gun cloning,Physical and restrictionmapping. Site directed mutagenesis, Screening of recombinant – phenotypic expression of characters – antibiotic resistance, lacZ complementation (Blue-white selection), fluorescent markers (e.g. GFP). Blotting techniques – Western, Northern, Southern.

**Unit III**

PCR – basic process, types and applications in gene amplification, primer designing, optimization, variation in the PCR-reverse transcriptase and Real-Time PCR. Automated DNA sequencing, high throughput pyrosequencing, DNA sequencing – Sanger – Coulsen's method, Maxam Gilbert's method. DNA foot printing. Next generation sequencing concepts.

**Unit IV**

Industrial application of rDNA technology. Synthesis and purification of proteins from cloned genes- Native and fusion proteins. Production of enzymes and therapeutic products for use in human health care - insulin, growth hormones, interferon, somatostatin and Hepatitis B vaccine. Human antibody production by r-DNA technology. Recombinant vaccine development - HBs Ag in yeast. Cloning for commercial production of antibiotics (Penicillin). Chymosin (Rennin) in *E. coli* andyeast.

**Unit V**

Gene silencing and antisense technology: Types and mechanism of gene silencing. Gene silencing in crop plants-tomato and rice. Si RNA and disease control. Vector based DNA delivery-Ti& Ri plasmid, vector less DNA delivery– microprojectile bombardment, microinjection, electroporation and pollen tubes. rDNA technologyin clinical diagnosis of inherited disorders and infectious diseases, Multiplex PCR. Gene therapy for cystic fibrosis.

## Reference Books


- Brown, T.A. 2020. Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell. 8th Edition. New Jersey. United States.
- Thieman, W.J. and Palladino, M.A. 2019. Introduction to Biotechnology, Books a la Carte. Fourth Edition, Pearson Education, Noida.
- Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2018. Lewin's Gene XII, Jones &Bartlelt Publishers, Boston. United States.
- Primrose, S.B. and Twyman, R.M. 2016. Principles of Gene manipulation and Genomics, Eighth Edition, John Wiley and Sons Ltd, Wiley-Blackwell. United Kingdom.
- Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. 2010. Molecular Biotechnology. Principles and Applications of Recombinant DNA. Fourth Edition. ASM Press. University of Michigan. United States.
- Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.


## ICT Tutorials

- Cloning vectors-Plasmids: https://www.youtube.com/watch?v=Bz02Qlsu4XI
- Blue white screening: https://www.youtube.com/watch?v=4fnS2xKjIbg
- Gene silencing and antisense technology: https://www.youtube.com/watch?v=dNWpM7a23Cw

## Course Designers


**1. Dr.K.Renugadevi– Assistant Professor**

**2. Dr.A.Kanakalakshmi– Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CL33 | Lab in rDNA Technology | Core Lab - 7 | - | - | 4 | 2 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Third | 40 | 60 | 100 |

## Preamble

Provide hands on training about the various procedures of gene manipulation techniques and its significance

## Prerequisite

Basic knowledge on the principle behind the methods of rDNA technology

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Perform the nucleic acid isolation and separation procedures | 60 | 70 |
| **CO2** | Analyze the restriction endonuclease activity and its significance | 70 | 80 |
| **CO3** | Demonstrate the procedures of gene cloning and PCR analysis | 60 | 70 |
| **CO4** | Execute thecloning technologies to elucidategenetic issues | 70 | 60 |
| **CO5** | Elucidate the computational tools in comparative studies of genes and its target approach | 70 | 80 |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **L** | **M** | **L** | **-** |
| **CO2** | **S** | **M** | **S** | **-** | **M** | **M** | **M** |
| **CO3** | **S** | **M** | **S** | **M** | **S** | **M** | **M** |
| **CO4** | **S** | **S** | **S** | **M** | **S** | **M** | **L** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO5** | **S** | **S** | **S** | **L** | **M** | **M** | **S** |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **M** | **-** | **M** |
| **CO2** | **S** | **M** | **M** | **S** | **M** |
| **CO3** | **S** | **S** | **M** | **S** | **-** |
| **CO4** | **S** | **S** | **M** | **M** | **M** |
| **CO5** | **S** | **S** | **M** | **S** | **M** |

**S: Strong M: Medium L: Low**

## Title of the paper: Lab in rDNA technology

1. Isolation and purification of DNA from plant samples and agarose gel electrophoresis.
2. Isolation and purification of DNA from animal samples and agarose gel electrophoresis.
3. Isolation of Plasmid by alkaline detergent method - A miniprepprocedure
4. Primer designing by *in-silico* method
5. PCR amplification of DNA
6. Determination of fragment order of plasmid by single and double restrictiondigestion.
7. Demonstration of T4 DNA Ligation.
8. Cloning of DNA fragment in pBR322 / pBluescript – insertion inactivation/blue whiteselection.
9. Acrylamide gel electrophoresis and silver stainingprocedure.
10. Virtual demonstration of blotting techniques- WesternBlotting, Southern Blotting, Northern Blotting
11. Protoplast isolation and fusion
12. *In-silico* analysis:
    A. Database-homology searches using different types ofBLAST analysis
    B. Multiple sequence alignment using CLUSTAL W andMultalin tools.
    C. Identification of restriction site using NEBcutter tool.
    D. Identification of protein cleavage site using PEP cuttertool.

## Reference Books:


- Brown, T.A. 2020. Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell. 8th Edition. New Jersey. United States.
- Gary W. Procop, Deirdre L. Church, Geraldine S. Hall, William M. Janda. 2020. Konemans Color Atlas And Textbook Of Diagnostic Microbiology. Seventh Edition. Jones and Bartlett. Massachusetts. United States.
- Susan Carson, Heather B. Miller, Sue Carson, D. Scott Witherow · 2019. Molecular Biology Techniques. A Classroom Laboratory Manual. Fourth Edition. Elsevier Science. Netherlands.
- Betty A.F., Daniel F.S., Alice S. 2007. Bailey & Scotts Diagnostic Microbiology, 12th Edition. Diagnostic Microbiology, Elsevier Mosby. London.
- Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. 1996. Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.

## ICT Tutorials

- Demonstration of T4 DNA Ligation: https://www.youtube.com/watch?v=51brWA7j-OU
- Cloning of DNA fragment-https://www.youtube.com/watch?v=26SoY5obNxs
- WesternBlotting analysis-https://www.youtube.com/watch?v=-Zchea9xGT0

## Course Designer:

1. **Dr. K. Renugadevi – Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21C41 | **Fermentation Technology** | Core-10 | 5 | - | - | 5 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Fourth | 25 | 75 | 100 |

## Preamble

Elaborates the applications of microorganisms in fermentation process. Brief on upstream and downstream processes of fermentation, process optimization and strain development.

## Prerequisite

Basic knowledge and understanding on the principle involved in the industrial production of microbial products

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Define the basic principles of bioprocess technology like strain development and preservation techniques | **70** | **80** |
| **CO2** | Summarize and apply the different methods of fermentation and various designs of fermenters | **70** | **60** |
| **CO3** | Appraise the several media based on optimization technique and secure a wide view on fermentation kinetics | **70** | **80** |
| **CO4** | Gives a diverse knowledge on the production of different fermentation products | **60** | **70** |
| **CO5** | Illustrates the fermentation economics and social issues in industrial microbiology | **70** | **60** |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | M | M | - | L |
| **CO2** | S | S | M | L | S | - | M |
| **CO3** | S | M | S | M | M | L | L |
| **CO4** | S | S | S | M | L | M | - |
| **CO5** | S | M | M | - | M | M | L |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **M** | **M** | **-** |
| **CO2** | **S** | **L** | **L** | **M** | **S** |
| **CO3** | **S** | **L** | **M** | **M** | **-** |
| **CO4** | **S** | **S** | **M** | **M** | **L** |
| **CO5** | **M** | **L** | **M** | **-** | **-** |

**S: Strong M: Medium L: Low**

## Blooms taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15% (9) | 15% (9) | 15% (20) |
| Understand -K2 | 15% (9) | 15% (9) | 15% (20) |
| Apply-K3 | 30% (18) | 30% (18) | 30% (40) |
| Analyze-K4 | 20% (12) | 20% (12) | 20% (25) |
| Evaluate-K5 | 20% (12) | 20% (12) | 20% (25) |
| Total Marks | **60** | **60** | **130** |

## Title of the paper: Fermentation Technology

### Unit I

General concepts of industrial microbiology. Isolation of productive strains-screening technique - primary and secondary. Strain development – mutation, protoplast fusion and recombinant DNA techniques. Preservation techniques.Inoculum development- Bacterial, fungal spores, fungal mycelium. Sterilization- fermenter, feed- filter sterilization (media & air).

**Unit II**

Design of fermenters- Body construction- aeration and agitation- Valves and steam traps. Instrumentation and control- Methods of measuring process variables (Temperature, Measurement and control of pH, Flow and Pressure), safety valves, Control system (Manual & automatic). Computer applications in fermentation technology. Types of fermentation. Methods of fermentation-batch, continuous and fed batch system. Types -batch, CSTF, air lift, tower, bubble column, fluidized bed fermenter.

**Unit III**

Media-chemical composition, raw materials –Carbon source, Nitrogen source, minerals, oil and fat, Antifoam agents and industrial wastes. Media optimization (response surface methodology- Central composite design) . Fermentation kinetics-Batch and continuous. Downstream processing –cell disruption-physical and chemical methods. Separation-filtration, centrifugation, liquid-liquid extraction, chromatography, precipitation, drying and crystallization.Immobilization of cells and enzymes-methods and application.

**Unit IV**

Microbial assay: vitamin ($B_2$, $B_{12}$), Amino acid (lysine, Glutamic acid), Antibiotics (Streptomycin, Erythromycin). Fermentation products-Anaerobic fermentation (Beer, wine, Palm wine,alcohol). Aerobic fermentation (Vinegar, citric acid, Lactic acid), Amino acid (lysine, glutamic acid, Valine), Antibiotics (Penicillin, Streptomycin, Tetracyclin), Antitumour Antibiotics, Enzymes (Amylase, Protease), Vitamins ($B_{12}$, Riboflavin), Hormones (Gibberellic acid, Indole acetic acid). Ergot Alkaloids. Vaccine production (Viral vaccine and bacterial toxoids)

**Unit V**

Fermentation economics- Market potential, Process cost, recovery cost, water usage and recycling, Treatment of effluent from the fermenter industry, market potential and Cost benefit ratio. Societal issues in industrial microbiology- Impact- Influence in society- Public perception to policy development- impact to policy development. Societal issues in industrial microbiology.

**Reference Books:**


- Casida, J.F. 2019. Industrial Microbiology, second edition, New Age International India Pvt. Ltd., New Delhi.
- Peppler, H, and Pearman, D. 2014. Microbial Technology,second edition,Vol.I, Academic Press, New York.
- Atlas, R.M, 2000. Microbiology Fundamentals and Applications, second edition,MacMillan Pub. Co., New York.
- Crueger, W. and Crueger, A. 2017. Biotechnology: A Test Book of Industrial Microbiology, Third Edition, Panima Publishing corporation, New Delhi.

- Stanbury, P.F, Whitaker, A. and Hall, S.J. 2016. Principles of Fermentation Technology, Third Edition, Aditya Book (P) Ltd., New Delhi.
- Patel, A.H., 2022, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.


## ICT Tutorials

- Design of fermenters- https://youtu.be/-ddTYPSa2Ao
- Fermentation Kinetics- https://youtu.be/J6kpFAGYH6s
- Ergot Alkaloids- https://youtu.be/_YSv2NUmdXc

## Course Designer:


**1.Dr. A. Kanakalakshmi- Assistant Professor**

**2. Dr. K. Renugadevi- Assistant Professor**

**THIAGARAJAR COLLEGE, MADURAI:: 9**
**An Autonomous Institution affiliated by Madurai Kamaraj University**
**(Re-Accredited with 'A$^{++}$' Grade by NAAC)**
**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CL41 | **Lab in Fermentation Technology** | Core Lab-8 | - | - | 4 | 2 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Fourth | 40 | 60 | 100 |

## Preamble

Isolate, Screen and mass production of industrially important microbes. Gain a basic knowledge on the working mechanism of a bioreactor.

## Prerequisite

Basic knowledge on the principles involved in the industrial production of microbial products

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Discuss the important aspects in bioprocess technology for commercialization purpose of biotechnology products | **70** | **80** |
| **CO2** | Analyze the mass transfer and material balance calculation in different types of application in bioprocess | **60** | **80** |
| **CO3** | Infer the kinetics parameter values in different types of fermentation process | **70** | **80** |
| **CO4** | Apply fundamental calculation in bioprocessing | **70** | **80** |
| **CO5** | Illustrate the schematic diagram of upstream and downstream processing for product recovery and purification | **70** | **80** |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | M | M | M | L |
| **CO2** | S | S | M | S | M | L | M |
| **CO3** | S | M | S | M | L | M | L |
| **CO4** | S | S | M | S | L | M | L |
| **CO5** | S | M | S | S | L | L | L |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSO

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **L** | **S** |
| **CO2** | **S** | **S** | **S** | **L** | **S** |
| **CO3** | **S** | **S** | **S** | **L** | **S** |
| **CO4** | **S** | **M** | **M** | **L** | **S** |
| **CO5** | **S** | **S** | **S** | **L** | **S** |

**S: Strong M: Medium L: Low**

## Title of the paper: Lab in Fermentation Technology

1. Demonstration of fermentation using Kuhn's fermentation vessel.
2. Screening, production and assay of amylase from microbes
3. Screening, production and assay of protease from microbes
4. Screening, production and assay of cellulase from microbes
5. Screening, production and assay of Phosphatase from microbes
6. Screening, production and assay of citric acid from microbes
7. Screening of antibiotic producing microbes
8. Production and assay of sucrase from microbes
9. Production and assay of gluconic acid from microbes
10. Production and assay of glutamic acid from microbes
11. Production and assay of Pectinase from microbes
12. Production and estimation of Proline
13. Production and estimation of alcohol
14. Production and quantitative analysis of beer and wine
15. Bacterial cell /enzyme immobilization in sodium alginate gel
16. Cell disruption for endoenzymes by sonication
17. Enzyme purification by acetone precipitation

18. Estimation of biomass and substrate concentration in fermentation, determination of kinetic parameters (yield and productivity)
19. Preservation of industrially important bacteria by lyophilization.

## Reference Books:


- Kulanthaivel,S and Janarthanan. S 2012. Practical Manual on Fermentation Technology. First Edition, I.K. International Publishing house. New Delhi.
- Peppler,H,J and Periman,D. 2008.Microbial Technology Fermentation Technology, (Two Volumes ), Second Edition, Elsevier, Academic Press.U.K.
- Demain, A.L, and Davis, J.E. 2010. Manual of Industrial Microbiology and Biotechnology, third edition, American Society for Microbiology, Washington.
- Mc.Neil, B. and Harvery, L.M. 1990. Fermentation: A Practical Approach (Units I-III), IRL Pvt ltd, New York.


## ICT Tutorials

- Cell disruption using Sonicator- https://youtu.be/f_G1N8BH0CY
- Lyophilization-https://youtu.be/-INsuz3H1M0

## Course Designers:

**1. Dr. A. Kanakalakshmi- Assistant Professor**

**THIAGARAJAR COLLEGE, MADURAI:: 9**
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**(Re-Accredited with 'A$^{++}$' Grade by NAAC)**
**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credits |
|---|---|---|---|---|---|---|
| PMB21C42 | Food & Agriculture Microbiology | Core - 11 | 5 | - | - | 5 |

L - Lecture T – Theory P – Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Second | Fourth | 25 | 75 | 100 |

## Preamble

The course illustrates the process of food spoilage and preservation methods. Elaborates the application of microbes in plant growth promotion and disease management.

## Prerequisite

Basics of chemistry and biology

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Define and classify the process involved in preparation of fermented food products and its applications | **70** | **60** |
| **CO2** | Demonstrate the fundamental principles and techniques involved in food preservation | **70** | **60** |
| **CO3** | Identify the mechanism of microbial pathogenicity and transmission of plant pathogens | **60** | **70** |
| **CO4** | Categorize the techniques involved in the processing biofertilizers | **70** | **60** |
| **CO5** | Appraisethe elemental concepts in formulation of biopesticides and nanofertilizers | **70** | **60** |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | - | S | - | S | L | M |
| **CO2** | M | L | S | - | - | - | M |
| **CO3** | M | L | S | - | L | S | M |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO4** | M | L | S | - | S | S | M |
| **CO5** | M | L | S | - | S | S | M |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **L** | **S** | **-** | **M** |
| **CO2** | **M** | **L** | **S** | **-** | **L** |
| **CO3** | **S** | **L** | **S** | **-** | **M** |
| **CO4** | **M** | **L** | **S** | **-** | **S** |
| **CO5** | **M** | **L** | **S** | **-** | **S** |

**S: Strong M: Medium L: Low**

## Blooms taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15% (9) | 15% (9) | 15% (20) |
| Understand -K2 | 15% (9) | 15% (9) | 15% (20) |
| Apply-K3 | 30% (18) | 30% (18) | 30% (40) |
| Analyze-K4 | 20% (12) | 20% (12) | 20% (25) |
| Evaluate-K5 | 20% (12) | 20% (12) | 20% (25) |
| Total Marks | **60** | **60** | **130** |

## Title of the Paper: Food & Agriculture Microbiology

### Unit I

Production of fermented dairy products: Cheese, yoghurt and butter milk.Fermented vegetables; Sauerkraut, pickles and soy sauce. Fermented meat, Fermented Indian foods – Dhokla, Hawaijar, Dahi. Food spoilage**:** Spoilage of fruit and vegetables, cereal and cereal products, Meat and meat products, milk and milk products. Food borne diseases – food intoxications & food poisoning.Microbes as food (Probiotics) – Potential and therapeutic applications. Microbial pigments and applications in food industry,

### Unit II

Food preservation – principle, Methods - physical – asepsis, high temperature, low temperature, drying, radiation, canning, controlled atmosphere; chemical preservatives- organic

acids and their salt, nitrites, sulfur dioxide, sulfites, sugar, salt and oxidizing agents. Biopreservation of food materials. Food Inspection – Hazard Analysis Critical Control point.

**Unit III**

Transmission of plant pathogens, mechanism of microbial pathogenecity, factors affecting disease incidence. Bacteria – *Xanthomonas malvacearum*(Cotton blight), and *Xanthomonas citri*(Citrus canker). Fungi – *Ustilago maydis* (Smut rust of Corn) and *Cercosporaarachidicola*(Tikka disease of ground nut). Virus – DNA virus (Bhendi yellow vein clearing virus), RNA virus – (Cucumber mosaic virus). Phytoplasma – Brinjal little leaf and seasamum phyllody.

**Unit IV**

Biofertilizers: General account of taxonomy, physiology, mass cultivation, carierbased inoculants and application of Biofertilizers: Nitrogenous Bacteria - (*Rhizobium, Frankia, Azotobacter), Cyanobacteria (Nostoc & Anabaena)* and *AM.* Mechanism of phosphate solubilization and phosphate mobilization. Storage, shelf life, quality control and marketing of Biofertilizers. Biomanures. Plant growth promoting bacteria (PGPB), Endophytic bacteria and its significance

**Unit V**

Biopesticides: Bacterial pesticides: *Bacillus thuringiensis*, *Pseudomonas.* Viral Pesticides: Nuclear Polyhedrosis virus. Fungal pesticides: Entomopathogenic fungi - *Beaveriabassiana.* Bioherbicides - Integrated weed management.Nanotechnology in Agricultre – Nanopesticides and Nanofertilizers

**Reference Books:**


- Frazier, W.C.,Westhoff, D.C. and Vanitha 2017. Food Microbiology, Fifth edition, Tata McGraw Hill Publishing Ltd., New Delhi.
- Garbutt, J., 1997. Essentials of Food Microbiology, Arnold – International Students edition, London.
- Rengaswami, G., and Rajagopalan, S., 1973. Bacterial Plant Pathology – Tamil Nadu Agriculture University, Coimbatore.
- Subba Rao, N.S., 2009. Soil Microorganisms and Plant Growth, Fourth Edition, Oxford and IBH Publishing Co, London.


**ICT Tutorials**

- Biofertilizer production - https://www.youtube.com/watch?v=P9vfXkiHmqQ
- Food processing Start up in India - https://www.youtube.com/watch?v=IZ4ZVPwoSoA
- Nanopesticides - https://www.youtube.com/watch?v=Lams7PqbnCE

**Course Designers:**


**1.Dr. M. Karthikeyan– Assistant Professor**
**2. M. Vijayasarathy– Assistant Professor**

**THIAGARAJAR COLLEGE, MADURAI:: 9**
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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credits |
|---|---|---|---|---|---|---|
| PMB21CL42 | Lab in Food and Agriculture Microbiology | Core Lab-9 | - | - | 4 | 2 |

L - Lecture T – Theory P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| Second | Fourth | 40 | 60 | 100 |

## Preamble

The course provides hand on training on the isolation, identification of microbes involved in crop protection and food spoilage. Demonstrates the techniques involved in production of biofertilizers and pesticides

## Prerequisite

Basic microbiology and chemistry

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Spell the role of intrinsic and extrinsic factors on growth and survival of microorganisms in food | **70** | **80** |
| **CO2** | Demonstrate the mechanism of food spoilage and preventive strategies of food preservation. | **70** | **80** |
| **CO3** | L Apply the experimental protocols for the isolation, identification and application of plant growth promoting bacteria in agriculture | **70** | **80** |
| **CO4** | Distinguish the effects of plant pathogens in agriculture | **70** | **80** |
| **CO5** | Appraise the role of plant growth promoting microbes incrop protection | **70** | **80** |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | S | - | L | M | M |
| **CO2** | L | M | S | - | M | M | L |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO3** | M | L | S | - | S | S | M |
| **CO4** | M | L | S | - | S | S | M |
| **CO5** | M | L | S | - | S | S | M |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **M** | **-** | **S** | **-** | **M** |
| **CO2** | **M** | **-** | **S** | **L** | **M** |
| **CO3** | **M** | **L** | **S** | **M** | **L** |
| **CO4** | **M** | **L** | **S** | **L** | **M** |
| **CO5** | **M** | **L** | **S** | **M** | **M** |

**S: Strong M: Medium L: Low**

## Title of the Paper: Lab in Food & Agriculture Microbiology

1. Viable count of bacteria in milk.
2. Methylene Blue Dye reduction test.
3. Resazurin dye reduction test.
4. Phosphatase test.
5. Turbidity test
6. Litmus milk reactions.
7. Microbial Contamination in plant food products.
8. Microbial Contamination in animal food products.
9. Potability analysis of drinking water and food samples.
10. Structure of root & stem nodules.
11. Isolation of *Rhizobium*from root nodules.
12. Isolation of *Xanthomonasmalvacearum*from angular leaf spot of cotton
13. Isolation of pathogenic fungi from plant
14. Isolation of cyanobacteria from soil
15. Isolation of Arbuscular Mycorhizal spores from soil.
16. Staining of VAM.
17. Isolation & enumeration of *Azospirillum* – an associative symbiotic nitrogen fixing bacteria.
18. Isolation & enumeration of *Azotobacter&Beijerinekia* – non symbiotic nitrogen fixing bacteria.
19. Isolation of Phosphate solubilizing Microorganisms from soil.

## Reference Books:


- Reddy, S.M., and Ram Reddy, S.R. 2000. Microbiology - A Laboratory Manual, BSC Publishers & Distributors.
- Thangaraj, M., and Santhana Krishnan, P. 1998. Practical Manual on Microbialinoculants, Centre of Advanced Studies in Agricultural University, TNAU, Coimbatore.
- Harrigan, W.F. 1998. Laboratory Methods in Food Microbiology, Third Edition. Academic Press, US.
- Aneja K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture,
- WishwaPrakashan, New Delhi.

## ICT Tutorials:

- Biofertilizer production - https://www.youtube.com/watch?v=P9vfXkiHmqQ
- Food processing Start up in India - https://www.youtube.com/watch?v=IZ4ZVPwoSoA
- Nanopesticides - https://www.youtube.com/watch?v=Lams7PqbnCE

## Course Designer:

1. **Dr. M. Karthikeyan- Assistant Professor**

**THIAGARAJAR COLLEGE, MADURAI:: 9**
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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21C43 | Research Methodology | Core-12 | 5 | 1 | - | **5** |

L - Lecture T - Tutorial P – Practicals

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| Second | Fourth | 25 | 75 | 100 |

## Preamble

Acquire knowledge on the procedure and the techniques adopted while conducting the research.

## Prerequisite

Basic knowledge on research

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Elaborates the basic framework of research process | **70** | **60** |
| **CO2** | Illustrates the various research design and techniques | **60** | **70** |
| **CO3** | Provides various sources of information for literature review and data collection | **70** | **60** |
| **CO4** | Elaborates the Understanding of ethical dimensions of conducting applied research | **60** | **70** |
| **CO5** | Appreciate the components of scholarly writing and evaluate its quality. | **60** | **70** |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | M | M | L | M |
| **CO2** | S | M | S | - | S | - | L |
| **CO3** | S | S | M | S | S | - | M |
| **CO4** | S | M | M | S | M | L | M |
| **CO5** | S | S | M | S | S | S | - |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | S | M | S | S | S |
| **CO2** | S | M | S | S | - |
| **CO3** | S | S | - | M | S |
| **CO4** | S | S | S | S | S |
| **CO5** | S | M | M | M | S |

**S: Strong M: Medium L: Low**

## Blooms Taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15%(9) | 15% (9) | 20%(30) |
| Understand -K2 | 15%(9) | 15% (9) | 20%(30) |
| Apply-K3 | 30%(18) | 30% ( 18) | 20%(30) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (30) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20%(30) |
| Total Marks | **60** | **60** | **150** |

## Title of the Paper: Research Methodology

### Unit I

Research- meaning, objectives- significance, types of research-descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical; literature review - various sources of information; identification, defining and devising of research problem. Review of literature-meaning-objectives- functions- importance of literature review in defining the problem, source- primary and secondary sources. Criteria of good research.

### Unit II

Identification of research problem: sources and considerations,Steps in formulating a research problem. Research Design: Concept and its Importance – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables Hypothesis - null and alternate hypothesis - hypothesis testing.

**Unit III**

Sampling methods - sample, sampling frame, sampling error, sample size, non-response, simple random sample, systematic sample, stratified random sample and multi-stage sampling, determining size of the sample - practical considerations in sampling and sample size; Sample collection, transport, handling and preservation of microorganisms, insects, plant, animals from natural and lab bred population; Biological models.

**Unit IV**

Observation and collection of data - methods of data collection; data Processing and analysis strategies - univariate analysis (frequency tables, bar charts, pie charts, percentages), measures of central tendency and dispersion; bivariate analysis - cross tabulations and chisquare test including testing hypothesis of association; standard error and standard deviation. Correlation, Regression, ANOVA – one and two way, DMRT, Tukey test.

**Unit V**

Thesis writing - Introduction, Review of literature, Methodology, Results - illustrations and tables, Discussion, Bibliography, Foot notes and proof correction. Oral presentation - planning and preparation - use of visual aids - importance of effective communication; Publication of research and review articles –copyright violation – choosing the right journal; refereed journals, open access journals, citation, impact factor, SCI, H index, i10 index, referencing software (Zotero/Mendeley), software for paper formatting like LaTex/MS Office, Software for detection of Plagiarism.

**Reference Books:**


- Fink, A. 2019. Conducting Research Literature Reviews: From the Internet to Paper. Fifth edition, Sage Publications, Thousand Oaks, California
- Graziano, A.M. and Raulin, M.L. 2019. Research Methods: A Process of Inquiry, Ninth edition, Pearson publications, Hoboken, New Jersey.
- Kothari, C.R. 2019. Research methodology: Methods and Techniques, Fourth edition New Age International publishers, New Delhi.
- Zar, J.H.2014. Biostatistical analysis, Fifth edition,Pearson Education publishers, India.
- Gastel, B. and Day, R.A. 2016. How to Write and Publish a Scientific Paper, Eighthedition, Greenwood publishing house, Westport, Connecticut, USA
- Coley, S.M. and Scheinberg, C. A. 2016. Proposal Writing: Effective Grantsmanship for Funding, Fifth edition, Sage Publications, Thousand Oaks, California.


**ICT Tutorials**

- How to write thesis- https://youtu.be/XDgXzdl9bCw
- LaTex Tutorial- https://youtu.be/VhmkLrOjLsw

**Course Designers:**

1. **Dr. Rm. Murugappan- Associate Professor**
2. **Dr. A. Kanakalakshmi- Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CE(A) | Advanced Nanobiotechnology | Elective | 5 | - | - | 5 |

L - Lecture T - Tutorial P – Practical

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| First/Second | First/Second/Third | 25 | 75 | 100 |

## Preamble

Provide comprehensive theoretical knowledge on nanobiotechnology to perceive various nanomaterial synthesis and characterization.

## Prerequisite

Basics of chemistry and biology.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course outcome | Expected Proficiency % | Expected Attainment % |
|---|---|---|---|
| **CO1** | Spell the basic concept on nanobiotechnology and the importance nanoscience | **70** | **60** |
| **CO2** | Describes the DNA nanostructures and the applications of biosensors and 3D bioprinting | **60** | **70** |
| **CO3** | Explains the synthesis and characterization of nanoparticles | **70** | **60** |
| **CO4** | Expound the fabrication of nanomaterials and various biomedical applications | **60** | **70** |
| **CO5** | Enlists the toxicological issues and the guidelines | **70** | **60** |

## Mapping of COS with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | M | M | L | - | - | - |
| **CO2** | S | S | S | M | L | M | L |
| **CO3** | S | M | S | M | M | M | M |
| **CO4** | S | S | S | M | S | S | M |
| **CO5** | S | S | S | M | S | M | M |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | S | M | L | - | - |
| **CO2** | S | M | L | - | L |
| **CO3** | S | S | M | M | M |
| **CO4** | S | S | S | M | S |
| **CO5** | S | S | S | L | S |

**S: Strong M: Medium L: Low**

## Blooms Taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15%(9) | 15% (9) | 20%(30) |
| Understand -K2 | 15%(9) | 15% (9) | 20%(30) |
| Apply-K3 | 30%(18) | 30% (18) | 20%(30) |
| Analyze-K4 | 20% (12) | 20% (12) | 20% (30) |
| Evaluate-K5 | 20% (12) | 20% (12) | 20%(30) |
| Total Marks | **60** | **60** | **150** |

## Title of the Paper: Advanced Nanobiotechnology

**Unit: I**

Nanobiotechnology- definition, concepts, importance of nanoscience and historical background. Classification of nanostructures –Nanomaterials, Nanocomposites-Micelles-Polymer Micelles, Vesicles, Liposomes, Dendrimers, Nanocapsules, Nanopores, Nanoconjucates.

**Unit: II**

Synthesis of Nanoparticles and Nanostructures- Synthesis methods- physical (ball milling, Thin film deposition), Chemical (reduction method using sodium borohydride, sodium citrate), Biological (protein, microorganisms, plants). Mechanism of nanoparticle formation-Strategies for shape and size control. Characterization of nanoparticles - spectroscopic methods (UV-visible, FTIR, Raman spectroscopy, NMR), Differential Scanning Calorimetry (DSC)-Microscopic (AFM, Scanning and Transmission Electron microscopy), Structural (XRD), EDAX.

**Unit: III**

Biomedical applications of nanoparticles: drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels; functionalization of nanomaterials and Targeted drug delivery. Imaging technique; quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular.Nanobiomaterials to combat antimicrobial resistance and in cancer treatments.

**Unit: IV**

DNA, RNA and protein-based nanostructures. Nanobiosensors- Cantilever- Optical biosensors- DNA enabled biosensors. 3D bioprinting- types- bioinks for 3D bioprinting – Application of 3D bioprinting.

**Unit: V**

Nanotoxicology-National Personal Protective Technology Laboratory (NIOSH) Guidelines and toxicity issues. Immune response to nanoparticles, Safety concerns about using nanotechnology.

## Reference Books:


- Nicolini, C, 2019. Nanobiotechnology &Nanobiosciences, First edition, Pan Stanford Publishing Pvt. Ltd. UK.
- Villiers, M.M, Aramwit, P and Kwon, G. S. 2009. Nanotechnology in Drug Delivery, First edition, Springer-American Association of Pharmaceutical Scientists Press. USA
- Niemeyer, C.M and Mirkin, C.A.2004. Nanobiotechnology, Concepts, Applications and perspectives, First edition, Vol I & II, WILEY-VCH, Verlag GmbH&Co,. New Jersey.
- Goodsell, D.S. 2004. Bionanotechnology, Lessons from Nature, First edition, Wiley-Liss, Inc,. New York


## Course Designers:


1. **Dr. A. Kanakalakshmi- Assistant Professor**
2. **Dr. K. Renugadevi- Assistant Professor**

**THIAGARAJAR COLLEGE, MADURAI:: 9**
**An Autonomous Institution affiliated by Madurai Kamaraj University**
**(Re-Accredited with 'A$^{++}$' Grade by NAAC)**
**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CE(B) | Genome Biology | Elective | 5 | - | - | 5 |

L - Lecture T – Tutorial P – Practical

| Year | Semester | Int. Marks | Ext.Marks | Total |
|---|---|---|---|---|
| First/Second | First/Second/Third | 25 | 75 | 100 |

## Preamble

Focused on genome organization, phylogenetic alignment with its expression and culture dependent interactions

## Prerequisite

Basic knowledge on microbiology and genetic engineering

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Outline the microbial genomes and structural genomics of *E.coli* | **60** | **70** |
| **CO2** | List the general characteristics of microbial genomes-viral, fungal and Protist genome | **60** | **70** |
| **CO3** | Introduce the importance of human microbiome interaction network and CRISPR-Cas typing | **70** | **60** |
| **CO4** | Analyze the concepts involved in the processing of functional genomics and genome-wide gene expression | **70** | **60** |
| **CO5** | Explain the principles and applications of culture independent studies of microorganisms – metagenomics approach | **60** | **70** |

## Mapping of COS with POs

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | L | M | - | M | M | M |
| **CO2** | S | L | M | - | L | M | M |
| **CO3** | S | S | S | - | S | M | S |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO4** | S | M | S | L | S | L | M |
| **CO5** | S | M | S | M | M | S | M |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **S** | **-** | **L** |
| **CO2** | **S** | **S** | **S** | - | **L** |
| **CO3** | **S** | **S** | **M** | M | **M** |
| **CO4** | **S** | **M** | **M** | M | **M** |
| **CO5** | **S** | **M** | **S** | M | **L** |

**S: Strong M: Medium L: Low**

## Blooms taxonomy

| Blooms Taxanomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15%(9) | 15% (9) | 20%(30) |
| Understand -K2 | 15%(9) | 15% (9) | 20%(30) |
| Apply-K3 | 30%(18) | 30% ( 18) | 20%(30) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (30) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20%(30) |
| Total Marks | **60** | **60** | **150** |

## Title of the paper: Genome Biology

**Unit I**

Microbial genomes: Introduction to microbial genomics, Genome organization of Archaea and Bacteria. History of genome projects-*E.coli* genome.

**Unit II**

Genome structure and organization-genome assembly, annotation and identification of an open reading frame and promoter regions. Viral Genomics- Rhinovirus and *SARS*, Fungal Genomics- *Saccharomyces cerevisiae*, Protist Genomics- *Entamoeba histolytica*.

**Unit III**

Genome editing-Introduction and concepts of genome editing, CRISPR-Cas as typing tool in functional diversity of bacterial mutants and pathogens/Tn-Seq,. CRISPR-based genome editing of microbes for commercial and industrial applications, CRISPR tagging and identification of virulent strains. Future of CRISPR and ethical considerations.

**Unit IV**

Functional genomics: Genome-wide gene expression analyses, DNA microarray and transcriptomes-gene chips and its applications. RNA sequence analysis and methods in proteomics: Comparative genomics and proteomics, transcriptional networks and metabolomics, interactomics. Protein micro arrays-markers, Clinical proteomics. Personalized medicine and protein engineering.

**Unit V**

Metagenomics: principle and applications – steps in construction of libraries. Metaproteomics principle and applications. Systems Biology- Metabolic engineering, network concepts and analysis, protein-protein interaction and protein-DNA interaction.

## Reference:


- Brown, T.A. 2020. Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell. 8th Edition. New Jersey. United States.
- Madigan, M.T, Bender, K.S, Buckley, D.H, Sattley W.M and Stahl D.A. 2018. Brock Biology of Microorganisms. Global Edition, Published by Pearson, London.
- Sandhya Mitra. 2017. Genetic Engineering: Principles and Practice. Second Edition, McGraw Hill Education (India) Private Limited, New Delhi, India.
- Watson, J.D, Baker, T.A, Bell, S.P, Gann, A, Levine, M, Losick R. 2017. Molecular Biology of the Gene, 7th edition. Published by Pearson, London.
- Primrose, S.B. and Twyman, R.M. 2016. Principles of Gene manipulation and Genomics, Eigth Edition, John Wiley and Sons Ltd, Wiley-Blackwell.United Kingdom.
- Wilson, K. and Walker, J. 2010. Principles and Techiques of Biochemistry and Molecular Biology, 7th Edition. Cambridge University Press. New York, United States.


## ICT Tutorials

- Genome editing with crispr-cas9:https://www.youtube.com/watch?v=4YKFw2KZA5o
- DNA microarray:https://www.youtube.com/watch?v=6ZzFihESjp0
- Metagenomics:https://www.youtube.com/watch?v=oLu6UdazPxM

## Course Designers:


**1. Dr. K. Renugadevi – Assistant Professor**

**2. Dr. A. Kanakalakshmi – Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CE(C) | **Cell Structure and dynamics** | Elective | 5 | - | - | 5 |

**L - Lecture T - Tutorial P – Practicals**

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| First/Second | First/Second/Third | 25 | 75 | 100 |

## Preamble

Acquire knowledge on the fundamental concepts of cell structure and organization. Elaborate the mechanism of cell division and its functions.

## Prerequisite

Nil.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Understand the fundamentals of cell structures and organelles | **60** | **70** |
| **CO2** | Explore the role of cell organelles and transport of biomolecules | **60** | **70** |
| **CO3** | Become familiar with cell signaling and its regulations | **70** | **60** |
| **CO4** | Secure a wide knowledge on cell communication and quorum sensing | **70** | **60** |
| **CO5** | Gather an extempore knowledge on different phases of cell cycle | **60** | **70** |

**K1–Knowledge K2– Understand K3–Apply K4–Analyse K5 –Evaluate**

## Mapping of COs with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | M | M | L | L |
| **CO2** | S | S | M | M | M | L | L |
| **CO3** | S | S | M | M | L | M | L |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO4** | S | S | M | M | M | M | M |
| **CO5** | S | S | S | S | S | L | L |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO 1 | PSO2 | PSO 3 | PS O4 | PSO 5 |
|---|---|---|---|---|---|
| **CO1** | S | L | M | L | L |
| **CO2** | S | M | L | L | L |
| **CO3** | S | M | L | L | L |
| **CO4** | M | S | L | L | L |
| **CO5** | S | M | L | L | L |

**S: Strong M: Medium L: Low**

## Blooms Taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15%(9) | 15% (9) | 20%(30) |
| Understand -K2 | 15%(9) | 15% (9) | 20%(30) |
| Apply-K3 | 30%(18) | 30% ( 18) | 20%(30) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (30) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20%(30) |
| Total Marks | **60** | **60** | **150** |

## Title of the Paper: Cell Structure and Dynamics

### Unit I

Discovery of cell and Cell theory. Ultrastructure of plant, bacterial and animal cells. Cell types epithelial cells, endothelial cells and Nerve cells. Specialization of cells into tissues and colonies. Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Peroxisomes, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus – Nucleolus, Chromosome – Eukaryotic and prokaryotic, Histones and Plasmids

### Unit II

Microfilaments, Microtubules, Cilia, Flagella, Pili, Capsule, Plasma membrane models - Davson-Danielli and Fluid mosaic model - chemical constituents of plasma membrane, lipid bilayer, Phospholipids, Membrane proteins, Hydropathy plot, Freeze – fracture technique, Transport proteins, cell coat or glycocalyx. ABO blood group antigens on plasma membrane, Transport of molecules across plasma membrane – Endocytosis – Macropinocytosis, clathrin mediated endocytosis, caveolae mediated endocytosis, Clathrin and caveolae independent endocytosis and Phagocytosis.

**Unit III**

Extra Cellular Matrix (ECM), Cell Adhesion, Cell migration, Cell junctions- gap junctions, tight junctions & anchoring junctions, & Cell-cell Communication, Vesicle formation- Transport of proteins from ER to Cis – golgi (Clathrin coated, COPI coated, COPII coated, ) ER resident proteins often are retrieved from the cis – golgi, Quorum sensing, Intracellular signaling- calcium, receptors- G protein, MAPK.

**Unit IV**

Cell signalling- G-protein coupled and TGFβ receptor system JAK/STAT, Ras and MAP kinase pathway, Protein targeting and translocation, Endoplasmic reticulum – N linked glycosylation of dproteins, protein folding, Cell ageing, Cell death and its regulation.

**Unit V**

Cell cycle & its regulation- mitosis and Stages of cell cycle, regulation of cell cycle, Phases and significance of Mitotis, Meiosis, Apoptosis, Necrosis and Oncogenesis - meiosis Molecular and biochemical characteristics of cancer cells. Introduction to Stem cells.

## Reference Books:


- De Roberties, E.D.P and De Roberties, E.M.F. 2011. Cell and Molecular Biology,Eighth edition, B.I. Publications Pvt. Ltd.India
- Allison, L.A. 2021. Fundamental Molecular Biology, Third edition, Blackwell Publishing Ltd, USA.
- Lodish, Berk, Zipursky, Matsudara, Baltimore and Darnell.2021. Molecular Cell Biology, Ninth Edition, W.H.Freeman and Company,Newyork.
- Watson, J.D, Hopkins, Baker, T. A, Bell, S. P, Gann A, Levine, M, Losick R. 2014. Molecular Biology of the Gene, Seventh edition, The Benjamin / Cummings Publishing Company Inc.,Tokyo.


## Course Designers:

1. **Dr. A. Kanakalakshmi- Assistant Professor**
2. **Dr. K. Renugadevi- Assistant Professor**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CE(D) | IPR and Bioethics | Elective | 5 | - | - | 5 |

**L – Lecture T – Tutorial P – Practicals**

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| First/Second | First/Second/Third | 25 | 75 | 100 |

## Preamble

The course provides the elemental concepts of bioethics, IPR, patent filling and infringement of biotechnological process and products. Impart knowledge on regulations and guidelines for the ethical treatment of animals and clinical trials.

## Prerequisite

Basic knowledge on biology.

## Course Outcomes

**On the completion of the course the student will be able to**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Define the fundamental concepts of Bioethics and Biosafety | **60** | **70** |
| **CO2** | Outline the protocol for ethical and legal implications for GMOs | **60** | **70** |
| **CO3** | Identify the regulations and guidelines for animal studies | **70** | **60** |
| **CO4** | Categorize the intellectual property law and policy. | **70** | **60** |
| **CO5** | Appraise the process of patent filing and licensing process | **60** | **70** |

**K1 – Knowledge K2 – Understand K3 – Apply K4 – Analyse K5 – Evaluate**

## Mapping of COs with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | M | S | M |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO2** | M | M | M | M | L | L | L |
| **CO3** | M | M | L | L | M | L | M |
| **CO4** | M | M | M | M | L | L | L |
| **CO5** | M | M | L | M | M | L | L |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | L | L | L | L | L |
| **CO2** | L | L | M | L | L |
| **CO3** | L | L | L | L | M |
| **CO4** | M | L | L | L | L |
| **CO5** | M | M | S | M | M |

**S: Strong M: Medium L: Low**

## Blooms Taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge -K1 | 15% (9) | 15% (9) | 15% (20) |
| Understand -K2 | 15% (9) | 15% (9) | 15% (20) |
| Apply-K3 | 30% (18) | 30% ( 18) | 30% (40) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (25) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20% (25) |
| Total Marks | **60** | **60** | **130** |

## Title of the paper: IPR and Bioethics

**Unit-I**

Introduction to ethics and bioethics. Perspectives of Ethics-Ethical theories Deontological, Utilitarianism – Ethical leadership (integrity and ingenuinity) - framework for ethical decision making- Michael Macdonald model &Storch model. Overview of National Regulations and relevant International Agreements including Cartagena Protocol. Ethical implication of biotechnological products and Techniques.

**Unit-II**

GM crops and GMO‟s - Ethical implications for genetically modified foods. Benefits and risks – ethical aspects of genetic testing and bio-warfare. Ethical implications of cloning - Reproductive and therapeutic cloning; Ethical, legal and socio-economic aspects of gene therapy, germ line, somatic and adult stem cell research. Biotechnology and biopiracy – ELSI of human genome.

**Unit III**

Animal Rights: Making New Strains of Animal: Ethical limits and regulations of Animal use. Human Gene Therapy: Ethical issues in Gene Therapy: Efficiency of treatment; Safety of Transferred Genes; Human rights, Ethical guidelines for genetically modified foods.

**Unit IV**

Introduction to intellectual property Rights- patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentables and non patentables – patenting microorganisms – legal protection of biotechnological inventions. Patent writing for product and process patents. World intellectual property rights organization (WIPO)

**Unit V**

Patent filing procedures-National & PCT filing procedure-Time frame and cost- Status of the patent applications filed- Precautions while patenting–disclosure/non-disclosure. Financial assistance for patenting-introduction to existing schemes, Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies.Bioentrepreneurship-scope and applications.

**Reference Books:**


- Jecker, N.S., Johnson, A.R., and Pearlman R.A. 2011. Bioethics: An Introduction to history, methods and practice, Jones and Barlett Publishers.
- Manomy V. 2009 Animal Experimentation: A guide to the issues, Second edition, - Cambridge university press.
- Goel, D., and Parashar, S. 2013. IPR, Biosafety and Bioethics, First edition, Pearson Education, India.
- BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.


**Course Designers:**


**Dr. M. Karthikeyan- Assistant Professor**

**Dr. A. Kanakalakshmi- Assistant Professor**

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(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| PMB21CE (E) | **Biology for competitive exams (CSIR, NET, SET)** | Elective | 5 | - | - | 5 |

**L - Lecture T - Tutorial P – Practicals**

| Year | Semester | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|
| First/Second | First/Second/Third | 25 | 75 | 100 |

## Preamble

Provide in–depth knowledge on fundamental and advanced topics inbiology for cracking national level exams.

## Prerequisite

Basic knowledge on physical, chemical and biological sciences.

## Course Outcomes

**On the completion of the course the student will be ableto**

| # | Course Outcome | Expected Proficiency (%) | Expected Attainment (%) |
|---|---|---|---|
| **CO1** | Demonstrate Mendel's laws of inheritance and recognize the deviations | **60** | **70** |
| **CO2** | Demonstrate broad view on the evolution of Plants and Animals | **60** | **70** |
| **CO3** | Illustrates the fundamental concepts of ecosystem | **70** | **60** |
| **CO4** | Interprets the threats in biological diversity and aiming at the conservation of species and habitats. | **70** | **60** |
| **CO5** | Elaborates the various stages of embryogenesis | **60** | **70** |

**K1–Knowledge K2– Understand K3–Apply K4–Analyze K5 –Evaluate**

## Mapping of COs with POs

| # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | M | M | M | L |
| **CO2** | S | M | S | M | M | L | M |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CO3** | S | S | S | M | S | L | M |
| **CO4** | M | M | M | S | L | M | L |
| **CO5** | S | M | M | S | L | M | M |

**S: Strong M: Medium L: Low**

## Mapping of COS with PSOs

| # | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | S | M | M | S | M |
| **CO2** | S | S | M | S | S |
| **CO3** | M | M | S | M | L |
| **CO4** | S | S | M | S | M |
| **CO5** | M | M | S | S | L |

**S: Strong M: Medium L: Low**

## Blooms Taxonomy

| Blooms Taxonomy | | | |
|---|---|---|---|
| | **CA** | | **End of Semester (Marks)** |
| | **First (Marks)** | **Second(Marks)** | |
| Knowledge –K1 | 15%(9) | 15% (9) | 20%(30) |
| Understand –K2 | 15%(9) | 15% (9) | 20%(30) |
| Apply-K3 | 30%(18) | 30% ( 18) | 20%(30) |
| Analyze-K4 | 20% ( 12) | 20% ( 12) | 20% (30) |
| Evaluate-K5 | 20% ( 12) | 20% ( 12) | 20%(30) |
| Total Marks | **60** | **60** | **150** |

## Title of the paper: Biology for competitive exams (CSIR, NET, SET)

**Unit: I**

Genetics: Principles of Mendelian inheritance, chromosome structure and function; Gene Structure and regulation of gene expression; Linkage and genetic mappings; Extrachromosomal inheritance (episomes, mitochondria and chloraplasts); Mutation; DNA damage and repair, chromosome aberration; Transposons; Sex-linked inheritance and genetic disorders; Somatic cell genetic; Genome organisation (in both prokaryotes and eukaryotes).

**Unit: II**

Evolutionary Biology: Origin of life (including aspects of prebiotic environment and molecular evolution); Concepts of evolution; Theories of organic evolution; Mechanisms of speciation; Hardyweinberg genetic equilibrium, genetic polymorphism and selection; Origin and evolution of economically important microbes; plants and animals.

**Unit: III**

Environmental biology: Concept and dynamics or ecosystem, components, food chain and energy flow; productivity and biogeochemical cycles; Types of ecosystems, Population ecology and biological control; Community structure and organisation; Environmental pollution; Sustainable development; Economic importance of microbes, plants and animals.

**Unit: IV**

Biodiversity and Taxonomy: Species concept; Biological nomenclature, theories of biological classification, Structural and biochemical and classification, molecular systematics; DNA finger printing, numerical taxonomy, Biodiversity, characterization, generation maintenance and loss; Magnitude and distribution of biodiversity, economic value, wildlife biology, conservation strategies, cryopreservation.

**Unit: V**

Gametogenesis in animals: Molecular events during fertilization, Cleavage patterns and fate maps, Concepts of determination, competence and induction, totipotency and nuclear transfer experiments. Cell differentiation and differential gene activity. Morphogenetic determinants in egg cytoplasm; Role of maternal contributions in early embryonic development; Genetic Regulations of early embryonic development in Drosophila; Homeotic genes.

## Reference Books:


1. Cooper, G. M, Hausman, R. E. 2013. The Cell: A Molecular Approach. Sixth edition, Sinauer Associates, Inc.;Massachusetts.
2. Chaudhary, B. L, Choudhary,K, Chaudhary, A. 2007. CSIR-NET Life Sciences. New Age Publishers, India.
3. Hossain, Q. J, Kumar,P, Nagesh, A. 2018. UGC CSIR NET / SET (JRF & LS) Life Sciences. Arihant Publishers. India.
4. Kumar P, Usha Mina. 2021. Life Sciences. Eighth edition, Vol-I and II, Path Finder publications. India


## Course Designers:

1. **Dr. Rm. Murugappan- Assistant Professor**
2. **Dr. A. Kanakalakshmi- Assistant Professor**