# B.Sc., Biotechnology

## Programme Code: UBT

## Programme outcome (PO) Bachelor of Science (B.Sc.)

**PO1** **Scientific Knowledge and Critical Thinking:**

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

**PO2** **Problem Solving:**

Identify and analyse 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.

**PO3** **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 technique.

**PO4** **Life-Ling 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.

**PO5** **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.

**PO6** **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)**

## THIAGARAJAR COLLEGE , MADURAI – 9

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

## Department of Biotechnology

## Programme Educational Objectives (PEO)

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

| | |
|---|---|
| **PEO1** | Graduates of this program will build up competency in basic Biotechnology required for decisive learning and research. |
| **PEO2** | Graduates will develop diversified indispensable professional skills through a wide range of laboratory technical training, communication and presentation skills. |
| **PEO3** | Graduates will acquire an ability to identify, formulate, and solve biosafety, environmental and socio-ethical issues to contribute service efforts to community in both the professional and private realm. |
| **PEO4** | Gradates will amalgamate related topics from their curriculum such as biochemical techniques, cell biology, microbiology, molecular biology, genetic engineering, plant biotechnology, animal biotechnology, environmental biotechnology, computational biology for higher studies, research and other career. |
| **PEO5** | Graduates could develop adequate skill to evaluate the scope of biotechnology, understand the complexities of microbes, plants and animal system and address contentious scientific issues in a lucid way. |

## Programme Specific Outcomes (PSOs) - B.Sc., Biotechnology

**On the successful completion of B.Sc., Biotechnology the students will**

| | |
|---|---|
| **PSO1** | Recognize various groups of microbes using specific identification keys and characteristic features. |
| **PSO2** | Exhibit the acquired knowledge and appreciate the core concepts of Biotechnology at cellular, biochemical and molecular level with basis of physiology of living system. |
| **PSO3** | Identify somaclones and gametoclones using appropriate molecular markers and bioinformatics tools. |
| **PSO4** | Demonstrate the principles of inheritance, transgenesis and commercial exploitation of recombinant DNA technology. |
| **PSO5** | |

**THIAGARAJAR COLLEGE, MADURAI - 9.**
**(Re-Accredited With A++ Grade by NAAC)**
**Department of Biotechnology**
**B.Sc. Biotechnology Curriculum (w.e.f. 2020 - 21 batch onwards)**
**Programme Code - UBT**
**Semester – I**

| Course | Code No. | Subject | Hrs / Week | Credits | Total Hrs | Max Mark CA | Max Mark SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part I | U20P111 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II | U20EN11 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 1 | UBT20C11 | General Microbiology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core Lab 1 | UBT20CL11 | General Microbiology lab | 2 | 1 | 30 | 40 | 60 | 100 |
| Core 2 | UBT20C12 | Elements of Biotechnology | 3 | 3 | 45 | 25 | 75 | 100 |
| Generic Elective | UBT20GE11 | Bioinstrumentation | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab1 | UBT20CL21 | Bioinstrumentation Lab | 2 | - | 30 | | | |
| AECC | | Environmental Studies | 2 | 2 | 30 | 15 | 35 | 50 |
| **Total** | | | **30** | **21** | | | | **650** |

**Semester - II**

| Course | Code No. | Subject | Hrs / Week | Credits | Total Hrs | Max Mark CA | Max Mark SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part 1 | U20P121 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II | U20EN21 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 3 | UBT20C21 | Cytology and Cytogenetics | 5 | 5 | 75 | 25 | 75 | 100 |
| Core Lab 2 | UBT20CL21 | Cytology and Cytogenetics Practical | 2 | 1 | 30 | 40 | 60 | 100 |
| Core 4 | UBT20C22 | Microbial Genetics | 3 | 3 | 45 | 25 | 75 | 100 |
| Generic Elective 2 | UBT20GE21 | Biomolecules | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab2 | UBT20GL21 | Bioinstrumentation & Biomolecules lab | 2 | 2 | 30 | 40 | 60 | 100 |
| AECC | | Value Education | 2 | 1 | 30 | 15 | 35 | 50 |
| **Total** | | | **30** | **22** | | | | **750** |

**Semester - III**

| Course | Code No. | Subject | Hrs / Week | Credits | Tota lHrs | Max Mark CA | Max Mark SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part 1 | U20P131 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part 2 | U20EN31 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 5 | UBT20C31 | Molecular Biology | 4 | 4 | 60 | 25 | 75 | 100 |
| Core 6 | UBT20C32 | Computational Biology Basics | 4 | 4 | 60 | 25 | 75 | 100 |
| Core lab3 | UBT20CL31 | Molecular Biology & Computational Biology Basics lab | 2 | 1 | 30 | 40 | 60 | 100 |
| Generic Elective 3 | UBT20GE31 | Genetics &Biostatistics | 4 | 4 | 60 | 40 | 60 | 100 |
| Generic Elective lab 3 | UBT20GL41 | Genetics & Biostatistics lab | 2 | - | 30 | - | - | - |
| NME1 | UBT20NE31 | Mushroom Technology | 2 | 2 | 30 | 15 | 35 | 50 |
| **Total** | | | **30** | **21** | | | | **650** |

**Semester - IV**

| Course | Code No. | Subject | Hrs / Week | Credits | Total Hrs | Max Mark CA | Max Mark SE | Total |
|---|---|---|---|---|---|---|---|---|
| Part 1 | U20P141 | Tamil | 6 | 3 | 90 | 25 | 75 | 100 |
| Part 2 | U20EN41 | English | 6 | 3 | 90 | 25 | 75 | 100 |
| Core 7 | UBT20C41 | Immunology and Immunotechniques | 4 | 4 | 45 | 25 | 75 | 100 |
| Core 8 | UBT20C42 | Clinical Laboratory Technology | 4 | 4 | 45 | 25 | 75 | 100 |
| Core lab 4 | UBT20CL41 | Immunology and Immunotechniques & Clinical laboratory technology lab | 2 | 1 | 30 | 40 | 60 | 100 |
| Generic Elective 4 | UBT20GE41 | Physiology and Pathology | 4 | 4 | 60 | 25 | 75 | 100 |
| Generic Elective lab 3 & 4 | UBT20G 41 | Genetics and Biostatistics & Physiology lab | 2 | 2 | 30 | 40 | 60 | 100 |
| NME2 | UBT20NE41 | Vocational Biotechnology | 2 | 2 | 30 | 15 | 35 | 50 |
| **Total** | | | **30** | **23** | | | | **800** |

**Semester – V**

| Course | Code No | Subject | Hrs / Week | Credits | Total Hrs | Max Mark CA | Max Mark SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core 9 | UBT20C51 | Genetic Engineering | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 10 | UBT20C52 | Bioprocess Technology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core 11 | UBT20C53 | Marine Biotechnology | 5 | 5 | 75 | 25 | 75 | 100 |
| Core lab 5 | UBT20CL51 | Genetic Engineering lab | 4 | 2 | 60 | 40 | 60 | 100 |
| Core lab 6 | UBT20CL52 | Bioprocess Technology lab | 2 | 1 | 30 | 40 | 60 | 100 |
| Core lab 7 | UBT20CL53 | Marine Biotechnology lab | 2 | 1 | 30 | 40 | 60 | 100 |
| Core Elective1 | UBT20CE51 A/B/C | (A) Applied Microbiology<br>(B) Metabolic pathways<br>(C) Pharmaceutical Biotechnology | 5 | 5 | 75 | 25 | 75 | 100 |
| SBE1 | UBT20SE51 A/B/C/D | A)Biomedical Sciences<br>B)Stem Cell Biology/<br>C)Biofertilizersand Biopesticides/<br>D)Agricultural Biotechnology | 2 | 2 | 30 | 15 | 35 | 50 |
| **Total** | | | **30** | **26** | | | | **750** |
| | **UBT20IN** | **Internship** | | **2** | | **15** | **35** | **50** |

**Semester –VI**

| Course | Code No. | Subject | Hrs / Week | Credits | Total Hrs | Max Mark CA | Max Mark SE | Total |
|---|---|---|---|---|---|---|---|---|
| Core12 | UBT20C61 | Plant Conservation Biotechnology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core13 | UBT20C62 | Animal Biotechnology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core14 | UBT20C63 | Environmental Biotechnology | 4 | 4 | 75 | 25 | 75 | 100 |
| Core lab 8 | UBT20CL61 | Plant Conservation Biotechnology Practical | 2 | 1 | 30 | 40 | 60 | 100 |
| Core lab 9 | UBT20CL62 | Animal Biotechnology lab | 4 | 2 | 60 | 40 | 60 | 100 |
| Core lab10 | UBT20CL63 | Environmental Biotechnology lab | 2 | 1 | 30 | 40 | 60 | 100 |
| Core Elective2 | UBT20CE61 D/E/F | (D) Forensic Biotechnology<br>(E) Genomics and Proteomics<br>(F) Biosafety and IPR | 5 | 5 | 75 | 25 | 75 | 100 |
| | UBT20SE61 A/B/C/D | A) Bioprospecting<br>B) Health & Hygiene<br>C) Entrepreneurs in Biotechnology/Nano Biotechnology | | | | | | |
| | UBT20PJ | Students Project | 3 | 3 | | 15 | 35 | 50 |
| | Total | | 30 | 26 | | | | |

## A) CONSOLIDATION OF CONTACT HOURS AND CREDITS : UG

| Semester | Contact Hrs/ Week | Credits |
|---|---|---|
| I | 30 hrs. | 21 |
| II | 30 hrs. | 23 |
| III | 30 hrs. | 21 |
| IV | 30 hrs. | 23 |
| V | 30 hrs. | 26 |
| VI | 30 hrs. | 26 |
| | Extra credit | 2 |
| Total | 180 hrs | 142 |

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20C51 | Genetic Engineering | Core 9 | 5 | - | - | 5 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

Learn the recent development in Gene technology and appreciate the advancement in Genetic Engineering

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Apply the principle of Genetic engineering; appreciate the importance of DNA modifying enzymes | 90% | 88% |
| **CO2** | Summarize the use of gene cloning vectors | 85% | 80% |
| **CO3** | Analyze the core techniques in gene manipulation. | 80% | 75% |
| **CO4** | Explain the mechanisms in the construction of gene libraries | 85% | 80% |
| **CO5** | Understand the principle of PCR | 85% | 80% |
| | | | |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the paper Genetic Engineering

**Unit I:**

Principles of genetic engineering : Restriction enzymes – nomenclature , classification , types. DNA modifiying enzymes – ligases – alkaline phosphatase – DNA polymerase, Holoenzyme – RNases – reverse transcriptase – Poly(A) polymerase, S1 nuclease, terminal deoxy nucleotide transferase.

**Unit II:**

Gene cloning vectors – plasmids: types – isolation and amplification – bacterial plasmids as cloning vectors. PBR322, pUC18 and Col E1. Bacteriophage vector for *E. coli* – lambda phage as a vector – Lambda replacement and insertion vectors and their uses. Shuttle vectors - 2µm plasmid - YAC – expression vectors - P Blue script vectors - Cosmid & Phasmid vectors.

**Unit III :**

Core techniques in gene manipulation: Cloning strategies, sticky and blunt end cloning. Cloning from mRNA – synthesis of cDNA - cloning of cDNA using plasmid and phage vectors – Cloning from genomic DNA. Construction of libraries – genomic - cDNA .

**Unit IV :**

Methods of selection and screening of recombinant DNA: α -complementation. Hybridization - colony & plaque. Marker inactivation – insertional inactivation – expression screening techniques- radio-labeling. Blotting techniques: Southern - Northern and Western - Chromosome walking & jumping.

**Unit V :**

Gene amplification: Basic principles and applications of PCR - primer designing and optimization - Types of PCR. DNA profiling - DNA foot printing-finger printing. Mapping of human genes – human genome project.

**Text Books:**


- Primrose, S.B. and R.M. Twyman, 2009. Principles of Genome Analysis and genomics, 7th edition. Blackwell publishing, USA.
- Primrose, S.B. . Twyman , R.M and.Old, R.W. 2001. Principles of Gene Manipulation. 6th edition, S.B.University Press.

- Sandya Mitra, 1998. Genetic engineering, Mac India ltd., New Delhi.
- Watson, J. D., N. H. Hopkins, J.W. Roberts, J.A. Steitz and A .M . Weiner, 2014. Molecular Biology of the gene, 7th edition, The Benjamin / Cummings Publishing Company Inc., Tokyo.


**Reference Books:**


- Brown. T. A., 2000. gene cloning, Seventh edition, Chapman and Hall Publication, USA.
- Lewin B., 2008, 11th edition. Genes IX, Oxford University Press, Oxford, U.K.
- Winnaker, E.L., 2003. From Genes to Clone: Introduction to Gene Technology, VCH publications, Weinbeim Fedreral Republic German.


**Course designers:**

1. Dr.S.Yogachitra
2. Mrs. S.Siva durga

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CL51 | Genetic Engineering Practical | Core lab-5 | - | - | 4 | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | III | 40 | 60 | 100 |

## Preamble

Acquire knowledge on the extraction of Nucleic Acids, procedures of Gene Manipulation. Have hands on training on electrophoretic procedures and blotting techniques.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Acquire knowledge on the principle of electrophoretic separation of nucleic acids | 90% | 88% |
| **CO2** | Summarize the mechanisms in the extraction of nucleic acids. | 95% | 82% |
| **CO3** | Analyze the restriction digestion and ligation. | 80% | 75% |
| **CO4** | Explain the mechanisms of blotting. | 95% | 80% |
| **CO5** | Understand the mechanisms involved in PCR | 75% | 72% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

**Blooms taxonomy**

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

**Title of the paper Genetic Engineering Practical**

1. Separation of bacterial genomic DNA by Agarose Gel electrophoresis.
2. RNA separation by Agarose gel electrophoresis.
3. Isolation and estimation of Cyanobacterial DNA
4. Isolation of plasmid DNA from bacteria
5. Demonstration of Restriction digestion
6. Demonstration of Ligation process
7. Demonstration of Southern blotting of DNA
8. Demonstration of Northern blotting of RNA
9. Demonstration of PCR
10. Separation of proteins by PAGE
11. Demonstration of Western blotting

**Text books:**

- Jhon Vennison.S. 2009. Laboratory Manual for Genetic Engineering. Prentice Hall India Learning pvt. Ltd.
- Sengar. R.2012.Laboratory manual on Molecular Biology and Genetic Engineering – A new approach.
- Janarthanan.S, Vincent.S. 2007. Practical Biotechnology, Methods and Protocols. Universities Press, England.

**Reference books:**

- Jane K. Setlow.2010. Genetic Engineering, Principles and Methods. Springer, NewYork.

**Web Sources:**

- https://books.google.co.in/books/about/Laboratory_Manual_For_Genetic_Engineerin.html?id=npAGCwAAQBAJ&redir_esc=y
- https://www.scientificpubonline.com/bookdetail/plant-biotechnology-molecular-biology-laboratory-manual/9788172332037/34

**Course Designer(s):**

1. Dr. S.Yogachitra
2. Mrs. S. Siva durga

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20C52 | Bioprocess Technology | Core -2 | 4 | - | | 4 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

This course is to provide students with an extensive and concise knowledge about bioprocess principles and strategies to optimize the production of by-products from industrial important microbial strains.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Screening industrial important microbe and its preservation technique | 80% | 78% |
| **CO2** | Describe the comprehension of types of fermentor, and fermentation | 85% | 80% |
| **CO3** | Apply the concept of downstream processing; instrumentation technique | 78% | 75% |
| **CO4** | Acquire the knowledge on production and assay of biologically important materials | 87% | 85% |
| **CO5** | Apply the perception of enzyme production; Cell and enzyme immobilization and its application | 75% | 72% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the paper: Bioprocess Technology

**Unit I**:

Introduction to Bioprocess Technology:The Historical foundation and development; Importance of microbes in Industry; Isolation of productive strains; screening - primary and secondary screening; strain improvement and its methods;media formulation, media sterilization, inoculum development.

**Unit II:**

Fermentation and Fermentors: Types of fermentation - solid state fermentation and submerged fermentation; types of substrates; methods of fermentation - batch, continuous and fed batch system. Principles of chemostat and turbidostat; Types and design of fermentors - batch, CSTF, air lift, tower, bubble column, fluidized bed fermentor; auxiliary equipments.

**Unit III:**

Downstream processing: Product separation methods: centrifugation, precipitation, filtration (membrane filtration, gel filtration and fluid filtration) - cell disruption - product recovery – liquid-liquid extraction, chromatography purification, concentration, lyophilization and crystallization.

**Unit IV:**

Industrial production of amino acid (L – Glutamic acid and L- Lysine); antibiotics (Penicillin & Streptomycin); organic acids (Citric acid, Lactic acid, Vinegar & Kojic acid), Vitamins (Riboflavin & Cyanocobalamine), steroids, alcohol, gasohol, wine and beer.

**Unit V:**

Enzyme biotechnology – Principles – Industrial enzyme production methods: tray and deep bedcultivation– enzyme recovery and purification – methods of enzyme immobilization. Production of α –amylase, protease and cellulase - application of industrial enzymes.

**Text books:**


- Crueger, W. and Crueger, A. 2005. Biotechnology: A Test Book of Industrial Microbiology, II Edn., Panima Publishing corporation, New Delhi.
- Kalaichelvan, P.T. and Arul Pandi, I. 2007. Bioprocess Technology, MJP publishers, Chennai.
- Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi


**Reference Books:**


- Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
- Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
- Cruger, W., Cruger, A. and Brock, T.D. 1991. Biotechnology, A Text book of Industrial Microbiology
- Demain A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology & Biotechnology. ASM press.
- El-Mansi, E.M.T., Bryce, C.F.A., Dahhou, D., Sanchez, S., Demain, A.L. and Allman, A.R. 2012. Fermentation Microbiology and Biotechnology. III Edn., CRC Press, London.
- Flickinger, M.C. and Drew, S.W. 1999. Encyclopaedia of Bioprocess Technology Fermentation, Biocatalysis and Bioseperation Vol. V., John Wiley and Sons Publications.
- Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology – Fundamentals of Applied Microbiology. W.H. Freeman and Company. New York.
- Peppler, H. and Pearman, D. 2008. Microbial Technology, II Edn. Vol.I, Academic Press, New York.
- Stanbury, P.F, Whitaker, A. and Hall, S.J.1999. Principles of Fermentation technology, II Edn. Aditya Book (P) Ltd., New Delhi.
- Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, London.


**Course Designer:**

Dr. C. Balachandran

**Thiagarajar College: Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
**Programme Code -UBT**

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20CL52** | **Bioprocess Technology Practical** | **Core Lab-6** | **-** | **-** | **4** | **2** |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 40 | 60 | 100 |

## Preamble

To provide the students with the hands on experimental exposure on isolate the industrial important microbes. Perform the production and assay of bioproducts.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Acquire knowledge on screening, production assay of industrial important microbes. | 80% | 80% |
| **CO2** | Apply the knowledge on the immobilization procedures | 85% | 85% |
| **CO3** | Experiment with fermentation of alcohol | 90% | 90% |
| **CO4** | Understand the mechanisms involved in enzyme production | 87% | 87% |
| **CO5** | Demonstration of wine production | 90% | 90% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the paper: Bioprocess technology Practical

1. Giant colony technique for antibiotic producing organisms.
2. Isolation of antibiotic producing organism
3. Screening, Production and assay of Amylase
4. Screening, Production and assay of Protease
5. Screening, Production and assay of Cellulase
6. Mutant strains by UV irradiation
7. Immobilization of cells in calcium alginate beads
8. Alcohol fermentation by yeast and quantification of ethanol.
9. Citric acid production by *Aspergillus niger*
10. Production and estimation of wine.
11. Production of lovastatin by solid state fermentation

**Text Book / Manuals:**


- Chellapandi P. 2007. Laboratory manual in Industrial Biotechnology. Pointers publishers, Jaipur.
- Richard H.,Julian D. Davies. 2010. Manual of Industrial Microbiology and Biotechnology. Third Edition. ASM press,
- Washington D.C.Dodds. J. H. 1991. *In vitro* Methods of Conservation of Plant Genetic Resources. Chapman and Hall, London.
- Thorpe, T. A. 1993. *In vitro* organogenesis and somatic embryogenesis: physiological and biochemical aspects. In: Roubelakis-Angelakis KA, Tran Tranh Van T (Eds.). Morphogenesis in Plants. Plenum Publishing Corp., New York.

**Reference Book / Manuals:**


- William M. Fogarty, Catherine T. Kelly.2011.Microbial Enzymes and Biotechnology. Second edition. Springer, United Kingdom.

- Jose Luis Barredo.2010. Microbial Enzymes and Biotransformations. Humana press, NewYork.


**Course Designer:**

Dr. C. Balachandran

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20C53 | Marine Biotechnology | Core 11 | 4 | - | - | 4 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

Enlighten about the ecology of the oceanic habitat and the artistic beauty and economic importance of marine resources.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| CO1 | Understand the ecological importance of oceanic habitat | 90% | 85% |
| CO2 | Analyze the impact of pollutants in the marine ecosystem. | 85% | 82% |
| CO3 | Appreciate and admire artistic beauty of marine seaweeds. | 80% | 75% |
| CO4 | Understand the commercial importance of seaweeds. | 75% | 70% |
| CO5 | Experiment with Marine biotechnology in the wider biological sense | 75% | 72% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong  M (++) - Medium  L (+) – Low**

## Blooms taxonomy

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

## Title of the paper  Marine Biotechnology

**Unit I:**

Different strata of Oceanic habitat- Physical, chemical and biological aspects and their interaction withmarine life- Marine flora: Phytoplankton, Benthos, Seaweeds and Sea grasses - Distribution pattern of sea weed resources in Indian Seas.

**Unit II:**

Marine Pollution: Major pollutant – Biodegradation of waste materials by sea weeds. Biological indicators: Marine microbes and Algae. Monitoring of heavy metal pollution using phytoplankton and seaweeds – Algal bloom – Red tide – Toxic Dinoflagellates – exo and endo toxins – Bioluminescence.

**Unit III:**

Warm water Mari culture: Seaweed farming in India, Japan and Thailand – Methods of seaweed cultivation : Lagoon culture, Coir rope culture, Net cultivation method, Seaweed culture by spores method . Indoor & Outdoor mass cultivation & harvesting strategies of marine species of *Spirulina subsalsa.*

**Unit IV:**

Commercial exploitation of Micro & Macro algae: Sources, chemistry and extraction of Phycocolloids: Alginates, Agar-agar and Carrageenan. Seaweed manure and Seaweed liquid fertilizersfor agriculture.

**Unit V:**

Utilization of Micro & Macro algae : Major uses of *Porphyra, Gracilaria, Undaria, Laminaria, Hypnea* and *Ulva* - Edible seaweeds. Neutraceuticals: Micro algal products – Pigments, Anti-oxidant, Omega-3 Fatty acids and Immuno stimulant. Fodder: Seaweed meal for Pisiculture, Poultry feed and other farm animals .Uses of Diatomite.

**Text Books:**


- Frances Dipper, 2022. Elements Of Marine Ecology. 5th edition. Elsevier.
- Colin B. Munn, Taylor and Francis .2020. Marine Microbiology Ecology And Applications. 3rd edition. Taylor and Francis.
- Kim, John Wiley, 2013. Marine Microbiology Bioactive Compounds And Biotechnological Applications. Wiley.
- Austin.1992. Marine Microbiology. Cambridge press. London
- Raymont.J. 1980. Plankton and productivity in the Ocean. 2nd edition. Pergamon press. London
- Venkataraman,G.S. 1974. Algae: Form and Function. Todays & Tomorrow_s publishers, New Delhi.
- Imai, LT. 1982. Progress in shallow sea culture techniques of seaweed culture. Tokyo: Koseisha Koseika publishers (English translation)
- Sundaralingam,V. 1991. Marine Algae. 5th edition. Bishan Singh and Mahendra Pal Singh Publishers,Dehradun.


**Reference Books:**


- Venkataraman,L.V. 2002. Application of algal Biotechnology in the next millennium. In: A.Anand (ed.) Algal research in India. Dehradun.India.
- Subramanian G. 1998. Marine Cyanobacteria for feed, fine chemicals & Pharmaceuticals. Cyanobacterial Biotechnology.Oxford IBH Co.pvt.Ltd., New Delhi. ISBN 81-2041269-9.
- Subba Rangaiah, G. 1999. Recent trends in Algal Research. Publisher-Marine Algal Laboratory. Visakapatanam.A.P.
- Krishnamurthy,V. 2000. Algae of India and neighbouring countries. Oxford & IBM Publ


**Web Sources:**

- https://www.frontiersin.org/journals/marine-science/sections/marine-biotechnology
- https://www.frontiersin.org/articles/10.3389/fmars.2021.629629/full
- https://www.isaaa.org/resources/publications/pocketk/52/default.asp
- http://aquafind.com/articles/Marine-Biotechnology.php

**Course designers:**

1. Dr. S.Yogachitra
2. Mrs. S.Siva durga

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CL53 | Marine Biotechnology Practical | Core lab-7 | - | - | 3 | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| II | III | 40 | 60 | 100 |

## Preamble

Acquire knowledge on the morphological feature of seaweeds and appreciate the economical importance of seaweeds.

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency | Expected attainment |
|---|---|---|---|
| **CO1** | Analyze the structural organization and diversity of seaweeds. | 95% | 90% |
| **CO2** | Acquire knowledge of culturing of cyanobacteria | 85% | 80% |
| **CO3** | Describe the methodology in the extraction of phycocolloids | 80% | 78% |
| **CO4** | Illustrate the preparation of sea weed manure and liquid fertilizer. | 80% | 78% |
| **CO5** | Assess the strategies of bioremediation using marine algae. | 85% | 73% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COS with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the paper: Marine Biotechnology Practical

1 .Study of external morphology and micro preparations of the marine seaweeds : Ulva, Caulerpa, Sargassum, Turbinaria, Padina and Gracilaria.

2. Observation of micro algae.

3. Culturing of marine cyanobacteria.

4. Extraction and processing of agar agar and carrageenan from red seaweeds.

5. Extraction and processing of alginates from marine kelp.

6. Extraction of chlorophylls and carotenoids from macroscopic marine green algae

7. Bioremediation of oil spilled effluent using marine cyanobacteria.

8. Biosorption of heavy metal from ore effluent using seaweeds and cyanobacteria.

9. Preparation of sea weed liquid fertilizers (SLF) from brown and red seaweeds.

10. Effect of SLF of on seed germination.

**Reference Manual/s:**


- Amy Sauter Hill, 2002. Marine Biology Lab Manual: An Introduction to Ocean Ecosystems. Walch Education.
- Karleskint, 2012 .Introduction To Marine Biology.4th edition (International edition). Cengage Learning.
- George Karleskint, James Small, Richard Turner, 2010. Introduction to Marine Biology, Laboratory Manual.3rd edition. Wadsworth Publishing Co Inc.
- George Karleskint, James Small, Richard Turner, 2012. Introduction to Marine Biology + Lab Manual. 4th edition. Cengage Learning.

**Web Sources**:

- https://www.rainbowresource.com/product/019438/Marine-Biology-Lab-Manual.html
- https://www.routledgehandbooks.com/doi/10.1201/b22246

**Course Designer(s):**

1. Dr. S.Yogachitra
2. Mrs. S. Siva durga

**Thiagarajar College : Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code - UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CE51(A) | Applied Microbiology | Core Elective | 4 | - | - | 5 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

Enable the students to understand the application of microorganisms in diverse fields

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency (EP) | Expected Attainments (EA) |
|---|---|---|---|
| CO1 | Gain an understanding of the role of microorganisms infood, agro and environmental microbiology. | 85% | 80% |
| CO2 | Understand the conceptual applications of microbes in various fields | 80% | 78% |
| CO3 | Grab a basic idea about the fermenter and fermented products | 80% | 83% |
| CO4 | Analyse the biochemical role of microorganisms in different industries | 75% | 73% |
| CO5 | Depict the industrially important microorganisms used for fermentation | 78% | 75% |

## Mapping of COs with POs

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

S (+++) - Strong M (++) - Medium L (+) - Low

## Mapping of COs with PSOs

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

S (+++) - Strong M (++) - Medium L (+) - Low

Blooms taxonomy

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

**Unit I:**

Physical and chemical characteristics of soil. Rhizosphere and phyllosphere. Plant growth - promoting microorganisms - mycorrhizae, rhizobia, *Azospirillum*, *Azotobacter*, cyanobacteria, *Frankia* and phosphate - solubilizing microorganisms. Outlines of biological nitrogen fixation (symbiotic, non- symbiotic). Symptoms of plant diseases caused by fungi, bacteria, and viruses, Biological control of plant diseases. Biopesticides – *Bacillus thuringiensis*, Nuclear polyhedrosis virus (NPV), *Trichoderma*.

**Unit II:**

Microorganisms of environment (soil, water and air). Role of microorganisms in nutrient cycling (carbon, nitrogen, sulphur). Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation. Microbiology of potable and polluted waters. *E.coli* and *Streptococcus faecalis* as indicators of water pollution. Sanitation of potable water. Sewage treatment (primary, secondary and tertiary). Outlines of biodegradation of environmental pollutants – pesticides.

**Unit III:**

Microorganisms of food spoilage and their sources. Food intoxication (botulism and staph poisioning), food borne diseases (salmonellosis and shigellosis) and their detection. Microbiological production of fermented foods – bread, cheese, yogurt. Biochemical activities of microbes in milk. Microorganisms as food – SCP, Concept of probiotics.

**Unit IV:**

Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes. Screening and isolation of industrially important microorganisms. Types of fermentation – aerobic, anaerobic, batch, continuous, submerged, surface, solid state.

**Unit V:**

Design of a stirred tank reactor fermentor. Fermentation media. Industrial production of alcohols (ethyl alcohol), beverages (beer), enzymes (amylases), antibiotics (penicillin), amino acids (glutamic acid), organic acids (citric acid), vitamins (B12), biofuels (biogas - methane).

**Text books**


- Kalaichelvan, P.T. and Arul Pandi, I. 2007. Bioprocess Technology, MJP publishers,Chennai.
- Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, VII Edn., McGrawHill, New York.
- Rangaswami, G. and Bagyaraj, D.J. 2009. Agricultural Microbiology. II edn. PHILearning Pvt. Ltd., New Delhi.
- Adams, M.R and M.O.Moss, 2006, Food Microbiology, New Age international (P) Ltd., New Delhi.


**Reference books**


- Crueger, W. and Crueger, A. 2005. Biotechnology: A Test Book of Industrial Microbiology, II Edn., Panima Publishing corporation, New Delhi.
- Tortora G.J., Funke, B.R. and Case, C.L.2011. Microbiology An introductio, IXEdn., Pearson Education Inc., New York.
- Frazier, W.C., and D.C.Westhoff, 2005, Food Microbiology, Sixth edition, Tata McGraw-Hill Publishing Ltd., New Delhi.


**Web Sources**

- http://www.jnkvv.org/PDF/02042020180252
- https://faculty.ksu.edu.sa/sites/default/files/industerial_microbiology-2-3.pdf
- https://egyankosh.ac.in/bitstream/123456789/61874/1Food%20Microbiology%Microbiology.pdf

**Course Designer:**

1. Dr.S.Yogachitra
2. Dr.S.Padmavathy

**Thiagarajar College: Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code - UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CE51(B) | Metabolic Pathways | Core Elective | 4 | - | - | 5 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

Understand the types of metabolic pathways and the role of common intermediate compounds. Learn the biosynthesis and breakdown of biomolecules.

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency (EP) | Expected Attainments (EA) |
|---|---|---|---|
| CO1 | Acquire knowledge about bioenergetics | 85% | 80% |
| CO2 | Analyze the metabolism of carbohydrates | 78% | 75% |
| CO3 | Understand the significance of lipid pathways | 80% | 78% |
| CO4 | Learn protein biosynthesis and degradation | 85% | 83% |
| CO5 | Make use of knowledge on metabolism of nucleic acids | 80% | 78% |

## Mapping of COs with POs

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

**S (+++) - Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | L | M | M | L | L |
| CO2 | M | M | L | L | L |

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

**S (+++) - Strong M (++) - Medium L (+) - Low**

**Blooms taxonomy**

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

**Title of the paper : Metabolic Pathways**

**Unit I:**

Introduction – Types of metabolic pathways: Catabolic, anabolic, cyclic, anapluerotic, amphibolic Pathways - intermediate metabolism. Bioenergetics: Laws of thermodynamics – First and Second Law, Redox reactions - Redox potential - coupled reactions, High energy compounds: Standard free energy - ATP biosynthesis

**Unit II:**

Metabolism of carbohydrates: Glucose - Glycolysis - Gluconeogenesis, Glycogen metabolism - Glycogenesis - glycogenolysis, Pentose phosphate pathway, Pyruvate oxidation and Citric Acid cycle. Interrelationship between pathways of glucose metabolism.

**Unit III:**

Metabolism of Lipids; Biosynthesis - Fatty acid – Triacyl glycerols – Cholesterol. Oxidation of Saturated acids fatty acids and unsaturated fatty acid: β oxidation, α oxidation.

**Unit IV:**

Biosynthesis of Aminoacid (Overview) – Protein degradation, oxidative deamination – Urea cycle – transmination.

**Unit V:**

Metabolism of nucleic acids. Purine – Biosynthesis – Catabolism, Pyrimidine – Biosynthesis - Degradation, salvage and denovo pathway of nucleic acids.

**Text Books:**


- Rastogi, S.C.2010. Biochemistry, 3rd Edition, Tata McGraw Hill Edition, New Delhi.
- Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, New Delhi.
- Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books & Allied Pvt. Ltd.,

Kolkata.

**Reference Books:**


- Nelson, D.L., and M.M. Cox, 2010, Lehninger Principles of Biochemistry, 5th Edition, Worth Publishers, New York.
- Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.
- Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency
  Pvt. Ltd., Kolkata.


**Web Sources:**

- http://www.csun.edu/~hcchm001/biosites.htm
- https://opentextbc.ca/biology2eopenstax
- https://www.wadsworth.k12.oh.us
- https://www.cambridge.org

**Course designers:**

1. Mrs.S.Siva Durga
2. Dr.S.Padmavathy

**Thiagarajar College: Madurai – 625 009**

**Department of Biotechnology**

(For those joined B.Sc. Biotechnology on or after June 2020)

Programme Code - UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20CE51(C)** | **Pharmaceutical Biotechnology** | **Core Elective** | **4** | **-** | **-** | **5** |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

Enable the students to understand the application of microorganisms in diverse fields

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency (EP) | Expected Attainments (EA) |
|---|---|---|---|
| **CO1** | Gain an understanding on the history and scope of biopharmaceuticals | 85% | 80% |
| **CO2** | Understand the drug development process | 80% | 78% |
| **CO3** | Grab an idea and importance of pharmagenetics in drug development | 80% | 83% |
| **CO4** | Learn concepts of pharmacokinetics and pharmacodynamics | 75% | 73% |
| **CO5** | Depict the role and usage of nucleic acid based therapeutics | 78% | 75% |

## Mapping of COs with POs

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

S (+++) - Strong M (++) - Medium L (+) - Low

## Mapping of COs with PSOs

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

S (+++) - Strong M (++) - Medium L (+) - Low

*Blooms taxonomy*

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

**Unit I:**

Introduction - History, scope and basic principles of pharmacology. Biopharmaceuticals: current trends and future prospects; Types of Drug and classification systems. General principle of drug action and its measurement.

**Unit II:**

Pharmaceutical products - Drug Development process – Introduction, Discovery and development formula of pharmaceuticals, Preclinical studies, Clinical trials – Clinical trial design, drug approval guidelines- Indian Pharmaceutical alliance- Regulatory boards and organizations – FDA - NPPA.

**Unit III:**

Delivery of pharmaceutical compounds (Oral, Pulmonary, Nasal, transmucosal, transdermal delivery systems), Chemotherapeutic drugs – Protein Synthesis Inhibitors, Anti-Inflammatory drugs-constituents and mode of action-Antibacterial drugs- Antifungal drugs-Antiviral drugs- Antiparasitic drugs.

**Unit IV:**

Nucleic acid and cell based therapeutics – Introduction to gene therapy, gene therapy and genetic disease, gene based vaccines, Antisense Technology (Antisense oligonucleotides and their mode of action), Advantages and disadvantages

**Unit V:**

Pharmacokinetics and pharmacodynamics – Protein pharmacokinetics, tailoring of pharmakinetic profile, Protein mode of action and its pharmacodynamics, Toxicity studies (Reproductive toxicity, teratogenicity, mutagenicity, carcinogenicity). Pharmacogenomics - Personalized medicine.

**Text books**


- Gad, S .2007. Handbook of Pharmaceutical Biotechnology, Techno World Publishers, India.

- S.S. Purohit, Kaknani, Saleja, 2018, Pharmaceutical Biotechnology. Lippinwitt Williams Pharmacology edition

**Reference books**

- Gary Walsh, 2007. Pharmaceutical Biotechnology - Concepts and Applications, Wiley Science Publishers.

**Web Sources**

- https://www.mypharmaguide.com/biotechnology-notes-free-download/
- https://issuu.com/brainkart.com/docs/pharmaceutical_biotechnology_fundam
- https://ocw.mit.edu/courses/15-136j-principles-and-practice-of-drug-development-fall-2013/pages/lecture-notes/

**Course Designer:**

1. Dr.S.Padmavathy

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20 SE51(A) | Biomedical Sciences | SBE1 | 2 | - | - | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 15 | 35 | 50 |

## Preamble

Appreciate the importance of biomedical sciences and develop knowledge.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency | Expected attainment |
|---|---|---|---|
| CO1 | Acquire basic knowledge on history of Biomedical sciences | 80% | 76% |
| CO2 | Learn the biochemical and physiological function | 75% | 73% |
| CO3 | Make use of the scope of Biomedical sciences | 80% | 78% |
| CO4 | Understand the molecular mechanisms of genetic diseases | 75% | 73% |
| CO5 | Apply the knowledge in treatment of diseases | 80% | 78% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong  M (++) - Medium  L (+) – Low**

**Blooms taxonomy**

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

**Title of the paper: Biomedical Sciences**

**Unit I:**

Introduction – history - scope of Biomedical sciences – biochemical – physiological function- anatomical and histological structures - Epidemiology and pharmacology. Patho physiology.

**Unit II:**

Molecular mechanisms of genetic metabolic disorders – lysosomal storage disorders – Hurler syndrome – Niemann – Pick disease – Tay – Sachs disease – Gaucher disease – Fabry disease – causes – symptoms – treatments.

**Text Books:**


- Raymond Iles , Suzanne Docherty , 2012. Biomedical Sciences: Essential Laboratory Medicine, 1st edition, Wiley.
- Walter F. Boron, Emile L. Boulpaep, 2016. Medical Physiology E-Book, Elsevier.
- Thomas C. Timmreck, 2002. An Introduction to Epidemiology. Jones & Bartlett Learning.
- Nessar Ahmed (Ed), Hedley Glencross (Ed), Qiuyu Wang (Ed), Biomedical Science Practice (Fundamentals of Biomedical Science). Oxford.


**Reference Books**:


- Ian Lyons, 2011.Biomedical Science (Lecture notes) Wiley – Blackwell.
- Guy Orchard (Ed), Brian Nation (Ed), 2014. Cell Structure & Function (Fundamentals of Biomedical Science), OUP Oxford.
- Guy Orchard (Ed), Brian Nation (Ed), 2017. Histopathology (Fundamentals of Biomedical Science), OUP Oxford.


**Web sources:**

- https://www.qmul.ac.uk/library/library-skills/resource-guides-by-subject/biological-sciences/useful-websites/biomedicine---useful-websites/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3544328/
- https://libguides.brighton.ac.uk/biological/webresearch

**Course designer(s)**

1. Dr. S. Yogachitra
2. Mrs. S. Siva durga

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Biotechnology**

(For those joined in B.Sc., Biotechnology on or after June 2020)

Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20SE51(B) | Stem Cell Technology | SBE | 2 | - | - | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 15 | 35 | 50 |

## Preamble

This course provides the basic foundation to the students regarding the concept and properties of stem cells. Enrich the knowledge to comprehend the applications and social implications of stem cell therapy.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency | Expected attainment |
|---|---|---|---|
| **CO1** | Study the stem cell and it self-renewal mechanism | 75% | 73% |
| **CO2** | Describe the pluripotency and their functions | 75% | 72% |
| **CO3** | Learn the stem cell isolation, identification and their characterization | 80% | 75% |
| **CO4** | stem cell application in domesticated, wild animals and in horticulture | 75% | 70% |
| **CO5** | Stem cell therapy and its guidelines with clinical trials. | 75% | 73% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

**Blooms taxonomy**

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

## Title of the paper: Stem Cell Technology

**Unit I:**

Stem cells:Definitions and properties; Pluripotency, Stem-cell plasticity, Regulators of pluripotency; Differences between adult and embryonic stem cells; Adult Stem Cell Niches; primordial germ cells as stem cells;Identification, isolation and characterization of stem cells;mechanism of stem cell self-renewal.

**Unit II:**

Stem cells in biomedicine: stem cells in aging and cancer; stem cell application in domesticated, wild animals and in horticulture. Clinical application of stem cell technologies; Pluripotent stem cell differentiation; Trans-differentiation and direct programming; Adult stem cell disease modeling and therapy; Stem cell therapy guidelines and clinical trials.

**Text books:**


- Daniel Marshak, Richard Gardner, David Gottleib, 2001.Stem cell biology, Cold spring Harbor Press.
- Robert Lanza, John Gearhart, Douglas Melton, E. Donnall Thomas, Brigid Hogan, Roger A. Pedersen, James A .Thomson. 2009. Essentials of Stem Cell Biology, Elsevier Science.
- Bernard A. J. Roelen, Gabriela Rodrigues, 2020. Concepts and Applications of Stem Cell Biology. Springer International Publishing.


**Reference books:**


- Anthony Atala and Robert Lanza, 2012. Hand Book of Stem Cells. Volume 2, Elsevier Science
- Jonathan Slack, 2021. Stem Cells: A Very Short Introduction. Second edition, OUP Oxford.


**Course designer:** Dr. C. Balachandran

**Thiagarajar College : Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code - UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20SE51(C) | Biofertilizers and Biopesticides | SBE | 2 | - | - | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 15 | 35 | 50 |

## Preamble

Intend to replace conventional fertilizers, pesticides and to use with economic and ecofriendly biopesticides and biofertilizers

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency (EP) | Expected Attainments (EA) |
|---|---|---|---|
| CO1 | Emphasize the importance of organic farming | 75% | 73% |
| CO2 | Learn the mass production of different biofertilizers | 78% | 75% |
| CO3 | List the importance of biofertilizers towards field application | 80% | 78% |
| CO4 | Importance of biopesticides over chemical pesticides | 80% | 83% |
| CO5 | Understand the production methods of pesticides using several microbes | 85% | 80% |

## Mapping of COs with POs

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

**S (+++) - Strong M (++) - Medium L (+) - Low**

## Mapping of COs with PSOs

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|

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

**S (+++) - Strong M (++) - Medium L (+) - Low**

**Blooms taxonomy**

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

**Unit I:**

**Biofertilizers:** General account of taxonomy, physiology, mass cultivation, carier based 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.

**Unit II:**

***Biopesticides***: *Conventional Biopesticides – Limitations. Bacterial pesticides:* Bacillus thuringiensis, Pseudomonas*. Viral Pesticides: Nuclear Polyhedrosis virus, Cytoplasmic Polyhedrosis Virus. Fungal pesticides: Entomopathogenic fungi – Beaveria bassiana. Nematode Pesticide:* Steinernema *and* Heterorhabditis *Species*

**Text books**

- Krishnendu Acharya, Surjit Sen, Manjula Rai, 2019, Biofertilizers and Biopesticides, Techno World Publishers, India.
- Rangaswami, G. and Bagyaraj, D.J. 2009. Agricultural Microbiology. II edn. PHILearning Pvt. Ltd., New Delhi.

**Reference Books**

- H.C. Lakshman Channabasava A. 2014, Biofertilizers and Biopesticides, Jaipur , Rajasthan
- R.M. Khobragade, 2007, Handbook of Biofertilizers and Biopesticides, ABD Publishers, India.

**Web Sources**

- http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Lec-11-Biofertilizer-

and-biopesticide.pdf

- https://opjsrgh.in/Content/Worksheet/PRACTICE-WS/day174/12-BIOLOGY.pdf
- http://www.apaari.org/web/wp-content/uploads/2009/09/Biopest%20Concept%20Note.pdf

**Course designer:**
Dr. S.Padmavathy

**Thiagarajar College : Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code – UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20SE51(D) | Agricultural Biotechnology | SBE | 2 | - | - | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | V | 25 | 75 | 100 |

## Preamble

Comprehend the ever – evolving concepts, techniques and development in the field of agricultural biotechnology

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency (EP) | Expected Attainments (EA) |
|---|---|---|---|
| CO1 | Recognize the rationale and basic principle of agriculture biotechnology towards crop improvement | 85% | 80% |
| CO2 | Appraise various organizations and institutions contributing towards the innovative agricultural strategies | 80% | 78% |
| CO3 | Illustrate different approaches for the development of new plant varieties and holistic objective-improved and integrated agriculture. | 80% | 83% |
| CO4 | Study commercial micropropagation of economically important crops | 75% | 73% |
| CO5 | Make use of bioinformatics tools in crop improvement | 78% | 75% |

## Mapping of COs with POs

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

**S (+++) - Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) - Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

**Unit I:**

Agricultural biotechnology - introduction-history of Indian agriculture - Intensive agriculture - Green revolution and innovations in recent past, global status of genetically modified crops; ICAR, IARI, ICRISAT, CAU, SAUs and other institutions and organizations contributing towards the innovative agricultural production; Commercial micropropagation of some economically important crops (pineapple, pomegranate, lemon, turmeric, and ginger); Hydroponics and Aeroponics cultivation of economically important crops.

**Unit II:**

Somatic hybridization, haploid production and cryopreservation. Innovative approaches in the disease management. Genetic engineering approaches to improve nitrogen fixation potential of crop plants. Role of Nanofertilizer in smart agriculture, Integrated agriculture - lives stock improvement of farm animals. Application of Bioinformatics in crop improvement

**Text Books**

- Dinesh Kumar Srivastava, Ajay Kumar Thakur, Pankaj Kumar, 2021.Agricultural Biotechnology: Latest Research and Trends, Springer.
- R.C. Dubey, 2014. A Text Book of Biotechnology. S.Chand & Co Ltd, New Delhi.

**Reference Books**

- Ahindara Nag, 2022, Textbook of Agricultural Biotechnology, PHI Learning Publishers, India.
- Geetha, S., Jebaraj, S., Pandiyarajan, S, Agricultural Biotechnology, Agrobios Publications, India.

**Web Sources**

- https://www.isaaa.org/resources/publications/agricultural_biotechnology/download/Agricultural_Biotechnology.pdf

- https://science.umd.edu/classroom/bsci124/lec41.html
- https://naldc.nal.usda.gov/download/CAT10756706/PDF
- https://www.researchgate.net/publication/336459777

**Course Designers:**

1. Dr.S.Padmavathy
2. Dr.C.Balachandran

Thiagarajar College: Madurai – 625 009
Department of Biotechnology
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code –UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20C61** | **Plant Biotechnology and Conservation** | **Core - 10** | **4** | **-** | **-** | **4** |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 25 | 75 | 100 |

## Preamble

To facilitate the students with basic knowledge on plant conservation strategies and plant genetic engineering.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (%) | Expected attainment (%) |
|---|---|---|---|
| **CO1** | Appraise the rationale, different strategies and organizations involved in plant conservation | 75% | 73% |
| **CO2** | Analyze the principles and applications of different *in vitro* methods plant cell, tissue and organ culture | 77% | 73% |
| **CO3** | Summarize different modes of gene transfer in plants | 80% | 75% |
| **CO4** | Prepare to address environmental, biosafety and socio-ethical issues on transgenic plants | 83% | 80% |
| **CO5** | Illustrate the innovative and recent strategies for the production of resistant plants, useful healthcare products through transgenic plants. | 75% | 73% |

## Mapping of COs with POs

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

**S (+++) - Strong M (++) - Medium L (+) – Lo**

## Mapping of COs with PSOs

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

**S (+++) - Strong M (++) - Medium L (+) – Low**

**Blooms taxonomy**

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

## Title of the paper: Plant Conservation Biotechnology

**Unit I:**

Plant conservation –different strategies of plant conservation- in situ and ex situ conservation – BSI-NBPGR - CIMAP- NMPB-and other organizations and institutions involved in plant conservation. I*n vitro* strategies in plant conservation and propagation- Totipotency- Haberlandt and other contributors in Plant tissue culture- Plant growth substances and plant growth regulators. Seed Bank.

**Unit II:**

Micropropagation- types and applications-auxiliary bud culture - meristem culture- haploid plant production *in vitro* - callus culture – organogenesis – hardening and acclimatization - Somatic embryogenesis –types-synthetic seeds and applications. Protoplasts: isolation, viability analysis and culture- somatic hybridization.

**Unit III:**

Gene transfer in plants – direct transfer methods- Electroporation -Biolistics- Sonication. Indirect methods- Agrobacterium mediated gene transfer — Ti Plasmid –Ri Plasmid. Vectors- co integrate vectors – shuttle vector. Plant viral vectors – Gemini virus and CaMV vectors.

**Unit IV:**

Transgenic plants- reporter genes and marker genes- antibiotic – antimetabolite – herbicide resistance markers- Transgene stability-transgenic plants and environmental issues- Bt cotton – Bt brinjal- other recombinant plants-environmental and biosafety issues- GEAC guidelines- BTRAI -gene silencing strategies in plants – types and applications.

**Unit V:**

Plant genetic engineering and crop improvement- golden rice-biotic and abiotic resistant plants-cytoplasmic male sterility – Biopharming – plant as bioreactors-Production of plantibodies, edible vaccines and other health care products from transgenic plants- Important – milestone events and discoveries in Plant genetic engineering in recent past- an overview.

**Text Books:**


- Slater, A., N.W. Scott and M.R.Fowler. 2009. Plant Biotechnology: the genetic manipulation of plants, Oxford University Press, US.
- Chawala (2001) plant Biotechnology, oxford and IBH Publication co. New Delhi.
- Bhojwani, S.S and Dantu, P. 2013. Plant Tissue Culture – An Introductory Text. Springer Publications.
- Gamborg, O.L and G.C.Philips (eds.). 2013. Plant Cell, Tissue and Organ culture-Lab Manual. Springer Science & Business media.
- Old, R. W. and S. B. Primrose. 2000. Principles of gene manipulation. An introduction to genetic engineering, 5th edition. Blackwell Science Ltd., Oxford.
- Winnacker, E. N. 2003. From genes to clones. Panama publishing corporation Pvt., Ltd., New Delhi.
- Sunil, D, Puruhit and G.K. Kukda. 2013. Molecular Biotechnology.


**Reference Books**:


- Chawla, H.S. 2004 Introduction to Plant Biotechnology, 2nd edition. Oxford publishing Co. Pvt Ltd, New Delhi.
- Bhojwani, Razdan and M. K. Razdan. 1994. Plant Tissue culture. Elsevier North Holland.
- Ignacimuthu, S.J., 1997. Plant Biotechnology, Oxford and IBH Publishing Company, New Delhi.
- Satyanarayana . U, 2008, Biotechnology, Books and Allied (p) Ltd.


**Course Designer:**

Dr. C. Balachandran

**Thiagarajar College: Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
**Programme Code -UBT**

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CL61 | Plant Biotechnology and Conservation Practical | Core Lab-8 | - | - | 3 | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 40 | 60 | 100 |

## Preamble

To provide the students with the hands on experimental exposure on basic plant cell, tissue and organ culture and plant microbe interactions.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (%) | Expected attainment (%) |
|---|---|---|---|
| **CO1** | Prepare plant tissue culture medium, different explants and initiate different cell and organ cultures *in vitro.* | 75% | 73% |
| **CO2** | Evaluate the applications of different PGRs in germination, plant cell tissue and organ culture. | 77% | 73% |
| **CO3** | Demonstrate the methods of acclimation and production of useful phytochemicals through cell and organ cultures *in vitro*. | 80% | 75% |
| **CO4** | Assess the plant microbe interaction with reference to symbiotic nitrogen fixation. | 83% | 80% |

## Mapping of COs with POs

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

**Blooms taxonomy**

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

**Title of the paper: Plant Biotechnology and Conservation Practical**

1. Preparation of tissue culture medium (MS medium).
2. Preparation and surface sterilization of different explants.
3. Callus induction from seedling explants and carrot cambium tissue.
4. Shoot tip and axillary bud culture.
5. Root initiation from *in vitro* formed shoots.
6. Hardening and transplantation (Demonstration).
7. Isolation of nitrogen fixing Rhizobium, Azotobacter, Azospirillum and Phosphate solubilizing bacteria from soil.
8. Isolation and determining the viability of protoplast from mesophyl tissue.
9. Preparation of synthetic seeds.

**Reference Manual/s:**


- Dodds, J. H. and L. W. Roberts. 1982. Experiments in Plant Tissue Culture. 3rd edition. Cambridge University Press, Cambridge.
- Dodds. J. H. 1991. *In vitro* Methods of Conservation of Plant Genetic Resources. Chapman and Hall, London.
- Thorpe, T. A. 1993. *In vitro* organogenesis and somatic embryogenesis: physiological and biochemical aspects. In: Roubelakis-Angelakis KA, Tran Tranh Van T (Eds.). Morphogenesis in Plants. Plenum Publishing Corp., New York.
- Vasil, I. K. and T. A. Thorpe. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers. Dordrecht.


**Course Designer:**
**Dr. C. Balachandran**

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20C62 | Animal Biotechnology | Core 13 | 4 | - | - | 4 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 25 | 75 | 100 |

## Preamble

Acquires knowledge on the mammalian cell culture techniques and transgenesis in animal

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| CO1 | Apply the principles and concepts of animal cell culture. | 80% | 78% |
| CO2 | Summarize the mechanisms of Gene Transfer | 75% | 72% |
| CO3 | Analyze the principle involved in transgenesis. | 70% | 65% |
| CO4 | Explain the mechanisms of recombinant DNA technology . | 75% | 70% |
| CO5 | Understand the mechanism of preimplanted diagnosis. | 75% | 72% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the paper Animal Biotechnology

**Unit I:**

History - development of animal cell culture. Conditions for growing animal cells. Types of media - importance of growth factors. Primary culture - anchorage dependent and non anchorage dependent cells. Secondary culture - transformed animal cells – established / continuous cell lines. Commonly used animal cells lines – their origin and characteristics.-Applications of animal cell culture.

**Unit II:**

Transfection of mammalian cells: Calcium phosphate mediated co- transfection – microinjection – liposome mediated – electroporation - ultrasonication – – detergent mixture– use of viruses – viral vectors –SV40 and adenovirus – improved strains – basic properties.

**Unit III:**

Transgenic animal technology: concept of transgene and transgenics- Expression of foreign genes in transgenic mice –production of transgenic sheep for growth hormone genes – Insertion and expression of transgenes – production of transgenic cattle by pronuclear injection – collection, culture and transfer of embryos. Advantages - disadvantages of transgenesis. Transgenic animals as a model for human disease diagnosis

.

**Unit IV:**

Production of biotechnological molecules : Hybridoma technology - Steps involved in production of recombinant pharmaceuticals – recombinant insulin and interferons. Human growth hormone: Somatostatin and Somatotrophin – Blood products - TPA - clottting factor VIII.

**Unit V:**

Pre implanted genetic diagnosis in human beings: Introduction, Methods and applications - Artificial insemination – IVR technology-embryo transfer technology: Gamete intra fallopian transfer technology (GIFT) and Zygote intra fallopian transfer technology (ZIFT), Multiple Ovulation Embryo Transfer (MOET). Stem cell culture. Embryonic stem cells - applications.

**Text Books:**

- Ranga M. M. 2007 Animal biotechnology 3rd edition. Agrobios, Jodhpur
- Prakash. M, and K. Arora. 1998. Cell & tissue culture 1st Edition, Anomol publication, New Delhi.
- Jogdand, S. N. 2001. Advances in Biotechnology 3rd edition. Himalaya Publishing House, Mumbai.

**Reference Books:**

- Glick, B. R. and J. J. Pasternak. 2010. Moleculer biotechnology. Principles and application of Recombinant DNA; 4th edition. ASM press Washington D.C

**Web Source:**

- https://www.tandfonline.com/journals/labt20
- https://www.aboutbioscience.org/topics/animal - biotechnology/

**Course designers:**

1. Dr. S.Yogachitra
2. Mrs. S.Siva durga

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CL62 | Animal Biotechnology Practical | Core lab -9 | - | - | 4 | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 40 | 60 | 100 |

## Preamble

Acquire knowledge on the extraction of DNA procedures from animal tissues .Have hands training onthe isolation and enumeration of cells from animal tissues.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| CO1 | Analyze the different types of Blood groups | 85% | 82% |
| CO2 | Acquire knowledge on the preparation of cellular antigen | 90% | 85% |
| CO3 | Utilize the extraction procedures of DNA | 90% | 85% |
| CO4 | Apply the knowledge in the antibody titration | 95% | 90% |
| CO5 | Learn the mechanisms of complement fixatiion | 85% | 82% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COS with PSOs

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

**S (+++) – Strong  M (++) - Medium  L (+) – Low**

**Blooms taxonomy**

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

**Title of the paper: Animal Biotechnology Practical**

1. Bleeding techniques.
2. Haemagglutination – Immunoelectrophoresis
3. Preparation of antigens-methods of bleeding-preparation of serum.
4. Complement fixation.
5. Antibody titration
6. Lymphocytes isolation from spleen.
7. Lymphocytes isolation from blood.
8. Isolation of DNA from Blood.
9. Isolation of DNA from animal tissue (Spleen, liver)
10. Isolation and enumeration of spleenocytes and hepatocytes.
11. Total RBC count and Total WBC count (Neubauer counter)
12. Observation and assessment of animal sperm cells.

**Text books:**

- Nigel Jenkins.1999.Animal cell Biotechnology, Methods and protocols. First Edition. HumanaPress.
- Jack G. Chirikijan.2009. Biotechnology theory and techniques,(Plant biotechnology, AnimalCell culture, Immuno Biotechnology).CBS publishers.
- Debajit Borah.2012. Biotechnology Lab Practice. Global Vision Publishing House.

**Reference books:**

- Shiju Mathew.2011. Practical Manual in Biotechnology-An Experimental protocol Guide.Lambert Academic publishing.
- Ashish Verma, Anchal Singh (Ed), 2013. Animal Biotechnology Models in Discovery and Translation, 1st Edition, Elsevier.

**Web Sources:**

- https://www.tandfonline.com/journals/labt20
- https://www.omicsonline.org/scholarly/animal-biotechnology-journals-articles-ppts-list.php
- https://libguides.rutgers.edu/c.php?g=415715&p=2835073

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20C63 | Environmental Biotechnology | Core 14 | 4 | - | - | 4 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 25 | 75 | 100 |

## Preamble

Acquires knowledge on the bioremediation of pollutants and learn the processes of utilizing alternative sources

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Apply the principles and concepts of waste water treatment | 80% | 78% |
| **CO2** | Summarize the various mechanisms in effluent treatment | 75% | 72% |
| **CO3** | Analyze the principle of bioconversion of organic substrates | 70% | 65% |
| **CO4** | Explain the mechanisms of bioleaching | 75% | 70% |
| **CO5** | Understand the mechanism of bioremediation and treatment of xenobiotics | 75% | 72% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong  M (++) - Medium  L (+) – Low**

**Blooms taxonomy**

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

**Title of the paper  Environmental Biotechnology**

**Unit I:**

Definition- concept and scope of Environmental Biotechnology – Role of Biotechnology in environmental protection – Application of biotechnology – Role of microbial systems – Principles – Characteristics - application of microbial systems.

.

**Unit II:**

Biotechnology of waste water treatment – Bioreactors – Microbial systems in waste water treatment – Bio films – immobilization technology in waste water treatment – Industrial effluent treatment – advanced oxidation processing – distillation – adsorption – chemical immobilization – land fill.

**Unit III:**

Biofuel: Biogas- construction of biogas plant – composting – biogas slurry – use of compost in organic farming – Coir pith compost - Biodiesel – bioconversion of cellulose to ethanol – Hydrogen production from microbes.

**Unit IV:**

Microbial mining – microbial recovery of mineral resources - bioleaching of metals - copper and uranium - Biodegradable and eco friendly products – Bio pesticides and Bioplastics.

**Unit V:**

Bioremediation – principles - types of bioremediation: *in situ* and *ex situ* – application. Phytoremediation. - Xenobiotics - Microbial degradation of xenobiotics – Superbug Construction - Biodegradation of pesticides.

**Text books:**

- Chatterji, A.K. 2011. Introduction to Environmental Biotechnology, 3rd edition. Prentice Hall of India Pvt. Ltd., new Delhi..
- Dash, M.C. 2011. Fundamentals of ecology, 2nd edition, Tata McGraw Hill Publishing company Ltd., New Delhi.
- Alexander Glazer, N. 2007, 2nd edition. Microbial biotechnology, Third reprint. W.H. Freeman & Company, New York.
- Pradipta Kumar Mohapatra, 2006. Text book of environmental biotechnology, I.K. International publishing house, New Delhi.
- Daniel,A. Vallero.2015.Environmental Biotechnology: A Biosystems Approach, 2nd edition.Elsevier.
- Miller Jr. G. T., 2013. Environmental Science. 14th Edition. Thompson Brooks/Cole. United States


**Reference Books:**


- Jogdand, S. N.2015. Environmental biotechnology, 6th edition. Himalaya Publishing House, Mumbai.
- Markandy, D.K and N. Rajvaidys. 2011. Environmental Biotechnology. APH Publishing Corporation, New Delhi.
- Hans.J.J. and Josef Winter (Ed). 2004. Environmental Biotechnology: Concepts and Applications,1st edition. Wiely – Blackwell


**Web Source:**

- http://deskuenvis.nic.in/nationalorg.asp
- https://environbiotechnology.com
- www.scitechnol.com/scholarly/environmental-biotechnology-journals-articles-ppts-list.php

**Course designers:**

1. Dr. S.Yogachitra
2. Mrs. S.Siva durga

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CL63 | Environmental Biotechnology Practical | Core lab -10 | - | - | 4 | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 40 | 60 | 100 |

## Preamble

Analyze biochemical parameters of waste water and have hands training in the preparation of eco friendly products

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Analyze the physico - chemical characteristics | 85% | 82% |
| **CO2** | Acquire knowledge on treatment of effluents | 90% | 85% |
| **CO3** | Learn the mechanisms of composting | 90% | 85% |
| **CO4** | Apply the knowledge in the preparation of Biodisel | 95% | 90% |
| **CO5** | Learn to utilize the lignocellulosic substrates | 85% | 82% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COS with PSOs

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

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

**Blooms taxonomy**

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

**Title of the paper: Environmental Biotechnology Practical**

1. Physico -chemical characterization of effluents – colour, pH, Temperature. DO & BOD.
2. Analysis of alkalinity in water sample.
3. Analysis of free $Co_2$ in water sample.
4. Analysis of salinity in water sample
5. Biological treatment of oil spilled effluent.
6. Bioremediation of heavy metal.
7. Study of effect of treated effluent on seed germination / plant growth.
8. Decolorization of dyes using fungal isolates.
9. Demonstration of Biogas production
10. Demonstration of composting of Agricultural wastes.
11. Demonstration of composting from coir pith.
12. Extraction of Biodiesel.
13. Demonstration of bioconversion of cellulose to ethanol.
14. Demonstration of production of bioplastics

**Text books:**

- Ismail Sadooun, Environmental Biotechnology: A Laboratory manual, Department of Biotechnology, Islamic University of Gaza.
- W. B. Vasantha Kandasamy, Florentin Smarandache, S. R. Kannan S.Ramathilagam.2010. Methods in Environmental Biotechnology for Environmentalists. ProQuest Information & Learning. USA.

**Reference Books:**

- Jayanta Kumar Patra ,Gitishree Das, Swagat Kumar Das, Hrudayanath Thatoi.2020. A Practical Guide to Environmental Biotechnology.1st edition. Springer.

**Web sources:**

- https://dokumen.pub/a-practical-guide-to-environmental-biotechnology-1st-ed-9789811562518-9789811562525.html

**Course designers:**

1. Dr. S.Yogachitra
2. Mrs. S.Siva durga

**Thiagarajar College (Autonomous) :: Madurai – 625 009**
**Department of Biotechnology**
(For those joined on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20CE61(D)** | **Forensic Biotechnology** | **Core Elective-2** | **4** | **1** | | **4** |

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

## Preamble

The course will endow knowledge to understand the basics of investigation procedures

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency | Expected Attainment |
|---|---|---|---|
| **CO1** | Outline the development of forensic science in India to examine the crime scene | 85% | 80% |
| **CO2** | Distinguish examination of different samples for forensic investigation | 82% | 78% |
| **CO3** | Understand bioterrorism and concept s of biosecurity | 85% | 80% |
| **CO4** | Learn the recent trends in forensic science | 80% | 75% |
| **CO5** | Analyze the digital based crimes | 83% | 80% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the Paper : Forensic Biotechnology

**Unit I:**

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

**Unit II:**

Examination of biological fluids - blood, semen and saliva : Examination of hair, bones, teeth and skull - Fundamentals of DNA typing. 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.

**Unit III:**

Forensic Criminology and Laws :Crime in context with Organization, Industrialization, Family set up and Psychology ,Criminal Profiling :Need and types-Forensic scientific evidence-Psychopathology-Genetics and crime-Serial crimes-Modus Operandi,Principles of Forensic Science-Law of exchange(Locard)-Law of Individuality, Law of Comparison, Law of Progressive changes, Law of Probability.

**Unit IV:**

Recent Trends in Forensic Science- Environmental Forensics: Definition, Legal processes involving environmental forensic science. Geo-forensics Global Positioning System; Basic principles and applications. Biometrics in Personal Identification: Introduction, Concepts of Biometric Authentication, Role in person Identification, Techniques and Technologies (Finger Print Technology, Face Recognition, IRIS, Retina Geometry, Hand Geometry, Speaker Recognition, Signature Verification and other forensic related techniques).

**Unit V:**

Computer Forensics: Introduction, Nature of digital evidence, Retrieval and analysis of digital evidence,Sources of digital evidence, Computer security and its relationship to computer forensics. Emergence of computer crime: Classification of computer crimes, computer virus and types, computer worms, Trojan Horse, trap door, super zapping, logic bomb, salami logic, characteristics of computer crime and criminals.

**Text books:**


- Attwood, T.K., Parry-Smith, D.J. and Phukan, S. 2011. Introduction to Bioinformatics. Pearson Education, Asia, New Delhi.
- James, S.H., and Nordby, J.J. 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton.


**Reference books:**


- Bevel, T., and Gardner, R.M. 2008. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton.
- Duncan, G.T., and M.I. Tracey, M.I. 2013. Introduction to Forensic Sciences, W.G. Eckert (Ed.), CRC Press, Boca Raton .
- Nanda, B.B., Tiwari, R.K. 2019. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
- Poklis. 2011, Forensic toxicology in, Introduction to Forensic Sciences, 8th Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton.
- Tilstone, W.J., M.L. Hastrup, M.L., and C. Hald, Fisher's, C. 2013.Techniques of CrimeScene Investigation, CRC Press, Boca Raton .


**Course designer(s)**

1. Mrs.S.Siva durga
2 .Dr.S.Yogachitra

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20CE61(E) | Genomics and Proteomics | Core Elective 2 | 4 | - | - | 4 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 25 | 75 | 100 |

## Preamble

Acquire basic knowledge on genome organization, protein complement and comparative analysis of different genomes.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (EP) | Expected Attainment (EA) |
|---|---|---|---|
| **CO1** | Acquire knowledge on various genomes | 80% | 78% |
| **CO2** | Summarize the various mechanisms in gene sequencing and mapping. | 75% | 72% |
| **CO3** | Analyze the functional genomics. | 70% | 65% |
| **CO4** | Acquire basic knowledge on proteomics | 75% | 70% |
| **CO5** | Understand the working principle tools used in the proteome analysis | 75% | 72% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong  M (++) - Medium  L (+) – Low**

## Blooms taxonomy

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

## Title of the paper  Genomics and Proteomics

**Unit I:**

Introduction to Genomics: Structure and organization of prokaryotic and eukaryotic genomes – nuclear, mitochondrial and chloroplast genomes – interaction between nuclear and chloroplast genome.

**Unit II:**

Structural genomics: Automated DNA sequencing - Genome mapping projects – Human, microbes, plants and animals – viral genome - comparative genomics of Prokaryotes and Eukaryotes.

**Unit III:**

Functional genomics: Gene prediction methods- classical, novel methods; Neural networks, Micro array – cDNA, Oligo nucleotide Microarray. Personal genomics.

**Unit IV:**

Introduction to Proteomics – Genome – Transcriptome – Proteome – Metabolome – Interactome - Application of Proteomics.

**Unit V:**

Proteomic tools – Identification and analysis of protein by 2D PAGE analysis – Mass spectrophotometry- MALDI –TOF – NMR _ CD - FTIR - X - ray crystallography.

**Text Books:**


- Cantor. C and C.W. Smith, 2000, Genomics: The Science and Technology Behind the HumanGenome Project, wlley – Interscience, New York.
- Arthur M Lesk, 2008. Introduction to genomics. Oxford University Press, Oxford.
- Primrose, S.B. and R.M. Twyman, 2007. Principles of Genome Analysis and genomics,Blackwell publishing, USA.
- Wilkins. M. R., K. L. Wilkins., R.D. Appel and Hochstrasser, 1997. Proteome Research andNew Frontires in Functional Genomics Spring – Velag New York,.
- Walsh G and Haeden, 1994. Protein Biotechnology, John Wiley and sons.

**Reference Books:**


- Davies. J.M. 1995. Genome Analysis – A Practical Approach, Oxford University Press.Oxford.
- Dear. P.H. 1997. Genome Mapping _ A Practical Approach, Oxford University Press, Oxford.
- Vestermeier, R and T Naven. 2002. Proteomics in practice: a laboratory manual of genomeanalysis . Wiley – VCH, Weinheim ISBN 357303545.
- Liebler, C. C. 2002 Introduction to proteomics: Tools for the new biology Human, press,Totowa, NJ. ISBN 0585418799
- Link A.L., 1998 2-D Proteome Analysis Protocols, Human press, Totowa, NJ.


**Web Source:**

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4411487/
- https://www.ncbi.nlm.nih.gov/books/NBK20256/
- http://www.genomicglossaries.com/content/chaptergenomicinfosources.asp

**Course designers:**

1. Dr. S.Yogachitra
2. Mrs. S.Siva durga

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20CE61(F)** | **Biosafety and IPR** | **Core Elective** | **5** | **-** | | **5** |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 25 | 75 | 100 |

## Preamble

This courses to provide students acquirethe fundamental aspects of Intellectual property Rights and disseminate knowledge on patents, copyright patent regime, in addition to this, to develop a sense of responsibility towards thebiosafety.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency | Expected Attainment |
|---|---|---|---|
| **CO1** | Acquire knowledge on various concepts of IPR | 90% | 82% |
| **CO2** | Apply the knowledge of Patenting | 85% | 78% |
| **CO3** | Analyze the concepts of biohazards | 82% | 75% |
| **CO4** | Make use of knowledge in biosafety | 90% | 88% |
| **CO5** | Develop mechanisms to protect traditional knowledge | 75% | 72% |

## Mapping of COs with POs

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

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

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

## Title of the paper: Biosafety and IPR

**Unit I:**

Biohazards – Risk assessment – Risk Groups – Containment levels; Introduction to Biosafety- need and application for biosafety. Levels of Biosafety – Criteria used for biosafety level; Biosafety guidelines and regulations in India; issues in use of Genetically Modified Organisms both animals and plants.

**Unit II:**

Institutional biosafety Committee (IBSC) – Functions of IBSCs – Organization network. Status ofGovernment strategies in rDNA technology and human gene cloning. CPCSEA – Guidelines forlaboratory animal facility - National Good Laboratory Practice Programme – GLP authority functions– standard tests for clinical trials.

**Unit III:**

Agreements and Treaties: General Agreement on Tariffs and Trade (GATT) - TradeRelated Intellectual Property Rights (TRIPs) -World Trade Organization (WTO): objectives, functions and principles of trade policy – Convention on International Trade on Endangeredspecies(CITES) –World Intellectual Property Organization (WIPO) -RED data book.

**Unit IV:**

Introduction and the need for intellectual property right (IPR) – Kindsof IPR: Patent, Copyright, Trade Mark, Industrial Design, Geographical Indication, Plant Varieties and Traditional Knowledge. Patent: genesis and development in India, importance of patent system, features of patent right, types of patent application, stages or steps in patenting.

**Unit V:**

Protection of traditional knowledge – biopiracy – documentation of traditional knowledge – some casestudies – basmati rice issue - revocation of turmeric and neem patent. Indigenous knowledge – kanitribe, jeevani.

**Text books:**

- Ramakrishna,B and H.S. Anil Kumar, 2017. Fundamentals of Intellectual Property Rights. Notion Press, Chennai.

- Neeraj, P., andD. Khusdeep, 2014. Intellectual Property Rights.PHI learning Private Limited.
  Brown. T.A., 2000. Gene cloning, Seventh edition. Chapman & Hall Publication, New York.
- Dubey, R.C. 2006, 4th edition. a Text book of Biotechnology .S. Chand & Co, New Delhi.
- Jogdand,. S. N 2001. Advances in Biotechnology 3rd edition; Himalaya Publishing House,Mumbai.
- Old, R. W. and S. B. Primrose. 1994. Principles of gene manipulation. An introduction togenetic engineering, 5th edition. Blackwell Science Ltd.,


**Reference book:**


- Ahuja, V K. (2017). Law relating to Intellectual Property Rights. Lexis Nexis.
- Glick, B.R. and J.J. Pasternak. 2010. Molecular biotechnology. Principles and application ofRecombinant DNA , 4thedition. ASM press, Washington D.C.


**Course Designer:**

Dr. C. Balachandran

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20 SE61(A) | Bioprospecting | SBE2 | 2 | - | - | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 15 | 35 | 50 |

## Preamble

Decipher the systematic exploration of novel natural bioproducts.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency | Expected attainment |
|---|---|---|---|
| CO1 | Learn the concepts of bioprospecting | 85% | 80% |
| CO2 | Acquire knowledge on biopiracy | 80% | 78% |
| CO3 | Understand the laws of bioprospecting | 75% | 72% |
| CO4 | Explore the various fields of bioprospecting | 85% | 80% |
| CO5 | Implement knowledge for deriving products | 85% | 80% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Blooms taxonomy

| | CA | | End of Semester |
|---|---|---|---|
| | First | Second | |
| Knowledge | 40% | 40% | 40% |

| | | | |
|---|---|---|---|
| Understand | **40%** | **40%** | **40%** |
| Apply | **20%** | **20%** | **20%** |

## Title of the paper: Bioprospecting

**UNIT I:**

Bioprospecting: Rationale and Methods of bioprospecting- Role of traditional knowledge in bioprospecting; Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric, Periwinkle, Enola bean); Traditional Knowledge Digital Library (TKDL)-concept and importance. Bioprospecting act-Phases of Bioprospecting-Exemption to Act. Current practices in Bioprospecting for conservation of Biodiversity and Genetic resources.

**UNIT II:**

Fields of Bioprospecting: Pharmaceutical bioprospecting-medicinal plants prospection for novel drugs-assays:Marine Bioprospecting-Marine bioresources -microbes and macro organisms-marine bioactive metabolites-isolation-characterization -industrial applications;Microbial bioprospecting-isolation of microbial biochemicals -bioactivity and their applications. Bioprospecting derived resources and their products.

**Text Books:**

- Simon E. Levin,2001, Encyclopedia of Biodiversity, Academic Press Publishers.
- Edward Hammond,2013,Biopiracy Watch,A compilation of some recent cases ,Vol. 1,TWN publishers
- Cori Hayden,2021,When Nature Goes Public, The Making and Unmaking of Bioprospecting ,Princeton University Press.

**Reference Books:**

- Russell Paterson,Nelson Lima,2017,Bioprospecting-success,Potential and constraints, Volume 16,Springer.
- Neetaraj Sharma,Gaurav Kumar,2018, Microbial Bioprospecting for Sustainable Development,Springer.
- Santosh Kumar Upadhyay , Sudhir P. Singh ,2021, Bioprospecting of Plant Biodiversity for Industrial Molecules,Wiley.
- Pradeep Verma ,Maulin P.Shah,2022, Bioprospecting of Microbial Diversity: Challenges and Applications in Biochemical Industry, Agriculture and Environment Protection,Elsevier.

**WeLb sources:**

- https://doi.org/10.1515/9780691216362
- https://www.sciencedirect.com/topics/medicine-and-dentistry/bioprospecting
- https://www.frontiersin.org/articles/10.3389/fmicb.2018.01526/full
- https://www.undp.org/content/dam/sdfinance/doc/Bioprospecting
- https://www.wri.org/biodiversity-prospecting

**Course designer(s)**

1. Mrs. S. Siva durga
2. Dr.S.Yogachitra

**Thiagarajar College (Autonomous): Madurai – 625 009**
**Department of Biotechnology**
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| UBT20 SE61 | Health and Hygiene | SBE2 | 2 | - | - | 2 |

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

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 15 | 35 | 50 |

## Preamble

Delineates the practices and determinants of good health and hygiene.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency | Expected attainment |
|---|---|---|---|
| CO1 | Acquire knowledge on balanced diet and malnutrition | 80% | 76% |
| CO2 | Learn the need for balanced diet | 75% | 73% |
| CO3 | Make use of the hygienic practices | 80% | 78% |
| CO4 | Understand the causes and effect of pollution | 75% | 73% |
| CO5 | Apply the knowledge in the disease control | 80% | 78% |

## Mapping of COs with POs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

## Mapping of COs with PSOs

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

**S (+++) – Strong M (++) - Medium L (+) – Low**

**Blooms taxonomy**

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

**Title of the paper: Health and Hygiene**

**UNIT I:**

Dimensions and Determinants of health - Indicators of health- Nutrition – definition, importance. Good nutrition and mal nutrition - Balanced Diet - Basics of Meal Planning. .Nutrition – Classification and functions of food, sources and requirements of Carbohydrates, Proteins, Fats, Vitamins and Minerals. Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies.

**Unit II:**

Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (WAter, Sanitation and Hygiene) programme - Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places -. Public Awareness through Digital Media - An Introduction to Mobile Apps of Government of India: NHP- My Hospital (Mera aspataal)- India fights Dengue- Ayushman Bhava,- Arogya Setu - Covid 19AP.

**Text Books:**

- Murugesh, N, 2002. Health education and community pharmacy, 3rd edition, Sathya Publisher, Madurai
- Park, J.E. and Park, 2000. Text book of preventive and social medicine, 17th Edition, BanarasidasPublishers, Jabalpur.

**Reference Books**:

- Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
- Swaminathan (1995)Food & Nutrition(Vol I, Second Edition) The Bangalore Printing &Publishing Co Ltd., , Bangalore
- Vijaya Khader (2000)Food, nutrition & health, Kalyan Publishers, New Delhi
- Srilakshmi, B., (2010)Food Science, (5th Edition) New Age International Ltd., New Delhi

**Web sources:**

- https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49
- https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=153&lid=229
- https://www.who.int/hia/about/faq/en/
- http://www.euro.who.int/__data/assets/pdf_file/0011/261929/Health-inImpact-Assessments-final-version.pdf?ua=1
- https://www.unicef.org/wash/ and
- https://www.unicef.org/wash/files/UNICEF_Strategy_for_WASH_2016_203
- https://www.nhp.gov.in/healthylivingViewall

**Course designer(s)**

1. Dr. S. Yogachitra
2. Mrs. S. Siva durga
3.

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

Programme Code -UBT

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20SE61(C)** | **Entrepreneurs in Biotechnology** | **SBE** | **2** | **-** | **-** | **2** |

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 15 | 35 | 50 |

## Preamble

Enable the students to enhance their organizing and managerial abilities to act as efficient entrepreneur.

## Course Outcomes

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

| # | Course Outcome | Expected Proficiency (EP) | Expected Attainments (EA) |
|---|---|---|---|
| **CO1** | Familiarize with the latest programs of the government authorities in promoting small and medium industries | 85% | 80% |
| **CO2** | Enlist the function and services of biotech park with initiating government autonomous bodies | 80% | 78% |
| **CO3** | Impart essential knowledge of how to start one's own business venture | 80% | 83% |
| **CO4** | Realize skills and inspiration for developing an entrepreneurial mindset<br>Preparing project plan with cost analysis and market planning | 75% | 73% |
| **CO5** | Encompass with critical ideas of the economics of Entrepreneurship for successful setting up and operations | 78% | 75% |

## Mapping of COs with POs

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

S (+++) - Strong M (++) - Medium L (+) - Low

## Mapping of COs with PSOs

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

S (+++) - Strong M (++) - Medium L (+) - Low

## Blooms Taxonomy

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

## Title of the paper : Entrepreneurs in Biotechnology

**Unit I:**

Biotechnology emerging industries - examples from Transgenic, Environmental, New drug development, DNA chip technology, Tissue engineering). Biotech parks and Incubation centers – concept, functions, facilities and services; initiatives of government, BCIL (Biotech Consortium of India Limited), CSIR, DBT, DST, BIRAC (National Science and Technology Entrepreneurship Development Board); regulations and requirements. Ethics and IPR in biotech-Industries – Fundamentals of ethics in business, Ethical dilemmas in biotech industry, IPR- Introduction, Forms of IPR.

**Unit II:**

Business development in biotechnology - Basic principles and practices of management – Definition, concepts and application, Factors affecting biotech business: finance, infrastructure, equipment, manpower, resources, project location, end product, quality issues, etc., Marketing research - concepts, techniques, identification and evaluation of market potential of various bioentrepreneur sectors. Considerations in establishment of biotechnological start-up – Different models, budget, seed capital raising for a biotechnological start - up company

**Text Books:**


- Shreya Sanghvi Malik and Shiv Kant Shukla, 2018. Bioentrepreneurship Development, Biotech Consortium Limited.
- Anonymous. 2007. Entrepreneurship development programme in biotechnology, Department of biotechnology of India.

**Reference Books:**


- Craig Shimasaki, 2020. Biotechnology Entrepreneurship - Leading, Managing and Commercializing Innovative Technologies, , 2nd Edition
- Craig Shimasaki, 2014. Biotechnology Entrepreneurship - Starting, Managing and Leading Biotech Companies, Copyright © 2014 Elsevier Inc. All rights reserved.


**Web Sources:**

- https://www.ott.nih.gov/sites/default/files/documents/pdfs/Ferguson-BiotechEntrepreneur - 2014.pdf
- https://lecturenotes.in/subject/2017/bio-entrepreneurship

**Course Designer:**

Dr.S.Padmavathy

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Biotechnology**

(For those joined in B.Sc., Biotechnology on or after June 2020)

| Course Code | Course Title | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **UBT20SE61(D)** | **Nano Biotechnology** | **SBE** | **2** | **-** | **-** | **2** |

| Year | Semester | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|
| III | VI | 15 | 35 | 50 |

## Preamble

This courses to provide students will be able to gain the knowledge on fundamental concepts of nanotechnology and understand the methods of synthesis, characterization and applications of nanoparticles.

## Course Outcomes

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

| # | Course Outcome | Expected proficiency (%) | Expected attainment (%) |
|---|---|---|---|
| **CO1** | Understand the concept, types and applications of nano particles | 70% | 68% |
| **CO2** | Gain knowledge of the characterization of nanoparticles by spectroscopic, microscopic and structural methods | 80% | 78% |
| **CO3** | Describe the different types drug delivery system | 75% | 71% |
| **CO4** | Learn the biomedical applications of nanoparticles | 82% | 80% |
| **CO5** | Discern the guidelines for working with nanomaterials. | 78% | 75% |

## Mapping of COs with POs

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

S-Strong M-Medium L-Low

## Mapping of COs with PSOs

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

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

**Blooms taxonomy**

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

**Title of the paper: Nano Biotechnology**

**Unit I:**

Introduction to Nanoscience and basic concepts, scope and application; Different types of nanoparticles: Metallic nanoparticles (Gold, silver, titanium), Non metallic nanoparticles(carbon and silicon). Characterization of nanoparticles: Spectroscopic methods (UV-visible, FTIR and NMR), Microscopic methods (AFM, SEM,TEM) and Structural (XRD, EDAX).

**Unit II:**

Biomedical applications of nanoparticles: Drug carriers-liposomes, nanoshells and micelles, dendrimers and hydrogels; Imaging technique; quantum dots and magnetic nanoparticles, Implants- orthopaedic and vascular. NIOSH guidelines for working with nanomaterials.

**Text books:**


- Balaji, S. 2010. Nanobiotechnology. MJ.P.Publications, New Delhi.
- Tuan VoDinh, 2007. Nanotechnology in Biology and Medicine: Method, Devices and Applications. CRC Press


**Reference books:**


- Bhatia, M. 2010. Nanotechnology. Anmol Publications Pvt.Ltd.,, New delhi.
- Chattopadhyay, K.K. and Banerjee, A.N. 2012. Introduction to Nanoscience and Nanotechnology. PHI Learning Pvt. Ltd., New Delhi.
- Niemeyer, C.M. and Mirkin, C.A. 2006. NanobiotechnologyConcepts : Application and properties. Wiley, VCH Publishers.
- Poole, Jr. C.P. and Owens, F.J. 2009. Introduction to Nanotechnology. Wiley India Pvt. Ltd., New Delhi.
- Pradeep, T. 2011. Nano: The Essentials. Tata Mc Graw Education Private Ltd., New Delhi.
- Ratner, M and Ratner, D. 2005. Nanotechnology: A Gentle Introduction to the Next Big Idea. Pearson education.Inc.


**Course designer:**

Dr. C. Balachandran