



## **THIAGARAJAR COLLEGE MADURAI - 625009**

(An Autonomous Institution, affiliated to Madurai Kamaraj  
University)

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

## **Department of Biotechnology**

# **M.Sc., Biotechnology**



**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

**Course Structure**  
**Semester – I**

Course	Code	Title of the paper	Cont Hrs/W	Credits	Tot Hrs	Max Mks CA	Max Mks SE	Total
Core 1	S1PBT1	General Microbiology	5	4	75	25	75	100
Core 2	S1PBT2	Biochemistry	5	4	75	25	75	100
Core 3	S1PBT3	Cell and Molecular Biology	5	4	75	25	75	100
Elective 1	S1PBTE1	Bioinstrumentation / Clinical lab technology	5	4	75	25	75	100
Lab	S1PBTL1	Lab in General Microbiology & cell biology	5	3	75	40	60	100
Lab	S1PBTL2	Lab in Biochemistry & molecular biology	5	3	75	40	60	100
			30	22				

**Semester –II**

Core 4	S2PBT1	Genetic engineering	5	4	75	25	75	100
Core 5	S2PBT2	Plant Biotechnology	5	4	75	25	75	100
Core 6	S2PBT3	Animal Biotechnology	5	4	75	25	75	100
Elective 2	S2PBTE1	Genetics / Molecular genetics	5	4	75	25	75	100
Lab	S2PBTL1	Lab in Genetic Engineering	5	3	75	40	60	100
Lab	S2PBTL2	Lab in Plant and Animal Biotechnology	5	3	75	40	60	100
			30	22				

**Semester –III**

Core 7	S3PBT1	Immunology & Immunotechnology	5	4	75	25	75	100
Core 8	S3PBT2	Forensic science and bioinformatics	5	4	75	25	75	100
Core 9	S3PBT3	Statistics and Mathematical Modelling	5	4	75	25	75	100
Elective 3	S3PBTE1	Health care biotechnology / Food processing technology	5	4	75	25	75	100
Lab	S3PBTL1	Lab in immunology & immunotechnology	5	3	75	40	60	100
Lab	S3PBTL2	Lab in bioinformatics and biostatistics	5	3	75	40	60	100
			30	22				

### Semester –IV

Core 10	S4PBT1	Bioprocess technology	5	4	75	25	75	100
Core 11	S4PBT2	Rural and entrepreneurial biotechnology	5	4	75	25	75	100
Core 12	PJ	Project	5	6	75	40	60	100
Elective 4	S4PBTE1	Environmental Biotechnology / Nanotechnology	5	4	75	25	75	100
Lab	S4PBTL1	Lab in Bioprocess technology and Environmental biotechnology	5	3	75	40	60	100
Lab	S4PBTL2	Lab in rural and entrepreneurial biotechnology	5	3	75	40	60	100
			30	24				

### Consolidated of contact hours and credits

Semester	Contact Hrs/Week	Credits
I	30	22
II	30	22
III	30	22
IV	30	24
Total	120	90

Core - 74 Credits

Elective - 16 Credits

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Total 90 Credits

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: I Sem	Ext. Mks.	: 75
Sub. Code	: S1PBT1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04
Title of the paper	: <b>General Microbiology</b>		

Course outcomes	On successful completion of the course, the students will be able to
	1. acquire the fundamental knowledge about microbes
	2. understand the characteristics of various microbes

**Unit 1.** History and scope of microbiology; Characteristics of microorganisms - Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenicity and ecological; Microbial classification (Bergy’s manual of Systematic Bacteriology), nomenclature and identification

**Unit 2.** Preparation of solutions and media. Principles, functioning and types of Biosafety cabinets; Common hazards in the laboratory - Electrical equipments, chemicals (corrosive, irritant, toxic, flammable, explosive), Ionizing radiations, Infectious materials, gas and fire. Safety measures – In the use of equipments and gas facility; Personal protection, Waste disposal, First aid.

Control of microorganisms - Physical agents and chemical agents; conditions influencing antimicrobial action; Evaluation of antimicrobial chemical agents

**Unit 3.** Morphology and structure of bacteria - size, shape and arrangement of bacterial cell; External structure and chemical composition of - flagella, pili, capsules, sheaths, prostheca and cell wall (Gram positive and Gram negative); Internal structure - cell membrane, cell inclusions-carbon storage polymers, polyphosphate, sulphur, minerals, magnetosomes, gas vesicles and carbonate; Formation of endospores

**Unit 4.** Outline classification of viruses; Structure and life cycle of viruses- bacterial virus (T4 and Lamda), Animal virus (Pox, Influenza, Adeno), Plant virus (TMV and CaMV), Insect virus (Baculovirus). Mycophages and cyanophages.

**Unit 5.** Outline classification of fungi and algae; Distribution, importance, structure, nutrition and reproduction of fungi - *Physarum*, *Rhizopus*, *Saccharomyces*, and *Fusarium*; Algae - *Chlamydomonas*, *Chrysamoeba*, *Sargassum*, *Gellidium*; Lichens - Structures and types

**Text books:**

1. Pelczar, M.J., Schan, E.C. and Kreig, N.R. 2011. Microbiology – An application based approach, V Edn., Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, VII Edn., McGraw Hill, New York.

**Reference Books:**

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, VI Edn. Addison Wesley Longman, Inc. California.
2. Alexopoulos, E.J., Mims, C.W. and Blackwell, M. 2010. Introductory Mycology, V Edn. John Wiley and Sons, New York.
3. Ananthanarayanan, R. and Paniker, C.K.J. 2009. Textbook of Microbiology. University Press (India) Pvt. Ltd., Hyderabad.
4. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
5. Cappuccino, G.J. and Sherman, N. 2005. Microbiology – A laboratory manual. VII Edn., Pearson Education Inc., New York.
6. Davis, B.D., Dulac, R., Fisen, H.N. and Ginsberg, H.S. 1990. Microbiology, IV Edn, Harper & Row Publishers, Singapore.
7. Kreig, N.R. 2012. Bergey's Manual of Systematic Bacteriology Springer Verlag, New York.
8. Madigan, M.T., Martinka, M.J., Dunlap, P.V. and Clark, D.P. 2009. Brock Biology of Microorganisms. XII Edn. Pearson Education Inc., New York.
9. Rangaswami, G. and Bagyaraj, D.J. 2009. Agricultural Microbiology. II edn. PHI Learning Pvt. Ltd., New Delhi.
10. Salle, A.J. 1996. Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Company, New Delhi.
11. Tortora G.J., Funke, B.R. and Case, C.L. 2011. Microbiology An introduction, IX Edn., Pearson Education Inc., New York.

**Course designer(s):**

- 1 Mr. S. Kulandaivel
- 2 Dr. N. Arun Nagendran

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: I Sem	Ext. Mks.	: 75
Sub. Code	: S1PBT2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Biochemistry**

Course outcomes : On the successful completion of the course, the students will be able to  
1. understand the structure and functions of biomolecules  
2. learn the metabolism and biological significance of biomolecules

**Unit 1.** Carbohydrates: Classification - structure and properties of monosaccharides (glucose, fructose) and disaccharides (lactose, maltose, sucrose). Properties of polysaccharides – starch and cellulose

Metabolism of carbohydrates: Glycolysis, Kreb’s cycle, hexose monophosphate shunt, Entner Doudroff pathway, Gluconeogenesis, Glycogen metabolism

**Unit 2.** Amino Acid: Classification based on structure and polarity; physical properties and chemical reactions, biological importance; an over view of aminoacids biosynthesis.

Protein: Classification, physical and chemical properties. Structure – primary, secondary (Ramachandran plot), tertiary and quaternary structure of proteins – structure and biosynthesis of haemoglobin and myoglobin

**Unit 3.** Lipids: Classification, structure, properties and biological importance; Metabolism of lipids -  $\alpha$ ,  $\beta$  and omega oxidation of fatty acids; ornithine and uric acid mechanism and significance of lipid peroxidation.

**Unit 4.** Enzymes: Classification, mechanism of enzyme action; Enzyme kinetics – Michaelis Menten equation, Lineweaver Burk plot. factors influencing enzyme activity; enzyme inhibitors/activators, active site, allosteric enzyme; coenzyme, isozyme, ribozyme and abzyme.

**Unit 5.** Nucleic acids: Structure, synthesis and degradation of purines and pyrimidines. Vitamins: Types and properties of vitamins – Water soluble vitamins (B, C) and fat soluble vitamins (A, D, E & K), deficiency diseases of vitamins



**Text books:**

1. Mckee, T. and Mckee, R.K. 1996. Biochemistry and Introduction, Won.C.Brown Publishers, London
2. Deb, A.C. 2011. Fundamentals of Biochemistry, X Edn., New Central Book Agency Pvt. Ltd., Kolkata.

**Reference books:**

1. Berg J. M., Tymoczko J. L., Stryer L., Biochemistry, V Edn., W. H. Freeman and Company, New York.
2. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
3. Boyer R., Modern experimental Biochemistry, III Edn., Pearson education publication, Singapore.
4. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) Ltd. New Delhi.
5. Casey, E.J. 1969. Biophysics – Concepts and mechanism. East West Press. New Delhi.
6. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.Do, 1999. Outline of Biochemistry, John Wiley & Sons Inc., New York.
7. Devlin, T. 2006. Text Book of Biochemistry, VI Edn., Wiley-Liss, USA.
8. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, V Edn., S. Chand and Company Ltd, NewDelhi.
9. Jayaraman, J. 2007. Laboratory Manual in Biochemistry, New Age International (P) Limited Publishers, New Delhi.
10. Morris, J.G. 1974. A Biologist's physical chemistry. II Edn. Edward Arnold – A division of Holder and Stoughton, London.
11. Murray, R.K., Granner, D.K. and Rodwell, V.W. 2006. Harper's Illustrated Biochemistry. XXVII Edn. McGraw Hill Publications. New Delhi.
12. Nelson, D.L., and Cox, M.M. 2010, Lehninger Principles of Biochemistry, V Edn., Worth Publishers, New York.
13. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11<sup>th</sup> UVS Publishers Distributors Pvt. Ltd., New Delhi.
14. Rastogi, S.C.2010. Biochemistry, III Edn., Tata McGraw Hill Edition, New Delhi.
15. Satyanarayana, U. and Chakrapani, U. 2010. Biochemistry, Books and Allied Pvt. Ltd., Kolkata.
16. Shanmugam, A. 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
17. Stryer, L., 2000. Biochemistry, IV Edn. W.H. Freeman and Company, New York.
18. Voet, D. and J.G.Voet, 1995, Biochemistry, II Edn. John Wiley & Sons Inc, New York.
19. Zubay, G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England

**Course designer(s):**

1. Dr. M. Karthikeyan
2. Dr. C. Ravi

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: I Sem	Ext. Mks.	: 75
Sub. Code	: S1PBT3	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Cell and Molecular Biology**

Course outcomes On the successful completion of the course, the students will be able to  
1. understand the structure and functions of cell and cell organelles  
2. know about gene structure and regulation

**Unit 1.** Structure of plant and animal cells; Cell theory, Cell types; Structure and functions of Plasma membrane, nucleus, endoplasmic reticulum, golgi complex, mitochondria, plastids, ribosomes, lysosomes; Structural organization of chromosomes and giant chromosomes

**Unit 2.** Cell cycle, mitosis and meiosis; Cell migration and Cell-cell interaction; Cell signalling - G-protein coupled and TGF $\beta$  receptor system, JAK/STAT, Ras and MAP kinase pathway, Cell ageing, Cell death and its regulation in plants and animals, Molecular and biochemical characteristics of cancer cells, metastasis

**Unit 3.** DNA as genetic material - experimental evidences; DNA - forms and types, replication (both prokaryotes and eukaryotes); DNA damage: lesions, dimerization, AP sites, oxidative damage, alkylation and genotoxic effects; repair – photoreactivation, NER, mismatch repair, SOS repair; RNA – mRNA, tRNA, rRNA, SiRNA & SnRNA;  
Genetic code and characteristics

**Unit 4.** Transcription in prokaryotes: Initiation - promoters and binding of RNA polymerase, elongation - role of RNA polymerase, termination – rho dependent and rho independent process;  
Translation in prokaryotes: Initiation – Shine-Dalgarno sequence, initiation complex and initiation factors, elongation – peptide bond formation and translocation, termination  
Gene regulation in prokaryotes: lac, trp operon models

**Unit 5.** Transcription in eukaryotes: Initiation – promoters, pre initiation complex, elongation, termination and post transcriptional modifications Translation in eukaryotes: Initiation – binding of ribosome and scanning of start codon, circularization of mRNA – elongation – binding and translocation of tRNA, termination, Mono and poly cistronic mRNAs; post translational modifications  
Gene regulation in eukaryotes – acetylation and methylation

**Text books:**

1. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology.VIII Edn. Lippincott Williams & Wilkins, Pheladelphia.
2. Frifelder, D. 2000. Molecular Biology II Edn. Narosa Publishing House, New Delhi.

**Reference Books:**

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Robersts, K. and Walter, P. 1994. Molecular Biology of the Cell, III Edn. Garland Publishing, Inc.,
2. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach VI Edn. Sinauer
3. Griffiths, A.J.F., Lewontin, R.C., Gelbart, W.M. and Miller, J.H. 2002. Modern Genetic Analysis. II Edn., W.H. Freeman and Company, New York.
4. Hardin J., Bertoni, G.P. and Lewis, J. 2011 Becker's World of the Cell VIII Edn. Pearson Education Inc., New York
5. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc., New York.
6. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett
7. Lodish, H., Berk, A., Zipursky, S.L., Matsudara, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology, IV Edn. W.H.Freeman and Company, Newyork.
8. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 2004. Molecular Biology of the Gene, IV Edn. Pearson Education Inc., New York.
9. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company, California.

**Course designer(s):**

1. Dr. N. Arun Nagendran
2. Mrs. V. Santhi

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Sub. Code	: S1PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Bioinstrumentation**

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

1. understand the basic principle of bioinstruments
2. know the application of the techniques

**Unit1.** Microscopy: Resolving powers of different microscopes; Principle, instrumentation, working and applications of light, phase contrast, confocal, fluorescent, scanning and transmission microscopes, fixation and staining techniques for EM, freeze etch and freeze fracture methods for EM, image processing methods in microscopy.

**Unit 2.** Centrifugation: Basic principle - centrifugal force, sedimentation coefficient; types of rotors; types of centrifugation – differential and density gradient; types of centrifuges – instrumentation and applications of clinical, high speed, ultra, refrigerated centrifuges; Principle and applications of pH meter, sonicator, lyophilizer, flame photometer

**Unit 3.** Chromatography: Introduction and types of chromatography – principle, working and applications of paper, TLC, column, GLC, FPLC, HPLC, GCMS, LCMS, HPLC

**Unit 4.** Spectrophotometry: Principle, apparatus, working and applications of UV/Vis Spec (single and double beam), AAS, FTIR, NMR and ICP

Electrophoresis: Principle, working and applications of agarose gel electrophoresis, Native PAGE, SDS PAGE, PFGE; Gel documentation and molecular weight analysis

**Unit 5.** Radiolabelling techniques: Radioisotopes – properties and biological applications; Detection and measurement of radioactivity – based on gas ionization (ionization chamber, proportional counters, GM counters), based on excitation (solid scintillation counters, liquid scintillation counters), photographic methods (autoradiography), immunological method (RIA)

**Text books:**

1. Boyer R., Modern experimental Biochemistry, III EDn., Pearson education publication, Singapore.
2. Jayaraman, J. 2007. Laboratory Manual in Biochemistry, New Age International (P) Limited Publishers, New Delhi.

**Reference books:**

1. Bier, M. 2013. Electrophoresis. Theory, methods and applications. Academic press.
2. Hoppert, M. and Holzenburg, A. 1998. Electron microscopy in microbiology (Microscopy hand books) Springer-verlag, New York Inc.
3. Knoll, G.F. 2010. Radiation detection and measurement. IV edn., John Willey & Sons publishers.
4. Mann, W.B., Rytz, A. and Spornol, A. 2012. Radioactivity measurements: Principle and Practice (Kindle edn.) Pergamon publications.
5. Sharma, B.K. 2014. Chromatography. Krishna's educational publishers.
6. Torrence, A. 2015. Microscopy: A very short introduction, OUP Oxford publishers.

**Course designer(s):**

1. Dr. A. Surendran
2. Mr. S. Kulandaivel
3. Dr. N. Arun Nagendran

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Year & Sem	: I Year: I Sem	Ext. Mks.	: 75
Sub. Code	: S1PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Clinical lab technology**  
Course outcomes : On the successful completion of the course, the students will be able to  
1. follow safety measures in clinical labs and while collecting clinical samples  
2. diagnose the nature of the diseases by examining the clinical samples

**Unit 1.** Laboratory management – Biosafety in containment laboratory - Personal hygiene for Laboratory Technologists, National and International GLP and GMP, Accidents - types and safety measures. Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections. Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA. Biomedical waste management

**Unit 2.** Collection and processing of blood sample. Determination of TC, DC, ESR, Hb, BT & CT. ABO Blood group system and determination of blood group. Blood transfusion and Compatibility testing. Determination of blood glucose, Urea, Cholesterol and Bilirubin. VDRL and Widal test. Blood culture and sensitivity.

**Unit 3.** Collection, transport and Storage of Urine sample. Physical properties of Urine. Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies. Microscopic Examination of Urine – Cast Crystals and Cells. Pregnancy Test. Urine culture and sensitivity.

**Unit 4.** Collection and transport of stool sample. Macroscopic and Microscopic examination of stool. Chemical examination of stool. Stool Culture and sensitivity. Occult blood and its clinical significance

**Unit 5.** Collection and transport of sputum specimen. Macroscopic and Microscopic examination of sputum. AFB staining. Sputum culture and sensitivity. Collection of semen. Semen analysis – motility, total count and abnormality.

**Text books:**

1. Sood, R, 2010. Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.

2. Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.

**Reference Books:**

1. Alex, C., Sonnenwirth, 1998. Gradwohl's Clinical Laboratory Methods and Diagnosis, Vol. 1&2, eighth edition, B.I. Publications Ltd., New Delhi.
2. David, S. Jacob, Wayne R. Demott, Paul R. Finley, 1994. Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.
3. Jacques Wallac, L., 1986. Interpretation of Diagnostic Tests: A Synopsis of Laboratory Medicine, Little Brown and Company, Boston/Toronto, USA.
4. Kathleenbecan, M.C., Bride, 1982. Text Books of Clinical Laboratory supervision, Century Crosts, New York.
5. Mukherjee, L.K. 2010. Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., New Delhi.
6. Rapael, S.S., 1983. Lynch Medical Laboratory Technology, Fourth edition, W.B. Saunders Co, Singapore.
7. Woohan, I.D.P., Heather Freeman, 1990. Micro Analysis in Medical Biochemistry, VI edition, Churchil Livingstone Publishing Ltd., USA.

**Course designer(s):**

1. Mr.S.Kulandaivel
2. Ms.S.Padmavathy
3. Mrs.V.Ananthi
4. Dr.M.Karthikeyan

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Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: I Year: I Sem	Ext. Mks.	: 60
Sub. Code	: S1PBTL1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in General Microbiology and Cell Biology**

1. Laboratory rules, regulations and GLP
2. Cleaning and methods of sterilization
3. Isolation of microbes from soil/water/air
4. Simple staining techniques - Simple, negative,
5. Differential staining technique - Gram's staining
6. Special staining techniques – capsule and spore staining
7. Motility test – Hanging drop method
8. Biochemical characterization of bacteria
9. Cultivation of anaerobic microbes by pyrogallic acid method
10. Identification of fungi by lactophenol cotton blue staining method
11. Fungi slide culture technique
12. Determination of bacterial cell size by micrometry
13. Development of Winogradsky column.
14. Display of giant chromosome
15. Observation of cell divisions (mitosis and meiosis)



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Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: I Year: I Sem	Ext. Mks.	: 60
Sub. Code	: S1PBTL2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in Biochemistry and Molecular biology**

1. Qualitative analysis of Carbohydrates
2. Qualitative analysis of Proteins
3. Qualitative analysis of Lipid
4. Preparation of buffers, normal and molar solutions
5. Determination of pH in different samples
6. Verification of Beer's law and determination of  $\lambda$  max
7. Extraction and estimation of bacterial carbohydrates
8. Extraction and estimation of yeast protein
9. Quantitative estimation of lipids
10. Separation of amino acids/pigments/dyes by Paper Chromatography
11. Separation of amino acids/pigments TLC
12. Separation of pigments by column chromatography
13. Extraction and estimation of genomic DNA from bacteria/yeast/coconut endosperm/liver
14. Extraction and estimation of total RNA from bacteria/yeast/coconut endosperm/liver
15. Determination of purity of DNA and RNA by spectrophotometric method

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: II Sem	Ext. Mks.	: 75
Sub. Code	: S2PBT1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Genetic Engineering**

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

1. comprehend the principles and methods of gene cloning
2. appreciate the significance of gene cloning principles in modern biotechnology

**Unit 1.** Molecular Tools: Restriction enzymes – nomenclature, type I, II and III, DNA modifying enzymes – nucleases, alkaline phosphatase, polymerases, terminal nucleotidyl transferase, polynucleotide kinase, ligases. Ligation – mode of action of ligase, sticky end and blunt end ligation, linkers, adapters and homopolymer tailing; Vectors – plasmid vectors pBR322, pUC18 (lac selection), phagemid (M13), Cosmids ( $\lambda$ ), BAC, YAC, BIBAC, TAG

**Unit 2.** Introduction of DNA into living cells: Transformation – preparation of competent cells, selection of transformed cells; Identification of recombinant cells – insertional inactivation, colony hybridization; Transfection – *in vitro* packaging of  $\lambda$  cloning vectors, identification, recombinant phages – insertional inactivation of lacZ' gene; transformation into individual cells – liposome mediated gene transfer, electroporation, microinjection, biolistics

**Unit 3.** Selection of clones – direct selection, colony hybridization (nucleic acid hybridization using radiolabelled, non radiolabelled; probes – oligonucleotide, heterologous probes) by translation products (Western blotting), by locating genes within DNA molecule (Southern blotting), within chromosomes (FISH), by amplifying gene (PCR)

**Unit 4.** Sequence analysis: Sanger-Coulson method, Maxam-Gilbert method, automated DNA sequencing; Genome sequencing – shot gun approach, clone contig approach, chromosomal walking; Gene mapping – RFLP, RAPD, microsatellites; Gene library and genomic library

Transcript analysis: Northern blotting, RACE, RT-PCR; DNA foot printing; translation product analysis: HRT and HART techniques

**Unit 5.** Expression of cloned genes and role of promoters – in *E.coli* and *S.cerevisiae*, cassettes and gene fusion, synthesis and expression of artificial insulin gene, synthesis of human growth hormone

**Text book:**

1. Brown, T.A. 2008. Gene Cloning and DNA analysis – An Introduction. V Edn., Blackwell Publishing Ltd., UK.
2. Das, H.K. 2011. Textbook of Biotechnology. IV Edn., Wiley India Pvt. Ltd., New Delhi
3. Sathyanarayana, U. 2012. Biotechnology. Books and Allied (P) Ltd., Kolkatta.

**Reference books:**

1. Brown, T.A. 2007. Genomes 3. Garland Science Publishing, New York.
2. Brown, T.A. 2011. Genetics – A molecular approach, III Edn., BIOS Scientific Publishers, New York.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C.
5. Hammong, J., Mc Garvey, P. and Springer, V.Y. 2000. Plant Biotechnology.
6. Ignachimuthu, S. 2008. Biotechnology – An introduction. Narosa Publishing House, New Delhi.
7. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. Lewin’s Gene X. Jones and Bartlett Publishers, London.
8. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
9. Lesk, A.M. 2008. Introduction to Genomics. Oxford University Press, New York.
10. Mitra, S. 2007. Genetic Engineering Principles and Practice. MacMillan India Ltd., New Delhi.
11. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
12. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
13. Symonds, N., Toussaint, A., Van De Putte, P. and Howe, M.M. 1987. Phage Mu. Cold Spring Harbor Laboratory.
14. Talwar, G.P., Rao, K.V.S. and Chauhan, V.S. 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
15. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
16. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.
17. Winnaker, E.L. 1987. From Gene to Clone: Introduction to Gene Technology, VCH
18. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

**Course designer(s):**

1. S. Kulandaivel
2. N. Arun Nagendran

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
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**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: II Sem	Ext. Mks.	: 75
Sub. Code	: S2PBT2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Plant Biotechnology**

Course outcomes : On the successful completion of the course, students will be able to  
1. comprehend the structure and functions of plant genome  
2. elucidate transgenesis and *in vitro* culture techniques of plants

**Unit 1.** Plant genome and gene transfer: structural organization and functions of molecular, mitochondrial and plastid genome. Gene transfer: *Agrobacterium tumefaciens*: Ti and Ri vectors, mechanism of DNA transfer and role of virulence genes, crown gall formation and hairy root culture, selectable marker genes, use of 35S and other promoters as genetic markers, use of reporter genes and transgene stability.

**Unit 2.** Transgenic plants and crop improvement: transgenic plants with insect resistance (Bt cotton), tolerance to abiotic stress (drought and salinity resistance), improved nutrition (golden rice), improved photosynthetic efficiency. Crop improvement: DNA marker assisted selection, antisense RNA and gene silencing in crop improvement

**Unit 3.** Secondary metabolite production: Control mechanisms and manipulation of (Shikimate and PHA pathway), high yielding cell line selection, biotransformation, plant bioreactor, large scale industrial production of alkaloids (reserpine), pigment (flavinoid), biodegradable plastics (PHP), PMF for therapeutic proteins (HGH), edible vaccines (banana), factors affecting secondary metabolite production, immobilization of plant cells. A brief note on plant molecular farming

**Unit 4.** Plant tissue culture: Concept of cellular totipotency, explant, nutritional requirements: MS medium, callus, micro-propagation, somaclonal and gametoclonal variation, embryoids. Types of culture – callus culture, cell suspension culture, organ culture, meristem culture, embryo culture, somatic embryogenesis, haploid and double haploid production, protoplast culture: somatic hybridization and cybrid production.

**Unit 5.** Plant Genetic Resources – Germplasm conservation: *in-vitro* collection, recalcitrant and slow growth cultures, Principles and types of storage: cryopreservation and cryoprotectants, *In-vitro* conservation of key crops, gene bank, artificial seeds, and embryo rescue. Gene silencing; farmer’s and breeder’s rights

**Text books:**

1. Chawla, H.S. 2009. Introduction to Plant Biotechnology. III Edn. CRC Press, USA.

2. Keshavachandran, R. and Peter, K.V. 2009. Plant Biotechnology – Methods in Tissue Culture and Gene Transfer, University Press (India) Pvt. Ltd., Hyderabad.

**References:**

1. Brown, T.A. 2007. Genomes 3. Garland Science Publishing, New York.
2. Brown, T.A. 2008. Gene Cloning and DNA analysis – An Introduction. V Edn., Blackwell Publishing Ltd., UK.
3. Brown, T.A. 2011. Genetics – A molecular approach, III Edn., BIOS Scientific Publishers, New York.
4. Das, H.K. 2011. Textbook of Biotechnology. IV Edn., Wiley India Pvt. Ltd., New Delhi.
5. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
6. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C.
7. Hammong, J., Mc Garvey, P. and Springer, V.Y. 2000. Plant Biotechnology.
8. Ignachimuthu, S. 2008. Biotechnology – An introduction. Narosa Publishing House, New Delhi.
9. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. Lewin’s Gene X. Jones and Bartlett Publishers, London.
10. Lesk, A.M. 2008. Introduction to Genomics. Oxford University Press, New York.
11. Mitra, S. 2007. Genetic Engineering Principles and Practice. MacMillan India Ltd., New Delhi.
12. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
13. Sathyanarayana, U. 2012. Biotechnology. Books and Allied (P) Ltd., Kolkatta.
14. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
15. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
16. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz , J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.
17. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

**Course designer(s):**

1. Dr. K. Saraswathi

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: II Sem	Ext. Mks.	: 75
Sub. Code	: S2PBT3	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Animal Biotechnology**

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

1. explain the basic principles, techniques and applications of animal biotechnology
2. know the methodology of handling animals and biosafety issues

**Unit 1.** Animal cell culture: Historical perspective, biology and characterization of cultured cells; Biosafety level 1 - 4, safety data sheet, personal protective equipment, safety laboratory practice, requirements for animal cell culture – equipments and media; types of cell culture – primary, secondary cultures and cell line; categories of tissue culture – organ culture and cell culture (stem cells, precursor cells and differentiated cells), cell culture systems – monolayer culture and suspension culture

**Unit 2.** Protocol for animal cell culture – preparation of substratum, inoculum (physical and chemical disaggregation of cells), culture media, methods of cell culture (slide, Carrel flask and test tube culture), Applications of animal cell culture: in vitro testing of drugs, testing of toxicity of environmental pollutants,

**Unit 3.** Biology of animal viral vectors - SV40, adeno virus, retro virus, vaccinia virus and baculovirus; Construction of recombinant animal viral vectors; Targeted gene transfer - knock in and knock out technology.

**Unit 4.** Transgenic animals – methods of production and its applications (reteroviral, microinjection and embryonic stem cell); Transgenic mice as model organism; Transgenic sheep, transgenic goat, transgenic pig, transgenic mosquitoes and transgenic birds; Vaccine: Types - killed, attenuated vaccine, recombinant vaccines and DNA vaccines

**Unit 5.** Manipulation of reproduction - IUI, AI, IVF and ET; Gamete intrafallopian transfer, Zygote intrafallopian transfer, intravaginal culture, cytoplasmic transfer, micromanipulation of animals and cryopreservation; Bioethics and IPR – ethical issue, IPR, TRIPS and patenting.

**Text books:**

1. Das, H.K. 2011. Textbook of Biotechnology. IV Edn., Wiley India Pvt. Ltd., New Delhi.
2. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology: Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C

3. Sathyanarayana, U. 2012. Biotechnology. Books and Allied (P) Ltd., Kolkatta.

**Reference books:**

1. Brown, T.A. 2008. Gene Cloning and DNA analysis – An Introduction. V Edn., Blackwell Publishing Ltd., UK.
2. Brown, T.A. 2011. Genetics – A molecular approach, III Edn., BIOS Scientific Publishers, New York.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Ignachimuthu, S. 2008. Biotechnology – An introduction. Narosa Publishing House, New Delhi.
5. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. Lewin's Gene X. Jones and Bartlett Publishers, London.
6. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
7. Lesk, A.M. 2008. Introduction to Genomics. Oxford University Press, New York.
8. Mitra, S. 2007. Genetic Engineering Principles and Practice. MacMillan India Ltd., New Delhi.
9. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
10. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
11. Symonds, N., Toussaint, A., Van De Putte, P. and Howe, M.M. 1987. Phage Mu. Cold Spring Harbor Laboratory.
12. Talwar, G.P., Rao, K.V.S. and Chauhan, V.S. 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
13. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
14. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.

**Course designer(s)**

1. Dr. A. Balachandran
2. Dr. C. Ravi
3. Dr. N. Arun Nagendran
4. Mr. S. Kulandaivel

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: II Sem	Ext. Mks.	: 75
Sub. Code	: S2PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Genetics**

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

1. understand the basic concepts of gene
2. explain the basis of inheritance

**Unit 1.** Mendelian Principles – Dominance, Segregation, independent assortment, deviation from mendelian inheritance; Concept of gene – Allele, multiple alleles, pseudoallele, complementation test; Extensions of mendelian principles – epistasis, codominance, incomplete dominance, gene interactions, genomic imprinting, penetrance and expressivity; phenocopy.

**Unit 2.** Linkage and crossing over, sex linkage, sex limited and sex influenced characters; Gene mapping methods - Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

**Unit 3.** Human chromosomes; sex determination and sex linked inheritance; Simple Mendelian traits in man; Pedigree analysis, Lod score for linkage testing, karyotype, genetic disorders (Sickle cell anemia, Down’s, Klienfelter’s and Turner’s syndrome); Quantitative genetics - Polygenic inheritance, heritability and its measurements

**Unit 4.** Mutation – types: spontaneous and induced mutations; Point mutation and chromosomal mutations; ploidy and their genetic implications; Molecular basis of mutations – base substitution, (numerical and structural alterations of chromosomes), frame shift mutation and mismatch; Mutagenesis and mutagenic agents. Detection of mutagen - Ames test

**Unit 5.** Extra chromosomal inheritance - Inheritance of mitochondrial and chloroplast genes, maternal inheritance (kappa particles); Microbial genetics: Plasmids – F, R & Col plasmids; Methods of genetic transfer – transformation, conjugation, transduction and sexduction; mapping genes by interrupted and uninterrupted mating; site specific recombination, Holliday model

**Text books:**

1. Gardner E.J., Simmons, M.J. and Snustad, D. P. (2006) Principles of Genetics, 8<sup>th</sup> edition, Wiley India Pvt. Ltd., New Delhi.
2. Verma, P.S. and Agarwal, V.K. 2010. Genetics. 21<sup>st</sup> Edn. S. Chand Publishing, New Delhi



**References:**

1. Brown, T. 2011. Introduction to Genetics: A molecular approach, Garland Science, USA.
2. Klug, W.S., Cummings, M. R., Spencer, C. A. and Palladino, M.A. 2016. Genetics, X Edn. Pearson Education India, New Delhi.
3. Pierce.A.B. 2014. Genetics: Conceptual approach, IV Edn. W. H. Freeman and company, UK.
4. Strickberger, 2015. Genetics, IV Edn. Pearson Education India, New Delhi.

**Course designer:**

Dr. A. Surendran

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: II Sem	Ext. Mks.	: 75
Sub. Code	: S2PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Molecular genetics**

Course outcomes : On the successful completion of the course, the students will be able to  
1. analyse molecular basis of inheritance  
2. explain the regulation of gene expression

**Unit 1.** Physical organization of prokaryotic genome – structure of nucleoid, DNA super coiling, Protein HU, physical organization: genome complexity, histones, packaging DNA into chromosomes, nucleosomes, second level chromatin structure, organization of chromatin in the cells, higher levels of chromatin.

**Unit 2.** Origin of mutation, molecular basis of mutation, spontaneous mutation – random and non – adaptive mutation, mutation rates. Origin of spontaneous mutation – isolation of mutants. Selection of bacterial variation: Direct - fluctuation test, indirect - replica plating. Mutagenesis and mutagenic agents. Detection of mutagen - Ames test.

**Unit 3.** Plasmids: Types and Properties of plasmids - F, R & Col plasmids. Agrobacterium Ti and broad host range plasmid. Detection and purification of plasmid DNA. Transfer of plasmid DNA. Replication of plasmid. Control of copy number, plasmid amplification, curing and incompatibility

**Unit 4.** Transposable elements: IS elements and transposons – composite and non-composite transposans; transposable elements in plasmids and phage mu; mechanism of transposition – replicative and conservative transpositions

**Unit 5.** Transduction of Lambda phage DNA, generalized & specialized transduction, molecular mechanism of lytic and lysogenic cycle in Lambda phage, mechanism of specialized transduction, co-transduction, mapping based on transduction

**Text books:**

1. Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, NewDelhi.
2. Malacinski, G.M. and Freifelder, D. 1998. Essentials of Molecular Biology, Third Edition, Jones and Bartlett publishers, Boston.
3. **Reference Books:**
4. Albert, B., Lewis, R. and Watson, B. 1994. Molecular Biology of the cell, Third Edition, IUOII. Gariand Publishing Inc., New York.
5. Allison, L.A., 2007. Fundamental Molecular Biology, Blackwell Publishing, USA.
6. Freifelder, D. 2000. Molecular Biology, Second Edition, Narosa Publishing house. NewDelhi.
7. Hayes.W. 1968. Genetics of Bacteria and their viruses, Black Well Publication, London.
8. Krebs, J.E., E.S.Goldstein and S.T. Kilpatrick 2009 Lewin’s Gene X Jones & Bartlett Publishers, Boston.
9. Stanley R. Maloy, John E.C. and Freifelder, D.2008. Microbial Genetics, Narosa Publishing House, New Delhi.

**Course designer(s):**

1. Dr. N. Arun Nagendran
2. Dr. M. Karthikeyan

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**M.Sc., BIOTECHNOLOGY**

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Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: II Sem	Ext. Mks.	: 60
Sub. Code	: S2PBTL1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in Genetic Engineering**

1. Isolation of auxotroph
2. Selection of Rec A<sup>+</sup> and Rec A<sup>-</sup> strains
3. Isolation of *Z E. coli* strains
4. Isolation of streptomycin resistant mutants using gradient plate technique
5. Demonstration of transformation in bacteria
6. Demonstration of uninterrupted conjugation in bacteria
7. Isolation of Plasmid by alkaline lysis method - A miniprep procedure
8. Isolation of DNA from bacteria
9. Restriction digestion of DNA (Single and double)
10. Cloning of DNA fragment into plasmids
11. Separation of DNA by Agarose gel electrophoresis
12. Separation of proteins by native and SDS PAGE.
13. Identification of specific proteins by Western Blotting
14. Demonstration of PCR reaction

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**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: II Sem	Ext. Mks.	: 60
Sub. Code	: S2PBTL2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in Plant and Animal biotechnology**

1. Preparation of media for tissue culture
2. Preparation of explants
3. Callus culture
4. Morphogenesis of root and shoot system
5. Isolation of protoplast from leaves
6. Protoplasmic fusion by PEG.
7. Culture of anther/ovule
8. Induction of algal pigmentation by different light intensity.
9. Synthetic seed preparation
10. Microscopic observation of developmental stages of mosquito/chicken
11. Preparation of media for animal cell culture
12. Suspension cell culture
13. Testing the viability of the cells
14. Soft agar assay for stem cell culture

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**M.Sc., BIOTECHNOLOGY**

**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: III Sem	Ext. Mks.	: 75
Sub. Code	: S3PBT1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Immunology and Immunotechnology**

Course outcomes : On the completion of course, the students will be able to

1. understand basic immune mechanisms
2. apply immunological principles in diagnosis and treatment

**Unit 1.** Types of immunity – innate and adaptive, humoral and cell-mediated immunity; lymphoid organs – primary and secondary; cells of the immune system; immunogens and antigens – characteristics, classes of antigens; MHC - Structure and regulation of its expression; Role of APCs and TCR in antigen processing and presentation; Maturation, activation and differentiation of B and T cells; Regulation of B cell development and immune response; Antibody – structure, types & functions; Generation of antibody diversity;

**Unit 2.** Immune effector mechanisms: Cytokines – types and receptors; Complement – Components, their functions and activation; Biological consequences of complement activation and regulation; General properties of effector T cells, Cytotoxic T cells, and NK cells; ADCC and its assessment - Leukocyte migration; Hypersensitivity – Types (I - IV).

**Unit 3.** Immunodeficiencies – Primary and Secondary; Autoimmunity – organ specific and systemic diseases; Mechanism for induction of autoimmunity; Immunological basis of graft rejection, clinical manifestation of graft rejection; Histocompatibility testing - HLA typing - HLA 1 and 2, cross matching, serological, cellular and genomic typing; Immunosuppressive therapy; Tumor Immunology - tumor antigens, classification, immune responses to tumors, immune therapy to cancer

**Unit 4.** Ag-Ab interactions; Agglutination based assays – WIDAL, VDRL, blood grouping, CRP; precipitation based assay – Ig quantification by SRID, double immunodiffusion, immunoelectrophoresis; Effector cell assays – PFC, lymphocyte stimulation test, CM lympholysis, ELISA, RIA, ELISPOT

**Unit 5.** Hybridoma technology - murine monoclonal antibody production and enrichment, Human monoclonal antibodies, T cell hybridomas; Abzymes; antibody engineering; Chimeric and humanized antibodies and their applications; Immunoconjugates – immunotoxins and immunotargeting; FACS, immunohistochemistry

**Text books:**

1. Coleman R.M., Lombard M.F., Sicard R.E and Rencricca N.J., Fundamental Immunology, (1994), 3<sup>rd</sup> ed., Wm.C.Brown Publishers, Iowa.
2. Goldsby R.A., Kindt T.J and Osborne B.A. 2003. Kuby Immunology, V Edn. W.H. Freeman and Co., New York.

**Reference Books:**

1. Abbas A.K and Lichtman A.H. 2003. Cellular and Molecular Immunology, V Edn., Saunder's Publishers, Philadelphia.
2. Abbas A.K and Lichtman A.H. 2004. Basic Immunology, II Edn., Elsevier Inc., New Delhi.
3. Benjamini E., Sunshine G and Leskowitz S. 1996. Immunology: A Short Course, III Edn., Wiley-Liss Inc, New York.
4. Rao C.V., Immunology – A Text Book, (2006), Narosa Publishing House, New Delhi.
5. Roitt I.M and Delver P.J. 2005. Essential Immunology, X Edn., Blackwell Publications, London.
6. Roitt M., Brostoff and Male D.K., Immunology, (1996), 4<sup>th</sup> ed., Times Mirror International Pub. Ltd., UK.
7. Stites D.P., Terr A.I and Parslow T.G., Basic and Clinical Immunology, (1994), Prentice Hall Publishing, UK.

**Course designer(s)**

1. Dr. C. Binu Ramesh
2. Dr. A. Surendran

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Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: III Sem	Ext. Mks.	: 75
Sub. Code	: S3PBT2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Forensic science and bioinformatics**  
 Course outcomes : On completion of the course, the students will be able to  
 1. understand basics of detection of crime with physical, chemical and biological samples  
 2. application of bioinformatics tools in crime investigation

**Unit 1.** Introduction to forensic Science –Development of Forensic science in India - Organization and functions of Forensic laboratory; Physical evidences - their classification and significance, Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation. Fundamentals of crime scene photography. Tool marks - identification - restoration of field off/erased marks.

**Unit 2.** Foot and tyre impressions - examination of foot and tyre prints. Finger prints - Finger print patterns and classification – Toxicology - classification and mode of action of poisons - narcotic drugs - alcoholic beverages - Examination of biological fluids - blood, seminal and saliva Examination of hair, bones, teeth and skull - Fundamentals of DNA typing.

**Unit 3.** Types and identification of microorganisms, bacteria and fungi of forensic significance, Techniques in forensic microbiology. Bioterrorism- Types of biological agents – Category A, B, C. Planning and response to bioterrorism – Preparedness, Biosurveillance, Biodefence. Epidemiology of Bioterrorism- Study of spore, powdered minerals and pollens of forensic importance, Use of pollen grains & spores in criminal or civil investigation

**Unit 4.** Introduction – Bioinformatics and databases – sequence, structure & domain, application and scope. Biological databases: Nucleotide sequence databases – protein databases – specialized sequence data bases. Data retrieval and analysis. Sequence alignment: Types - local and global alignment. Alignment methods – pair wise sequence alignment: FASTA and BLAST. Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou –Fasman.

**Unit 5.** Multiple sequence alignment – methods and softwares – Clustal W, Multalign – phylogenetic analysis. Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Drug designing and docking analysis. Structure visualization tool-RASMOL. micro RNA SnRNA analysis

**Text books:**

1. Attwood, T.K., Parry-Smith, D.J. and Phukan, S. 2011. Introduction to Bioinformatics. Pearson Education, Asia, New Delhi.
2. 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:**

1. Baxevanis, A.D. and Qullette, B.F.F. 2001. Bioinformatics - Practical guide to analyse genes and proteins. Wiley International Science Publications. New York.
2. Bevel, T., and Gardner, R.M. 2008. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton.
3. Bosu, O. and Thukral, S.K. 2007. Bioinformatics – databases, tools and algorithms. Oxford University Press. UK.
4. Duncan, G.T., and M.I. Tracey, M.I. 1997. Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton .
5. Hepsyba, S.G.H. and Hemalatha, C.R. 2009. Basic Bioinformatics. MJP Publishers, Chennai.
6. Khan, I.A. 2007. Elementary Bioinformatics. Pharma Book Syndicate, Hyderabad.
7. Krawetz., S.A. and Womble, D.D. 2009. Introduction to Bioinformatics – A theoretical and Practical Approach. Human Press, New Jersey.
8. Lesk, M.A. 2011. Introduction to Bioinformatics. Oxford University Press. UK.
9. Mount, W. 2001. Bioinformatics - Sequence and Genome analysis. Cold Spring Harbor Laboratory Press, New York.
10. Murthy, 2008. Bioinformatics, Himalayan Publishing House Pvt. Ltd., Mumbai.
11. Nanda, B.B., Tiwari, R.K. 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
12. Pevsner, 2009. Bioinformatics and Functional Genomics – The analysis of genes and proteins . II Edn. Wiley International Science Publications, New York.
13. Poklis. 1997. Forensic toxicology in, Introduction to Forensic Sciences, 2<sup>nd</sup> Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton.
14. Rajadurai, M. 2010. Bioinformatics – A practical approach, PBS Book Enterprises, Chennai
15. Roy, D. 2009. Bioinformtics. Narosa Publishing House, New Delhi.
16. Stekel, D. 2005. Microarray Bioinformatics. Cambridge University Press, UK.
17. Tilstone, W.J., M.L. Hastrup, M.L., and C. Hald, Fisher's, C. 2013. Techniques of Crime Scene Investigation, CRC Press, Boca Raton .
18. Twyman, R.H. 2003. Instant notes on Bioinformatics. Viva Books Ltd., New Delhi

**Course designer(s)**

1. Dr. M. Karthikeyan



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Year & Sem	: II Year: III Sem	Ext. Mks.	: 75
Sub. Code	: S3PBT3	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Statistics and Mathematical Modelling**

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

1. apply statistics in biological research
2. learn to apply modelling in biological problems

**Unit 1.** Definition – Descriptive and inferential statistic; population and sample in biological studies; variables – qualitative and quantitative; Representation of data – table, histogram, pie diagram, frequency curve and ogives; Basic concepts and principles in replication, randomization and control

**Unit 2.** Measures of central tendency -mean, median, mode; Measures of dispersion- range, quartile deviation, standard deviation, variance and standard error; Probability distribution (binominal, poisson and normal distribution); Confidence interval; Level of significance; Chi-square test and its application, goodness of fit.

**Unit 3.** Correlation - types, methods of correlation- graphic method, mathematical method, testing the significance of the coefficient of correlation; Regression analysis – equation, estimation of unknown value from known value; Analysis of variance and its application; Statistical softwares – SPSS and MS-Excel

**Unit 4.** Mathematical Modelling: Need, Techniques, Classifications and Simple Illustrations: Simple situations requiring mathematical modelling – The technique of mathematical modelling – Classification of mathematical models – Some characteristics of mathematical models. Mathematical Modelling through ordinary differential equations of first order: Populational growth models – growth of science and scientist – effects of immigration and emigration on population size.

**Unit 5.** Mathematical modelling through systems of ordinary differential equations of the first order: Prey – Predator models – Competitions models - A Simple epidemic model – A susceptible – Infected – Susceptible (SIS) model – SIS models with constant number of carriers – Simple Epidemic model with carriers – model with removal – model with removal and immigration.

**Text books:**

1. Gurumani, N. 2004. An Introduction to Biostatistics. MJP publishers, Chennai.
2. Kapur, J.N. 2005. Mathematical Modelling. New Age International Publishers Ltd., New Delhi.
3. Khan., IA, Khanum, A. (2004) Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad,

**Reference Books:**

1. Berg, H.V. 2011. Mathematical Models of Biological Systems Oxford University Press, New York
2. Britton, N.F. 2004. Essential Mathematical Biology. Springer-verlag, New Delhi
3. Daniel, W.W (2006) Biostatistics - A foundation for analysis in health sciences, John Wiley (Asia) & Sons, Singapore.
4. Green, D.G. 1990. Cellular automata models of crown-of-thorns outbreaks. In: Acanthaster and the coral reef: A Theoretical perspective. Springer-verlg, New York.
5. Gupta S.P. 1987. Statistical Methods. Sultan Chand & Sons Publishers, New Delhi
6. Khan., IA, Khanum, A. (2004) Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad,
7. Mishra, B.K. and Satpathi, D.K. 2007. Mathematical Modeling – Applications, Issues and Analysis. Ane Books India, New Delhi.
8. Misra, B.N. and Misra, B. K. 1998. Introductory Practical Biostatistics. Naya Prakash, Calcutta.
9. Palanichamy, S. Manoharan, M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.
10. Pillai, RSN and Bagavathi, V. 1989. Statistics Theory and Practice. S Chand & Company Ltd. New Delhi.
11. Renshaw, E. 1995. Modelling Biological Populations in Space and Time. Cambridge University Press. New York.
12. Rumbaugh, J., Blaha, M., Premerlani, W., Eddy, F. and Lorenzen, W. 1991. Object oriented ecosystem modelling and Design. Printice-Hall, New Jersey.
13. Scheffler, W.C. 1980. Statistics for the biological sciences. Addison-Wesley Publishing Company, New York.
14. Sokal, R.R. and Rohlf, F.J. 1987. Introduction to Biostatistics. W.H. Freeman and company, New York.
15. Sundar Rao, P.S.S. and Righard, J. 2002. An Introduction to Biostatistics. III Edn. Prentice Hall of India, New Delhi.
16. Zar, J.H. 2007. Biostatistical Analysis, IV Edn., Pearson Education Inc., New York.

**Course designer(s):**

1. Dr. C. Balachandran
2. Dr. D. Pandiaraja

**THIAGARAJAR COLLEGE, MADURAI – 9.**

**(Re-Accredited with ‘A’ Grade by NAAC)**

**NATIONAL CENTRE OF EXCELLENCE**

**M.Sc., BIOTECHNOLOGY**

**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: III Sem	Ext. Mks.	: 75
Sub. Code	: S3PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Health care biotechnology**

Course outcomes : On the completion of the course, the students will be able to  
1. elucidate the causes and the characteristics of genetic diseases  
2. know chemo and nano products for health care

**Unit 1.** Genetic disorders: Types – Definition and examples for monogenetic disorder (autosomal dominant, autosomal recessive, sex linked, maternal inheritance, imprinted genetic disorders) multifactorial disorders; Characteristics and genetic causes of Huntington’s disease, cystic fibrosis, haemophilia, mitochondrial genetic disorder, Prader-Willi syndrome, Alzheimer’s disease.

**Unit 2.** Diagnosis of genetic diseases: Carrier screening, prenatal diagnosis (amniocentesis, CVS, chemicals, ultrasonic sound, preimplantation genetic diagnosis), newborn genetic screening, pre-symptomatic testing, biochemical testing, Karyotyping, FISH and SKY, genetic microarray, exome sequencing

**Unit 3.** Gene therapy: Gene therapy strategies – gene augmentation, targeted killing of specific cells, targeted mutation correction, targeted inhibition of gene expression at DNA and protein level; types of gene therapy; somatic cell gene therapy (kidney and pulmonary), germ line cell therapy, stem cell therapy

**Unit 4.** Pharmaceutical Products – production and applications of somatostatin, insulin, interferons, B-cell growth factors, tissue plasminogen activator, blood products,

**Unit 5.** Bionanotechnology: Introduction to bionanotechnology and nanoparticles, biomedical applications of nanoparticles - drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels; functionalisation of nanomaterials and Targeted drug delivery; Imaging technique; quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular; Bionanosensors: nanocantilevers based on single stranded DNA.

**Text books:**

1. Balaji, S. 2010. Nanobiotechnology. MJ.P.Publications, New Delhi.
2. Kelly, E.B. 2013. Encyclopedia of human genetics and disease. ABC-CLIO/Greenwood, California.
3. Milunsky, A. And Milunsky, J.M. 2015. Genetic disorders and the Foetus: Diagnosis, prevention and treatment. Wiley-Blackwell Publishers, USA.

**Reference books:**

1. Bhatia, M. 2010. Nanotechnology. Anmol Publications Pvt.Ltd.,, New delhi.
2. Chattopadhyay, K.K. and Banerjee, A.N. 2012. Introduction to Nanoscience and Nanotechnology. PHI Learning Pvt. Ltd., New Delhi.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C.
5. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
6. Niemeyer, C.M. and Mirkin, C.A. 2006. Nanobiotechnology Concepts : Application and properties. Wiley, VCH Publishers.
7. Pasterneck, J.J. 2005. An introduction to Human Molecular Genetics. II Edn. Wiley-Blackwell Publsiher, USA.
8. Poole, Jr. C.P. and Owens, F.J. 2009. Introduction to Nanotechnology. Wiley India Pvt. Ltd., New Delhi.
9. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
10. Tuan Vo Dinh, 2007. Nanotechnology in Biology and Medicine: Method, Devices and Applications. CRC Press, USA
11. Verlinsky, Y. and Kuliev, A. 2004. An Atlas of preimplantation genetic diagnosis: An illustrated textbook and reference for clinician. II Edn. CRC Press, USA
12. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz , J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.

**Course desiner(s):**

1. Dr. N. Arun Nagendran
2. Mr. S. Kulandaivel

## THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)  
NATIONAL CENTRE OF EXCELLENCE  
M.Sc., BIOTECHNOLOGY

(For those who join in 2017 and after)

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: I Year: III Sem	Ext. Mks.	: 75
Sub. Code	: S3PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Food processing technology**

Course outcomes : On the successful completion of the course, the students will be able to  
1. understand the basic principles of processing of different food.  
2. know how the preparation of food varieties

**Unit 1.** Drying of grains; Processing of rice and rice products; Milling of wheat and production of wheat products, including flour and semolina; Milling, processing and production of corn, oat, sorghum, ragi products; Processing of tea and coffee

**Unit 2.** Manufacture of bread, cake and biscuits; Manufacture of bread rolls, sweet yeast dough products, pies and pastries, doughnuts, chocolates and candies; Analysis of bakery products;

Preparation of juice, jam, jelly, squash, marmalade, pickles, and sauce; Storage and handling of fresh fruits and vegetables; Preservation of fruits, vegetable and fruit juice

**Unit 3.** Varieties of milk; Manufacture of milk products evaporated milk, powder milk, condensed milk, cream butter, cheese, yogurt, ice cream, ghee.

Spoilage and preservation of milk

**Unit 4.** Meat processing - curing and smoking; Fermented meat products (meat sausages & sauces); Frozen meat & meat storage;

Processing of poultry meat and eggs; Spoilage and control;

**Unit 5.** Fish products - production of fish meal, fish protein concentrate, fish liver oil and fish sauce; Spoilage of Fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, Smoking and Curing.

### Text books:

1. Bhatti, S and Varma, U. 1995. Fruit and Vegetable Processing. CBS Publishers and distributors, New Delhi
2. Chakraverty A and De DS. 1981. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH.
3. Matz. S.A., 1991. Bakery technology and Engineering, Springer, New York.
4. Potter, N.N. and J.H. Hotchkiss. 1995. Food Science, V Edn. Springer, New York

### Reference books:

1. Cruess W.V. 2000. Commercial Fruit and Vegetable Products. Agrobios
2. Harper, J.M. 1981. Extrusion of Food, Vol 2. CRC Press. Florida.
3. Jongen, W. 2002. Fruit and vegetable processing, I Edn. Woodhead Publishing. Elsevier, Amsterdam
4. Srivastava R.P and Sanjeev Kumar. 1994. Fruit and Vegetable Preservation. Principles and Practices. International Book Dist. Mumbai.
5. Thompson A.K. 1996. Post Harvest Technology of Fruits and Vegetables. Blackwell.
6. Verma L.R and Joshi V.K. 2000. Post Harvest Technology of Fruits and Vegetables. Vols. I-II. Indus Publishing Company, New Delhi.

### Course designer(s):

1. Dr. N. Arun Nagendran
2. Mr. S. Kulandaivel

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: III Sem	Ext. Mks.	: 60
Sub. Code	: S3PBTL1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in Immunology & Immunotechnology**

1. Preparation of soluble antigen – human serum
2. Preparation of cellular (particulate) antigen - bacterial antigen
3. Separation and preservation of serum / complements.
4. Determination of differential leukocyte count.
5. Isolation and enumeration of lymphocytes from human blood.
6. Determination of lymphocyte viability by trypan blue exclusion test.
7. Identification and enumeration of human T – lymphocyte using E – rosette technique
8. Direct agglutination to determine ABO blood grouping
9. Visualization and study of Lymphoid Organs from mice and Chicken (Model)
10. Immunization protocols
11. Routes of antigen administration.
12. Demonstration of natural resistance to infection by bacterial killing of serum factors.
13. Electrophoretic separation of serum proteins.
14. Immunoelectrophoretic technique
15. Agarose Ouchterlony double immunodiffusion.
16. Mancini single radial immunodiffusion.
17. Haemagglutination titration assay.
18. Immunodiagnosis – Pregnancy test, HIV/ WIDAL

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
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**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: III Sem	Ext. Mks.	: 60
Sub. Code	: S3PBT2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in Bioinformatics and biostatistics**

1. Retrieval of nucleotide sequence data and protein sequence data.
2. Pair-wise sequence alignment by using BLASTn and BLASTp.
3. Multiple sequence alignment by using ClustalW.
4. Primer designing using free internet software.
5. Phylogenetic analysis of protein and nucleic acid by using MEGA-4.
6. Retrieving PDB sequence data and analysis of secondary structure
7. Protein prediction – nep cutter and pep cutter
8. Homology modeling of a protein using SPDBV.
9. Gene profiling
10. Bioengineering using DOCK – ADAM
11. Graphical representation of data
12. Evaluating mean, median, mode, standard deviation and its interpretation
13. Test of significance using Z test, t test, Chi square test
14. Non parametric test: Mann Whitney, Kruskal Wallis
15. ANOVA
16. Finding the Correlation coefficient for the given data
17. Fitting the Regression lines for the given data

Note:

Wherever necessary/possible, Statistical practicals will be conducted using MS-Excel, SPSS

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
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**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 75
Sub. Code	: S4PBT1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Bioprocess technology**

Course outcomes On completion of the course, the students will be able to

1. understand the basic principles of fermentation process
2. explain the process involved in the industrial production of microbial products

**Unit 1.** Introduction to Bioprocess engineering; Isolation of productive strains; screening - primary and secondary screening; strain improvement – mutation, protoplast fusion and recombinant DNA techniques; Preservation techniques - serial sub-culture, mineral oil, freeze drying, N<sub>2</sub> storage, Storage of fungi - soil culture, silica gel culture and water storage; fermentation media – carbon and nitrogen sources, media formulation – Packet-Burmen design and Box Wilson design

**Unit 2.** Types of fermentation - solid state fermentation and submerged fermentation; types of substrates; methods of fermentation - batch, continuous and fed batch system; Types and design of fermentors - batch, CSTF, air lift, tower, bubble column, fluidized bed fermentor; auxiliary equipments; sterilization – batch sterilization, continuous sterilization (media and fermentor), sterilization of air, sterilization kinetics of cell death

**Unit 3.** Material balance in biological system; energy balance in biological system; growth kinetics in batch and continuous cultures; maintenance requirement; mass transfer and heat transfer; production kinetics in fed batch culture; feed of concentrated media, feed of dilute substrate; Cell and enzyme immobilization and its applications

**Unit 4.** Inoculum development, production, recovery and assay of antibiotics (penicillin, streptomycin) and Vitamins (cyanocobalamine, riboflavin), amino acids (glutamic acid, phenylalanine), and organic acids (citric acid, vinegar) and enzymes (amylase, protease), alcoholic beverages (alcohol and wine)

**Unit 5.** Downstream processing – release of intracellular compounds – physical and chemical methods; methods of recovery - filtration, centrifugation, precipitation, liquid-liquid extraction, chromatography, dialysis, reverse osmosis, drying, crystallization, lyophilization



**Text books:**

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

**Reference Books:**

1. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
2. Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
3. Cruger, W., Cruger, A. and Brock, T.D. 1991. Biotechnology, A Text book of Industrial Microbiology
4. Demain A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology & Biotechnology. ASM press.
5. 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.
6. Flickinger, M.C. and Drew, S.W. 1999. Encyclopaedia of Bioprocess Technology Fermentation, Biocatalysis and Bioseparation Vol. V., John Wiley and Sons Publications.
7. Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology – Fundamentals of Applied Microbiology. W.H. Freeman and Company. New York.
8. Peppler, H. and Pearman, D. 2008. Microbial Technology, II Edn. Vol.I, Academic Press, New York.
9. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New Delhi.
10. Stanbury, P.F, Whitaker, A. and Hall, S.J.1999. Principles of Fermentation technology, II Edn. Aditya Book (P) Ltd., New Delhi.
11. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, London.

**Course designer(s):**

1. Mr. S. Kulandaivel

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 75
Sub. Code	: S4PBT2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Rural and entrepreneurial biotechnology**

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

1. explain the basics of environmental biology
2. integrate biotechnological principles to solve ecological problems

**Unit 1.** Organic farming – green manure, green leaf manure, farm yard manure, concentrated organic manure (oil cakes), panchagavya, Dasagavya, composting – vermicompost, coir compost, composting of poultry waste

**Unit 2.** Mushroom cultivation – edible and non-edible mushroom, Preparation of mother spawn, bed spawn, bed preparation, production technology (paddy straw mushroom, oyster mushroom, milky mushroom, button mushroom), post harvest technology  
SCP – cultivation of spirulina, baker’s yeast

**Unit 3.** Biofertilizers - mass production and mode of application of *Rhizobium*, *Azospirillum*, phosphate solublizers, iron chelators, AM;  
Biopesticides large scale cultivation and mode of application of *Bacillus thuringiensis*, *Beauveria bassiana*, NPV, CPV

**Unit 4.** Biotech parks – concept, functions, facilities and services; initiatives of government, BCIL (Biotech Consortium of India Limited), CSIR, DBT, DST, NSTEDB (National Science and Technology Entrepreneurship Development Board); regulations and requirements

**Unit 5.** Market potential, production capacity, project costs, cost analysis and regulation for organic farming and commercial production of biofertilizer, biopesticides and enzymes

**Text books:**

1. Anonymous. 2007. Entrepreneurship development programme in biotechnology. Department of biotechnology of India.
2. Anonymous. Organic farming. TNAU agricultural portal, [agritech.tnau.ac.in/org\\_farm/orgfam\\_index.html](http://agritech.tnau.ac.in/org_farm/orgfam_index.html).

**Reference books:**

1. Alexander M. 1997. Introduction to soil microbiology, John Wiley & Sons, Inc, New York.
2. Benwart, G.J. 1987. Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
3. Deak, T. and Beuchat, L.R. 1996. Hand Book of Food Spoilage yeasts, CRC Press, New York.
4. Mehrotra, R.S. 1983. Plant Pathology, Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Pandey, B.P. 1997. Plant Pathology (Pathogen & Plant Disease), S.Chand & Company Ltd., New Delhi.
6. Ray Chadhuri, S.P. 1977. A Manual of Virus Diseases of Tropical Plants, MacMillan Company of India Ltd., Delhi.
7. Rengaswami, G. and Rajagopalan, S. 1973. Bacterial Plant Pathology – Tamil Nadu Agriculture University, Coimbatore.
8. Subba Rao, N.S. 2000. Soil Microorganisms and Plant Growth, Third Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

## Course designer(s):

1. Dr. N. Arun Nagendran
2. Mr. S. Kulandaivel

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 60
Sub. Code	: S4PBT3	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 06

**: Project**

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 75
Sub. Code	: S4PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Environmental Biotechnology**  
Course outcomes : On successful completion of the course, the students will be able to  
1. explain the basics of environmental biology  
2. apply biotechnological principles to solve ecological problems

**Unit 1.** Ecosystem and its components; Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factors; Energy flow, food chain, food web and trophic levels; types of pollution and their effects – land, water and air, global climate change and its impact.

**Unit 2.** Waste water treatment - Waste water collection, Physico-chemical properties of water; primary treatment – anaerobic digesters, secondary treatment – oxidation ponds, trickling filters, tertiary treatment – activated charcoal, chlorination  
Solid waste management – sources, steps involved in solid waste management, solid waste disposal – open dumping, sanitary landfills, thermal treatment, biological treatment

**Unit 3.** Biotechnology for processing and waste management in pesticide, tannery, textile, dye and food industries; Biodegradation of hydrocarbons, Bioleaching of copper and uranium; e-waste and hospital waste management. Bioremediation – types, biomechanism of metal chelation and detoxification; Bioenergy production (hydrogen production, biodiesel from algae); bioplastics

**Unit 4.** Application of nanotechnology in pollution abatement – photocatalyst oxidation (TiO<sub>2</sub> based nanoparticles), reduction (iron based nanoparticle), absorption (nanoclay), encapsulation (dendrimers), nanofiltration (nanosieve membranes); nanosensors, CO<sub>2</sub> capture, adsorption of toxic gases

**Unit 5.** EIA: Introduction, definition, Objectives, basic principles and classification; Strategic EIA (SEIA), Regional EIA, Sectoral EIA, Project Level EIA and Life Cycle Assessment, Project Cycle, Grouping of Environmental Impacts - direct impacts, indirect impacts, cumulative impacts and induced impacts; Significance of impacts - criteria/methodology to determine the significance of the identified impacts.

**Text books:**

Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.

Jogdand, S.N.2010. Environmental Biotechnology, Himalaya Publishing House. New Delhi

**Reference Books:**

Allsopp, D., and J.Seal, 1986, Introduction to Biodeterioration, Edward Arnold Pub. London.

Chatterji, A.K. 2005.Introduction to Environmental Biotechnology.

Markandy, D.K and N. Rajvaidys. 2004. Environmental Biotechnology. APH Publishing Corporation, New Delhi.

Mohapatra, P.K. 2006. Text book of environmental biotechnology, I.K. International publishing house, New Delhi.

Norris, R.D. 1994, Handbook of Bioremediation, Lewis Publishers, London.

Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New Delhi.

Rajendran, P and Gunasekaran, P. 2006. Microbial Bioremediation. MJP Publishers, Chennai.

Stilling, P. 2009. Ecology – Theories and Applications. IV Edn., Pearson Education Inc. New Jersey.

Subba rao, N.S. 2001. Soil microbiology. Raju Primplani Publishing Pvt. Ltd., New Delhi.

**Course designer(s):**

1. Dr. N. Arun Nagendran
2. Mr. S. Kulandaivel

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 25
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 75
Sub. Code	: S4PBTE1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 04

Title of the paper : **Nanobiotechnology**

Course outcomes : On successful completion of the course, the student will be able to

1. explain the methods of synthesise, characterization of nanoparticles
2. gain knowledge on the applications of nanoparticles

**Unit 1.** Introduction to Nanoscience and basic concepts; Interaction of surface molecules and its chemical and physical properties; Nanoprocessess in nature - lotus effect, colour patterns in butterflies, adhesive pads in lizards; Different types of nanoparticles - metallic nanoparticles - Gold/silver, titanium based, non metallic nanoparticles - carbon and silicon based.

**Unit 2.** Synthesis of nanoparticles - solid state, vapour state and solution based (mechanical ball milling, sol gel process, chemical vapor deposition); Characterization of nanoparticles - spectroscopic methods (UV-visible, FTIR, Raman spectroscopy, NMR), microscopic (AFM, Scanning and Transmission Electron microscopy), Structural (XRD), EDAX

**Unit 3.** Fabrication of nanomaterials: Lithography and Thin film deposition, high energy Arc discharge. Polymer nanoparticles, biomaterials, nanocomposites- Its Significance and application.

**Unit 4.** Biomedical applications of nanoparticles: drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels; functionalisation of nanomaterials and Targeted drug delivery. Imaging technique; quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular; Bionanosensors: nanocantilevers based on single stranded DNA.

**Unit 5.** Health and environmental issues about nanoparticles. Nanotoxicology, Immune response to nanoparticles, Safety concerns about using nanotechnology. The National Personal Protective Technology Laboratory (NIOSH) Guidelines for working with nanomaterials.

**Text books:**

Balaji, S. 2010. Nanobiotechnology. MJ.P.Publications, New Delhi.

Tuan Vo Dinh, 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. Nanobiotechnology Concepts : 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(s):**

1. Dr. Poornima Kkani



**THIAGARAJAR COLLEGE, MADURAI – 9.**  
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**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 60
Sub. Code	: S4PBTL1	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in Bioprocess technology and Environmental biotechnology**

1. Demonstration of fermentation using Kuhn’s fermentation vessel.
2. Screening, production and assay of amylase from microbes
3. Screening, production and assay of protease from microbes
4. Screening, production and assay of citric acid from microbes
5. Screening of antibiotic producing microbes
6. Production and assay of glutamic acid from microbes
7. Production and estimation of alcohol
8. Production and quantitative analysis of wine
9. Bacterial cell /enzyme immobilization in sodium alginate gel
10. Cell disruption for endoenzymes by sonication
11. Enzyme purification by acetone precipitation
12. Estimation of biomass and substrate concentration in fermentation, determination of kinetic parameters (yield and productivity)
13. Physico chemical analysis of effluents – TS, TSS, TDS, Acidity, Alkalinity, BOD
14. Screening of biodegrading microbes from industrial effluents
15. Biodegradation of dyes using microbes
16. Microbial assessment of waste water - MPN method and microbial load analysis
17. Submission of environmental diary (activity based)

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**NATIONAL CENTRE OF EXCELLENCE**  
**M.Sc., BIOTECHNOLOGY**  
**(For those who join in 2017 and after)**

Course	: M.Sc., Biotechnology	Int. Mks.	: 40
Year & Sem	: II Year: IV Sem	Ext. Mks.	: 60
Sub. Code	: S4PBTL2	Max.Mks.	: 100
Hours/Week	: 5	No. of Credits	: 03

Title of the paper : **Lab in rural and entrepreneur biotechnology**

1. Preparation of panchakavya
2. Production of vermicompost
3. Production of coir compost
4. Production of poultry waste compost
5. Preparation of spawn for mushroom cultivation
6. Production of mushroom
7. Isolation of AM fungi/spore
8. Isolation and identification of BT endospore
9. Isolation of rhizopium
10. Isolation of phosphate solublizing bacteria
11. Cultivation of rhizopium
12. Drafting budget proposal for organic farming, commercial production of biofertilizer /  
biopesticide /enzymes