

Dr. G. R. DAMODARAN COLLEGE OF SCIENCE (AUTONOMOUS), COIMBATORE - 14  
M. Sc. BIOTECHNOLOGY, Scheme under CBCS – 2019 – 2020

EIV - 01  
2019-20

Sem	Category	Course Title	Credits	Marks			Hrs/ Wk	Exam duration
				CA	TEE	Total		
I	Core	Biochemistry	4	25	75	100	5	Theory : 3 hrs  Practical : 9 hrs
	Core	Applied Microbiology	4	25	75	100	5	
	Core	Molecular Biology and Genetics	4	25	75	100	5	
	Core	Practical I - Lab in Analytical Biochemistry	4	40	60	100	5	
	Core	Practical II - Lab in Applied Microbiology	4	40	60	100	5	
	Elective	Computational Biology and Omics <sup>s</sup>	4	25	75	100	5	
II	Core	Bioprocess Technology	4	25	75	100	5	
	Core	Plant Biotechnology	4	25	75	100	5	
	Core	Research Methods and Biostatistics	4	25	75	100	5	
	Core	Practical III - Lab in Industrial Biotechnology	4	40	60	100	5	
	Core	Practical IV - Lab in Plant Biotechnology	4	40	60	100	5	
	Elective	Subject chosen from Group I	4	25	75	100	5	
III	Core	rDNA Technology and Medical Biotechnology	4	25	75	100	5	
	Core	Immunology and Animal Biotechnology	4	25	75	100	5	
	Core	Food Biotechnology	4	25	75	100	5	
	Core	Practical V - Lab in Genetic Engineering and Animal Biotechnology	4	40	60	100	5	
	Core	Practical VI - Lab in Immunotechnology and Food Biotechnology	4	40	60	100	5	
	Elective	Subject chosen from Group II	4	25	75	100	5	
	Core	Internship**	4	NA	100	100	-	
IV	Elective	Subject chosen from Group III *	4	25	75	100	3	
	Core	Project***	10	25	75	100	30	
<b>TOTAL</b>			<b>90</b>			<b>2100</b>		

**ELECTIVE PAPERS:**

Semester II Elective	Semester III Elective	Semester IV Elective*
Group I	Group II	Group III
Biophysics and Bioinstrumentation	Genomics and Proteomics	Bioentrepreneurship
Nanobiotechnology	Systems Biology	Biosafety, Bioethics and IPR
Biopharmaceuticals	Cancer Biology	Protein Engineering and Cell Signalling
Agricultural Biotechnology	Marine Biotechnology	Biobusiness

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\* Self Study – Both CA and TEE internal evaluation only

\*\* Internship - Internal evaluation only, report to be evaluated by not less than two faculty members

**Break up for Internship Evaluation:**

1. Content of the report	: 30 marks
2. Methodology and Instrumentation	: 30 marks
3. Duration of the project	: 5 marks
4. Practical skills gained	: <u>35 marks</u>
<b>Total</b>	<b><u>100 marks</u></b>

**\*\*\*Project**

In the TEE the project report will be evaluated and viva voce test will be conducted jointly by the internal (research supervisor) and external examiner.

**Break up for CA**

1. Interaction frequency and attendance	: 5 marks
2. Timely submission of drafts and proofing	: 5 marks
3. Value Addition/ original ideas	: 10 marks
4. Application of concepts and work execution	: <u>5 marks</u>
<b>Total</b>	<b><u>25 marks</u></b>

**Break up for TEE (25 marks)**

1. Clarity of presentation	: 15 marks
2. Content of report	: <u>10 marks</u>
<b>Total</b>	<b><u>25 marks</u></b>

**Break up for TEE (50 marks)**

1. Methodology	: 10 marks
2. Literature review	: 10 marks
3. Dissertation preparation	: 10 marks
4. Results and discussion	: <u>20 marks</u>
<b>Total</b>	<b><u>50 marks</u></b>

Teaching hours for all theory subjects is allocated as 55 - 60 hours. Teaching hours are not same for all subjects.

\$ - Computational Biology and Omics – 2 Internal Assessments; Mid term Exam will include Theory only and Model Exam will include Practical Only.

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Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

SEMESTER-I

CORE: BIOCHEMISTRY

**Objective of the subject:** This paper presents the study of biomolecules, studies of their structure, determining how they are synthesized metabolized and degraded in organisms, and elucidating their role in the operation of the organism. The students will get an overall understanding of structure of atoms, molecules and chemical bonds, enzyme kinetics, biopolymers and metabolic reactions in a living system.

**UNIT I:**

(12 hours)

**Chemistry of Biomolecules: Carbohydrates-** Classification, Structure, Reaction of Monosaccharides, Structure and properties of Disaccharides and Polysaccharides, artificial sweeteners (aspartame, amino asparagine, saccharin, neoasparagine).

**Lipids** –Structure and classification of lipids- Simple, compound and derived lipids, physical and chemical properties of fats, industrial uses of lipids.

**UNIT II:**

(12 hours)

**Chemistry of Biomolecules: Amino acid and Proteins-** Structure, and Classification of amino acids, chemical reactions of amino acids due to Carboxyl groups and amino groups. Peptides and peptide bond, classification of proteins. Levels of organization-primary, secondary, tertiary and quaternary structure. Bonds involved in protein structure, protein denaturation (reversible and irreversible). **Nucleic Acids-** Structure of purines and pyrimidines, nucleotides, DNA, structure of DNA double helix (A, B and Z forms), RNA structure- mRNA, tRNA, rRNA, snRNA; unusual bases (pseudouridine, dihydrouridine, ribothymine, inosine) Biosynthesis of purines and pyrimidines.

**UNIT III:**

(11 hours)

**Metabolism of Carbohydrates:** Glycolysis, TCA cycle, Starch and Glycogen metabolism, Gluconeogenesis, Pentose phosphate pathway, Electron transport chain,



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Oxidative phosphorylation, Glucuronic acid synthesis and Glyoxylate cycle, Metabolism of other Hexoses, Regulation of carbohydrate metabolism.

**UNIT IV:**

(12 hours)

**Lipid Metabolism:** Oxidation of Fatty acids, Biosynthesis of Saturated and Unsaturated fatty acids, Biosynthesis of Lecithin, Cephalin, Inositol, Phosphatidyl serine, Cholesterol, Biosynthesis of glycolipids. Fate of dietary proteins-transamination, oxidative deamination, non-oxidative deamination, Biosynthesis and oxidation of amino acids, Urea cycle.

**UNIT V:**

(12 hours)

**Enzymes:** Enzymes as catalysts: International classification of enzymes; extraction, purification and characterization of enzymes. Basic principles and factors affecting enzyme activity. Michaelis Menten equation, active sites, coenzymes, inhibitors (reversible and irreversible), isoenzymes. Mechanism of enzyme regulation- allosteric enzymes with reference to aspartate transcarbomylase. Industrial uses of enzymes (amylase, protease).

**REFERENCES:**

1. Biochemistry, Donald Voet, Judith G. Voet, Published by J. Wiley & Sons, 2010, Edition: 4.
2. Harper's Illustrated Biochemistry, Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Published by McGraw-Hill Professional, 2012, Edition: 29.
3. Biochemistry, Geoffrey L. Zubay, Published by Wm.C. Brown Publishers, 1993, Edition: 3.
4. Lehninger principles of biochemistry, Albert L. Lehninger, David Lee Nelson, Michael M. Cox, Published by W.H. Freeman, 2008, Edition: 6.
5. Biochemistry, Jeremy Mark Berg, John L. Tymoczko, Lubert Stryer, Published by W. H. Freeman, 2006, Edition: 7.
6. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, Published by Horwood Publishing Limited, 2001, Edition: 5.
7. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto. W.H.Freeman & Co Ltd, 2015, edition:8.
8. Principles of biochemistry, Laurence A. Moran , Robert A. Horton , Gray Scrimgeour , Marc Perry , David Rawn. Pearson Education Limited, 2013.

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Subject code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - I

CORE: APPLIED MICROBIOLOGY

**Objective of the subject:** This paper aims to empower the students regarding the microorganisms, microscopy principles, use of microbes in environment and genetic engineering and its application in food and industry.

**UNIT I:**

(12 hours)

**Introduction to Microbiology:** History of Microbiology - Ultra structure of bacterial cell - Growth phases - Generation time, Batch culture, continuous culture, synchronous culture (definition and brief description). Physical factors influencing growth – Temperature, pH, osmotic pressure, salt concentration. Classification of algae, protozoa and fungi. General properties and outline classification of viruses - structure and properties of T4 phage, Tobacco mosaic virus and HIV. Pure culture techniques. Control of microbial growth. Working principle and construction of bright field, dark field, phase contrast and Electron microscopy (TEM and SEM).

**UNIT II:**

(12 hours)

**Environmental Microbiology:** Brief account of microbial interactions (symbiosis, neutralism, commensalism, competition, ammensalism, synergism, parasitism, and predation); Biological nitrogen fixation - symbiotic and asymbiotic; Biofertilizers, Biological pest control. Carbon, Nitrogen, Phosphorus, and Sulphur cycles. Different types of microorganisms in air, aerosols and air sampling techniques. Coliform test - detection of faecal coliform; Treatment of municipal wastewater.

**UNIT III:**

(11hours)

**Food Microbiology:** Normal microflora in milk, meat, poultry, eggs, fruits and vegetable; fresh food, canned food and stored grains; milk quality tests, Microbiology of fermented food: curd, cheese, idli, yogurt, acidophilic milk. Microorganisms as food - SCP: *Spirulina* and Edible mushrooms; Food borne diseases: Salmonellosis and Shigellosis.

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**UNIT IV:**

(12 hours)

**Industrial Microbiology:** Primary screening and secondary screening of industrially important strains; strain improvement through random mutation (random and rational selection), genetic recombination and genetic engineering; preservation. Microbial production of organic acids - citric acid; antibiotics – Streptomycin; enzymes- amylase; vitamins - B12; Alcoholic beverage – Beer. Mineral leaching by microorganisms.

**UNIT V:**

(12 hours)

**Microorganisms in cloning technology** – Applications of *Escherichia coli*, *Bacillus subtilis*, *Streptomyces* and *Saccharomyces cerevisiae* in cloning technology. Types of vectors - plasmids - host range and incompatibility - Vectors constructed based on bacteriophages (M13 and Lambda), cosmids, phasmids, phagemids and BACs - Yeast vectors. Animal virus as vectors: Simian virus 40, Adeno virus, Retrovirus, Vaccinia virus and Baculovirus.

**REFERENCES:**

1. Principles of Microbiology - Atlas R M, WCB McGraw Hill Publications, New Delhi, 2015, Edition: 2.
2. Microbiology: Principles and Explorations - Black J G, Prentice Hall International, Inc. 2015, Edition: 9.
3. Microbiology – Prescott L M, Harley J P and Klein D A, Tata McGraw Hill, New Delhi. 2015, Edition: 7.
4. Fundamentals of Microbiology - Alcamo E, Jones and Bartlett Publishers, New Delhi, 2001, Edition: 9.
5. Environmental Microbiology - Mitchell R., John Wiley and Sons, New York. 2016. Edition: 2.
6. Microbial Ecology - Fundamentals and Applications - Atlas R N and Bartha R, Redwood City C A Benjamin / Cumming. 1998, Edition: 4.
7. Microbial Ecology - Campbell R., Blackwell Scientific Publication, London. 1983, Edition: 2.
8. Modern Food Microbiology - Jay J M, Chapman and Hall Inc, New York, 2006. Edition: 7.
9. Food Microbiology - Frazier W C and West Hoff D C, Tata McGraw Hill Ltd, New Delhi, 1989, Edition: 8.
10. Principles of fermentation Technology - Stanbury P F, Whittaker A and Hall S J, Aditya Books (P) Ltd., New Delhi. 2016, Edition: 3.
11. Biotechnology - A Textbook of Industrial Microbiology, Cruegar and Cruegar, Panima publishing Corporation, New Delhi. 2002, Edition: 2.



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12. Gene Cloning and DNA analysis- An introduction - Brown T A, Blackwell Science Ltd., London. 2010, Edition: 6.
13. Genetic Engineering: Concepts and Applications by R. Suganthi and C.S. Shobana, Published by Kalaikathir Achchagam, Coimbatore - 37, 2013, Edition:1

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Subject Code:

Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

SEMESTER - I

CORE: MOLECULAR BIOLOGY AND GENETICS

**Objective of the subject:** This paper provides insight on replication, transcription and translation processes in prokaryotes and eukaryotes, various mutations, their repair mechanisms. The major objective of the paper is to provide knowledge of molecular biology and genetics of prokaryotic and eukaryotic organisms to the students. Helps the student understand and apply this knowledge in research to study the molecular mechanism of mutation, repair in eukaryotes and prokaryotes.

**UNIT I:**

**(11 hours)**

**Cell Biology:** Cell architecture- structure and function; Organelles. Cell cycle - molecular aspects of mitosis and meiosis. Regulation of eukaryotic cell cycle; membrane architecture and function; Transport across membranes; cytoskeleton.

**UNIT II:**

**(11 hours)**

**Gene Structure:** Structure of prokaryotic and eukaryotic gene; Human genome; Chromosome architecture.

**DNA replication:** Enzymes and proteins, mechanism, differences between prokaryotic and eukaryotic replication; Restriction and modification systems.

**UNIT III:**

**(12 hours)**

**Gene Expression and Regulation in Prokaryotes:** Transcription - RNA Polymerase, promoters, mechanism; Processing of rRNA, tRNA; Translation- ribosome structure and role; tRNA structure and role; Mechanism of protein synthesis. Regulation: The lac operon- positive and negative control; Trp operon- repression, attenuation and anti-termination, RNA editing, ribozymes; Riboswitches and global regulation of gene expression.

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**UNIT IV:**

**(12 hours)**

**Gene Expression and Regulation in Eukaryotes:** Transcription- promoters, enhancers, response elements, TF's, RNA polymerases- I, II and III, mechanism; rRNA, tRNA, mRNA processing- poly A tailing, capping, splicing, RNA editing; Translation-mechanism; post translational modifications; Regulation: transcriptional control, mRNA transport control, RNA processing control, translation control, mRNA degradation control, protein degradation control and tissue specific control.

**UNIT V:**

**(12 hours)**

**Gene as a Unit of Mutation and Recombination:** Mutation types- forward, reverse and suppressor; Mutagenesis- spontaneous and induced. DNA repair mechanisms- direct reversal; Excision repair (base excision, nucleotide excision and mismatch); recombinational repair; SOS response and SOS bypass. Recombination - Models; Rec A, RecBCD, Ruv ABC, and molecular mechanism of recombination. Conjugation; transformation and transduction. Transposons - simple and complex in prokaryotic and eukaryotic systems.

**REFERENCES:**

1. Genes X by Benjamin Lewin. Published by Oxford University Press, U.K., 1997. Edition: 8.
2. Molecular Cell Biology by Darnell, Lodish, Baltimore. Published by Scientific American Books, Inc., 1994, Edition:5
3. Genomes 2 by T A Brown. Published by Garland Science Publishing, New York. 2002, Edition: 2.
4. Genetics: A Conceptual Approach by Benjamin A Pierce. Published by Freeman and Company, New York. 2005. Edition: 2.
5. Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness. Published by ASM Press, Washington DC. 2007. Edition: 3.
6. Molecular Biology by David P Clark. Published by Elsevier Press. 2006, Edition: 2.
7. Cell and Molecular Biology by Gerald Karp. Published by John Wiley, 2009 Edition: 6.



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8. Molecular Biology of the Cell by Alberts, Bruce et al. Published by Garland Science, Taylor & Francis, 2012, Edition: 5.
9. The Cell- A Molecular Approach by G.M. Cooper. Published by ASM Press, Washington. 1997, Edition : 1.
10. BRS Biochemistry, Molecular Biology, and Genetics, Michael Lieberman , Rick E. Ricer. Lippincott Williams and Wilkins, 2013.
11. Genetics: A Conceptual Approach, Benjamin A. Pierce. Mar, W.H. Freeman & Co Ltd, 2014.

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Subject code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - I

CORE: LAB IN ANALYTICAL BIOCHEMISTRY

**Objective of the subject:** To give overall understanding of common instruments used for analysis. Starting with practical exercises on techniques then moving on to experiments with biological molecules and their analysis using quantitative and qualitative techniques.

**Outline of the laboratory programme:** The first section deals with the principles of the use of common instruments like colorimeter, pH meter etc, and also standard separation techniques like chromatography. In the second section on biomolecules the analysis of carbohydrates, lipids etc.

1. Colorimetry and Spectrophotometry
2. pH and Buffer Solutions
3. Methods of protein Estimation (Lowry, Biuret Method)
4. Estimation of carbohydrates by anthrone method
5. Determination of reducing sugars using 3, 5, dinitrosalicylic acid
6. Estimation of blood cholesterol
7. Estimation of Vitamin C
8. Quantification of Amino acid
9. Determination of the acid value, Saponification value, Iodine number of fat
10. Thin layer chromatography
11. Paper chromatography
12. Gel Permeation Chromatography
13. PAGE
14. Silver staining of protein

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**REFERENCES:**

1. Principles of Instrumental Analysis by D.A. Skoog, F. J. Holler and T.A. Nieman. Published by Saunders. 1998. Edition: 6.
2. Laboratory Manual of Biochemistry by J. Jayaraman. Published by Wiley Eastern. 1981. Edition: 2.
3. Protein Methods by Daniel M. Bollag *et al.* Published by Wiley-Liss, Inc. 1996. Edition: 2.
4. Biochemical Methods by S. Sadasivam and A. Manickam Published by Reprint New age international (P) Limited. 1996. Edition: 3.
5. An Introduction to practical Biochemistry by David T Plummer. Published by Tata Mcgraw hill Publication. 1971. Reprinted 2004. Edition: 3.



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Subject code:

**Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE**

**M. Sc. BIOTECHNOLOGY 2019 onwards**

**SEMESTER - I**

**CORE: LAB IN APPLIED MICROBIOLOGY**

**Objective of the Subject:** The scope of this work is to make the students understand basic and applied Microbiology techniques in detail and to give an apparent depiction of the complete microbiology techniques starting from isolation to application.

**Outline of the laboratory Programme:** This Practical course covers the area of Isolation (All Pure culture techniques), Identification (Morphology and Biochemical) and application of microbes.

1. Safety guidelines in Microbiology laboratory practices.
2. Study of aseptic techniques-Disinfection
3. Preparation of culture media for growth of microorganisms.
4. Isolation and Identification of various microorganisms (Bacteria, Fungi and Yeasts) from soil and water.
5. Study of colony characteristics and morphology of bacteria.
6. Staining of Microorganisms - Gram's stain, simple stain, Lactophenol Cotton Blue Stain for fungi.
7. Biochemical tests used for the identification of microorganisms.
  - a. Fermentation of carbohydrates-glucose.
  - b. Starch hydrolysis.
  - c. Gelatin liquefaction.
  - d. Urease test.
  - e. Catalase test.
  - f. Oxidase test.
  - g. Triple sugar Iron agar test (TSIA).
  - h. Nitrate reduction Test.
  - i. Indole Test.
  - j. Methyl red and VP Test
  - k. Citrate utilization test

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8. Counting of microorganisms by using Haemocytometer (yeast sample)/ DMC.
9. Study of bacterial motility by Hanging Drop Method.
10. Isolation of rhizosphere/phyloplane microflora microflora
11. Isolation of actinomycetes from soil.
12. Assay of antibiotics by agar disc method and dilution method
13. Isolation of *Rhizobium* from legume root nodules
14. Vesicular Arbuscular Mycorrhiza (VAM)

**REFERENCES:**

1. Microbiology: A Laboratory Manual, James G. Cappuccino, SUNY, Rockland Community College. Chad T. Welsh, Lindenwood University. 11th Edition.
2. Manual of Microbiology Tools and Techniques by Kanika Sharma, Published by Ane Books, 2007. Edition: 4.
3. Laboratory Manual on Biotechnology- Prof. P.M. Swamy, Published by Rastogi Publications, 2008, Edition:1.
4. Laboratory Manual in General Microbiology. N. Kannan. Publisher, Panima Publishing Corporation.



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Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - I

**ELECTIVE: COMPUTATIONAL BIOLOGY AND OMICS**  
(QUESTIONS SHOULD BE TAKEN FROM UNIT I – IV, EXCLUDING UNIT V)

**Objective of the subject:** To impart basic knowledge in the fields of databases, sequence alignment, evolutionary studies. There is a necessity to furnish and educate students in the promising field of OMES and OMICS for fulfilling an industry needs.

**UNIT I:**

**(12 hours)**

**Biological databases:** Introduction to Bioinformatics. Biological databases: Types and classification with respect to the sequence: Primary nucleic acid sequence databases, Primary protein sequence databases, secondary and composite databases. Other Popular Resources in NCBI: PubMed and OMIM. KEGG. **Sequence Alignment:** Definitions: homology, similarity, identity and gaps. Pairwise and multiple sequence alignment methods. Local and global alignment: Needleman Wunsch and Smith Watermann Algorithm. **Similarity Searching and Phylogenetic analysis:** BLAST, phylogenetic tree construction methods.

**UNIT II:**

**(12 hours)**

**Structural Databases:** Protein Data Bank. Protein Structure Classification Databases: SCOP and CATH. **Protein Structure Modeling** - Comparative modeling, Abinitio prediction, threading, Protein folding. **Molecular Docking**, Drug designing: Structure based and ligand based drug designing. **Molecular Visualization:** Swiss-PDB Viewer and RasMol - Importance of molecular visualization.

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(12 hours)

**UNIT III:**

**Genomics and Transcriptomics** - Definition, genome features of prokaryote and eukaryote - Human Genome Project (HGP) - sequencing strategies, concept of genetic and physical maps. GeneFinder-GenScan, Genomic variations-SNP, Comparative genomics.

**Transcriptomics:** Definition, Techniques-Microarray, Differential gene expression – SAGE. Outline of Epigenomics and Pharmacogenomics.

**UNIT IV:**

(12 hours)

**Proteomics** - Definition, techniques - Identification and analysis of proteins by 2D electrophoresis, spot visualization. Peptide mass fingerprinting, Protein identification with amino acid composition. Protein-protein interaction (PPI); Pull down assay; PPI maps. Protein microarrays. Outline of Metabolomics and Interactomics.

**UNIT V:**

(10 hours)


**Practicals**

1. NCBI: Retrieving gene and protein sequences
2. BLAST: Nucleotide, protein, genome and primer
3. Sequence Alignment: BLAST, Clustal Omega and Phylogenetic analysis: MEGA7
4. Sequence analysis: ProtParam and SOPMA
5. Tertiary structure prediction and validation: Swiss-model and SAVeS server
6. Small molecule retrieving and drawing: PubChem and ChemSketch
7. Molecular docking: AutoDock
8. Drug likeness property: SwissADME
9. Molecular visualization: Swiss-PDB viewer
10. Protein-Protein interaction and visualization: String and CytoScape

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2019-20

**REFERENCES:**

1. Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery by Rastogi S C., Namita Mendiratta, Parag Rastogi. Published by Prentice Hall of India Private Limited, New Delhi, 2013, Edition: 4.
2. Bioinformatics and Functional Genomics by Jonathan Pevsner, Published by John Wiley, 2015, Edition: 3.
3. Bioinformatics Sequence and Genome Analysis by David W. Mount. Published by Cold Spring Harbor Laboratory Press, 2004, Edition: 2.
4. Introduction to Bioinformatics by Attwood, T.K. and D.J. Pary Smith. Published by Addison Wesley Longman Limited, 1999.
5. Genomes 3 - T A Brown. Published by Garland Science. 2006, Edition: 3.
6. Principles of Gene Manipulation and Genomics by Primrose S and Twyman R. Published by Blackwell, 2006, Edition:7.
7. Protein Biochemistry and Proteomics by Hubert Rehm. Published by Academic Press, 2006, Edition:4
8. <https://www.ncbi.nlm.nih.gov/>
9. [www.embl.org/](http://www.embl.org/)
10. [www.ddbj.nig.ac.jp/](http://www.ddbj.nig.ac.jp/)
11. <http://www.openrasmol.org/>
12. <http://spdbv.vital-it.ch/>
13. <https://www.ncbi.nlm.nih.gov/blast>
14. <https://www.ebi.ac.uk/Tools/msa/clustalo/>
15. <https://preadmet.bmdrc.kr/>
16. <https://web.expasy.org/protparam/>
17. [https://npsa-prabi.ibcp.fr/cgi-bin/npsa\\_automat.pl?page=npsa\\_sopma.html](https://npsa-prabi.ibcp.fr/cgi-bin/npsa_automat.pl?page=npsa_sopma.html)
18. <https://swissmodel.expasy.org/>
19. <https://services.mbi.ucla.edu/SAVES/>
20. <https://pubchem.ncbi.nlm.nih.gov/>
21. <http://www.swissadme.ch/index.php>
22. <https://string-db.org/>



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Subject Code:

Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER- II

CORE: BIOPROCESS TECHNOLOGY

**Objective of the subject:** This paper aims to empower the students with various designs of fermenter and Kinetics. The knowledge on fermentation process enables the students to manipulate microbes for improvement, upstream and downstream process. The students will be able to perform any fermentation processes to obtain novel products on completion of the paper.

**UNIT I:**

**(11 hours)**

**Introduction to Bioprocess Engineering:** Fermentation a Historical perspective. Biotechnology and bioprocess engineering, Bioprocess regulatory constraints, Basic of Biology – an engineering perspectives – Cell construction, cell nutrients. Stoichiometry of microbial growth and product formation. Alteration in cellular information.

**UNIT II:**

**(12 hours)**

**Bioreactor – Designs:** Introduction to fermentation process. Sterilization. Thermal death kinetics. Design of continuous sterilization process, Fibrous filters. Bioreactor design, parts and their functions, Alternative vessel designs - CSTR, Tower, Airlift, Loop jet, Bubble Column, Packed bed. Immobilized cells.

**UNIT III:**

**(11 hours)**

**Kinetic Studies:** Microbiology of Industrial fermentation, Fermentation kinetics, Rheological properties of the medium; Theory of mixing. Oxygen transfer rate, Oxygen transfer coefficient and correlation. Biological heat transfer and heat transfer coefficient.

**UNIT IV:**

**(11 hours)**

**Instrumentation Controls:** Different types of instrumentation, common measurement and control systems, Additional sensors, Feedback control, PID control, Computers in Bioprocess control systems, Biosensors in bioprocess monitoring and control.

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(12 hours)

**UNIT V:**

**Upstream and Downstream Processing:** Upstream processing, Recovery and purification of fermentation products- Membrane process, centrifugation-Ultracentrifugation, Ion exchange and gel permeation chromatography and HPLC.

**Fermentation in Industry and Applications:** Traditional and industrial bioprocess. Medical application of bioprocess engineering; Fermentation Economics and effluent treatment- primary, secondary and tertiary treatments.

**REFERENCES:**

1. Bioprocess Engineering Basic concepts by Michael L. Shuler FikretKarg. Published by Prentice Hall International services, 2017. Edition: 3.
2. Fermentation Microbiology And Biotechnology by E.M.T El-Mansi and C. F. A.Bryce. Published by Taylor & Francis. Reprinted 2011.Edition-3
3. Biotechnology-A Textbook of Industrial Microbiology by Wulf Crueger and Anneliese Crueger. Published by Panima Publishing Corporation New Delhi. 2000. Reprinted 2005. Edition: 2.
4. Principles of Fermentation Technology by Peter. F. Stanbury, Allan Whitaker, Stephen. J. Hall. Published by Elsevier Science Ltd., reprinted 2007, Edition: 2.
5. Bioprocess Engineering Principles by Pauline M. Doran, Published by Elsevier, Reprinted 2006.



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Subject code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - II

CORE: PLANT BIOTECHNOLOGY

**Objective of the subject:** To provide various techniques and aspects regarding Plant biotechnology. This paper has been designed to give the students comprehensive coaching in the field of plant biotechnology that benefit for agricultural production, the environment human nutrition and health.

**UNIT I:** (11 hours)

**Plant Tissue Culture:** Cloning: isolation of single cells, production of haploid plants, protoplast culture and somatic hybridisation, somaclonal variation, germplasm conservation and cryopreservation, Plant secondary metabolites; therapeutic proteins

**UNIT II:** (11 hours)

**Plant Genome Organization:** Nuclear genome organization; mitochondrial genome organization; chloroplast genome organization; Targeting of proteins to chloroplasts and mitochondria; RNA editing in mitochondria; chloroplast transformation; Cytoplasmic male sterility, Transposons.

**UNIT III:** (11 hours)

**Plant Genetic Transformation:** Direct and indirect methods of plant transformation; Ti and Ri plasmids in transformation- co-integrate and binary vectors; viral vectors; promoters; selectable markers and reporter genes; gene tagging, gene knock out, gene silencing- antisense and RNA interference; Molecular aided breeding- RAPD, RFLP and marker assisted selection.

**UNIT IV:** (11 hours)

Transgenic plants- herbicide resistance, drought tolerance, salt tolerance, insect resistance, virus resistance; plant pathogen interaction- virus, bacteria, fungi and nematodes; nitrogen fixation; phytoremediation; edible vaccines.

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(11 hours)

**UNIT V:**

**Applications:** Application of Plant genome organization - Tobacco and Rice. Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement, molecular farming.

**REFERENCES:**

1. An Introduction to Plant Tissue Culture by M.K. Razdan. Published by Oxford and IBH Publishing Co., New Delhi. 2003, Edition:2.
2. Genetic Engineering: Concepts and Applications by R. Suganthi and C.S. Shobana, Published by KalaikathirAchchagam, Coimbatore - 37, 2013, Edition:1
3. Plant Biotechnology , Transgenics, Stress Management, and Biosafety Issues: SangitaSahni , BishunDeo Prasad, Prasant Kumar, Apple Academic Press Inc.2017, vol:2.
4. Plant Biotechnology: The Genetic Manipulation of plants, by Slater *et al.* Published by Oxford University Press, Oxford. 2008, Edition :2.
5. Plant Cell and Tissue Culture - A Tool in Biotechnology : Basics and Application, Karl-Hermann Neumann , Ashwani Kumar , Jafargholi Imani, Publisher Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, 2010.
6. Plant Tissue Culture: Techniques and Experiments, Roberta H. Smith, Elsevier Science Publishing Co Inc, 2012.
7. Plant Tissue Culture: Theory and Practice by S.S. Bhojwani and M.K. Razdan, Elsevier Publications, Netherlands. 2004. Revised Edition.
8. Plants, Genes and Agriculture by M.J. Chrispeels and D.F. Sadava. Published by The American Scientific Publishers, USA. 2000.
9. Plant biotechnology by U.Satayanarayana, Edition: 1, 2005. Publisher: Books & Allied (P) Ltd.-Kolkata



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Subject code:

Dr. G. R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc BIOTECHNOLOGY- 2019 onwards

SEMESTER - II

**CORE: RESEARCH METHODS AND BIostatISTICS  
(EXCLUDING DERIVATIONS)**

**Objective of the Subject:** The main objective of this course is to enhance the knowledge in research and to give practice in the quantitative methods used by empirical researchers. It also expose the students to learn the methods used in statistical packages for academics as well as policy analysis. This course is understandable to the students who are skilled in statistical techniques and also to those who are less versed in quantitative methods.

**UNIT I:**

**(10 hours)**

**Research Methodology:** Definition, importance and meaning of research, characteristics of research, types of research, steps in research, research questions, research design, formulation of hypothesis, review of literature. Research report, types of reports, contents, styles of reporting, steps in drafting reports, editing the final draft, evaluating the final draft.

**UNIT II:**

**(12 hours)**

**Statistical Measures and Graphs:** Introduction, collection of data, classification of data, tabulation of data, uses of statistics. **Measures of Central Tendency:** mean, median, mode. **Measures of dispersion:** Standard deviation, variance, coefficient of variation.

**Graphical Representation of data:** Histogram, frequency curve, frequency polygon, cumulative frequency curves.

**Unit III:**

**(12 hours)**

**Probability and Distributions:** Probability: addition rule, multiplication rule on probability. **Distributions:** Introduction, binomial distribution, general form, simple applications- fitting a binomial distribution. poisson distribution: general form- simple applications- fitting a poisson distribution. normal distribution: general form- simple applications.

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**UNIT IV:**

(12 hours)

**Tests of hypothesis and significance:** Introduction, tests of significance, procedure for testing of hypothesis. tests of significance for large sample: tests of significance for single mean and differences of two means. student's t-test: test based on t-distribution for single mean and difference of two means.

**UNIT V:**

(12 hours)

**Chi-Square Test and ANOVA:** Chi-square Test: Introduction, Procedure of chi square test, Goodness of fit only. **Analysis of variance:** Test based on F distribution, One way classification and two way classification.

**REFERENCES:**

1. Research Methodology: Methods and Techniques, C.R Kothari, Gaurav Garg, New Age International Pvt Ltd Publishers, 2013.
2. Statistical Methods, S.P Gupta, Published by Sultan chand and sons, 2012.
3. Introduction to biostatistics and research methods, P S S Sundar Rao and J Richard, Published by PHI Private Limited, 2012. Edition: 5.
4. An Introduction to Biostatistics, N Gurumani, Published by MJP, 2015, Edition: 2.



Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - II

CORE: LAB IN INDUSTRIAL BIOTECHNOLOGY

**Objective of the Subject:** The scope of this work is to make the students understand industrial biotechnology in detail and to give a clear picture of the parts and design of a bioreactor, batch and continuous fermentation. The knowledge on fermentation process enables the students to manipulate microbes for improvement of the need-based society

**Outline of the laboratory Programme:** This Practical course covers the area starting from Screening and Isolation of microbes, Product production, Fermentation condition, Recovery and purification of products and its analysis.

1. Introduction to bioprocess technology parts and design of Bioreactor
2. Batch and continuous fed batch fermentation
3. Bacterial growth curve - pH, temperature effect
4. Conservation of bacteria by lyophilisation
5. Cell disruption by sonication and product recovery.
6. Isolation of industrially important microorganisms (amylase, Keratinase) for Microbial process & maintenance of bacterial & fungal cultures.
7. Downstream process - Purification of fermentation product by Ion exchange Chromatography
8. Detection and quantification of siderophores produced by *Pseudomonas spp*
9. Study of alcohol fermentation-alcohol production-estimation of percentage of alcohol
10. Production and analysis of SCP
11. Microbial production of citric acid using *Aspergillus niger*.
12. Microbial production of pectinase using agrowastes.
13. Microbial production and assay of amino acids
14. Microbial production of Penicillin and product recovery.
15. Microbial production and assay of Vitamins
16. Cell and enzyme immobilization
17. Preparation of Biofertilizer

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**REFERENCES:**

1. Protein Methods by Daniel M. Bollag et al. Published by Wiley-Liss, Inc. 1996.  
Edition: 2.
2. Manual of Microbiology Tools and Techniques by Kanika Sharma, Published by  
Ane Books, 2007. Edition: 4.
3. Laboratory Manual on Biotechnology- Prof. P.M. Swamy, Published by Rastogi  
Publications, 2008, Edition:1.
4. Microbial Technology: Fermentation Technology -Henry J. Peppler, D. Perlman,  
Published by Academic Press, 1979. Edition: 2.

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Subject Code:

Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - II

CORE: LAB IN PLANT BIOTECHNOLOGY

**Objective of the course:** To give hands on experience on various techniques and aspects regarding plant biotechnology. This paper has been designed to give the students comprehensive coaching in the field of plant biotechnology.

**Outline of the laboratory Programme:** Practical gives a broad knowledge and Hands on training in all techniques given

1. Preparation and sterilization of glass wares, instruments and explants
2. Composition and preparation of media and sterilization
  - a. White's Medium
  - b. Murashige and Skoog's Medium
  - c. Nitsch Medium
2. *in vitro* seed germination
3. Micropropagation - Nodal and apical meristems
4. Initiation and maintenance of callus
5. Organogenesis from callus
6. Somatic embryogenesis from root culture
7. Suspension cultures
8. Production of secondary metabolites
9. Anther culture
10. Embryo culture
11. Initiation of artificial seeds
12. Isolation of Protoplast
13. Isolation of Plant Chloroplast
14. Isolation of plant genomic DNA
15. Qualitative and quantitative analysis of plant genomic DNA
16. Isolation of Plasmid DNA from *Agrobacterium* sp.
17. *Agrobacterium* mediated transformation

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**REFERENCES:**

1. Plant Tissue Culture Concepts and Laboratory Exercise- Robert Nicholas Trigiano, Dennis John Gray, Published by CRC Press, 1999 Edition: 2.
2. Introduction to Plant Tissue Culture- M. K. Razdan, Published by Science Publishers, 2003, Edition: 2.
3. An Introduction to Practical Biotechnology- S. Harisha, Published by Firewall Media, 2006, Edition: 1.
4. Novo's Handbook of Practical Biotechnology- C. O. L. Boyce, Boyce, Published by Novo Industri A/S, 1986.
5. Genetic Engineering Principles and Practice, Sandhya Mitra, Published by Macmillan India, 1996, Edition : 1.
6. Molecular Cloning: A Laboratory Manual- Joseph Sambrook, E. F. Fritsch, Tom Maniatis, Chris Nolan Published by Cold Spring Harbor Laboratory, 1989 Edition: 2.
7. Molecular Cloning: A Laboratory Manual- Joseph Sambrook, David William Russell, Published by CSHL Press, 2001, Edition: 3



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2019 - 20

Subject Code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc BIOTECHNOLOGY- 2019 onwards

SEMESTER - II

ELECTIVE: BIOPHYSICS AND BIOINSTRUMENTATION

**Objective of the Subject:** To expose students to various biophysical techniques used in modern biotechnology research. The students also learn in detail about structure of atoms and bonds involved in biopolymer structures.

**UNIT I:**

(11 hours)

**Structural Characteristics:** Scope and definition of Biophysics. Biophysics at the macroscopic level - at the microscopic level and at the molecular level. Biophysical Chemistry: Atoms, Molecules, Energy, Structure of atoms and molecules: Elementary quantum mechanics, Covalent bonds, Hydrogen bonds. Stereochemistry, Molecular orbitals, Chirality.

**UNIT II:**

(12 hours)

**Conformational Analysis:** Van der Waals radii of atoms (equilibrium separation between non covalently bonded atoms), Contact distance criteria, Non covalent forces determining biopolymer structure, Dispersion forces, Electrostatic interactions, Van der Waals interactions- Hydrogen bonds, Hydrophobic interactions, Distortional energies, Description of various interactions by potential functions, Principles of minimization of conformational energy.

**UNIT III:**

(12 hours)

**pH:** pH Scale, Methods of calculating pH from instrumentation using Henderson's equation, Reference electrode, Glass electrode, pH indicators.

**Centrifugation:** Principles and instrumentation: analytical centrifuge, preparative and ultra centrifuge.

**Colorimetry:** Principles and application. **Spectroscopy:** Instrumentation, principle and applications : UV spectrophotometer, Infra red spectroscopy, Spectrofluorimetry, Flame spectrophotometry, AAS, NMR, ESR, X-ray crystallography, ICPMS and Mass spectroscopy

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**UNIT IV:**

(11 hours)

**Chromatography:** Principle, materials and applications: Paper, Thin layer chromatography, Adsorption, Ion exchange chromatography. Principles of HPLC, Gel permeation chromatography, affinity chromatography and GLC.

**Electrophoresis:** Principle, methods and applications: Agarose, Polyacrylamide gel, Immunoelectrophoresis and Pulse field gel electrophoresis. Blotting method: Western, Southern and Northern – applications.

**UNIT V:**

(11 hours)

**Radioactivity:** Units, types, fundamentals of radioactive decay, isotopes and radioisotopes, detection and measurement of radioactivity, liquid and solid state counting, instrumentation, autoradiography. Applications of radioactivity.

**REFERENCES:**

1. Principles of Physical Biochemistry by Kensal E. Van Holde, W. Curtis Johnson and P. Shing Ho, Published by Prentice-Hall international. INC, 1988.
2. Biophysical Chemistry Principles and Techniques by Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath Published by Himalaya Publishing House, 2008.
3. Modern Experimental Biochemistry – Boyer R. Published by Academic Press. 2001, Edition: 2.
4. A Biologist's Guide to Principles and Techniques of Practical Biochemistry – Keith Wilson, Kenneth H. Goulding. Published by Cambridge University press. 1992, Edition: 3.
5. Instrumental Methods of Chemical Analysis- Chatwal Anand. Published by Himalaya Publishing House, 1994
6. Introductory Biophysics by V. Pattabhi & N. Gautham. Published by Narosa Publications, 1999.
7. Biophysics: An Introduction, Roland Glaser, Springer-Verlag Berlin and Heidelberg GmbH & Co, 2010.
8. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson and John Walker Cambridge University Press, 2010, Edition:7.
9. Bioinstrumentation L. Veerakumari , MJP Publishers; 2011. Edition:1

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Subject Code:

Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

SEMESTER - II

ELECTIVE: NANOBIO TECHNOLOGY

**Objective of the subject:** This paper will provide ample introductory knowledge to the students undergoing this course and make them familiarize with the past, present and latest technologies involved in the synthesis and designing of nano particles for specific applications. The paper is framed to provide the principles, technology and applications of nano materials in biology to the students.

**UNIT I:**

(11 hours)

**Essentials of Nanotechnology:** History, Properties, Classification of nanomaterials, Concept of nanoscale engineering : size and confinement effects. Strategies for nano architecture- bottom up, top down and functional approaches; Chemical and Physical synthesis of nanoparticles - characteristics of nanoparticles; Characterization of nanoscale materials using UV Spectroscopy, particle size analyzer, TEM, AFM/STM, XRD and FTIR.

**UNIT II:**

(12 hours)

**Bionanomaterials:** DNA, protein and lipids based nanostructures (DNA cages, tiles, wires-protein nanotubes, nanospheres, nanorods, liposomes, SLP and neosomes etc), synthesis, characterization and applications; Bionanopores, biological synthesis of nanoparticles: bacteria, fungi, yeast and plants- mechanism; Molecular Self assembly in biology; Biological functionalisation of nanomaterials: DNA/protein-gold nanoparticle conjugates; biologically inspired nanocomposites.

**UNIT III:**

(11 hours)

**Bio-interface systems:** Lab on chip devices-their potentials for nanobiotechnology- Microfluidic devices- methods, materials for manufacturing microfluidic components - fluidic structures; Microcontact printing of proteins-strategies, printing types, methods

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and characterization, Cell nanostructure interactions-networks for neuronal cells-Biosensor development using DNA/protein as molecular recognition system.

**UNIT IV:**

**(11 hours)**

**Surface Biology:** Analysis of biomolecular structures by Atomic force Microscopy DNA and its condensation, DNA sequences recognized by mica, Drug binding to single double stranded DNA molecules, Protein analysis using AFM- Dynamic force microscopy-specific bimolecular bonds, cell membranes, proteins, DNA-protein interactions and molecular motors.

**UNIT V:**

**(12 hours)**

**Applications of Nanobiotechnology:** Antimicrobial activity of nanoparticles-mechanism; Nanoanalytics- Quantum dots- bioconjugates in cell and tissue imaging; Diagnosis of cancer and other diseases using bionano systems; Drug and gene delivery; Protein targeting- targeting signals, translocation and sorting; Micelles for drug delivery; Proteins and DNA coupled nanoparticles for biosensors;; Nanotechnology in agriculture.

**REFERENCES:**

1. The Chemistry of Nanomaterials Synthesis, Properties and Applications by C.N.R. Rao, A. Muller, A. K. Cheetham, , 2004.
2. Nano: The Essentials by T. Pradeep, Tata Mgraw Hill, New Delhi, 2007.
3. Nanobiotechnology: Concepts, Applications and Perspectives by Niemeyer C.M. and Mirkin C.A., Wiley-VCH Verlag GmbH and Co., KgaA, Weiheim, 2004.
4. Nanobiotechnology- II, More Concepts and Applications by C.A. Mirkin and C.M. Niemeyer, Wiley-VCH, Verlag GmbH & Co, 2007.
5. Nanobiotechnology & Nanobiosciences by Claudio Nicolini, Pan Stanford Publishing Pte. Ltd, 2009.
6. Bionanotechnology, Lessons from Nature by S. David Goodsell, Wiley-Liss, Inc, 2004.
7. Handbook of Nanotechnology by B. Bhushan, Springer, Heidelberg, 2014

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Subject Code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc BIOTECHNOLOGY- 2019 onwards

SEMESTER - II

ELECTIVE: BIOPHARMACEUTICALS

**Objective Of the Subject:** To enable the students to know the actual path of metabolism of drugs and drug discovery.

**UNIT I:** (11 hours)

**Biological systems-** Solubility- factors, Bio-availability, Pharmacodynamics of protein therapeutics, Chemical modification of protein, potential pitfall in tumor targeting, high throughput screening. Genotyping - Genetic predisposition and heterogeneity, Basic pharmaco-genomics.

**UNIT II:** (11 hours)

**Drug Metabolism:** Need for developing new drugs, procedure followed in drug designing, molecular modification of lead compounds, soft drugs, physico-chemical parameters in drug design, Active site determination of enzymes, Design of enzyme inhibitors.

**UNIT III:** (11 hours)

**Pharmacokinetics and Drug Discovery:** Drug receptor interaction: types of receptor, sources of actives principles, Assay systems and models (eg: Knockout-mice) Protein molecular modeling by computers, Docking studies, structure based drug-designing. Molecular Dynamics and Simulation. Cancer: chemotherapy- vincristine, vinblastine, taxol, methotrexate.

**UNIT IV:** (12 hours)

**Pharmaceutical products:** Antibiotics: penicillin, streptomycin, tetracycline, Vitamins. Plant Secondary metabolites: Alkaloids, flavanoids, steroids, terpenoids.

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**UNIT V:**

(12 hours)

**Use of DNA technology in pharma products:** Therapeutic Proteins: insulin, human growth hormone, clotting factors, interferons, interleukins, tissue plasminogen activators (TPA), erythropoietin, production, and applications. Gene therapy- antisense therapy, gene delivery system, vector usage for gene therapy, clinical trials.

**REFERENCES:**

1. Industrial Pharmaceutical Biotechnology by Heinrich Klefenz. Published by Wiley – VCH publication, Germany, 2002.
2. Pharmaceutical Biotechnology – Daan Crommelin, Robert D Sindelar. Published by Tailor and Francis publications, New York, 2002.
3. Handbook of Pharmaceutical Biotechnology – Jay P. Rho, Stan G Louie. Published by Pharmaceutical products press, New York, 2003.
4. Theory and Practice of Industrial Pharmacy – Lachman L Lieberman, HA Kanig. J., Easton, PA Published by Varghese publishing & Co. 2000, Edition: 2.
5. Introduction to Drug Design – SN Pandeya, Published by New Age International Publication. 2007.
6. Pharmacology and Pharmacotherapeutics - Satoskar, R.S., Bhandarkar, S.D., Ainapure, S.S, Popular Prakashan, Mumbai. 2002, Edition: 17.
7. Biopharmaceutics and Clinical Pharmacokinetics: An Introduction, Notari, Marcell Deckker, 2005.



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Subject Code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - II

ELECTIVE: AGRICULTURAL BIOTECHNOLOGY

**Objective of the subject:** The objective of this module is to provide an understanding of the principles and emerging concepts in agrobiotechnology. It will also demonstrate how we can manage sustainable exploitation of plant and microbial resources in an environmentally-sensitive manner with new approaches. The syllabus encompasses a wide range of novel and emerging scientific and technological advancements in the field.

**UNIT I:** (12 hours)

**Transgenic plants :** Introduction and importance of transgenic technology. Disease resistance: Genes and gene constructs used for viral resistance by coat protein mediated protection and RNA mediated protection. Bacterial resistance by lysozyme gene, Fungal resistance by chitinase and 1,3-beta glucanase genes. Herbicide resistance in commercially important plants. Insect resistance through BT genes (cry genes) and protease inhibitor genes, BT crops, current status in the world. Other biopesticides and their importance. Terminator gene technology. Male sterile plants, methods of inducing cytoplasmic male sterility, its importance in breeding, Barstar and barnase system

**UNIT II:** (12 hours)

**Plant breeding and crop improvents :** Introduction, Conventional breeding methods and their merits and demerits. Crop improvement to resist adverse soil conditions; Salinity tolerance, Drought resistance in plants. Protection breeding and quality breeding. Applications of plant breeding for crop improvement through mutations. Plant genetic resources: Plant introduction agencies in India-merits and demerits, Organizations involved in plant breeding in india. NBPGR, PBRs.

**UNIT III:** (11hours)

**Post harvest technology :** Introduction and importance of post harvest technology. Post harvest protection: Antisense RNA technology (ACC synthase gene and polygalacturonase) Delay of softening and ripening of fleshy fruits by antisense RNA for

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ACC synthase gene in tomato banana watermelons etc. Use of antisense RNA technology for extending shelf life of fruits and flowers. Protection of cereals, millets and pulses. Post harvesting using biotechnology. Biotechnology for fortification of agricultural products – golden rice, transgenic sweet potatoes.

**UNIT IV:**

**(12 hours)**

**Bioinoculants :** Introduction and Importance of biofertilizers in agriculture, Mass culturing and quality control of microbial inoculants-mother culture, shake culture and large scale production of biofertilizers (Rhizobium, Azotobacter, Mycorrhiza, Actinorhiza) types of carrier materials, packing storage, shelflife and transportation of biofertilizers. Methods of application to seed, soil and nursery. vermiculture, composting , current practices and production..

**UNIT V:**

**(12 hours)**

**Integrated pest management:** Brief introduction to entomology: Importance of JH and JH analogues in insect pest control. Insect pheromones and their applications. Biological control of insect pests and weeds using natural enemies, mass multiplication of predators and parasites. Biological control of plant pathogens using antagonistic fungi and antagonistic bacteria.

**REFERENCES:**

1. Handbook of Agriculture (1987), ICAR Publication New Delhi.
2. Disease of crop plants in India –G.Rangaswamy and D.H. Bagayraj 3rd Edition (1994), Prentice Hall of India Private Limited, New Delhi.
3. Plant Pathology –R.S. Mehrotra (1993) Tata McGraw Hill Publications Limited, New Delhi.
4. Agricultural Microbiology: G.Rangaswamy and D.J. Bagyaraj 1993, 2nd Edition, Prentice Hall of India Private Limited, New Delhi.
5. Microbial Biotechnology – Fundamentals of applied Microbiology. Glazer and Nikaido (1995) W.H. Freeman Publication company.
- Biotechnology theory and techniques –Chirikjian. Veena, D.P.S. and Hons T (1984) Plant gene research, Springer Verlag, Heidelberg and New York.
7. Trevan, M.D. Boffey, S. Goulding, K.H. and Starberry P (1990) Biotechnology – the basic principles Tata McGraw Hill Edition.

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8. Plant Pathology by Agrios. Powel C.L. and Bagyaraj, D.J. (1984) V. Mycorrhiza, CRD Press Florida.
9. Vincent J.M. (1982) Nitrogen fixation in legumes Cambridge University Press, London.
10. Stacey R.H. Evans H.J (1992) Biological Nitrogen fixation, Chapman and Hall Limited, London.
11. Biosafety for sustainable Agriculture –Krathiger and Rosemarin – International service for the agribiotech applications.
12. K.R. Aneja (1992) Experiments in microbiology, plant pathology, Tissue culture and Mushroom cultivation –Vishwa Prakashan.



Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER - III

**CORE: rDNA TECHNOLOGY AND MEDICAL BIOTECHNOLOGY**

**Objective of the subject:** This paper provides the student a thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms. The main objective of the paper is to expose students to application of genetic engineering and medical biotechnology in various fields of biotechnology, medicine and research areas. This paper will help the student get a grasp of the latest advances in genetic engineering, which is a powerful tool in modern Biotechnology.

**UNIT I:**

**(12 hours)**

**Gene Manipulation and Cloning Vectors:** Enzymes used in manipulation – Polymerases, ligases, endonucleases and modification systems. Biology and construction of plasmid vectors: pBR 322; pUC 18. Phages as vectors: Lambda phage; cosmids; phagemids. Expression vectors; shuttle vectors; artificial chromosomes: YAC, PAC, BAC, HAC.

**UNIT II:**

**(12 hours)**

**Recombinant DNA Techniques:** Construction of a recombinant molecule. Bacterial transformation, Blotting techniques - Southern, Northern, Western, Dot and Slot blot. HAT, HART, hybridization. Selectable markers and reporter genes. Genomic and cDNA libraries; PCR: principle and types; site directed mutagenesis; DNA sequencing. Microarrays- cDNA and protein chips. DNA fingerprinting; RAPD; RFLP; SNPs; VNTRs and microsatellites.

**UNIT III:**

**(12 hours)**

**Molecular Diagnostics:** Importance of diagnosis, DNA markers in disease diagnosis, DNA/RNA probes, PCR and probe based diagnosis for infectious diseases HIV and Typhoid and genetic diseases Sickle Cell anemia and Cancer, Prenatal diagnosis of genetic disease - amniocentesis and karyotyping. Bioinformatics tools for molecular diagnosis.

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**Assisted Reproductive Techniques:** Introduction- causes of infertility- methods: *In vitro* fertilization (IVF. Gamete Intrafallopian transfer and Zygote Intrafallopian transfer, Intra uterine insemination, ICSI

**UNIT IV:**

(12 hours)

**Tissue Engineering:** Role of Scaffolds, Bioartificial organs- Skin and Cartilage, 3D cell culture. **Xenotransplantation:** Terminology, technology, organ donors, social and ethical issues. **Cellular therapy:** Stem cells- definition, properties and potency of stem cells, Sources-embryonic and adult stem cells, Role of adult and embryonic stem cells, Clinical applications, Ethical issues and personalized medicine.

**UNIT V:**

(12 hours)

**Applications:** Gene therapy: cystic fibrosis; DNA forensics. Recombinant Products: blood products; vaccines; interferons; interleukins and therapeutic proteins. Molecular Pharming: Hirudin (Plant), Antibodies (Animal) and tissue plasminogen activator (Bacteria).

**REFERENCES:**

1. Principles of Gene Manipulation by Primrose by S.B., Twyman R.M., Old. R.W. Published by Blackwell Science Limited. 2001. Edition: 6.
2. DNA Science, A First Course in Recombinant Technology by D.A.Mickloss and G A Freyar, Published by Cold Spring Harbor Laboratory Press, New York, 1990.
3. Molecular Biotechnology by S. B. Primrose. Published by Blackwell Scientific Publishers, Oxford, 1994. Edition: 2.
4. Route Maps in Gene Technology by M.R.Walker and R.Rapley. Published by Blackwell Science Ltd., Oxford, 1997.
5. Genetic Engineering. An Introduction to Gene Analysis and Exploitation In Eukaryotes by S.M. Kingsman and A.J. Kingsman. Published by Blackwell Scientific Publications, Oxford, 1998.
6. Human Molecular Genetics by Tom Strachan and Andrew P. Read. Published by Bios Scientific Publishers, 1996.
7. Gene Cloning and DNA Analysis by Brown TA. Published by Garland Science. 2006. Edition: 5.
8. Monoclonal antibodies: Principles and Practice by James W Goding,, Published by Academic Press, 1996, Edition:3.
9. Molecular Diagnostics by George Patrinos and Wilhelm Ansoarge, Published by Academic Press 2005, Edition: 1.



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2019-20

Subject Code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc BIOTECHNOLOGY- 2019 onwards

SEMESTER-III

**CORE: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**

**Objective of the paper:** To study the basic and advanced concepts in immunology and animal biotechnology and acquire knowledge in applications of the techniques.

**UNIT I:**

**(12 hours)**

**Components of innate and adaptive immunity:** Humoral and cell mediated immunity, cells of immune system: Macrophages, B & T- Lymphocytes, dendritic cells, natural killer cells, LAK, eosinophils, neutrophils, mast cells. Organs of immune system: bone marrow, thymus, spleen, lymph nodes, MALT, CALT, haematopoiesis and differentiation, lymphocyte trafficking. Antigen Biology- immunogenicity, epitopes, haptens, adjuvants. Antibody: classes, structure and function. Antigen-Antibody reactions and application of immunological techniques. ELISA, Western Blotting, MHC: Structure and function.

**UNIT II:**

**(12 hours)**

**Antigen Processing and Presentation:** Pathways and the role of APC's. T-cell Receptor Complex, T-cell activation and differentiation, B-cell maturation, B-cell activation and proliferation. Effector Mechanism: Cytokines-Properties, function, Receptors, cytokine secretion by Th1 and Th2 cells. Complement: Classical pathway, Alternative Pathway. Cell Mediated effector response: T-cell and NK-cell mediated cytotoxicity, ADCC. Complement Fixation Test. Immune tolerance and immune suppression.

**UNIT III:**

**(12 hours)**

**Hypersensitivity reactions-** types, autoimmune diseases- organ specific, systemic autoimmune diseases. Transplantation Immunology- MLR, HLA typing, cell mediated graft rejection, Bone Marrow Transplantation, Organs Transplantation. Tumor Immunology-

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Tumor Antigen, Immune response to tumors, Cancer immunotherapy. Vaccines, AIDS and other immunodeficiencies. Structure of HIV, envelop glycoprotein, destruction of T-cells, immunologic symptoms of AIDS, AIDS vaccine and therapy for treatment.

**UNIT IV:**

**(12 hours)**

**Animal cell culture:** Culture media and its types; role of carbon dioxide in animal cell culture. Cell culture methods: primary culture, secondary culture; continuous cell lines; suspension cultures- Organ culture- Feeder layers- disaggregation of cells- cell separation- cell synchronization- apoptosis- Types of contaminants, testing of toxicity of environmental pollutants in cell culture.

**UNIT V:**

**(12 hours)**

**Applications of cell culture:** transgenesis- production of human and animal vaccines and pharmaceutical proteins. Animal Cloning- Gene knock out technology and animal models for human genetic disorders. Gene Silencing methods, cytotoxicity studies, FACS, microarray. *in situ* characterization of cells from tissue, Immunoscreening of recombinant library, Cryopreservation of germ cells.

**REFERENCES:**

1. Immunology by Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne, Published by Freeman, 2002. Edition: 6.
2. Fundamental of Immunology by Paul. Published by Lippencott Raven Publishers Philadelphia, 2008. Edition: 6.
3. Monoclonal antibody by Golding. Published by Academic Press. 1985.
4. Animal Cell Culture: A Practical Approach – R. Ian Freshney. Published by John Wiley & Sons Inc. 2009. Edition: 6.
5. Animal cell Biotechnology by Portner. Published by Humana Press, 2007: Edition: 2.
6. Animal Cell Culture methods- Jenney P. Mather and David Barnes Published by Academic Press, 1998, Vol.57.
7. Janeway's Immunobiology – Kenneth P. Murphy, Paul Travers, Mark Walport, Charles Janeway - Published by Garland Science, 2008. Edition : 8.

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8. Cellular and Molecular Immunology Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai Elsevier Health Sciences, 2014, Edition:8.
9. Essential Immunology by I Roitt. Published by Blackwell science, Singapore. 2016. Edition: 13.

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2019-20

Subject Code:

**Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE**

**M. Sc. BIOTECHNOLOGY- 2019 onwards**

**SEMESTER - III**

**CORE: FOOD BIOTECHNOLOGY**

**Objective of the subject:** This course has been designed to provide the student insights into the basic of food chemistry and also to have knowledge on food technology which play a crucial role in determining its future use and applications in food industry. Students get an idea about the advantages and disadvantages of Biotechnological applications in food production and processing of different challenging issues in food based industry.

**UNIT I:**

**(11 hours)**

**Food Chemistry and Sensory Evaluation:** Nutritional composition of food, metabolic rate and caloric needs, requirements and role of nutrients in human health, RDAs, Nutrition of dietary fibres. Biological value of proteins. Energy value of foods. Sensory evaluation: layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duotrio test, triangle test, hedonic scale, Amoore's classification of odorous compounds. Sherman and Szczniak classification of food texture.

**UNIT II:**

**(11 hours)**

**Harmful role of microbes in food technology:** History, developments in the field. food-borne diseases: symptoms, causes and control: *Campylobacter jejuni* and *Listeria monocytogens*, food intoxication: Aflatoxin and botulinum toxin. **Microbial spoilage in foods:** meat, poultry, sea foods, vegetables, dairy products, fruits and vegetables

**UNIT III:**

**(12 hours)**

**Food Preservation:** Low temperature - Freezing and Refrigeration, High temperature - Thermal Processing- Sterilization, commercial sterilization, Pasteurization, and blanching. Food Preservation by Moisture control – Drying and Dehydration,

Evaporation – Definition, factors affecting evaporation, names of evaporators used in food industry. Food Preservation by Irradiation.

**UNIT IV:**

**(11 hours)**

**Beneficial role of microbes in food technology:** Fresh meats and poultry, processed meats, seafood's, fermented and fermented dairy products and miscellaneous food products. microbial production of amylase, wine, acetic acid, streptomycin. medical foods: pre and probiotics, health benefits of fermented milk and foods products.

**UNIT V:**

**(11 hours)**

**Value added food products:** Milk and Milk Products: Butter, Cheese, Ice-cream ; Vegetable and fruit products- Jam, Marmalade, Pickle Production; Edible oils and fats- Extraction and Products; Meat Processing, Preservation and Products Poultry Processing, Preservation and Products Fish Processing, Preservation and Products Confectionery – Candy Production Beverages – Fruit drink – Squash Production

**REFERENCE:**

1. Food science, Potter Norman N, Hotchkiss Joseph, CBS Publications, 2005.
2. Fundamentals of Food Process Engineering , Toledo Romeo, CBS Publications, 2007.
3. Food Processing , Potty V.H, Mulky, M.J, Oxford and IBH, 1993.
4. Technology of Food Preservation, Desrosier and Desrosier, CBS publication, 2006.
5. Frazier, Food Microbiology, Tata McGraw Hill, 2007.
6. Nutrition and Dietetics, Joshi S.A, Tata Mc Graw Hill Publishing Co. Ltd, 2010, Edition: 3.
7. Food processing Technology: Principles and Practice, P.Fellow, Wood Head publishing Limited, Cambridge, England. 2000.



Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

**SEMESTER - III**

**CORE: LAB IN GENETIC ENGINEERING AND ANIMAL BIOTECHNOLOGY**

**Objective of the subject:** On successful completion the subject student should have understood the molecular techniques in genetic engineering including isolation of nucleic acids and restriction enzymes and Transformation into bacteria along with hybridization techniques and Polymerase chain reaction. And also the practical focus on the animal biotechnology techniques in detail.

**Outline of the laboratory Programme:** Practical gives a broad knowledge and Hands on training in all techniques given.

**GENETIC ENGINEERING**

1. Growth curve of bacteria
2. Phage titration
3. Isolation of genomic DNA from bacteria, plant, animal and purification.
4. Agarose gel electrophoresis
5. Isolation of plasmid DNA from bacteria
6. Isolation of Restriction Enzymes
7. Restriction digestion and ligation of Lambda phage DNA
8. Bacterial transformation, expression and selection
9. Isolation of RNA and separation in denaturing gel
10. Polymerase chain reaction
11. Southern Hybridization
12. Northern Blotting
13. RAPD

**ANIMAL BIOTECHNOLOGY**

1. Preparation of animal cell culture media
2. Primary cell culture (chicken fibroblasts)
3. Secondary cell culture
4. Determination of live cells from spleen cells

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**REFERENCES:**

1. An Introduction to Practical Biotechnology- S. Harisha, Published by Firewall Media, 2005, Edition: 1.
2. Novo's Handbook of Practical Biotechnology- C. O. L. Boyce, Boyce, Published by Novo Industri A/S, 1986.
3. Genetic Engineering Principles and Practice, Sandhya Mitra, Published by Macmillan India, 1996, Edition: 1.
4. Molecular Cloning: A Laboratory Manual- Joseph Sambrook, E. F. Fritsch, Tom Maniatis, Chris Nolan Published by Cold Spring Harbor Laboratory, 1989, Edition: 2.
5. Molecular Cloning: A Laboratory Manual- Joseph Sambrook, David William Russell, Published by CSHL Press, 2001, Edition: 3.
6. Animal Cell Culture: A Practical Approach- R. Ian Freshney, Published by IRL Press, 2006, Edition: 5.
7. Practical immunology - Leslie Hudson, F.C. Hay, Published by Blackwell Scientific Public., 2002, Edition: 4.
8. Animal Cell Culture: A Practical Approach- R. Ian Freshney, Published by IRL Press, 1986, Edition: 5.



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Subject Code:

**Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE**

**M. Sc. BIOTECHNOLOGY- 2019 onwards**

**SEMESTER- III**

**CORE: LAB IN IMMUNOTECHNOLOGY AND FOOD BIOTECHNOLOGY**

**Objective of the subject:** The scope of this work is to make the students to understand the techniques in detail. Immuno techniques and Food technology give good exposure for the students in application of this technique.

**Outline of the laboratory Programme:** This Practical focus on the immune techniques and food technology techniques in detail.

#### **IUMMUNOTECHNOLOGY**

1. Demonstration of animal handling for experimental purposes, cervical dislocation, dissection of mice, cardiac puncture, blood sample preparation and its handling
2. Immunization and generation of antisera in rabbit against antigen
3. Separation of Ig G using affinity chromatography
4. Blood grouping and Counting of blood cells
5. Antigen- Antibody Interactions
  - a. Radial Immunodiffusion
  - b. Ouchterlony double diffusion
  - c. Precipitin ring test
6. Immunoelectrophoresis and rocket immunoelectrophoresis.
7. ELISA for detection of Ag and Ab
8. Sandwich ELISA
9. SDS- PAGE and Immunoblotting

#### **FOOD BIOTECHNOLOGY**

1. Microbiological quality of water (MPN)
2. Microbiological quality of milk
3. Microbiological quality of packed fruit juices
4. Enumeration of Lactic acid bacteria from fermented foods
5. Yeast & Mould count from spoiled fruits
6. Enumeration of spores from pepper

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7. Inhibitory effect of spices on microbial load in fish & flesh foods
8. Enumeration & Isolation of *E. coli* from processed meat/chicken
9. Thermal destruction of microbes: TDT & TDP
10. Enumeration & Isolation of *Staphylococci* from ready to eat street foods
11. Effect of cleaning and disinfection on microbial load

**REFERENCES:**

1. Practical Immunology - Leslie Hudson, F.C. Hay, Published by Blackwell Scientific Public., 1981, Edition: 2.
2. Animal Cell Culture: A Practical Approach- John R. W. Masters Contributor John R. W. Master, Published by Oxford University Press, 2000, Edition: 3.
3. Practical Immunology- Leslie Hudson, Frank C. Hay, Published by Blackwell (Oxford), 1976, Edition: 4.
4. Laboratory Methods in Food Microbiology, Harrigan W.F, Academic Press, 2011.



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Subject code:

Dr. G. R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY - 2019 onwards

SEMESTER – III

ELECTIVE: GENOMICS AND PROTEOMICS

**Objectives:** To impart the knowledge about the basic concepts and features of genome, genome mapping, gene prediction methods and Proteomics. Educating the students to analyze the genome data as well as to gain knowledge on stand alone and online software for genetic studies.

**UNIT - I:**

**(15 hours)**

**Genome Sequencing and Mapping:** Methods of sequencing DNA. Genome Map: Introduction to genome maps. Genome Mapping Methods: Genetic Mapping and Physical Mapping - Restriction and Cytogenetic mapping and their uses. Map elements: Polymorphic markers, LINE, SINE, RFLP, SNP. Map Repositories and Genome Map Databases: GDB and Human genome map viewer. Genetic linkage map, cytogenic and radiation hybrid map resources. Uses of Genome Maps: Locating genome regions, Target identification, Arrangement of genes, SNP diagnosis, Position-Specific Cloning, Predicting gene functions and regulatory genes.

**UNIT - II:**

**(10 hours)**

**Human Genome:** Size, Features, Composition and Characteristics: Sequence repeats, Transposable elements, Gene structure, Pseudogenes, Split genes. Genome Analysis: Gene order (Synteny), Chromosome rearrangement, Computational analysis, Gene Cluster, Composite genes.

**UNIT - III:**

**(12 hours)**

**Genome Annotation:** Structural Annotation: Locating coding regions and other structural elements of the gene. Approaches to Gene Prediction: ORF prediction, Gene prediction in prokaryotes, Gene prediction in eukaryotes, Practical Aspects on Gene

prediction Tools: GenScan, GRAIL, Prediction of promoter sequences. Functional annotation (prediction of gene function): Employing the similarity in the sequence, gene family and metabolic pathway, Employing the conserved domain, Profile and motif, EST comparison.

**UNIT - IV:****(10 hours)**

**Comparative Genomics:** Methods of Comparison: Nucleotide level, Breakpoints level, Gene cluster level, Ontological comparison, Phylogenetic comparison. Comparative Genomic Databases: PEDANT, COG, Gene plot, KEGG, MBGD, Organism specific databases (Yeast, *Arabidopsis*).

**UNIT - V:****(12 hours)**

**Functional Proteomics:** Identification and analysis of proteins by 2D Gel Electrophoresis – spot visualization, peptide fingerprinting – mass spectrometry, Integrated Proteome Analysis: Phage antibody as tool, Protein expression analysis: Microarray. Automation of Proteomics Analysis: Cross species and Intraspecies comparison. Protein-protein interactions: pull-down assay and surface Plasmon resonance.

**REFERENCES**

1. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins - Andreas D Baxevas, Francis Quellerie B F, John Wiley & Sons Inc., USA, 2005. Edition: 3.
2. Genomes - Brown T A, Garland Science Publishing, USA, 2007, Edition: 3.
3. Bioinformatics and Functional Genomics by Jonathan Pevsner, Published by John Wiley, 2015, Edition: 3.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount. Published by Cold Spring Harbor Laboratory Press, 2004, Edition: 2.
5. Principles of Gene Manipulation and Genomics – Primrose S B and Twyman, Published by Blackwell Publishing Company, Germany, 2006, Edition: 7.
6. Mammalian Genomics - Ruvinsky A and Marshall Graves J A, CABI Publishing, UK, 2005.
7. Microarray Bioinformatics - Dov Stekel, Cambridge University Press, UK, 2003.

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8. Bioinformatics & Human Genome - Archana Mishra, Authors Press, New Delhi, 2001.
9. Proteomics - Pennigton S R and Dunn M J, BIOS Scientific Publishers Limited, UK, 2002.
10. Information in Proteomics - Sudhir Srivastava, Taylor & Francis Group, USA, 2005.
11. Introduction to Proteomics - Tools for the New Biology - Daniel C Leibler, Human Press Inc., Mumbai, 2002.
12. Proteome & Protein Analysis - Kamp R M, Kyriakidis, Choli T, Papa Dopulou (EDS), Springer - Verlag, Berlin Heidelberg, 2000.



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Subject code:

Dr. G. R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE  
M. Sc. BIOTECHNOLOGY - 2019 onwards  
SEMESTER - III  
ELECTIVE: SYSTEMS BIOLOGY

**Objectives:** To provide the clear knowledge in system level understanding of a biological pathways and their networking.

**UNIT - I:** (13 hours)

**Functional Genomics:** Developmental Biology and Differential Expression of Genes: Expression and regulation of entire set of genes: Sporulation Vs. Vegetative condition yeast and bacillus, Diseases vs. normal condition – Breast cancer, Brain vs. gut – organ specific. Analyzing Gene Expression: Microarray, Types of arrays, Tagging, Documentation, Stanford Microarray database. Microarray Analysis: Data normalization, Hierarchical clustering, Self-organizing maps.

**UNIT - II:** (13 hours)

**Central metabolism:** EMP, PPP, TCA, Electron transport, Alternative carbon sources, Amino acid metabolism, Vitamin and Lipid metabolism, Transport metabolism. Translating biochemical networks into linear algebra.

**UNIT - III:** (11 hours)

**Whole Cell Simulation:** Principle and levels of simulation, Virtual erythrocytes, Pathological analysis, Fermentation Analysis, Flux balance analysis, Minimal gene complement.

**UNIT - IV:** (11 hours)

**Relationship Analysis:** Predicting ligand binding function, Comparative genome analysis, Binding surface comparison, Detecting protein-protein interactions – use of EST databases for gene discovery, primer designing, restriction mapping, position specific cloning.

**UNIT - V** (10 hours)

**Protein Expression and Pathway Analysis:** Analyzing Protein Expression: Two-dimensional gel electrophoresis, Mass spectrometry. Metabolic Pathway Databases: Plant Metabolic Pathway (PMN) Database, *Kyoto Encyclopedia of Genes and Genomes* (KEGG) pathway database.

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## REFERENCES

1. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins - Andreas D Baxevanis, Francis Quellerie B F, John Wiley & Sons Inc., USA, 2005. Edition: 3.
2. Scott F Gilbert, Developmental Biology, 8<sup>th</sup> Edition, Sinauer Associates Inc., U S, 2006.
3. Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery by Rastogi S C., Namita Mendiratta, Parag Rastogi. Published by Prentice Hall of India Private Limited, New Delhi, 2013, Edition: 4.
4. <http://www.plantcyc.org/>
5. <http://www.genome.jp/kegg/>
6. Biochemistry and Molecular Biology, Daphne C. Elliott, William H. Elliott, Alison Snape, 2014, edition 5.
7. Biochemistry-Donald Voet, Judith G. Voet, Published by J. Wiley & Sons, 2010, Edition: 4.
8. Harper's Illustrated Biochemistry- Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Published by McGraw-Hill Professional, 2009, Edition: 29.



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Subject Code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

SEMESTER - III

ELECTIVE: CANCER BIOLOGY

**Objective of the paper:** To learn the basics and advanced processes of molecular and genetic basis of cancer. It helps to generate novel mechanistic insight into the processes of tumor development and translate these results for the diagnostic and therapeutic strategies.

**UNIT I:**

(12 hours)

**Introduction to Cancer:** Definition; Cancer incidence and Mortality; Types of Cancer: Benign Tumor Vs Malignant Tumors. Common Symptoms. **Causes of Cancer:** Chemical Carcinogenesis; Irradiation Carcinogenesis; Viral Carcinogenesis, Oxygen Free Radicals, Aging and Cancer; Genetic Susceptibility and Cancer; Multiple Mutations in Cancer; DNA Repair Defects.

**UNIT II:**

(12 hours)

**Cell Cycle Regulation and Cell Signaling in Cancer:** Growth characteristics of malignant cells; cell cycle regulation; evasion of apoptosis – intrinsic and extrinsic pathways; growth factors signal transduction mechanisms: G- Protein- Linked receptors, mTOR, Tyrosine kinase pathway, JAK-STAT pathway, estrogen receptor pathway, hypoxia-inducible factor, heat shock protein-mediated events; angiogenesis; invasions and metastasis; biology of tumor metastasis.

**UNIT III:**

(12 hours)

**Molecular Genetics of Cancer:** Molecular Basis of Cancer: DNA Methylation and Cancer ; Loss of Heterozygosity; Telomeres and Telomerase; Molecular Genetic Alterations in Cancer Cells– Translocation and Inversions, Chromosomal Deletions, Gene Amplification, Point Mutations, Aneuploidy, Disomy, Trinucleotide Expansion, Microsatellite Instability, Mismatch DNA Repair Defects, Oncogenes, Tumor Suppressor Genes: pRb and p53.

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(12 hours)

**UNIT IV:**

**Tumor Immunology:** Mechanism of the Immune Response to Cancer : Antigen Presenting Cells; Antigen Processing; T Lymphocytes and T Cell Activation: The Immunological Synapse; B Lymphocytes and B Cell Activation; Natural Killer Cells; Cell-Mediated Cytotoxicity; Role of Gene Rearrangement in the Tumor Response; Heat Shock Proteins as Regulators of the Immune Response; Inflammation and Cancer; Immunotherapy.

**UNIT V:**

(12 hours)

**Cancer Diagnosis and Treatment:** Tumor Markers; Gene Expression Microarrays; Proteomic Methods; Circulating Epithelial Cells; Circulating Endothelial Cells and Endothelial Progenitor Cells; Molecular Imaging; Mitochondrial Damage; Formation of Oxygen- Free Radicals; Diet and Cancer Prevention; Chemoprevention; Antiproliferative Agents; Antioxidants; Protease Inhibitors; Histone Deacetylase Inhibitors; Multiagent chemoprevention.

**REFERENCES:**

1. Cancer Biology-Raymond W. Ruddon. Oxford University Press, 2007, Edition: 2
2. Molecular Biology of Cancer- F. Macdonald, C.H.J Ford, and A.G Casson. Garland science/ Bios scientific Publishers.
3. The Biology of Cancer- Weinberg. Robert A. New York: Garland Science, 2007.
4. Molecular Biology of Human Cancers- Wolfgang Arthr Schulz. Springer.
5. Molecular Biology of Cancer; Mechanisms, targets and therapeutics-Lauren Pecorino. Oxford University press, Edition: 2.



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Subject Code:

Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

SEMESTER – III

ELECTIVE: MARINE BIOTECHNOLOGY

**Objective of the subject:** This paper provides the knowledge about marine ecosystems and marine biodiversity, commercially available natural and bioactive products of marine microbes Marine pollutants and their effects on marine biodiversity and Bioremediation of marine ecosystem.

**UNIT I:**

**(12 hours)**

**Marine Ecosystems and Marine Biodiversity:** Intertidal, estuarine, salt marsh, mangrove, coral reef, coastal, deep sea ecosystems and hydrothermal vents. Marine Flora- Phytoplankton, seaweeds, sea grasses, and mangroves - their characteristics and identification. Marine fauna–Zooplankton, major marine invertebrates (crustaceans & molluscs), Vertebrates(Pisces) and marine mammals (dolphin and whales) - characteristics and identification.

**UNIT II:**

**(10 hours)**

**Overview of Marine microorganisms:** Diversity of microorganism - Archaea, bacteria, cyan bacteria, algae, fungi, viruses and actinomycetes in the mangroves and coral environments. Methods of study of marine microbes: General microbiological methods, 16S rRNA genomic similarity, Content of guanine (G) + cytosine (C) (%GC), Fatty acid methyl ester analysis (FAME), DNA hybridization.

**UNIT III:**

**(10 hours)**

**Marine Bioactive compounds:** Anti tumor compounds, anti inflammatory / analgesic compounds, anti viral agents, antibiotics, antimicrobial agents and marine toxins and its analysis. Marine Products in Cancer therapies.

**UNIT IV:**

**(12 hours)**

**Marine natural products:** Marine algal products: single cell protein, hydrocolloids, agarose, carrageen, alginates; Marine Enzymes, Marine Lipids, Carotenoids, Chitosan, Chitin, Alginates, adhesives, fish oil and fish foods.

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**UNIT V:**

(12 hours)

**Marine Bioremediation and marine environment conservation:** Major pollutants of marine environment, Lethal and sub lethal effects of pollutants to marine organisms. Impact of global climate changes: oceans as a carbon sink, effects on corals bleaching. Aerobic and anaerobic bioremediation of marine environment. Conservation and management-in situ and ex situ methods, Marine biosphere reserves, Marine parks - heritage sites.

**REFERENCES**

1. Rheinheimer, G., 1980 Aquatic Microbiology-an Ecological Approach. Blackwell Scientific Publications.
2. Kirchman, L Microbial Ecology of the Oceans 2000 John Wiley and Sons. Hans G. Truper 1991.
3. Munn and Munn 1996. Marine Microbiology: Ecology and Applications. BIOS Scientific publisher.
4. Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.
5. Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience.
6. Artikeya, K., Biodiversity: Extinction and Conservation, (202pp) 2005.
7. Fingerman M., Recent advances in Marine Biotechnology, Science Publishers, 2000



**Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE**

**M.Sc. BIOTECHNOLOGY- 2019 onwards**

**SEMESTER - IV**

**ELECTIVE: BIOENTREPRENEURSHIP**

**Objective of the Subject:** To enable the students to know the actual path of self-Employment.

**UNIT I:**

**(11 hours)**

**Principles of Management:** Introduction, definition – Management principles of Henry Foyal - setting and managing Biotechnology industry: principles and decisions on starting a venture; sources of financial assistance – making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, basics in accounting practices - balance sheet, P&L account, and double entry bookkeeping; estimation of income, expenditure, profit, income tax etc.

**UNIT II:**

**(11 hours)**

**Human Resource Development (HRD):** Recruitment and selection process; leadership skills; managerial skills; organization structure; training; team building; teamwork; appraisal; rewards in small scale set up.

**UNIT III:**

**(11 hours)**

**Marketing:** Assessment of market demand for potential product(s) of interest; market conditions, segments; prediction of market changes; identifying needs of customers including gaps in the market, packaging the product; market linkages, branding issues; developing distribution channels; pricing/ policies/ competition/ promotion / advertising; services marketing.

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(12 hours)

**UNIT IV:**

**Information Technology:** How to use IT for business administration; use of IT in improving business performance; available software for better financial management; e-business setup, management.

**UNIT V:**

(12 hours)

**Fundamentals of Entrepreneurship:** Support mechanism for entrepreneurship in India; role of knowledge centre and R&D Knowledge centers like universities and research institutions; role of technology and up gradation; assessment of scale of development of technology; managing technology transfer; regulations for transfer of foreign technologies; technology transfer agencies.

**REFERENCES:**

1. Organizational Behavior by Robbins S.P., Prentice Hall International, New Delhi, 2015, Edition: 16.
2. Organizational Behavior: Text and Cases by UmaSekaran, Tata McGraw Hill Publications, 2015, Edition: 2.
3. Essentials of Management by Koontz, H., C. O'donnell and H. Wehrich, Mc Graw Hill Publishers, 2010, Edition: 8
4. Mastering Business Communication by Woolcott, L. A. and W.R. Unwin, Palgrave Macmillan Publishers, 1983.
5. Project Management by Choudhury, S., R. Kaul and S. Choudhury, Tata McGraw-Hill Publishers, 2001.
6. Human Resource Management in Canada by Dessler, G., Prentice Hall Publishers, Canada, 2012, Edition: 7.

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Subject Code:

Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE

M. Sc. BIOTECHNOLOGY- 2019 onwards

SEMESTER - IV

**ELECTIVE: BIOSAFETY, BIOETHICS AND IPR**

**Objective of the subject:** To get an idea about the advantages and disadvantages of biotechnology applications, ethical implications, and intellectual property rights. To provide the student insights into these invaluable areas of biotechnology, which play a crucial role in determining its future use and applications. To study the diversity of plants and animal life in a particular habitat, ethical issues and potential of biotechnology for the benefit of mankind.

**UNIT I:**

**(11 hours)**

Introduction to Biodiversity - levels of biodiversity - values of biodiversity - loss of biodiversity - species concept - classification and systematic: biological nomenclature - biological classification; biodiversity conservation: *in situ* and *ex situ* - magnitude and distribution of biodiversity - wild life biodiversity in India and global level- Biodiversity hotspots.

**UNIT II:**

**(12 hours)**

Introduction to ethics / bioethics frame work for ethical decision making; Biotechnology and ethics - Biotechnology in agriculture and environment; benefits and risks – benefits and risks of genetic engineering - ethical aspects of genetic testing- ethical aspects relating to use of genetic information - genetic engineering and biowarfare.

**UNIT III:**

**(10 hours)**

Ethical implications of cloning: reproductive cloning, therapeutic cloning, ethical, legal and socio - economic gene therapy, germ line, somatic, embryonic and adult stem cell research - GM crops and GMO's - Biotechnology and Biopiracy - ELSI of human genome project.

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**UNIT IV:**

**(12 hours)**

Introduction to biosafety - biosafety issues in Biotechnology - risks assessments and risk management- safety protocols: risk groups - biosafety levels- biosafety guidelines and regulations (National and International) - operation of biosafety guidelines and regulations - Types of biosafety containments.

**UNIT V:**

**(11 hours)**

Introduction to intellectual property and intellectual property rights - types: patents, copy rights, trade marks, design rights, geographical indications - importance of IPR - patentable and non-patentable - patenting life - legal protection of Biotechnological inventions - world intellectual property rights organization (WPIO).

**REFERENCES:**

1. Principles of cloning - Jose Cibelli, Robertp.Lanza, Keith.H.S Campbell. Michle D. West, Academic Press, 2002.
2. Ethics in Engineering - Martin. M.W and Schinzinger.R. Tata McGraw-Hill, New Delhi, 2003, Edition: 3.
3. Biosafety issues related to transgenic crops,BT guidelines, Biotech Consortium India Limited. New Delhi.
4. <http://books.cambrige.org/0521384737.htm>
5. <http://online.sfsu.edu/%7Erone/GEessays/gendanger.htm>
6. [http://www.actahort.org/members/showpdf?booknr=447\\_125](http://www.actahort.org/members/showpdf?booknr=447_125)
7. <http://www.cordis.lu/elsa/src/aboyt.htm>
8. <http://www.biomedcentral.com/content/pdf/147-6939-22.pdf>
9. [http://lifesciences.cornell.edu/vision/accelerating\\_focus05.php](http://lifesciences.cornell.edu/vision/accelerating_focus05.php)
10. <http://thompson.com/libraries/fooddrug/>
11. <http://assets.cambridge.org/0521792495/sample/0521792495WS.PDF>
12. [http://europa.eu.int/eurlex/pri/en/oj/dat/1998/I\\_213/I\\_21319980730en00130021.pdf](http://europa.eu.int/eurlex/pri/en/oj/dat/1998/I_213/I_21319980730en00130021.pdf)
13. <http://www.clubofastremdam.com/content.asp?contentid=281>

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Subject Code:

**Dr G R DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE**

**M. Sc. BIOTECHNOLOGY- 2019 onwards**

**SEMESTER - IV**

**ELECTIVE: PROTEIN ENGINEERING AND CELL SIGNALLING**

**Objective of the subject:** To enable students to know various wet lab and in silico tools for handling proteomic studies. This course will provide the student with a comprehensive understanding of the regulation of cellular function through signaling and will help them with a firm foundation for a future career in basic research such as diseases like cancer which are related to cellular signaling dysfunctions.

**UNIT I:** (11 hours)

Biogenesis of proteins and protein engineering – cloning and expression of genes and mutagenesis, chemical modification of proteins, design and construction of novel proteins and enzymes, conformation of proteins and enzymes.

**UNIT II:** (10 hours)

Structure of proteins – energy status and structure function relations, basic concepts in enzyme engineering, Stability and biological activity of proteins, single aminoacid changes, engineering for kinetic properties of enzymes.

**UNIT III:** (11 hours)

Protein structure based drug design – function and regulation of enzymes, protein protein interactions, protein DNA interactions, mechanism of protein degradation and proteolysis, Identification and characterization of interacting proteins by phenotypic screens, protein folding, protein sequencing, peptide sequence data, protein crystallization. Data analysis- Mass spectrometry based methods for protein identification, MALDI-TOF, 2D gel electrophoresis.

**UNIT IV:** (12 hours)

Introduction of cell signaling – receptors, extracellular signals: hormones and growth factors – Ser/Thr-specific protein kinase and protein phosphatase – G-protein coupled receptors and cell signaling, G protein effectors, calcium signaling, growth factors and receptor tyrosine kinase signaling, insulin signaling, nuclear receptor signaling, transforming growth factor signaling, cell cycle control.

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**UNIT V:**

(12 hours)

Signaling via hydrophobic molecules, ion channels – cell surface enzymes, non-receptor tyrosine kinases, Ras and other small G proteins, Intracellular signaling - signaling by cAMP, NF-kB, STAT – MAPK signaling pathway – TRAIL, mitochondria, apoptosis and aging.

**REFERENCES:**

1. Protein Structure, Stability and Folding - Kenneth P. Murphy. Published by Humana Press Inc. 2001.
2. Protein Engineering Principles and Practice - Jeffrey L. Cleland and Charles S. Craik. Published by Wiley-Liss Inc., 1996.
3. Protein Engineering and Design - Paul R. Carey. Published by Academic Press Inc., 1996.
4. Cell signaling - Hancock, J. Published by Oxford University Press, 2005. Edition: 2.
5. Cell Cycle Control: Mechanisms and Protocols - Humphrey, T. and G. Brooks, Published by Humana Press. 2005.



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2019-20

Subject Code:

**Dr. G.R. DAMODARAN COLLEGE OF SCIENCE (Autonomous), COIMBATORE**

**M.Sc. BIOTECHNOLOGY- 2019 onwards**

**SEMESTER - IV**

**ELECTIVE: BIOBUSINESS**

**Objective of the Subject:** The purpose of Biobusiness course is to provide specialized knowledge from the Biotechnology sector for effective business education for tomorrow's industry leaders and to develop knowledge and skills to master the future challenges of the biotechnology industries, to understand the Life Cycle Process of Biotech R&D and Marketing, to study and develop product launch and marketing strategies for a highly regulated industry and to learn how to analyze and manage different stakeholder interests (Pharma & biotech, patients and physicians).

**UNIT I:**

**(10 hours)**

**Biotechnology Business Management:** Principles & Practices of Management & Communication Skills. Biotechnology and Bioinformatics – Business, Marketing, Materials, & Logistics Management. Biotechnology plant, Project & Production management. Intellectual property rights & technology transfer Innovation & knowledge management.

**UNIT II:**

**(10 hours)**

**Marketing:** Assessment of the market demand for potential product(s) of interest; market conditions, segments; prediction of market changes; identifying needs of customers including gaps in the market, packaging the product; market linkages, branding issues; developing distribution channels; pricing/ policies/ competition/ promotion / advertising; services marketing.

**UNIT III:**

**(11 hours)**

**Pharmaceutical Business Industry & Management:** Pharmaceutical Industry: Issues, Structure & Dynamics; Legal, Regulatory, and Ethical Issues in the Pharmaceutical Industry; U.S Healthcare System & Pharmaceutical Managed Markets. Pharmaceutical Marketing: Pharmaceutical Marketing Research; Pharmaceutical Product Management; Managing the Pharmaceutical Sales Organization

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2019-20

**UNIT IV:**

(12 hours)

**Agriculture Business Management:** Management of Agricultural Input Marketing; Fertilizer Technology & Management; Management of Agro Chemical Industry; Management of Agro Chemical Industry; Seed Production Technology & Management; Transgenic Seeds/Crops (Soybean, Corn, Cotton, & Others (Includes Canola, Wheat, Rice, and Potato among Others), and Biopesticides.

**UNIT V:**

(12 hours)

**Health Care Business Management:** Economics of Health Care and Policy, Managed Care and Market Structure, Financial Management of Health Institutions, Health Policy, Health Services Delivery: A Managerial Economic Approach, Legal Aspects of Health Care, Management of Care for the Elderly, Health Care Marketing, Comparative Health Care Systems, E-Health: Business Models and Impact, Health Care Entrepreneurship.

**REFERENCES:**

1. Mark J. Ahn, Michael A. Alvarez, Arlen D. Meyers, Anne S York, "Building the Case for Biotechnology", 1st edition, 2011.
2. Peter Kolchensky, "The Entrepreneurship Guide to a Biotech startup", Evelexa, 2011.
3. Maureen D. MacKelvey, Luigi Orsenigo, "The Economics of Biotechnology" Edward Elgar Pub; 1 edition, 2001.
4. Steven B. Kayne, "Pharmacy Business Management" ,Pharmaceutical Press, 2005. 186 Biotech-2013 SRM (E&T)
5. Damian Hine, John Kapeleris, "Innovation and Entrepreneurship in Biotechnology", Concepts, Theories and Case", Edward Elgar Publishing, 2008.
6. Yali Friedman, "Best practices in biotechnology business Development", Logos Press, 2008.