

PROGRAMME: B.Sc. BIOTECHNOLOGY**CURRICULUM**

SEMESTER 1										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	STA 1101	Tamil - I	3	0	0	3	50	50	1
		SFR 1101	French – I					50	50	3
		SHN 1101	Hindi –I					50	50	4
2.	Theory	SHS 1109	General English-I	3	0	0	3	50	50	5
3.	Theory	SBB 1101	Cell Biology	4	0	0	4	50	50	7
4.	Theory	SBB 1102	Fundamentals of microbiology	4	0	0	4	50	50	8
5.	Theory	SBT 1001	Environmental Science	3	0	0	3	50	50	9
6.	Practical	SBB4101	Cell biology Lab	0	0		2	50	50	11
7.	Practical	SBB4102	Fundamentals of Microbiology Lab	0	0	4	2	50	50	11
Total Credits for Semester 1 – 21										
Total Marks for Semester 1 – 700										

SEMESTER 2										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	STA 1102	Tamil - II	3	0	0	3	50	50	12
		SFR 1102	French – II					50	50	14
		SHN 1102	Hindi –II					50	50	15
2.	Theory	SHS 1110	General English-II	3	0	0	3	50	50	16
3.	Theory	SMB 1102	Basic Biochemistry	4	0	0	4	50	50	18
4.	Theory	SBB 1201	Immunology	4	0	0	4	50	50	19
5.	Theory	SBB 1202	Intermediary Metabolism	3	0	0	3	50	50	20
6.	Practical	SMB4102	Basic Biochemistry Lab	0	0	4	2	50	50	21
7.	Practical	SBB4201	Immunology Lab	0	0	4	2	50	50	21
Total Credits for Semester 2– 21										
Total Marks for Semester 2 – 700										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS
 CAE – CONTINUOUS ASSESSMENT EXAMINATION,
 ESE – END SEMESTER EXAMINATION

SEMESTER 3										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SBB2101	Introduction to Molecular Biology & Genetics	4	0	0	4	50	50	22
2.	Theory	SBB2102	Genetic Engineering	4	0	0	4	50	50	23
3.	Theory	SBB2103	Concepts in Biotechnology	3	0	0	3	50	50	24
4.	Theory	SBB2104	Analytical techniques	3	0	0	3	50	50	25
5.	Theory		Elective	3	0	0	3	50	50	
6.	Practical	SBB4301	Molecular biology Lab	0	0	4	2	50	50	26
7.	Practical	SBB4302	Bioinstrumentation Lab	0	0	4	2	50	50	26
Total Credits for Semester 3– 21										
Total Marks for Semester 3 – 700										

SEMESTER 4										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SBB2201	Environmental and Agricultural biotechnology	3	0	0	3	50	50	27
2.	Theory	SBB2202	Basic Industrial Biotechnology	3	0	0	3	50	50	28
3.	Theory	SBB2203	Food biotechnology	4	0	0	4	50	50	29
4.	Theory	SBB2204	Enzyme technology	4	0	0	4	50	50	30
5.	Theory		Elective	3	0	0	3	50	50	
6.	Practical	SBB4401	Soil & Agricultural biotechnology Lab	0	0	4	2	50	50	31
7.	Practical	SBB4402	Food Biotechnology Lab	0	0	4	2	50	50	31
Total Credits for Semester 4– 21										
Total Marks for Semester 4 – 700										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS
 CAE – CONTINUOUS ASSESSMENT EXAMINATION,
 ESE – END SEMESTER EXAMINATION

SEMESTER 5										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SBB3101	Medical Biotechnology	4	0	0	4	50	50	32
2.	Theory	SBB3102	Advanced Genetic Engineering	4	0	0	4	50	50	33
3.	Theory	SBB3103	Plant Biotechnology	3	0	0	3	50	50	34
4.	Theory	SBB3104	Animal Biotechnology	3	0	0	3	50	50	35
5.	Theory		Elective	3	0	0	3	50	50	
6.	Practical	SBB4501	Genetic Engineering Lab	0	0	4	2	50	50	36
7.	Practical	SBB4502	Plant and Animal Biotechnology Lab	0	0	4	2	50	50	36
Total Credits for Semester 5– 21										
Total Marks for Semester 5 – 700										

SEMESTER VI										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SBT1002	Research Methodology	3	0	0	3	50	50	37
2.	Theory	SMB3201	Clinical Microbiology	3	0	0	3	50	50	38
3.	Project	S30PROJ	Project	0	0	30	15	50	50	
Total Credits for Semester 6 – 21										
Total Marks for Semester 6 – 300										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS
 CAE – CONTINUOUS ASSESSMENT EXAMINATION,
 ESE – END SEMESTER EXAMINATION

LIST OF ELECTIVES

ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SBB1601	Advanced instrumentation Techniques	3	0	0	3	50	50	39
2	SBB1602	Biopharmaceutical Technology	3	0	0	3	50	50	40
3	SMB1603	Food Fermentation Techniques	3	0	0	3	50	50	41
4	SBB1604	Protein engineering	3	0	0	3	50	50	42
5	SBB1605	Cancer biology	3	0	0	3	50	50	43
6	SBB1606	Computer Application in Biology	3	0	0	3	50	50	44
7	SBB1607	Genomics and Proteomics	3	0	0	3	50	50	45
8	SBB1608	Metabolic Engineering	3	0	0	3	50	50	46
9	SBB1609	Introduction to Bioinformatics	3	0	0	3	50	50	47
10	SBB1610	Entrepreneurial biotechnology	3	0	0	3	50	50	48
11	SBB1611	Biostatistics	3	0	0	3	50	50	49
12	SBB1612	Molecular Modeling & Drug Design	3	0	0	3	50	50	50
13	SBB1613	Marine biotechnology	3	0	0	3	50	50	51
14	SMB1602	Biofertilizers and Biopesticides	3	0	0	3	50	50	52
15	SBB1615	Bioethics, Biosafety and IPR	3	0	0	3	50	50	53
16	SBB1616	Nanobiotechnology	3	0	0	3	50	50	54

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CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION

Semester	Theory courses (including elective courses)			Practical Courses (including Project)		
	Total No.	Total Credits	Total Marks	Total No.	Total Credits	Total Marks
1	5	17	500	2	4	200
2	5	17	500	2	4	200
3	5	17	500	2	4	200
4	5	17	500	2	4	200
5	5	17	500	2	4	200
6	2	6	500	1	15	100
Overall Total	27	91	3000	11	35	1100

Overall total credits for B.Sc.(Biotechnology) Programme	126
Overall total marks for B.Sc.(Biotechnology) Programme	4100

SBB2102	GENETIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	4	100

COURSE OBJECTIVES

- The course aims to give an understanding on the fundamentals of r-DNA technology and thereby a deep understanding about deliberate manipulation of genetic material for the benefit of mankind.
- It also aims to understand the possible dangers in doing the same without much of forethoughts.

UNIT 1 rDNA TECHNOLOGY AND TOOLS INVOLVED IN GENETIC MANIPULATIONS**12 Hrs.**

Introduction to rDNA technology- pros and cons of genetic engineering. Restriction modification system, Restriction enzymes – function, classification (Based on recognition and restriction sequence:-type I, II and III; based on buffer salt concentration: - low, medium and high; based on pattern of restriction:-sticky (5' and 3') and blunt end cutters). Other DNA modifying enzymes and its functions/uses in r-DNA technology (DNA Polymerases, Klenow fragment, Ligase, S1 Nuclease, Mung Bean nuclease, Alkaline Phosphatase, Terminal Transferase, Polynucleotide kinases, alkaline Phosphatases (CIP, SAP and TAP), RNase A, RNase H, DNase 1, Exonucleases, Reverse Transcriptase)

UNIT 2 BIOLOGY OF CLONING VECTORS**12 Hrs.**

Ideal features of vectors; Plasmids (Types, copy number, properties, origin of replication and incompatibility group, plasmid amplification), bacteriophages eg λ (Life cycle, genome organization, feasibility as a cloning vehicle), Types of Cloning Vectors (structure and general features of General Purpose cloning vectors, shuttle vectors), Examples of cloning vectors (pBR322, pUC series of vectors, λ insertional and replacement vectors), derivatives of phages and plasmids (cosmids, phagemids, phasmids) cloning vectors for large DNA fragments using YACs, PACs and BACs

Unit-3 INTRODUCTION TO R-DNA TECHNOLOGY**12 Hrs.**

General strategies for isolation of genomic and plasmid DNA; Strategies for isolation of gene of interest (restriction digestion, PCR), Creation of r-DNA (Restriction Digestion, modification of vector and insert, linker, adaptors, homopolymer tailing, ligation.), PCR Cloning, Selectable and screenable markers, reporter genes.

UNIT 4 GENE TRANSFER TECHNIQUES**12 HRS.**

Selection of host and vector, Host Organisms and its genotypes- Prokaryotic and eukaryotic systems, Methods of gene transfer- Physical (micro injection, gene gun/biolistic, electroporation), Chemical (Calcium chloride, Calcium phosphate precipitation method, liposome mediated) and Biological methods (*Agrobacterium* and viral).

UNIT 5 IDENTIFICATION OF GENETIC TRANSFORMANTS AND THEIR APPLICATIONS**12 Hrs.**

Methods for clone identification-direct screening (insertional inactivation of marker gene, visual screening methods), indirect screening (PCR and hybridization based techniques-colony PCR/ hybridization and dot blot hybridization), hybridization techniques - Southern blotting, Northern blotting, Western blotting. Examples of Transgenic plants and animals, current status of commercial rDNA products, Bio-safety measures and regulations for rDNA work

TEXT / REFERENCE BOOKS

1. Primrose, S.B. and Twyman, R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006) 7th ed. ISBN 1-4051-3544-1
2. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor, 2006.
3. Brown T.A., Genomes, 3 by Third Edition (Garland Science Publishing), 2007.
4. Glick, B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 questions of 2 marks each - No choice**20 Marks****PART B :** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB2201	ENVIRONMENTAL AND AGRICULTURAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COUSE OBJECTIVE

- The primary objective is to exploit biotechnology principles for the sustained environment and agriculture

UNIT 1 ENVIRONMENT AND WASTE TREATMENT PROCESS**12 Hrs.**

Basic concepts of Environment and ecosystem- Effluents and sewages- Sewage treatment processes- Physical, chemical and biological. Biological processes for domestic and industrial waste water treatments: Aerobic system – activated sludge processes-Trickling filters – biological filters- fluidized bed reactors (FBR)

UNIT 2 WASTE MANAGEMENT**12 Hrs.**

Anaerobic biological treatment – contact digestion – packed column reactors - Methanogenesis. Methanogenic, acetogenic, and fermentative bacteria – technical process conditions, Solid waste management-Landfills, composting, earthworm treatment, recycling and processing of organic residues. Hazardous wastes: source management and safety.

UNIT 3 BIODEGRADATION OF PESTICIDES**12 Hrs.**

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydro carbons, pesticides, surfactants and microbial treatment of oil pollution.

UNIT 4 MICROBIAL LEACHING AND BIOREMEDIATION**12 Hrs.**

Microbial leaching and mining: Extraction of metals from ores; recovery of metals from solutions. Microbial petroleum extraction; Microbial desulfurization of coal wasteland; Uses and management; bioremediation and bioremediation of contaminated lands.-Phyto remediation – bioventing – and biosparging- liquid phase

UNIT 5 BIOFERTILIZERS AND SUSTAINABLE ORGANIC AGRICULTURE**12 Hrs.**

Bioinoculant Technology - Bioinoculants- various types- biofertilizer, biomanures and biopesticides-their importance in sustainable agriculture - organic farming and environmental health Historical development of Bioinoculants technology- Biofertilizers- Bacteria, fungi and algal biofertilizers.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Environmental biotechnology and cleaner bioprocesses – Eugenia J.Olguin, Gloria Sanchez, Elizabeth Hernandez, Taylor and Francis, London 2000.
2. Introduction to soil Microbiology – Alexander. M. 2ndedn. John Wiley and Sons, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB2202	BASIC INDUSTRIAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

The importance of microorganism in industries and product its application

UNIT 1 INTRODUCTION TO INDUSTRIAL BIOPROCESS**12 Hrs.**

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, **Process flow sheeting – block diagrams, pictorial representation.**

UNIT 2 PRODUCTION OF METABOLITES**12 Hrs.**

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. **Secondary Metabolites-** Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT 3 DEGRADATION OF POLLUTANTS**12 Hrs.**

Microbes role in degradation of pollutants, genetically modified microorganism-super bugs, advantage of biodegradation than the conventional method.

UNIT 4 PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS**12 Hrs.**

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture.

UNIT 5 PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS**12 Hrs.**

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2006.
2. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
3. Kumar, H.D. "A Textbook on Biotechnology" 2 nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
4. Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
5. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2 nd Edition Cambridge University Press, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB2203	FOOD BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	4	100

COURSE OBJECTIVE**UNIT 1 MICROORGANISMS IN FOOD****12 Hrs.**

Bacteria, fungi & yeast, role and significance. Enzymes in food preparation. Food carcinogens & mutagen (N – nitrosamines, Acrylamide & their mode of action).

UNIT 2 NUTRITIONAL BOOSTS AND FLAVOR ENHANCERS**12 Hrs.**

Antioxidants. Food colors (natural & artificial food colourants). Food flavoring agents. Properties & function of Emulsifiers & Stabilizers in food. Food Sweeteners – Saccharine, Acesulfane, Aspartame & Sucrolose).

UNIT 3 FOOD BORNE DISEASES AND CONROL**12 Hrs.**

Food borne diseases. Food Allergens. Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms, Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods.

UNIT 4 FERMENTATION**12 Hrs.**

Fermented food: pickles, yogurt, cheese, Beverages: Beer, wine and distilled spirits.

UNIT 5 FOOD PRESERVATION**12 Hrs.**

Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Radiation, Radappertization, Radicidation, and Radurization of Foods. Stability Food Preservation with Low Temperatures, Food Preservation with High Temperatures, Preservation of Foods by Drying.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. B.Siva 2011.Food Processing & Preservation –PHI Learning Pvt Ltd.
2. D.G. Rao, 2010. Fundamentals of Food Engineering –PHI Learning Pvt Ltd.
3. Michael P. Doyle, Larry. R. Food Microbiology – Fundamentals & Frontiers
5. Frazier, Food Microbiology

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB2204	ENZYME TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	4	100

UNIT 1 INTRODUCTION TO ENZYMES**12 Hrs.**

Nature and function of enzymes, Enzyme nomenclature, classification of enzymes, mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis., Role of co-enzymes and co-factors.

UNIT 2 ENZYME KINETICS**12 Hrs..**

Michaelis - Menton kinetics, determination of K_m , Lineweaver Burke plot, Eadie - Hofstee plot, Hanes-Woolf plot. Turnover number, Enzyme inhibition -Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition, Irreversible inhibition and inactivation kinetics. Multi substrate enzyme catalysed reaction.

UNIT 3 ENZYME IMMOBILIZATION**12 Hrs.**

Classification of enzyme immobilization, physical and chemical techniques for enzyme immobilization -adsorption, matrix entrapment, encapsulation, cross-linking, covalent bonding, advantages and disadvantages, Application of immobilized enzymes, mass transfer effect on immobilization, properties of immobilized enzymes.

UNIT 4 ENZYME SPECIFICITY AND EXTRACTION**12 Hrs.**

Types of specificity, Active site- Fischer hypothesis and Koshland hypothesis, Extraction of soluble enzymes, membrane bound enzymes, purification procedures, criteria of purity.

UNIT 5 CLINICAL AND INDUSTRIAL APPLICATIONS OF ENZYMES**12 Hrs.**

Application of enzymes in medicine and industry – Assay of plasma enzyme, enzyme biosensors, design of enzyme electrodes, Synzymes, Abzymes, Enzymes in genetic engineering.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Enzyme by Palmer (2001); Horwood publishing series.
2. Fundamental of Enzymology by Price and Stevens (2002): Oxford University Press.
3. Enzyme Technology: Pacemaker of Biotechnology Paperback – 2011: Prasad N K
4. Principles of Enzyme Technology – 2015: M. Y. Khan and Farha Khan
5. Enzyme technology by Helmut uhling (1998): John Wiley

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB1616	NANOBIOTECHNOLOGY	L	T	P	Credits	Total Marks
		4	0	0	3	100

COURSE OBJECTIVES

- Basic structure, function and application of diverse nanomaterials

UNIT 1 INTRODUCTION TO NANOTECHNOLOGY**12 Hrs.**

Introduction to nanotechnology – History and chronological development, micro and nanosystems and technologies. Strategies for nanoarchitecture (top down and bottom up approaches) – fabrication technologies and characterization – self assembly

UNIT 2 BIOSYNTHESIS AND FABRICATION OF NANOMATERIALS**12 Hrs.**

Synthesis and characterization of nanoscale materials – Physical, chemical and Biological Microbial nanoparticle production – Bionanofabrication - Biopolyester particles produced by microbes: synthesis and potential applications – Cyanophycin inclusions: biosynthesis and applications – magnetosomes in bacteria: biochemistry and applications

UNIT 3 APPLICATIONS OF NANODEVICES**12 Hrs.**

overview of nanodevices and techniques in organic nanoscale systems for biosystems – Fullerenes: properties and characterization – carbon nanotubes: characterization and application – quantum dots – quantum wires – gold nanoparticles – nanopores, Dendrimers.

UNIT 4 BIOSYNTHESIS OF NANOMOLECULES**12 Hrs.**

Microbial production of alginates: self-assembly and applications – Bacteriophages: self-assembly and applications – Bacterial spores in bionanotechnology – bacterial protein complexes with potential applications in nanotechnology – S-layer proteins: potential applications in nanotechnology – Bacteriorhodopsin and its potential technical applications – cell motility: nanomotors and cellular navigation – chemotaxis: transmembrane signaling and related proteins.

UNIT 5 APPLICATIONS OF NANOTECHNOLOGY**12 Hrs.**

Diverse application of nanotechnology-cancer treatment, diagnosis- cancer nanobiotechnology- nanobiosensors and nanobiochips – microarrays and genome chips –Drug delivery-Nanotoxicity assessment.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Biomolecular computation for Bionanotechnology – Jian Qin lin, Katsunori shimohara I-596939-014-4 Artech House Publishers
2. Nanobiotechnology Molecular Diagnostics: Current Techniques and Applications (Horizon Bioscience) by K.K. Jain PUBLISHER – Taylor and Francis. (March 2006)
3. Nanotechnology: A Gentle Introduction to the Next Big Idea by Ratner and Ratner.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 questions of 2 marks each - No choice**PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks**

SBB1201	IMMUNOLOGY	L	T	P	Credits	Total Marks
		4	0	0	4	100

COURSE OBJECTIVES

- To know the fundamentals of innate and acquired immunity. To understand how immune system fights and combats the infection and diseases. To get an insight about the principle mechanism of immunity

UNIT 1 IMMUNOLOGY AND IMMUNITY**12 Hrs.**

History of Immunology – Host-parasite relationship – Immunity – Innate and acquired immunity – Humoral and Cell-mediated immunity.

UNIT 2 IMMUNE CELLS**12 Hrs.**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

UNIT 3 ANTIGENS**12 Hrs.**

Antigens – Types, properties – Immunoglobulins – Structure, types and properties – Complement – Classical and alternative pathways.

UNIT 4 ANTIBODIES**12 Hrs.**

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; **Monoclonal and Chimeric antibodies. Antibody reactions – Agglutination – Precipitation – Complement fixation – Immunofluorescence – ELISA-RIA.**

UNIT 5 IMMUNOLOGICAL REACTIONS**12 Hrs.**

Hypersensitivity reactions – Antibody mediated – Type I, Type II and Type III – cell mediated – Type IV – Immunohaematology. Tumor immunology

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Zeev Pancer and Max D. Cooper, (2006), The Evolution of Adaptive Immunity, Ann. Rev. Immunol., 24: 497–518
2. Roitt Evan, Brostoff J. Male D. (1993) Immunology 6th Ed., Mosby & Co. London.
3. Roitt I. M. (1988) Essentials of Immunology, ELBS, London.
4. Roitt M. (1984) Essentials of Immunology, P. G. Publishers Pvt. Ltd., New Delhi.
5. Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V., (1982), Basic and Clinical Immunology, 4th Ed., Lange Medical Publications, Maruzen Asia Pvt. Ltd., Singapore
6. Janeway Charles A., Paul Travers, Mark Walport, Mark Shlomchik. Immunobiology interactive. 2005. Garland Science Publishing. USA.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB3101	MEDICAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		4	0	0	4	100

COURSE OBJECTIVES

- To study about the medicinal approach of Biotechnology and recent advancements in diagnosis.

UNIT 1 ANIMAL CELL CULTURE**12 Hrs.**

Animal cell culture-media, maintenance and culture of primary, secondary and continuous cell lines- organ culture-applications- cancer cell lines- apoptosis. Tissue Engineering – Skin, Liver, Pancreas. Assisted reproductive technology- Pregnancy diagnosis.

UNIT 2 CHROMOSOMAL ABNORMALITIES**12 Hrs.**

Chromosomal disorders – Gene controlled diseases –Identification of disease genes Haemophilia, DMD, Alzheimer's – Molecular basis of human diseases: Pathogenic mutations – Oncogenes – Loss of function – Tumour Suppressor Genes Immunopathology: Hepatitis, Autoimmune Disorders.

UNIT 3 DIAGNOSTIC TECHNIQUES**12 Hrs.**

Prenatal diagnosis – Invasive techniques and Non-invasive techniques – Diagnosis of pathogenic microbes: Classical and modern methods- Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis – Molecular markers – Microarray technology – genomic and cDNA arrays.

UNIT 4 PREVENTION AND TREATMENT**12 Hrs.**

Vaccines-conventional, recombinant, synthetic peptide, anti-idiotypic, DNA vaccines Deletion mutant and vaccinia vector vaccine- Antibiotics-mode of action- antibacterial, antifungal, antiviral, antitumor antibiotics- synthetic chemotherapeutic agent development of microbial resistance to antibiotics.

UNIT 5 MODERN MEDICINE**12 Hrs.**

Hybridoma technique for mAb production and applications- Gene therapy: Ex vivo, In vivo, In situ- Cell and tissue engineering- Stem cell therapy- Nanomedicines- Gene products in medicine – Humulin, Erythropoietin, Growth Hormone/Somatostatin, tPA, Interferon.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Ramasamy, P. "Trends in Biotechnology", University of Madras, Pearl press, 2002.
2. Trevan. "Biotechnology". Tata McGraw-Hill, 2005.
2. Betty Forbes, Daniel SAHM Alica Weinfield, Bailey 2007. Scott's diagnostic microbiology, 12th edition Mosby.
3. Jogdand, S. N. Medical Biotechnology, Himalaya Publishing house, Mumbai, 2005.
2. Click, B. R. and Pasternak. Molecular Biotechnology: Principle and applications of recombinant DNA. ASM Press, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB3102	ADVANCED GENETIC ENGINEERING	L	T	P	Credits	Total Marks
		4	0	0	4	100

COURSE OBJECTIVES

- The course aims to give an understanding on the modern techniques applied in genetic engineering. It also aims to understand the application of GMOs and evaluate the current status of genetic Engineering.

UNIT 1 ADVANCED MOLECULAR TECHNIQUES**12 Hrs.**

Genome mapping-genetic and physical mapping, Chromosome Walking, Chromosome Jumping, DNA foot printing, DNA library construction-Genomic and c-DNA library construction. PCR: basic concept on normal PCR and real time PCR (cyber green and taqman chemistry). DNA fingerprinting: basic genetic principle, Single locus and multi locus DNA fingerprinting. DNA sequencing: Maxam and Gilbert chemical method, Sanger and Coulson enzymatic chain termination method, Automated DNA sequencing, Pyrosequencing, Introduction to NGS.

UNIT 2 RECOMBINANT PROTEIN PRODUCTION**12 Hrs.**

Strategies for gene isolation and full-length cDNA: 5' and 3' RACE basic technique and comparison with RLM RACE. Modern molecular tools in genetic engineering: Gene expression systems - Studying the transcript of a cloned gene. expression vectors, binary vectors and Cointegrating vectors, transposons; Expression and Purification of Recombinant Proteins.

UNIT 3 GENE MANIPULATION TECHNIQUES**12 Hrs.**

Gene Silencing Techniques; Antisense RNA technology, Micro RNA- ShRNA, siRNA, technology; Construction of siRNA vectors. Site directed mutagenesis. Gene knock in and knock out technologies. Targeted gene replacement, Chromosome engineering. Gene Therapy: Strategies of gene therapy, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

UNIT 4 GENETICALLY MODIFIED ORGANISMS**12 Hrs.**

Application of genetic engineering in food & agriculture (golden rice and other improved nutritional qualities, herbicide and pesticide resistant plants), health & medicine (Gene editing, xenotransplantation and gene therapy), industry and environment (production of vaccines, antibodies, bioplastics and bioremediation).

UNIT 5 HAZARDS AND IMPACT OF GMOS**12 Hrs.**

Negative impacts of genetic engineering and Present controversies on genetically modified organisms (GMOs). Biosafety Considerations: Biological risks, ethical issues, economic issues, legal issues. Biosafety regulations/ norms for the release of genetically engineered organisms.

Max Hours.60**TEXT/ REFERENCE BOOKS:**

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor, 2006.
2. Lewin, B., Genes XI, International Edition, Jocelyn Krebs, Stephen Kilpatrick, and Elliott Goldstein. Jones & Bartlett Learning (2017), ISBN 978-1-4496-5985-1
3. Glick, B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.
4. Primrose, S.B. and Twyman, R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006) 7th ed. ISBN 1-4051-3544-1
5. Brown T.A., Genomes, 3 by Third Edition (Garland Science Publishing), 2007.
US- FDA guidelines on the genetically modified organisms

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB3103	PLANT BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The course aims to give an overview on application of biotechnology in agriculture. It also aims to understand the basic concepts in plant tissue culture and transgenic plants

UNIT 1 INTRODUCTION TO PLANT CELL AND TISSUE CULTURE**12 Hrs.**

History, Definition and Principle of plant tissue culture, Laboratory organization, Culture environment, Methods of sterilization, Nutritional components of tissue culture media, Plant growth regulators, Types of culture: Shoot, root, Callus and cell cultures, *In vitro* regeneration of plants- Organogenesis, Somatic embryogenesis, Different areas and applications of plant tissue culture, Factors affecting *in vitro* culture.

UNIT 2 APPLICATION OF PLANT TISSUE CULTURE**12 Hrs.**

Embryo culture and embryo rescue methods, Production of haploid plant through Androgenesis and Gynogenesis, Isolation and culture of protoplasts, Protoplast fusion and somatic hybridization, Somaclonal variations, Production of secondary metabolites by plant cell cultures, Germplasm conservation and cryopreservation.

UNIT 3 GENETIC ORGANIZATION AND GENETIC TRANSFORMATION OF PLANTS**12 Hrs.**

Structure and organization of plant genome, Chloroplast and Mitochondrial genome, Genetic Transformation methods for production of transgenic plants (Direct, Indirect) with a detailed methodology on chloroplast transformation, protoplast transformation and normal methods using particle bombardment.

UNIT 4 TRANSGENIC PLANTS**12 Hrs.**

Examples of transgenic plants and the methodologies adopted in the following areas-Production of transgenic plants for quality traits like increased biomass production (nif gene transfer) nutritional enhancements (Vitamins, proteins), increased shelf life of fruits (Flavr savr tomatos), Production of genetically modified plants for herbicide resistance (round up crops), pest resistance (Bt and other resistance gene candidates), stress tolerance (salt and draught), and horticultural quality (Designer flowers) Molecular farming for therapeutic protein (Plantibodies, Plantigens, Edible Vaccines), Protection of intellectual property (Seed terminator technology)

UNIT 5 APPLICATION AND SAFETY REGULATIONS**12 Hrs.**

Positive and negative impacts of genetic engineering in plants and Current issues and controversies related to transgenic plants, Guidelines on genetic engineering, safety regulations and patenting of transgenic plants, national and international regulations.

Max Hours.60**TEXT / REFERENCE BOOKS**

1. Adrian Slater, Nigel Scott, and Mark Fowler, Plant Biotechnology, Oxford University Press, NewYork, 2008.
2. Satyanarayana, U. Biotechnology, Allied Pvt. Ltd. Kolkata, 2007.
3. Purohit S.S., Agricultural Biotechnology, Agrobios Indi., Jodhpur, 2002.
4. Chawla H.S., Introduction to Plant Biotechnology, 2nd Edition, Oxford and IBH Press, 2003.
5. Lewin, B., Genes XI, International Edition, Jocelyn Krebs, Stephen Kilpatrick, and Elliott Goldstein. Jones & Bartlett Learning (2017), ISBN 978-1-4496-5985-1
6. Primrose, S.B. and Twyman, R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006) 7th ed. ISBN 1-4051-3544
7. US- FDA guidelines on the genetically modified organisms

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBB3104	ANIMAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 INTRODUCTION TO ANIMAL TISSUE CULTURE**12 Hrs.**

History and Scope of Animal tissue culture. Design & layout of ATC laboratory. Requirements for Animal cell culture. Types of media, ingredients of media. Foetal Bovine Serum.

UNIT 2 CELL LINES AND CELL CULTURE**12 Hrs.**

Basic Techniques of mammalian cell culture; Disaggregation of animal tissue. Primary culture & secondary culture. Evolution of cell line & continuous cell line, characterization of cell lines. Monolayer, suspension culture. Organ culture, Embryo culture. Maintenance of cell culture. Common cell culture contaminants.

UNIT 3 GENETIC ENGINEERING**12 Hrs.**

Genetic engineering in animals: methods of DNA transfer into animal cells- calcium phosphate co precipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors. Hybridoma technology, Vaccine production.

UNIT 4 APPLICATIONS OF GENETIC ENGINEERING**12 Hrs.**

Gene therapy, mapping of human genome. RFLP and applications. DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

UNIT 5 ANIMAL CELL AND TISSUE BASED PRODUCTS AND THEIR APPLICATIONS**12 Hrs.**

Applications of animal tissue culture for *in vitro* testing of drugs. Production of transgenic animals & molecular pharming, animal cloning techniques. Cell culture based vaccines. Ethical values in animal biotechnology.

Max Hours.60**TEXT / REFERENCE BOOKS:**

1. Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub. New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.
3. Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology- A Practical Approach. Oxford Univ. Press, Oxford.
4. R.C. Dubey., A Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.
5. Sudha Gangal, Animal Tissue culture. Second edition. University Press (India) Pvt Ltd. Hyderabad.
6. Sverdrup H.V., Oceans & their Physics, Chemistry & Biology –Johns & R.H. Fleming, Prentice Hall Inc.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**