SHSB1102	GENERAL ENGLISH– I	L	T	P	EL	CREDITS	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues
- To prepare the students to effectively communicate by applying reflective thinking practices
- To provide an opportunity to the students to improve their vocabulary
- To create and apply lateral and critical thinking
- To learn academic writing strategies

UNIT I **9 Hrs.**

Listening to identify vocabularies- Self Introduction - Developing dialogue between characters -Talking about neighbours, family members, likes and dislikes, Reading Comprehension strategies- Parts of Speech- Kinds of Sentences Connectives and Discourse markers - Rearranging the Jumbled sentences, E-Mail Writing.

UNIT II **9 Hrs.**

Listening for Inference- Just a Minute speech- Types of words- Compound words, abbreviations and acronyms, Word Association- Tenses and its Types- Voice- Impersonal Passive- Rules of Passive voice formation - Transcoding - Encoding and Decoding- Bar chart, Pie Chart

UNIT III **9 Hrs.**

Listening to telephonic talk to fill blanks- Giving information- travel, hotel booking, making enquiries about availability of seats for admission, asking about courses - Question Tags – Open ended and Close ended questions, Concord, Single - Line Definition - Note Making - Preparing checklists

UNIT IV **9 Hrs.**

Listening to summarise the information- Reading and identifying the topic sentence, - Editing - Punctuation- Error Corrections, 'If 'Conditionals, Idioms & Phrases, Instructions & Recommendations – Drafting a brochure/Advertisement.

UNIT V **9 Hrs.**

Listening to Movie reviews and book reviews, Listening and summarizing- Giving impromptu talks - Reading and Summarizing -Types of words- Homonyms, Homophones, eponyms, acronyms- Writing a Paragraph, Descriptive Essay, Dialogue Writing.

Max. 45 Hrs.

COURSE OUTCOMES

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

CO1 - Remember knowledge of linking words related to both spoken and written discourse
CO2 - Understand collocations, words to express one's point of view in both writing and speaking
CO3 - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given
CO4 - Analyse critical thinking skills by framing questions related to elements of reasoning
CO5 - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation
CO6 - Equip the students with the required Professional Skills

TEXT / REFERENCE BOOKS

1. Sen S, Mahendra etal. (2015) Communication and Language Skills. Foundation books. Chennai
2. Strunk, William Jr., and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
3. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2012.
4. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 1986.
5. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
6. O'Conner, Patricia T. Woe is I: The Grammarphoebe's Guide to Better English in Plain English. Riverhead Books, 2019

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:** 3 Hrs.
PART A:10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B: 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBA1102	CELL AND MOLECULAR BIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVES

- To provide in-depth knowledge of cell structure, components and nucleic acids as genetic material and the central dogma of a cell

UNIT 1 FUNDAMENTALS OF CELL STRUCTURE **9 Hrs.**

Discovery of cells; Basic properties of cells; Different classes of cells – Prokaryotic and eukaryotic cells. Cell division: Cell cycle; mitosis; meiosis, binary fission. Chemical composition and fluidity of membranes; dynamic nature of membranes; transportation across cell membrane; membrane potentials; extracellular matrices – structure and function; cytoskeleton – structure and function.

UNIT 2 CELLULAR ORGANELLES IN METABOLISM **9 Hrs.**

Mitochondria – structure and function; Chloroplast – structure and function. Structure of nucleus – nuclear membrane, nucleolus, chromatin, structure of nucleic acids. Endoplasmic reticulum – smooth & rough; function of endoplasmic reticulum; Golgi complex – structure and function; Ribosomes – Types, structure and function; Morphology and functions of peroxisomes and glyoxisomes; Plant cell vacuoles..

UNIT 3 TRANSPORT ACROSS CELL MEMBRANE **9 Hrs.**

Passive and active transports, Permeases, Sodium -potassium pumps, Ca 2+ ATPase pump, ATP dependant proton pumps, co-transport, symport, antiport, Endocytosis and Exocytosis. Introduction to intra and extra cellular products of medicinal use.

UNIT 3 TRANSPORT ACROSS CELL MEMBRANE **9 Hrs.**

Passive and active transports, Permeases, Sodium -potassium pumps, Ca 2+ ATPase pump, ATP dependant proton pumps, co-transport, symport, antiport, Endocytosis and Exocytosis. Introduction to intra and extra cellular products of medicinal use.

UNIT 4 NUCLEIC ACID AS GENETIC MATERIAL **9 Hrs.**

Introduction and History of Microbial Genetics. DNA as a Genetic material. Physical structure and Chemical composition of DNA – RNA and its types RNA as a Genetic material. DNA Replication – Types and Experimental proof of replication – Enzymes involved in DNA replication

UNIT 5 CENTRAL DOGMA **9 Hrs.**

Prokaryotic Transcription, Translation. Genetic code – Regulation of gene expression in prokaryotes – lac Operon. Gene transfer mechanisms – Transformation, conjugation and Transduction. Plasmid – Characteristics and types Max. 45 Hrs

COURSE OUTCOMES:

CO1: Learn the structure and functions of cells, nucleic acids as genetic material.
CO2: Understand the cell cycle process, Basic of DNA replication in prokaryotes and eukaryotes
CO3: Familiarize the cellular components and gene organization and mechanisms of control the gene expression in various organisms.
CO4: Understand the role of cellular components in metabolism
CO5: Understand the various processes and the importance of biological macromolecules
CO6- Demonstrate the importance of cellular components and molecular aspects of biology

TEXT / REFERENCE BOOKS

1. Lewin B. 2007. Genes IX. Oxford University Press, London.
2. Ajoy Paul. 2011. Textbook of Cell and Molecular Biology. Books and Allied Ltd.
3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2008. Molecular Biology of Cell. 6th Edition. Garland Science, Taylor & Francis group Publishers.
4. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. 1995. Molecular Cell Biology. 3rd Edition. W.H. Freeman Publishers.
5. Peter Snustad D and Michael J Simmons (2003). Principles of Genetics. 3rd Edition, John Wiley & Sons, Inc., Publication, New Delhi.
6. Robert H Tamarin (2002). Principles of Genetics. 7th Edition, Tata Mc GrawHill Publication, New Delhi.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A : 10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB2101	CELL AND MOLECULAR BIOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

➢ The experiments provide hands-on experience in performing basic **cell and** molecular biology techniques and emphasize the importance of in-depth knowledge over basic techniques.

SUGGESTED LIST OF EXPERIMENT

1. Light Microscopy
2. Simple staining
3. Studying algal cell
4. Studying fungal cell
5. Studying plant cell (Onion cells)
6. Studying animal cell (Human cheek cells)
7. tudying mitotic cell division in root tips of Allium cepa
8. Identifying meiotic cell division
9. Isolation of DNA from E. coli/ liver/ plant
10. Isolation of total RNA from E.coli.
11. Agarose gel electrophoresis of DNA and RNA.
12. Isolation of plasmid from E.coli
13. Separation of serum protein by SDS -PAGE

COURSE OUTCOMES

On completion of the course, the student will be able to
CO1 –build a strong foundation on basic cellular nad molecular techniques
CO2 – determine the amount of nucleic acids present in a given sample
CO3 – breakdown the fundamentals of handling laboratory equipment's and reagents
CO4 – apply the concepts of visualizing nucleic acids using dye
CO5 – discuss the use of cellular and molecular techniques
CO6 – recognize the principle behind isolation of nucleic acids from various organisms.

SHSB1201	GENERAL ENGLISH- II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES:

- To provide opportunities for students to read and respond to representations of current issues through texts that present themes and topics that are familiar, insightful and informative.
- To provide an opportunity to the students to improve their vocabulary
- To develop skills relating to creative writing.
- To provide an opportunity to the students to improve their Spoken Language.
- To comprehend the overall idea of a written and oral context.

UNIT I **9 Hrs.**

Listening for details, Speaking - making a presentation, reading for details and Global Comprehension Vocabulary Binomials, Types of Words- Synonyms, Antonyms that describe people, things and their actions - Paired Expressions -Letter Writing - Informal Letters- Letter to a Friend / Family Members - Creating blogs to post written materials.

UNIT II **9 Hrs.**

Listening for details - Speaking: Giving Interview, Public Speech based on specific topics given. Reading for Comprehension and for overall idea - Vocabulary: phrases - Sentence Pattern – Contextual guessing of words– Singular, Plural– Letter writing- Formal letters- Inviting dignitary for a function, Application for job with resume.

UNIT III **9 Hrs.**

Listening for details - Telephonic conversation – Speaking: Narrating a Story - Vocabulary: positive and negative connotations - Language Focus: Adjective- Degrees of Comparison, Direct and Indirect Speech - Types of Sentences (simple, compound, complex) - Collocations - Letter to the Editor (Social Issues) – Hints Development.

UNIT IV **9 Hrs.**

Listening for Overall information - Making requests and suggestions - Speaking: Group Discussion - Vocabulary: Homonyms and Homophones - Language Focus: Transitive and Intransitive verbs - Writing: Precis writing, Story Writing - Process description (Flow chart)

UNIT V **9 Hrs.**

Listening for specific details - Speaking using imagination. Reading to identify facts - Language focus: Modal Auxiliary Verbs Writing: Imaginative writing by predicting, Argumentative Essay, Writing a Book or Film review. Vocabulary: Countable and Uncountable Nouns, foreign nouns and framing of plurals.

Max. 45 Hrs.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 - Remember knowledge of linking words related to both spoken and written discourse

CO2 - Understand collocations, words to express one's point of view in both writing and speaking

CO3 - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given

CO4 - Analyse critical thinking skills by framing questions related to elements of reasoning

CO5 - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation

CO6 - Equip the students with the required Professional Skills

TEXT / REFERENCE BOOKS:

1. Sen S, Mahendra etal. (2015) *Communication and Language Skills*. Foundation books. Chennai
2. Strunk Jr., William, and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
3. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2019.

4. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 2013.
5. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
6. Swan, Michael. Practical English Usage. Oxford University Press, 2016
7.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1201	MOLECULAR GENETICS	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSEOBJECTIVES-

- The course aims to give an understanding on the fundamentals of molecular genetics and thereby a deep understanding about regulation of gene expression

UNIT1 GENE EXPRESSION **9hrs**

Genetic code: Brief account. Protein synthesis in prokaryotes and eukaryotes. Transcription ("rho" dependent a "rho" independent termination), Post Transcriptional modifications, Translation, Regulation of Gene expression:- Inducible operons – Galactose,Repressible operon – Tryptophan

UNIT2 GENOME ORGANISATION AND FINE STRUCTURE OF THE GENE **9 Hrs.**

Prokaryotic genome:- Chromosomal and plasmid, Eukaryotic genome:- Chromosomal and organellar , Fine structure of the Gene: Cistron, muton and recon, Bacterial Genetics Properties and evolution of genetic material, flow of genetic information,.Organization of viral,bacterial genomes and Eukaryotic genome , Mutation: Types and detection:

UNIT-3 REPLICATION **9 Hrs.**

:Prokaryotic and Eukaryotic DNA polymerases, Replicons, origin and termination, Replisome, Genes controlling replication,

UNIT4 TRANSCRIPTION AND TRANSLATION **9 Hrs.**

Prokaryotic RNA polymerase, sigma factors, initiation and termination, Eukaryotic RNA polymerases and their promoters, Processing of transcripts. Translation:General mechanism, Role of rRNA in translation

UNIT5 REGULATION OF GENE EXPRESSIOM **9 Hrs.**

Regulation of gene expression, Regulation of transcription, Operon and regulon , Positive and negative regulation, Enhancers and promoters, Transcription factors: types, DNA binding motifs , Regulation by attenuation and anti-termination, Post transcriptional regulation, Alternative splicing, Transport and targeting of RNA, Post-transcriptional gene silencing ,Translational control and targeting of proteins, Mechanism of steroid hormone and stress induced gene expressions

Max.45 Hrs

Course outcomes

On completion of the course, student will be able to
CO1- introduce the concept of genetics
CO2 -understand the structural organization of gene in prokaryotes and eukayotes
CO3- explore the rearrangements and anomalies in genetic material
CO4 -describe the mutations and repair
CO5 -study the regulation of gene expression
CO6 –understand the control at transcription and translation level

TEXT/REFERENCEBOOKS

1. Molecular Biology of the Gene, 4th edition by Watson J.D, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner (1987) Benjamin/Cummings.
2. The RNA World (2 edition) Gestel and R, T.Cech and J.Atkins (edition) 1999 Cold Spring Harbor, New York.
3. Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis, Saunder College.
4. advanced Molecular Biology by Twyman R.M (1998) Viva Books Ltd.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB2201	MOLECULAR GENETICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- To visualize the structure of plant, animal, bacterial and cancer cells; demonstrate the cell division stages and chromosomes

SUGGESTED LIST OF EXPERIMENTS

1. Studying of plant, animal and bacterial cell structures by microscopy
2. Study of mitotic stages
3. Study of meiotic stages
4. Preparation of buccal smear for identification of Barr Bodies
5. Preparation of Idiogram
6. Study of Chromosomal abnormalities (with the help of permanent slides)
7. Study of cancer cells (with the help of permanent slides)

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – define the anatomy of unicellular and multicellullar organisms
CO2 – explore the stages of cell division
CO3 – Understand the karyotype of chromosomes
CO4 – identify the sex chromatin
CO5 – introduce the structural organisation of mutated cell
CO6 – describe the abnormal genes

SBBA1301	GENETIC ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSEOBJECTIVES

- 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 fore thoughts.

UNIT1 rDNATECHNOLOGY AND TOOLS INVOLVED IN GENETIC MANIPULATIONS **9 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)

UNIT2 BIOLOGY OF CLONING VECTORS **9 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 INTRODUCTIONTOR-DNATECHNOLOGY **9 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.

UNIT4 GENE TRANSFER TECHNIQUES **9 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).

UNIT5 IDENTIFICATION OF GENETIC TRANSFORMANTS AND THEIR APPLICATIONS **9 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 r-dna products, Bio-safety measures and regulations for rDNA work

Max.45 Hrs

Course outcomes

On completion of the course, student will be able to
CO1- introduce the concept of tools used in genetics
CO2 -understand the structural organization of vectors; plasmids
CO3- explore the rearrangements and anomalies in genetic material
CO4 -describe the mutations and repair
CO5 -study the genetic gene transfer techniques
CO6 –understand the genetic transformation techniques

TEXT/REFERENCEBOOKS

1. Primrose, S.B.and Twyman,R.M.,Principles of Gene Manipulation and Genomics, Blackwell Publishing(2006)7thed.ISBN1-4051-3544-1
2. Sambrook, Joseph and David W.Russell "The Condensed Protocols: From Molecular Cloning A Laboratory Manual" Cold Spring Harbor ,2006.
3. BrownT.A., Genomes,3 by Third Edition (Garland Science Publishing),2007.
4. Glick,B.R.andJ.J.Pasternak."MolecularBiotechnology:PrinciplesandApplicationsofRecombinantDNA" 4thEdition.ASM,2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1302	IMMUNOLOGY	L	T	P	EL	Credits	Total Marks
		3	1	0	2	3	100

COURSE OBJECTIVES

- To know the fundamentals of Immunity and understand how immune system fights and combats the infection and diseases

UNIT 1 IMMUNITY **9HRS**

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

UNIT 2 CELLS AND ORGANS OF THE IMMUNE SYSTEM **9 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, Bursa of Fabricius, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

UNIT 3 ANTIGENS & ANTIBODIES **9HRS**

Antigens – Types, properties, Immunoglobulins – Structure, types and functions, Monoclonal Antibodies, Complement pathways - Classical and alternative

UNIT 4 ANTIGEN – ANTIBODY REACTIONS **9HRS**

Agglutination, Precipitation, Complement fixation, Immunofluorescence – ELISA, RIA

UNIT 5 AUTOIMMUNITY, HYPERSENTIVITY AND TRANSPLANTATION **9HRS**

Autoimmunity, Hypersensitivity, Immunohaematology, Transplantation immunology, Tumor immunology

Max Hrs.45

Course Outcomes

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

CO1 -Understand the principles and mechanism of immunity
CO2-Discuss the immune cells and organs alongside their structure and functions
CO3-Distinguish antigens and antibodies, their basic structure and functions
CO4-Summarize the various clinically important antigen antibody reactions
CO5-Discuss the various medically important immunological disorders
CO6-Discuss on the role of immune system in tumor biology

TEXT / REFERENCE BOOKS

1. Text book of Microbiology - Ananthanarayan & Jayaram Panicker
2. Kuby Immunology – Kindt, Goldsby and Osborne
3. Roitt's Essential Immunology - Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB2301	GENETIC ENGINEERING AND IMMUNOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Restriction digestion of DNA
2. DNA ligation
3. Polymerase Chain Reaction - Amplification of DNA of interest/ RAPD
4. Purification of PCR products
5. Identification of human blood groups.
6. To perform Total Leukocyte Count of the given blood sample.
7. To perform Differential Leukocyte Count of the given blood sample.
8. Agglutination reaction
    i) Widal test
    ii) ASO test
    iii) RA test
    iv) CRP test
    v) Pregnancy test (Direct/Indirect)
9. To perform immunodiffusion by
    i. Single Radial Immunodiffusion
    ii. Ouchterlony double diffusion.
10. To perform DOT ELISA.
11. To perform immunoelectrophoresis.

COURSE OUTCOMES

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

CO1- build a strong foundation on basic techniques in identifying immune reactions
CO2- determine various parameters affecting an antigen-antibody reaction
CO3- understand the remarkable role of restriction enzyme and ligase.
CO4- gain knowledge on various blotting techniques to identify the specific DNA fragment and gel electrophoresis
CO5- understanding on DNA amplification
CO6- recognize the applications of techniques to identify a particular infection

SBBB1401	MEDICAL BIOTECHNOLOGY	L	T	P	EL	Credits	TotalMarks
		4	0	0	2	3	100

COURSE OBJECTIVES

- By the end of the course, students should be able to critically analyze and evaluate the current trends and potential future directions in the field, keeping abreast of the latest advancements in medical biotechnology.

UNIT1 INTRODUCTION TO MEDICAL BIOTECHNOLOGY **9 Hrs.**

Overview of medical biotechnology and its applications in healthcare, Historical development and milestones in medical biotechnology, Ethical and regulatory considerations in medical biotechnology, Biotechnological techniques and tools used in medical research

UNIT2 INTRODUCTION TO MOLECULAR BIOLOGY TECHNIQUES USED IN MEDICAL BIOTECHNOLOGY 9 Hrs.

Introduction to molecular biology techniques used in medical biotechnology, Genetic engineering and its applications in medicine, DNA sequencing and genomic medicine, Gene therapy and its potential in treating genetic disorders, Molecular diagnostics and genetic testing

UNIT3 BIOPHARMACEUTICALS AND THERAPEUTIC PROTEINS **9 Hrs.**

Introduction to biopharmaceuticals and their production using biotechnological methods, Recombinant DNA technology for producing therapeutic proteins, Monoclonal antibodies and their applications in diagnosis and therapy, Protein engineering and design for improved drug efficacy, Biosimilars and their role in healthcare

UNIT4 MEDICAL IMAGING AND DIAGNOSTIC TECHNIQUES **9 Hrs.**

Principles and applications of medical imaging techniques, Radiology and nuclear medicine in disease diagnosis and treatment, Molecular imaging and its role in personalized medicine, Biomarkers and their use in diagnostics, Non-invasive diagnostic techniques in medical biotechnology

UNIT5 THERAPEUTIC APPLICATIONS OF MEDICAL BIOTECHNOLOGY **9 Hrs.**

Stem cell research and regenerative medicine, Tissue engineering and organ transplantation, Vaccines and their development using biotechnological approaches, Targeted drug delivery systems and nanomedicine, Emerging trends and future prospects in medical biotechnology

Max. 45 Hrs

COURSE OUTCOMES

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

CO1: Understand the fundamental principles and concepts of medical biotechnology, including its historical development, ethical considerations, and regulatory frameworks.

CO2: Apply molecular biology techniques, such as genetic engineering and DNA sequencing, in medical research and diagnostics.

CO3: Analyze the production and therapeutic applications of biopharmaceuticals and therapeutic proteins, including their design, production, and potential in disease treatment.

CO4: Evaluate the principles and applications of medical imaging techniques and diagnostic methods used in medical biotechnology, including radiology, nuclear medicine, and molecular imaging.

CO5: Demonstrate knowledge of stem cell research, tissue engineering, and regenerative medicine, and their potential for addressing medical challenges.

CO6: Assess the development and use of vaccines, targeted drug delivery systems, and emerging nanomedicine approaches in medical biotechnology, considering their role in disease prevention and treatment.

Text books/ References

1. "Medical Biotechnology: Principles and Applications" by Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten (Latest Edition: 2021)
2. "Introduction to Biotechnology" by William J. Thieman and Michael A. Palladino (Latest Edition: 2020)
3. "Biotechnology: Academic Cell Update Edition" by David P. Clark and Nanette J. Pazdernik (Latest Edition: 2019)
4. "Principles of Biomedical Science" by Anu Singh-Cundy and Phillip Reid (Latest Edition: 2020)
5. "Biotechnology: Science for the New Millennium" by Ellyn Daugherty (Latest Edition: 2020)
6. "Medical Biotechnology and Healthcare: A Comprehensive Guide to Research, Technology, and Industry" by Naveen Kumar, Ravindra P. Veerana, and Rajiv Kumar Upadhyay (Latest Edition: 2020)
7. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" by Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten (Latest Edition: 2021)
8. "Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs" by Rodney J. Y. Ho and Milo Gibaldi (Latest Edition: 2018)

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBA1402	INDUSTRIAL BIOTECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the importance of microorganism in industries and product its application
- To have deep understanding on the steps involved in production of various enzymes and products

UNIT1 INTRODUCTION TO INDUSTRIAL BIOPROCESS **9 Hrs.**

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

UNIT2 PRODUCTION OF METABOLITES **9 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.

UNIT3 DEGRADATION OF POLLUTANTS **9 Hrs.**

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

UNIT4 PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS **9 Hrs.**

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

UNIT5 PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS **9Hrs.**

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

Max.45 Hrs

COURSE OUTCOMES

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

CO1- understand how microorganism, enzymes and natural sources are used to produce cost effective energy and consumer needs especially life-saving medicines.
CO2-strudy the importance of primary and secondary metabolites that are directly or not directly involved in normal growth of the organism
CO3- gain knowledge on how microbial organism transform the substance through various processes
CO4-unsertnad the industrial importance of biopreservatives, biopolymers, biodiesel and biopesticides.
CO5- gain fundamental understanding of protein cloning and over expression in E.coli.
CO6- gain knowledge on various bioprocess methods and laboratory techniques

TEXT/REFERENCEBOOKS:

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."ATextbookonBiotechnology"2ndEdition.AffiliatedEastWestPressPvt.Ltd.,1998.
4. Balasubramanian, D.etal.,"ConceptsinBiotechnology"UniversitiesPressPvt.Ltd.,2004.
5. Ratledge, Colin and Bjorn Kristiansen"BasicBiotechnology"2ndEditionCambridgeUniversityPress,2001.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB2401	INDUSTRIAL AND MEDICAL BIOTECHNOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- This lab aims to use standard diagnostic methods, to monitor disease development and treatment by biochemical analysis

SUGGESTED LIST OF EXPERIMENTS

Introduction recombinant proteins production

i. Cloning techniques and expression vectors
ii. Isolation of plasmid from E.coli
iii. Confirmation of clone using restriction digestion
iv. SDS-PAGE for analysis of recombinant proteins
v. Strategies to increase the expression of recombinant proteins in soluble form
vi. scale-up production of recombinant proteins
vii. Criteria for the choice of the best expression host and final discussion

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 –understand the composition of blood and urine
CO2 –infer the nature of biochemical constituents in blood
CO3 – determine the normal and abnormal levels of enzymes and cholesterol
CO4 – integrate the analytical methods for quantification
CO5 – interpret the levels of biomolecules in biological systems
CO6 – explore the optimal schemes and algorithm of biochemical diagnosis

SBBB501	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

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

UNIT1 ENVIRONMENT AND WASTE TREATMEN TPROCESS **9 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 –activatedsludgeprocesses-Tricklingfilters–biologicalfilters-fluidizedbedreactors (FBR)

UNIT2 WASTE MANAGEMENT **9 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.

UNIT3 BIODEGRADATION OF PESTICIDES **9 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.

UNIT4 MICROBIAL LEACHING AND BIOREMEDIATION **9 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 bio restoration of contaminated lands. -Phytoremediation–bioventing–and biosparging – liquid phase.

UNIT5 BIOFERTILIZERS AND SUSTAINABLE ORGANIC AGRICULTUR **9 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 biofertlizers.

Max. 45 Hrs

COURSE OUTCOMES

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

CO1-Understanding the importance of various waste water treatment process

CO2- gain knowledge on bioprocess of domestic and industrial effluent and its environmental impact towards ecosystem

CO3- Understand the use of microbial species to clean up soil and contaminated groundwater

CO4-Understanding how pesticides are turned into useful products through various bioprocess methods

CO5- know how to restore or bring back the contaminated lands to its near original state through diverse microorganisms

CO-6- Understand how biofertilizers improve the soil nutrients in promoting the plant growth

TEXT/REFERENCEBOOKS:

1. Environmental biotechnology and cleaner bioprocesses Eugenia J. Olguin, Gloria Sanchez, Elizabeth Hernandez, Taylor and Francis, London2000.
2. Introduction to soil Microbiology–Alexander.M.2nd edn.John Wiley and Sons,2003.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1502	PLANT AND ANIMAL BIOTECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	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 PLANT CELL AND TISSUE CULTURE **9 Hrs.**

Plant tissue culture media (composition, types and preparation), plant hormones and growth regulators in tissue culture, Preparation of suitable explants for organo genesis. Micropropagation on large scale, somatic embryogenesis, protoplast culture and somatic hybridization, Anther, pollen and ovary culture for production of haploid plants and homozygous lines, cell culture methods for the secondary metabolite metabolite production, somaclonal variation and its significance, Cryopreservation, Gene banks for germplasm conservation.

UNIT 2 PLANT TRANSFORMATION TECHNIQUES **9 Hrs.**

Mechanism of DNA transfer – Agrobacterium mediated gene transfer, general features of TI and RI plasmids and their use as vectors, role of virulence genes; design of expression vectors; use of 35S and other promoters, reporter genes; viral vectors; direct gene transfer methods particle bombardment, electroporation, microinjection- vector construct with reference to tobacco. Molecular marker aided breeding, RFLP maps, RAPD markers and SCAR (Sequence Characterized applied regions).

UNIT 3 ANIMAL CELL CULTURE **9 Hrs.**

Culture media – composition and preparation, Balanced salt solution and simple growth medium, chemical, physical and metabolic functions of different constituents of culture medium-Role of CO2, serum and protein-free defined media and their applications; Culturing and maintenance of different animal cell lines (Primary and established cell lines). Characterization of cultured cell, measurement of viability, cyto-toxicity and growth parameters. Stem cell cultures, embryonic stem cell and their applications, cell culture-based vaccines, measurement of cell death, apoptosis, scaling up animals cell cultures and production of recombinant gene products.

UNIT 4 TRANSGENIC ANIMALS **9 Hrs.**

Method of obtaining transgenic animals using fertilized eggs and embryonic blastocyst cell, example, importance of transgenic animals – increased productivity of domestic animals, improved desired characters of domestic animals, production of proteins for pharmaceutical use. Animal models for tackling human diseases (Gene knock out and mice models), Transgenic silkworms. Animal cloning : Methods of cloning in animal system – Rat, Sheep, pig; importance of cloning.

UNIT 5 DIAGNOSTIC APPLICATIONS **9 Hrs.**

Application of immunological and molecular diagnostic method (RIA, ELISA, PCR, DNA fingerprinting) in forensic medicine and disease diagnostics. Gene therapy and cell medicated therapy; Genetic diseases targeted for gene therapy,

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- gain fundamental knowledge in plant and animal biotechnology and their applications

CO2 - understand the application of tissue culture importance

CO3 - explain plant genome organization and method used in transgenic plants

CO4 - Understand the basic principles and techniques in animal genetic manipulation.

CO5 - describe safety regulation in genetic engineering

CO 6 - describe techniques and problems both technical and ethical in national and international

TEXT/REFERENCEBOOKS:

1. Plant genetic engineering, Dodds J.H.
2. Plant molecule biology, Grierson and S.V. Convey 3. Molecular biotechnology,
3.Principle and applications of recombinant DNA technology, Bernard R Glick.
4. Plant Biotechnology-Monica Hughes.
5. Animal cell culture – a practical approach, 4 th ED., Freshney. John Wiley Pub.
6. Mammalian Cell Biotechnology- A practical approach. ED Butler. Oxford UNI Press.
7. Methods in Cell Biology. VOL 57 Animal methods, ED Mather & Barnes, Academic Press. 8. Exploring Genetic mechanisms. ED Singer & Berg.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1503	NANOBIOTECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVE

- ➢ To understand basic principles of nano and micro system
- ➢ To study the routs for the nanomaterial synthesis
- ➢ To explore the nanotechnology principles in nanodevices design and applications
- ➢ To familiar with the specific interactions of biological molecules in nano devices development
- ➢ To determine the toxicity assessment and application of nanotechnology
- ➢ To establish nanoprinciples for the welfare of society

UNIT 1 INTRODUCTION TO NANOTECHNOLOGY **9 Hrs.**

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

UNIT 2 BIOSYNTHESIS AND FABRICATION OF NANOMATERIALS **9 Hrs.**

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

UNIT 3 APPLICATIONS OF NANODEVICES **9 Hrs.**

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

UNIT 4 BIOSYNTHESIS OF NANOMOLECULES **9 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 **9 Hrs.**

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

Max.45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Learn about the background on Nanoscience

CO2 – Understand the bases for Introduction to Nanotechnology

CO3 – Understand the bases for the molecular structure and Nano composites

CO4 – Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

CO5 – Understand and improved the application of Nanotechnology

CO6 – Apply their learned knowledge to develop Nanomaterial's

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 EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

S77BPB61	RESEARCH METHODOLOGY	L	T	P	EL	Credits	Total Marks
		4	0	0	2	4	100

COURSE OBJECTIVES

This *course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project.*

UNIT 1 FOUNDATIONS OF RESEARCH **12Hrs**

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method: Understanding the language of research – Concept, Construct, Definition, Variable. Research Process. Problem Identification & Formulation: Research Question, Investigation Question, Measurement Issues. Hypothesis: Qualities of a good Hypothesis ,Null Hypothesis & Alternative Hypothesis; Hypothesis Testing – Logic & Importance

Practical component: Writing an abstract, articulation of null hypothesis and alternate hypothesis

UNIT 2 RESEARCH DESIGN **12Hrs**

Concept and Importance in Research; Features of a good research design, Exploratory Research Design and Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Qualitative and Quantitative Research

Practical component: writing a review paper,

UNIT 3 MEASUREMENT **12Hrs**

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Practical component: calculation of mean, median and mode in excel.

UNIT 4 DATA ANALYSIS **12Hrs**

Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

Practical component: generation of graph in excel, testing hypothesis in excel

UNIT 5 INTERPRETATION OF DATA AND PAPER WRITING **12Hrs**

Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Practical component: plagiarism checking

Max 60Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Discuss some basic concepts of research and techniques used in research works

CO2 - Explain how a research should be designed

CO3 – Understand measurements and sampling

CO4 – analysis given research data through various techniques

CO5 – Understand how to interpret a data through publications

CO6- apply the knowledge of scientific writing

Textbooks:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

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**

SBBB2501	PLANT BIOTECHNOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

LIST OF EXPERIMENTS

1. Preparation and sterilization of plant tissue culture media.
2. Preparation of explants.
3. Callus culture
4.Micropropgation
5.Anther culture
6.Embryo culture
7.Synthetic seeds
8.Isolation of Protoplast

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –know the medium used for tissue culture and preparation of medium
CO2 – understand the sterilization process of medium and samples used
CO3 – know the mediums used for animal tissue culture
CO4 – understand the working techniques and handling of plant samples
CO5 – know the cryopreservation of animal cells
CO6 –understand how to handle animal cells in lab and observation, staining of cells

SBBB2502	ANIMAL BIOTECHNOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

EXPERIMENTS

1. Media preparation for animal tissue culture
2. Primary cell culture-Chick Embryo Fibroblast
3. Sub culturing of normal cell/Cancer cell
4. Cryopreservation and Retrieval
5. Viability checking (Trypan Blue) and cell counting by Haemocytometer
6. Cytotoxicity assay
   a). Direct Microscopic Observationb). MTT assay
   c). Staining and observation of cell

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –know the medium used for tissue culture and preparation of medium
CO2 – understand the sterilization process of medium and samples used
CO3 – know the mediums used for animal tissue culture
CO4 – understand the working techniques and handling of plant and animal samples
CO5 – explain the cryopreservation of animal cells
CO6 –Understand how to handle animal cells in lab and observation, staining of cells

SBBB1601	BIOSAFETY, BIOETHICS AND IPR	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVES

- To understand biosafety and the importance of bioethics
- To be able to distinguish the different IPR and biotechnological patent

UNIT 1 INTRODUCTION TO BIOSAFETY **9 Hrs.**

Biosafety – definition, need, importance, applications, levels of biosafety and criteria for biosafety levels. NIH guidelines for biosafety. Regulations specific to biotechnology companies and research institutions. Biosafety guidelines in India. Role of institutional biosafety committee.

UNIT 2 IMPLICATIONS OF BIOSAFETY **9 Hrs.**

Guidelines for research with transgenic organisms. Environmental impact of genetically modified organisms (beneficial and hazardous impact), Field trials with GMO, Containment levels. Biosafety protocol, Cartagena Biosafety protocol, Mechanism of implementation of biosafety guidelines. Biosafety and politics. Biosafety database

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UNIT 3 INTRODUCTION TO BIOETHICS **9 Hrs.**

Bioethics – need, applications. Impact of bioethics to the environment and society. Bioethical issues pertaining to various aspects of Biotechnology. Bioengineering ethics, responsible researchers, research ethics, ethical decision making. Biowarfare and biopiracy

UNIT 4 INTELLECTUAL PROPERTY RIGHTS **9 Hrs.**

Forms of Intellectual property – patent, copyright, trademark, design, trade secret, domain name and geographical indications. WTO treaties, GATT articles, main features of TRIPS agreement, practical aspects of WIPO. IPR related legislatures in India.

UNIT 5 PATENT **9 Hrs.**

History of Indian patent system and law. Patenting authority. Different types of patent. Requirements and procedure for patenting. Patentable and Non-patentable things. Patent search and patent co-operation treaty (PCT). Farmer's right and plant breeders right. Importance, social consequences and controversies on biotechnology patents.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Define biosafety, bioethics and intellectual property rights.
CO2 - Discuss the different regulations pertaining to biosafety.
CO3 - Categorize the various forms of IPR.
CO4 - Appraise the importance of bioethics in biotechnology.
CO5 - Elaborate the different patents and the process of patenting.
CO6 - Interpret biotechnological novelty as patents.

TEXT / REFERENCE BOOKS

1. Sateesh M.K., Bioethics and Biosafety, I.K. International Publishing House Pvt. Ltd., 2013.
2. Fleming D.O. and Hunt D.L., Biological Safety: Principles and Practices, ASM Press, 2006.
3. Goel D. and Parashar S., IPR Biosafety and Bioethics, Pearson Education India, 2013.
4. Pandey N. and Dharni K., Intellectual Property Rights, PHI Learning, 2014.
5. Singh K.K., Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India, 2014.

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**

S77BLH61	BIOSTATISTICS	L	T	P	EL	Credits	Total Marks
		4	0	0	2	4	100

COURSE OBJECTIVES

- This course aim to use and interpret results of, descriptive statistical methods effectively; Demonstrate an understanding of the central concepts of basic biomathematics and biostatistical theory.

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

Definitions in Statistics, Sample and Population, Variables: Discrete and Continuous, Collection, Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram, Frequency curve and frequency polygon, Ogives.

Practical component:generation of different graph in excel

UNIT 2 SAMPLING AND MEASURES OF DEVIATION **12 Hrs.**

Concept of Sampling and Sampling Distribution. Measures of Central tendency (Mean, Median, Mode), Measures of deviation (Strandard deviation, variance and coefficient of variation).

Practical component: measures of central tendency and deviation in R

UNIT 3 TEST AND LEVEL OF SIGNIFICANCE **12 Hrs.**

Test of significance, Hypothesis Testing, Null and Alternate Hypothesis, Level of significance, Confidence LimitStudent, T and F Test, Chi-square test

Practical component:test of significance in excel

UNIT 4 PROBABILITY AND DISTRIBUTION **12 Hrs.**

Probability and Distribution, Concepts and problems on probability, Binomial, Poisson, Normal Distribution and their applications

Practical component:distribuition analysis in excel

UNIT 5 ANALYTICAL METHODS **12 Hrs.**

Simple Regression and Correlation, Concept of analysis of variance (one-way classification

Practical component:regression line in excel, Correlation in excel and annova in excel

Max. 60 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

CO1 – Familiarize students about the principal concepts of biostatistics

CO2 – Provide the knowledge of sampling and sample analysis

CO3 – Identify distribution form relating to the variable/variables

CO4 – Discuss the test of significance and ANOVA

CO5 – Explain different types of probability distribution

CO6 – Apply hypothesis testing via some of the statistical distributions

TEXT / REFERENCE BOOKS:

1. Fundamentals of Biostatistics. by Irfan A Khan.
2. An introduction to Biostatistics. by PSS Sunder Rao.
3. Introduction to the Practice of Statistics by Moore and McCabe

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SBBB1103	Ancillary Microbiology I	L	T	P	EL	Credits	TOTAL MARKS
		3	0	0	0	3	100

COURSE OBJECTIVES

- This course is aimed to give an insight about the basics of microbiology, diversity of microbes, their growth and metabolism and various techniques followed to control them

UNIT 1 HISTORY AND CONTRIBUTIONS **9 Hrs.**

History and scope of Microbiology, Spontaneous generation - Biogenesis theory - Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich and Sir Alexander Flemming.

UNIT- 2 MICROSCOPY **9 Hrs.**

Microscope- Principles, working mechanism and application - Simple and compound microscope -Dark field -Phasecontrast, Fluorescence, SEM and TEM

UNIT- 3 STRUCTURE OF BACTERIA AND STAINING **9 Hrs.**

Structure and organization of bacterial cell, Gram positive and Gram negative bacterial cell wall. Types of Staining – Bacterial: Simple, Differential (Gram's, AFB), Capsular staining (negative), Spore staining and Fungal: LPCB and KOH mount

UNIT- 4 MEDIA AND TECHNIQUES **9 Hrs.**

Culture and media preparation - solid and liquid. Types of media- Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques – Tube dilution, Pour, Spread, Streak plate

UNIT- 5 STERILIZATION **9 Hrs.**

Sterilization and Disinfection - principles and methods of sterilization: Physical methods - Dry heat, Moist heat, Radiation, Filtration (Membrane and HEPA) and Chemical sterilization- Agents and mode of action

COURE OUTCOMES

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

CO1-Know the fundamentals of microbiology alongside the contributions of various scientists in the field of microbiology
CO2-Understand the basic microbial structure and study the comparative characteristics of prokaryotes and eukaryotes
C03- Discuss the various staining techniques used to study microbial cells
CO4-Discuss the types of media employed to grow microbes in laboratories
CO5-Summarize the different methods of microbial growth control
CO6- Discuss the importance and various methods in sterilization

TEXT / REFERENCE BOOKS

1. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
2. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
3. Pelczar, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1202	ANCILLARY MICROBIOLOGY II	L	T	P	EL	Credits	Total Marks
		3	1	0	0	4	100

COURSE OBJECTIVES

- This course aims at providing knowledge about the various fields of microbiology and the applications of microbes

UNIT 1 MICROBES AND THE ENVIRONMENT **9 Hrs.**

Microbial Habitats – Terrestrial, Aquatic and Atmospheric, Biogeochemical cycles – Carbon, Nitrogen, Phosphorus, Sulphur Cycle, Microbial Interactions - Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation

UNIT 2 MEDICAL MICROBIOLOGY **9 Hrs.**

Sources of infection, methods of transmission, factors predisposing to microbial pathogenicity. Types of infectious diseases, Medically important microbial diseases – Tuberculosis, Typhoid, Leprosy, AIDS, Hepatitis

UNIT- 3 FOOD MICROBIOLOGY **9 Hrs.**

Factors affecting growth and survival of microbes in foods, Spoilage of vegetables, fruits, meat and milk, Methods of preservation of foods – Physical and Chemical, Food borne intoxications

UNIT- 4 INDUSTRIAL MICROBIOLOGY **9 Hrs.**

Types of fermentation processes - Solid-state and liquid-state; batch, fed-batch and continuous fermentations, Bioreactors – Types, Design and Operations, Production of commercially important products - Citric acid, ethanol, penicillin, Enzymes (amylase, protease, lipase)

UNIT- 5 ENTERPRENEURIAL MICROBIOLOGY **9 Hrs.**

Biofertilizers, Biopesticides, Mushroom Technology – Cultivation and Composting, Patents in India and Other countries, Fermentation Economics

COURSE OUTCOMES

ON COMPLETION OF THE COURSE, THE STUDENT WILL BE ABLE TO

CO1-Classify the various fields of Microbiology and their importance
C02-Understand how microbes are associated with the environment
CO3-Discuss on microbial contamination of foods, food preservation techniques and various food borne diseases
CO4-Summarize the industrial application of microbes and production of commercially important products
CO5-Analyze the importance of microbial products and their impact on environment and explain about product patents
CO6- Apply the knowledge in entrepreunership development

TEXT / REFERENCE BOOKS

1. Food Microbiology : William C Frazier
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
3. A Textbook of *Industrial Microbiology*: Wolf Crueger and Annelise Crueger, 2012.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1303	Ancillary Biochemistry I	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- This course is aimed to give an understanding of the basics of biochemistry dealing with carbohydrates, Amino acids, Lipids, nucleic acid, and vitamins

UNIT1 CARBOHYDRATES **9 Hr**

Carbohydrate–Definition, Classification, biological significance, structure of glucose, digestion and absorption of carbohydrates.

UNIT2 PROTEINS **9 Hrs.**

Amino acids–structure, classification (Essential and non-essential, protein and non-protein amino acids). Proteins–definition, classification and structure (primary, secondary, tertiary and quaternary).

UNIT3 LIPIDS **9 Hrs.**

Lipids–definition, classification and biological significance. Structure, properties and functions of fatty acids.

UNIT4 NUCLEICACIDS **9 Hrs.**

Nucleic acids–Structure of DNA and its functions. Different forms of DNA. Different types of RNA and its functions.

UNIT5 VITAMINS **9 Hrs.**

Vitamins–Source, biological function, daily requirement and deficiency symptoms of fat-soluble vitamins (A, D, E and K) and water-soluble vitamins (Ascorbic acid, thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, lipoicacid, biotin, folic acid andvitaminB12).

Max. 45 Hrs

COURSE OUTCOMES

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

CO1 – Define the structure, properties, and roles of carbohydrates.
CO2 – Discuss the structure, chemical properties, and biological importance of amino acids.
CO3 – Describe the classification, structure, and biological importance of proteins.
CO4 – Classify the nature and roles of lipids in the biological system
CO5 - Explain the role of vitamins and its associates diseases
CO6 – Discuss the structure and forms of DNA with types of RNA.

TEXT/REFERENCE BOOKS:

1. Lehninger Principles of Biochemistry-David L. Nelson, Michael M Cox, Macmillan Worth Publishers.
2. Harpers Biochemistry- RoberK.Murray, DarylK. Grammer,McGrawHill,LangeMedicalBooks.25thedition.
3. FundamentalsofBiochemistry-J.L.Jain,SunjayJain,NitinJain,S.Chand&Company.
4. Biochemistry-Dr.AmitKrishnaDe,S.Chand & Co.,Ltd.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB1403	Ancillary Biochemistry II	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- This course aims at understanding the essential metabolic functions of the organism as well as consumption and storage of energy intermediary metabolism of main biomolecules and its regulatory mechanisms.

UNIT 1 BASIC THERMODYNAMICS **9 Hrs.**

Anabolism – catabolism, entthaphy enthopy free energy, forward and reverse reaction equilibrium state

UNIT 2 C ARBOHYDRATE METABOLISM **9 Hrs.**

Glycolysis, TCA cycle and its energy production. Glycogen metabolism: Glycogenesis and Glycogenolysis, Alternative pathways: HMP pathway, gluconeogenesis

UNIT 3 LIPID METABOLISM **9 Hrs.**

Fatty acid oxidation – α, β, ω oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of cholesterol, triglycerides.

UNIT 4 PROTEIN METABOLISM **9 Hrs.**

Ketogenic and Glucogenic aminoacids metabolism. Deamination, Transamination and Decarboxylation, Ureacycle.

UNIT 5 NUCLEIC ACID METABOLISM & ENERGY PRODUCTION **9 Hrs.**

Biosynthesis and degradation of purine and pyrimidine nucleotides. Mitochondrial Electron Transport Chain: Oxidative phosphorylation

Max. 45 Hrs

COURSE OUTCOMES

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

CO1 –develop knowledge on basic thermodynamics.

CO2 – understand the carbohydrate metabolism and its regulatory mechanism

CO3 – understand the lipid metabolic process

CO4 – understand the protein metabolism

CO5 – gain a strong understanding of the synthesis, metabolism of nucleic acids

CO6 – Outline the concepts of important biochemical pathways involving energy metabolism

TEXT / REFERENCE BOOKS

1. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications, 2004.
2. Lehninger's Principles of Biochemistry (2000) by Nelson, David I. and Cox, M.M. Macmillan/Worth, NY.
3. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24th edition, Prentice Hall International. Inc.
4. Principles of Biochemistry, Geoffrey L. Zubay, 3rd edition William W. Parson, Dennis E. Vance, W.C. Brown Publishers, 1995.
5. Principles of Biochemistry, David L. Nelson, Michael M.Cox, Lehninger, 4th edition, W.H. Freeman and company.
6. Biochemistry, Lubert Stryer, 4th edition, W.H. Freeman & Co, 1995.
7. Fundamentals of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A : 10 Questions of 2 marks each uniformly distributed – No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB2102	ANCILLARY MICROBIOLOGY LAB I	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Handling of Instruments and Laboratory safety measures

2. Handling and Maintenance of compound microscope

3. Sterilization Techniques

4. Cleaning of Glassware and preparation of cleaning solutions

5. Staining Procedures

a. Simple staining

b. Gram's staining

c. Capsule staining

d. Spore staining

e. LPCB mount

COURE OUTCOMES

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

C01-Perform cleaning sterilization of glass wares
CO2-handling of laboratory instruments
CO3- Demonstrate practical skills in microscopy
CO4-Efficient handling of pathogenic microbes
CO5-competently perform the staining procedure
C06-differentiate and interpret various microrganisms

SBBB2202	ANCILLARY MICROBIOLOGY LAB II	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Preparation of solid and liquid media

a. Nutrient broth/agar

b. Mac Conkey agar

c. EMB agar

d. TCBS agar

2. Decimal dilution method

3. Plating Techniques

a. Pour plate method

b. Spread plate method

c. Streak plate method

4. Motility test – Hanging drop method

5. Antibiotic Sensitivity test.

COURE OUTCOMES

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

- Efficiently prepare different types of media
- Execute series of dilutions to reduce a dense culture of bacterial cells
- Analyse and interpret the morphology of various microbes
- Perform antibiotic sensitivity test and analyse the results
- Demonstrate the motility of bacteria
- Perform different plating techniques

SBBB2302	Ancillary Biochemistry Lab I	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Course Objective:

- The students understand fundamentals of biochemistry with a common reactions to analyse the unknown biomolecules.

SUGGESTED LIST OF EXPERIMENTS

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concepts
2. Estimation of Ascorbic acid.
3. Carbohydrates: Glucose,fructose,maltose andlactose.
4. Amino acids: Arginine, cysteine, tryptophan and tyrosine.
5. Colorimetric analysis (only for demonstration)
6. Estimation of protein by Lowry's method.
7. Estimation of DNA using diphenyl amine.
8. Estimation of glucose by O -Toluidine.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the unique property of water, concepts of acids and bases.
CO2 - Develop skill and proficiency in preparation of laboratory reagents.
CO3 - To estimate the presence of ascorbic acid in a given sample.
CO4 - To perform various reactions to identify unknown carbohydrates.
CO5 - Determine the presence of amino acids such as arginine, cysteine, tryptophan and tyrosine.
CO6 - Explain the working principle and standardization of colorimeter

SBBB2402	Ancillary Biochemistry Lab II	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- This lab aims to use standard diagnostic methods, to monitor disease development and treatment by biochemical analysis

SUGGESTED LIST OF EXPERIMENTS

1. Estimation of Lipoproteins
2. Glucose tolerance test
3. Estimation of bilirubin
4. Estimation of blood urea
5. Blood sugar determination by Folin-Wu method
6. Estimation of creatine phosphokinase
7. Normal and abnormal constituents of urine
8. Determination of blood cholesterol
9. Determination of glucose by glucose oxidase method
10. Estimation of glycosylated hemoglobin
11. Estimation of LDH and its isozymes
12. Estimation of alkaline phosphatase from serum
13. Estimation of total protein and albumin from serum
14. Determination of SGPT and SGOT
15. Estimation of serum amylase

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 –understand the composition of blood and urine
CO2 –infer the nature of biochemical constituents in blood
CO3 – determine the normal and abnormal levels of enzymes and cholesterol
CO4 – integrate the analytical methods for quantification
CO5 – interpret the levels of biomolecules in biological systems
CO6 – explore the optimal schemes and algorithm of biochemical diagnosis

SBBB3001	ANIMAL CELL CULTURE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study about the knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

UNIT 1 CELL CULTURE LABORATORY DESIGN AND EQUIPMENTS **9 Hrs.**

Planning, construction and services; Layout; Sterile handling area; Incubation; Hot room; Air circulation; Service bench; Laminar flow; Sterilizer; Incubator; CO2incubator;Refrigerators and freezers; Centrifuge; Inverted stage microscope; Magnetic stirrer; Liquid nitrogen freezers; Slow cooling system for cell freezing; Water bath; Autoclaves and hot air oven; Pipette washers; Water purification system; Fluid handling systems and other equipments; Washing, packing and sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Cell culture vessels.

UNIT 2 CELL CULTURE MEDIA AND REAGENTS **9 Hrs.**

Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics, growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.

UNIT 3 CELL CULTURE TECHNIQUES **9 Hrs.**

History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behaviour of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants.

UNIT 4 APPLICATIONS OF CELL CULTURE **9 Hrs.**

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT 5 SCALE UP TECHNIQUE **9 Hrs.**

Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fibre perfusion; Matrix perfusion; Microencapsulation; Growth monitoring

Max. 45 Hrs

COURSE OUTCOMES

On the successful completion of the course, students will be able to-

CO1-acquaint fundamentals of Animal cell culture.
CO2-utilize skills of cell culture for development of biomolecules of clinical importance
CO3-describe the relevance of cell cycle regulations in reference to cellular metabolism
CO4-understand the mechanism of cellular cytotoxicity.
CO5- gain knowledge on applications of cell culture
CO6-get to know about scale up of animal cell culture

TEXT / REFERENCE BOOKS:

1. Culture of Animal Cells (2005) 5th Edition, FreshneyWiley-Liss,
2. Animal Cell Culture - Practical Approach (2000), 3rd Edition, Ed. John R.W. MastersOxford University Press
3. Animal Cell Culture Techniques. (1998). Ed. Martin ClynesSpringer,

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3002	STEM CELL BIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

UNIT 1 STEM CELL BASICS **9 Hrs.**

Introduction to stem cells Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.

UNIT 2 EMBRYONIC STEM CELLS AND ETHICAL ISSUES **9 Hrs.**

Types of stem cells. Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology

UNIT 3 ADULT STEM CELLS **9 Hrs.**

Somatic stem cells, Test for identification of adult stem cells, Adult stem cell differentiation - Trans differentiation -Plasticity - Different types of adult stem cells- Isolation of haemopoietic stem cell, Muscle and Cardiac stem cell and their applications.

UNIT 4 ADVANCEMENT OF STEM CELL IN TISSUE ENGIEERING **9 Hrs.**

Tissue engineering triad, ECM components and their role in tissue development, Tissue engineering application - Production of complete organ - Kidney - Eyes - Heart - Brain.

UNIT 5 THERAPEUTIC APPLICATION OF STEM CELLS **9 Hrs.**

Gene therapy - genetically engineered stem cells - stem cells and Animal cloning - transgenic animals and stem cells - Therapeutic applications – Parkinson's disease - Neurological disorder - limb amputation - heart disease - spinal cord injuries - diabetes -burns - HLA typing- Alzheimer's disease.

Max. 45 Hrs

COURSE OUTCOMES

CO At the end of course, the students will

CO1 Explain the basics of stem cell
CO2 Appraise the ethical implications in using stem cells
CO3 Point out the applications of adult stem cells
CO4 Elaborate on the advancement of stem cells in tissue engineering
CO5 Compile the therapeutic applications of stem cells
CO6 Assess the role of stem cell in gene therapy

TEXT / REFERENCE BOOKS

1. Kursad and Turksen, Embryonic Stem cells, Humana Press, 2002
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research,12 National Academic press, 2002.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3003	CANCER BIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study about the knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

UNIT 1 Fundamentals of Cancer biology **9 Hrs.**

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumour markers, molecular tools for early diagnosis of cancer.

UNIT 2 Principles of carcinogenesis **9 Hrs.**

Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, X –ray radiation - mechanisms of radiation carcinogenesis.

UNIT 3 Principles of Molecular Cell Biology of Cancer **9 Hrs.** Signal targets and cancer, activation of kinases, Oncogenes, Identification of oncogenes, retroviruses and oncogenes, Oncogenes/proto-oncogene activity. Growth factors related to transformation, telomerases.

UNIT 4 Principles of cancer metastasis **9 Hrs.**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT 5 New Molecules for Cancer Therapy **9 Hrs.**

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, advances in cancer detection. Use of signal targets towards therapy of cancer, Gene therapy.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the nature of cancer and the processes underlying cancer formation and progression.
CO2 – Understand the application of radiation carcinogenesis
CO3 – Explore the molecular biology of cancer cells
CO4 – understand the principles of clinical significances
CO5 – explain the gene therapy and advances in cancer detection
CO6 –understand the cancer therapy treatments

TEXT / REFERENCE BOOKS:

1. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996. 2. Ruddon, Raymond W. " Cancer Biology" IIIrd Edition . Oxford University Press, 1995.
2. Weinberg RA. The Biology of Cancer, 2nd Edition. Garland Science, 2013.
3. Cellular signal processing , 2nd Edition by Friedrich Marks, Ursula Klingmuller and Karin Muller-Decker, Garland Science

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3004	PLANT PHYSIOLOGY AND BIOCHEMISTRY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study about the knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

UNIT 1 Photosynthesis **9 Hrs.**

Basic organization and parts of plant tissues. Photosynthesis – concepts and background, Chlorophyll -Structure and functions, two pigment systems, Light and dark reactions.

UNIT 2 Plant growth regulators **9 Hrs.**

Physiological effects, mechanism and transport of auxin, gibberellins, cytokinins, abscisic acid, ethylene, polyamines, jasmonic acid, vitamins.

UNIT 3 Respiration **9 Hrs.**

Glycolysis, TCA cycle, electron transport chain and ATP synthesis, pentose phosphate pathway, glyoxylate cycle.

UNIT 4 Nitrogen metabolism **9 Hrs.**

Biological nitrogen fixation, nodule formation - regulatory factors involved in nodulation- Role of *nif* genes. Mechanism of nitrate uptake, reduction and regulation.

UNIT 5 Stress physiology **9 Hrs.**

polysaccharides (starch and cellulose), synthesis and degradation of starch in plants. Broad classification of secondary metabolites; properties and functions of terpenoids, alkaloids and phenolics. Broad classification of vitamins; properties, occurrence, functions and deficiency symptoms of vitamins A, B complex, C, D, E and K from plant sources

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Summarize the tissue organization and events of photosynthesis in plants.
CO2 Classify plant growth regulators and metabolites and interpret their functions.
CO3 Analyze the mechanisms of respiration in plants.
CO4 Illustrate the mechanism of nitrogen fixation and metabolism.
CO5 Summarize on the plant metabolism
CO6 Dissect the mechanism of stress tolerance and appraise the role of antioxidants.

TEXT / REFERENCE BOOKS:

1. Kochhar, S., & Gujral, S. (2020). References. In Plant Physiology: Theory and Applications. Cambridge: Cambridge University Press.
2. Verma, Plant Physiology, Athena Academic Publishers, 2015
3. Lincoln Taiz, Angns Murphy, Fundamentals of Plant Physiology, Oxford University Press, 2018
4. S. K. Verma and MohitVerma, Plant Physiology, Biochemistry and biotech S Chand Publishers, 2018
5. Dr. V. K. Jain Fundamentals of Plant physiology, S Chand Publishers, 2016
6. Salisbury & Ross 2003. Plant Physiology
7.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3005	GENETICS AND PLANT BREEDING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study about the knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

UNIT 1 MENDELIAN GENETICS AND ITS EXTENSION **9 Hrs.**

Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Backcross and test cross; Incomplete dominance, co-dominance and lethal alleles; Gene interactions (Epistasis) – Dominant, Recessive, Complementary, Supplementary, Duplicate; Multiple alleles (blood groups in humans, self-incompatibility in plants), Pleiotropy, Penetrance and Expressivity. Characteristics of extrachromosomal inheritance; Cytoplasmic inheritance in Mirabilis jalapa; Kappa particles in Paramecium; Mitochondria in yeast

UNIT 2 LINKAGE, CROSSING OVER AND CHROMOSOME MAPPING **9 Hrs.**

Linkage, crossing over types and significance; Cytological basis of crossing over; Recombination frequency, two-point and three-point test crosses and their significance in chromosome mapping; Interference and coincidence. (experiments of McClintock in corn). Deletion, Duplication, Inversion, Translocation, meiosis in structural heterozygote; Position effect; Euploidy and Aneuploidy. Concept of multiple alleles; self incompatibility alleles in Nicotiana and Brassica;

UNIT 3 SEX DETERMINATION AND EXTRACHROMOSOMAL INHERITANCE **9 Hrs.**

Theories of sex determination -- chromosome theory and genic balance theory of sex determination, sex determination in dioecious plants {Marchantia, Ceratopteris, Silene (Melandrium), Humulus, Coccinia, Rumex, Papaya}. Criteria for extra chromosomal inheritance; plastid inheritance in Mirabilis, iojap in corn, Kappa particles in Paramecium, brief idea of mitochondrial (male sterility in plants) and .chloroplast genetics,

UNIT 4 PLANT BREEDING **9 Hrs.**

green revolution, evergreen revolution. Self-fertilization, full sib mating, half sib mating, back crossing; inbreeding and backcrossing; random mating, assortative and disassortative matings, sister line crosses, convergent crosses, complex crosses, diallel selective mating, mating designs for components of variation. selection; pure line theory and its genetic basis; sources of genetic variation, genetic consequences of hybridization (segregation and recombination of genes); composition of populations derived from hybrids; role of genotype and environment in continuous variation; heritability; genetic advance under selection.

UNIT 5 BREEDING METHODS **9 Hrs.**

selection, recurrent selection; development of hybrids, synthetics and composites. Mutation breeding, distant hybridization and polyploid breeding including analytical breeding, mutant variety data (MVD)-IAEA. Somatic mutations, examples of sugarcane and potato crops. Wide hybridization and alien gene transfer. Identification, release and notification of crop varieties, institutions involved in release of varieties.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the nature of cancer and the processes underlying cancer formation and progression.
CO2 – Understand the application of radiation carcinogenesis
CO3 – Explore the molecular biology of cancer cells
CO4 – understand the principles of clinical significances
CO5 – explain the gene therapy and advances in cancer detection
CO6 –understand the cancer therapy treatments

TEXT / REFERENCE BOOKS:

1. Hartwell L et al (2000). Genetics: From genes to genomics. McGraw Hill, New Delhi. 6. Lewin B. (2007). Genes IX. Wiley Eastern Ltd., New Delhi.
2. Pierce, B. (2005). Genetics: A conceptual Approach 2nd Ed. WH Freeman 8. Snustad D P , Simmons NJ and Jenkins JB (2003).
3. Principles of Genetics. John Wiely & Sons, New York. Allard, R.W. (1960). Principles of Plant Breeding. John Wiley, New York
4. Chopra, V.L. (2000). Plant Breeding: Theory and Practice 2nd Ed. Oxford & IBH, New Delhi.
5. Principles of Crop Improvement. Longman Groups Ltd. London. 10. Singh B. D. (2007).
6. Plant Breeding. Kalyani Publishers. Ludhiana. Campbell, P.N. and Smith, A.D. 2011. Biochemistry Illustrated. 4th edition. Churchill Livingstone, London.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3006	PLANT TISSUE CULTURE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- Know basics of Plant tissue culture. 2. Study of various culture techniques used in plant tissue culture. 3. Learn applications of plant tissue culture techniques.

UNIT 1 HISTORY AND LABORATORY ORGANIZATION **9 Hrs.**

History of plant tissue culture, Lab area – Washing, media preparation, transfer, culture and green house. Sterilization of materials and plants– moist, dry, chemical and physical methods.

UNIT 2 PLANT TISSUE CULTURE MEDIA AND SUPPLEMENTS

9 Hrs.

Types of plant tissue culture media, Murashige and Skoog (MS) and B_5 media preparation. Plant growth regulators and supplements.

UNIT 3 TYPES OF CULTURES **9 Hrs.**

Types of culture - Seed, callus, embryo, root, suspension, anther, pollen and protoplast culture –methodology and applications

UNIT 4 REGENERATION METHODS **9 Hrs.**

Micro propagation –Meristem and shoot tip culture, direct and indirect organogenesis, somatic embryo genesis. Germplasm conservation and cryopreservation.

UNIT 5 TRANSGENIC PLANTS **9 Hrs.**

Genetic engineering of plants – Gene transfer methods – direct or vector less and indirect. Application of transgenic plants.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 List out the contributions of scientists and explain the organization of plant tissue culture laboratory
CO2 Describe the media formulations and supplements for plant tissue culture technique
CO3 Demonstrate the techniques required for different plant cell cultures
CO4 Devise the methodology for the regeneration of various plant species
CO5 Discover the applications of plant tissue culture technology
CO6 Apply the plant tissue culture techniques to produce transgenic plants

TEXT / REFERENCE BOOKS:

1. Dr. U. Sathyanarayana – Biotechnology. Books and Allied Publications
2. Chawla H.S., Introduction to Plant Biotechnology, 2nd Edition, Oxford and IBH Press, 2003
3. Bhojwani S.S., Razdan M. K (2005) Plant tissue culture: Theory and practice, Studies in plant science 5,North Holland, Elsevier, New Delhi
4. Adrian Slater, Nigel Scott, and Mark Fowler, Plant Biotechnology, Oxford University Press, NewYork, 2008

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.
PART A :10 Questions of 2 marks each uniformly distributed – No choice 20 Marks
PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3007	FOOD CHEMISTRY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- **To be able to control the major chemical/biochemical (enzymatic) reactions that influence food quality with emphasis on home and food industry applications.**
- **To demonstrate the properties of different food components and interactions among these components modulate the specific quality attributes of food systems**

UNIT 1 GENERAL FOOD ANALYSIS **9 Hrs.**

Expression of reagent concentrations. Measurement of pH, the use of mass balance, titration methods, refractometry, density and brix value. Buffer capacity and buffer preparation. Expression of the results. Repeatability and reproducibility. Trueness and recovery. Concentration calculation and preparation of standard solutions. Calibration curves, sensitivity, linearity and limit of detection.

UNIT 2 CHEMISTRY OF FRUITS **9 Hrs.**

Main compounds present in fruits: reducing sugars, antioxidants, vitamins. The role of pectin, pectin properties, formation of pectin gel. The role of water activity, pH and organic acids in fruits. Enzymatic and non-enzymatic browning reactions. Effect of thermal treatments on the chemical quality of processed fruits (fruit juices, canned fruits, jams, jellies and marmalades). Main chemical analysis for the quality control of fruit products

UNIT 3 CHEMISTRY OF MILK AND DAIRY PRODUCTS **9 Hrs.**

Main compounds in milk and dairy products: lactose, proteins (casein and whey proteins), lipids. Concept of emulsion, foaming, creaming phenomena. Chemical reactions during dairy product preparation: yogurt gelation, cheese curd formation, ice-cream overrun. Cheese maturation and effect on flavor and taste. Methods for chemical analysis in the quality control of milk and dairy products. Methods for protein analysis (Kjeldahl, Dumas, spectrophotometric assays).

UNIT 4 CHEMISTRY OF BAKERY PRODUCTS **9 Hrs.**

Chemistry of cereals and flour. Main reactions in dough and bakery products: reducing group reactions. Starch and degraded starch properties. Gelation, gelatinization and retrogradation reactions. Gluten formation. Shortening in biscuits and pastry. Heat induced changes in bakery product quality. Maillard Reaction. Main chemical analysis in the quality control of bakery products. Methods for analysis of lipids.

UNIT 5 FOOD OXIDATION **9 Hrs.**

Oxidation reactions in food. Lipid oxidation. Radical chain reactions. Role and functions of antioxidants. Water soluble and lipid soluble antioxidants. Methods of analysis for antioxidant and radical scavenging activity

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – understand and be able to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food analysis techniques

CO2 – understand how the properties of different food components and interactions among these components modulate the specific quality attributes of food systems

CO3 – apply the theoretical knowledge of on the chemical changes occurring to foods. Student will be able to apply the theoretical knowledge of analytical methods in practice during laboratory exercises

CO4 – to analyze and compare the chemical properties of foods and their effect on its quality

CO5 – evaluated in class through the discussion of case studies and in the lab through the evaluation of the laboratory activity

CO6 – learn practical laboratory methods to analysis the chemical properties of foods.

TEXT / REFERENCE BOOKS:

1.H. D. Belitz, Foods chemistry, Springer, Doi: 10.1007/9783-540-69934-7.

2. Nielsen, S. Suzanne, ed. Food analysis. New York: Springer, 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration :** 3 Hrs.

PART A :10 Questions of 2 marks each uniformly distributed **–** No choice 20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

SBBB3008	FOOD QUALITY ANALYTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

To explore the food safety and quality assurance in national and international levels.

UNIT I GENERAL PRINCIPLES FOR FOOD SAFETY AND HYGIENE 9 Hrs.

Principles of food safety and quality - Food Safety System - Quality attributes - Total Quality Management. Good Hygienic Practices, Good Manufacturing Practices – HACCP - Risk Analysis, Risk Management, Risk Assessment, Risk Communication - Traceability and authentication.

UNIT II GENERAL PRINCIPLES FOR FOOD SAFETY REGULATION AT NATIONAL / REGIONAL LEVEL 9 Hrs.

The Structure of Food Law, Food Regulation , Laws and Regulations to Prevent Adulteration and Cross Contamination, Microbial Contamination, Hygienic Practice, Chemical and Environmental Contamination, Food Additives, Labeling, Food Laws and Regulations at the International Level for Harmonization.

UNIT III NATIONAL STANDARDS 9 Hrs.

Food Safety and Standard Authority of India regulations - Agricultural and Processed food Export Development Authority - Marine Product Export Development Authority - Export Inspection council and Export Inspection Agency.

UNIT IV INTERNATIONAL BODIES DEALING IN STANDARIZATION 9 Hrs.

International Standardization Organization (ISO), Joint FAO/WHO Food Standards Program. Codex Alimentarius Commission (CAC), Other International Organizations Active in Food Standard Harmonization. Advantages of Utilizing International Standards. Rapid Alert system.

UNIT V COUNTRY SPECIFIC STANDARDS 9 Hrs.

European Committee for Standardization (CEN), PAN American Standards Commission (COPANT), Euro-Asian Council for Standardization, FDA, EPA, EU, ASEAN, EFSA (EuropeanFood Safety Authority)

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – understand the basic principles of food safety

CO2 – summarize the general principles of food safety at national and international levels

CO3 – explore national standards in food safety

CO4 – construct the knowledge about international standards in food safety

CO5 – understand role of country specific standards

CO6 – evaluate about the overall quality assurance.

TEXT . REFERENCE BOOKS

1. Neal D. Fortin. 2009. Food regulation, Wiley Publishers.
2. Naomi Rees. David Watson. 2000. International standards for food safety, An AspenPublications.
3. O'Rourke. 2005. European Food law, 3rd Edition, Thomson, Sweet and Maxwell

END SEMESTER EXAMINATION QUESTION PAPERPATTERN

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**

SBBB3009	FOOD PROCESSING TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To impart knowledge of various areas about the food processing and safety technology.

UNIT 1 PROPERTIES OF FOODS AND PROCESSING THEORY **9 Hrs.**

Properties of Food – Intrinsic and Extrinsic properties - Effects of processing on sensory characteristics of foods – Effects of processing on nutritional properties - Food safety, good manufacturing practice and quality assurance : HACCP, Hurdle technology - Process control - Automatic control, Computer-based systems.

UNIT 2 AMBIENT-TEMPERATURE PROCESSING **9 Hrs.**

Raw material preparation : Cleaning, Sorting, Grading, Peeling - Size reduction in solid and liquid foods – separation and concentration of food components – fermentation and enzyme technology – Irradiation – processing using electric fields, high pressure, pulsed light and ultrasound.

UNIT 3 PROCESSING BY APPLICATION OF HEAT **9 Hrs.**

Heat processing using steam and water – Blanching – Pasteurization – Heat sterilization – Evaporation and distillation – Extrusion : Heat processing using hot air – Dehydration – Baking and roasting : Heat processing using hot oils – Frying : Heat processing by direct and radiated energy – Dielectric , ohmic and infrared heating.

UNIT 4 PROCESSING BY REMOVAL OF HEAT **9 Hrs.**

Chilling – Controlled or modified atmosphere storage and packaging – Freezing – Freeze drying and Freeze concentration.

UNIT 5 POST – PROCESSING OPERATIONS **9 Hrs.**

Coating or enrobing – Packaging – Types of packaging materials – printing – interactions between packaging and foods – environmental considerations – Filling and sealing of containers – materials handling, storage and distribution.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Learning of properties of food and food safety.

CO2 - Knowledge about the food processing by using ambient temperature

CO3 - Study of processing of food by using heat

CO4 - Processing of food by removal of heat using direct and radiant energy

CO5 - Scrutinizing of Post processing of food

CO6 - Gain wide knowledge about the processing technology of food

TEXT / REFERENCE BOOKS

1. Amit K Jaiswal , Food processing Technologies – impact on product attributes , CRC Press Taylor & Francis Group, 2017.

2. Sivashakar B., Food processing preservation, Prentice Hall of India Pvt. Ltd., 2002.

3. Fellows P., Food processing and technology, Principles and Practice, 4th Edition, Woodhead Publishing Limited, Cambridge – England, 2016.

4. Da-Wen Sun, Emerging Technologies for food, 2nd Edition, Academic Press, 2014.

END SEMESTER EXAMINATION QUESTION PAPERPATTERN

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 **80Marks**

SBBB3010	ENZYME TECHNOLOGY	L	T	P	EL	CREDITS	TOTAL MARKS
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes

UNIT 1 INTRODUCTION TO ENZYMES **9 Hrs.**

General introduction and historic background- General Terminology, Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity- chemical nature of enzymes. Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes. Metalloenzymes and metal activated enzyme. Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways. Classification of coenzymes. Isozymes, Abzymes, Synzyme

UNIT- 2 ENZYME CATALYSIS **9 Hrs.**

Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of Serine proteases-Chymotryspin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens).

UNIT- 3 ENZYME INHIBITION **9 Hrs.**

Reversible Inhibition- Competitive, Non Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Irreversible Inhibition- Suicide inhibition. Examples and Mechanism of various Inhibitions like Penicillin, Iodoacetamide and DIPF.

UNIT- 4 ENZYME KINETICS **9 Hrs.**

Culture and media preparation - solid and liquid. Types of media- Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques – Tube dilution, Pour, Spread, Streak plate

UNIT- 5 I NDUSTRIAL AND CLINICAL USES OF ENZYMES **9 Hrs.**

Industrial Enzymes- Thermophilic enzymes, amylases, lipases, proteolytic enzymes in meat and leather industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes. Clinical enzymes- Enzymes as thrombolytic agents, Anti-inflamatory agents, strptokinasae, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Amylases, Cholinesterases, Phosphatases. Immobilization of enzymes, ELIZA. Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes

Max.45 Hrs

COURSE OUTCOMES

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

CO1- To learn enzyme reactions and its characteristics along with the production and purification process
CO2- gain a basic knowledge concerning biotransformation reactions with the usage of enzymes
CO3- understanding of enzyme structure and functions, its production through different types strategies, purification etc.
CO4- Understanding different approaches to study the interaction of substrate with enzymes, enzyme assay and kinetics.
CO5- knowledge ion Broad over-view of different approaches to design inhibitors against enzyme, understanding the enzyme-inhibitor kinetics and mode inhibition.
CO6- Role of enzyme in cell metabolism, physiology and application of enzymes.

TEXT / REFERENCE BOOKS

1. Fundamentals of Enzymology : Nicholas Price & Lewis Stevens
2. Enzymes : Biochemistry, Biotechnology and Clinical Chemistry- Trevor Palmer
3. Biochemistry text books by Stryer, Voet and Lehninger (Relevant Chapters)
4. Proteins by Gary Walsh

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

SBBB3011	FERMENTATION TECHNOLOGY	L	T	P	EL	CREDITS	TOTAL MARKS
		3	0	0	0	4	100

COURSE OBJECTIVES

To acquaint students with technical and biological aspect of microbial utilisation for production of metabolites

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UNIT 1 INTRODUCTION TO FERMENTATION TECHNOLOGY **9 Hrs.**

History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms – primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.

UNIT- 2 FERMENTATION MEDIA **9 Hrs.**

Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation.

UNIT- 3 FERMENTOR DESIGN **9 Hrs.**

Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter; Scale up study and Product development; Down-stream processing and Product recovery; Regulation and safety.

UNIT- 4 PRODUCTION OF MICROBIAL PRODUCTS **9 Hrs.**

Production of alcohol; Organic acid – Citric acid; Antibiotic – Penicillin, Amino acid – Glutamic acid; Vitamin – B1; Single Cell Protein (SCP).

UNIT- 5 FOOD Fermentation **9 Hrs.**

Food fermentations, Food flavouring agents and preservative production, food colorants fermentation, Wine and Cider production

Max.45 Hrs

COURSE OUTCOMES

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

CO1- Enable the students to understand the basics of industrial fermentation process in prokaryotic and eukaryotic systems.
CO2- Gain knowledge about the fermentation department and product development in industries
CO3- Expandthe knowledge about the use of organisms to produce primary and secondary microbial metabolites on an industrial scale.
CO4- Learn about the production process of nutraceuticals and functional foods
CO5- knowledge in Design of various reactors used in Industries.
CO6- apply the knowledge in the development of fermented foods.

TEXT / REFERENCE BOOKS

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. Principles of Fermentation Technology. (2016)
2. Butterworth-Heinemann Press. UK. 2. H. J. Peppler, D. Perlman. Microbial Technology: Fermentation Technology. (2014). Academic Press.
3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. (2006). CRC Press, USA.
4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. (2013). Springer Press, Germany.

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

SBBB3012	DOWNSTREAM PROCESSING	L	T	P	EL	CREDITS	TOTAL MARKS
		3	0	0	0	4	100

COURSE OBJECTIVES

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D.
- Have depth knowledge on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion

UNIT 1 INTRODUCTION TO DOWNSTREAM PROCESSING **9 Hrs.**

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products.

UNIT- 2 PHYSICAL METHODS OF SEPARARTION **9 Hrs.**

Primary Separation: Removal of insolubles and Biomass (and particulate debris) separation techniques, Flocculation and sedimentation, Centrifugation-Ultracentrifugation, Gradient centrifugation, Filtration: Theory of Filtration, Pre-treatment of Fermentation Broth, Filter Media and Equipment, Conventional and Cross-flow Filtration, Continuous Filtration, Filter cake resistance, specific cake resistance, Washing and dewatering of filter cakes 09

UNIT- 3 ISOLATION OF PRODUCTS **9 Hrs.**

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT- 4 PRODUCT PURIFICATION **9 Hrs.**

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT- 5 FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS **9 Hrs.**

Crystallization, drying and lyophilization in final product formulation.

Max.45 Hrs

COURSE OUTCOMES

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

CO1- Define the fundamentals of downstream processing for product recovery
CO2- Understand the requirements for successful operations of downstream processing
CO3- Describe the components of downstream equipment and explain the purpose of each
CO4- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques
CO5- knowledge in various methods of product isolation.
CO6- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques required in multi-factorial manufacturing environment in a structured and logical fashion..

TEXT / REFERENCE BOOKS

1. Belter, P.A., E.L. Cussler and Wei-Houhu "Bioseparations – Downstream Processing for Biotechnology", John Wiley, 1988.
2. Sivasankar, B. "Bioseparations: Principles and Techniques". PHI, 2005.
3. Asenjo, Juan A. "Separation Processes in Biotechnology". CRC / Taylor & Francis, 1990.

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

SBBB3013	SOLID WASTE MANAGEMENT	L	T	P	EL	CREDITS	TOTAL MARKS
		3	0	0	0	4	100

COURSE OBJECTIVES

To learn broader understandings on various aspects of solid waste management practiced in industries.

To learn recovery of products from solid waste to compost and biogas, incineration and energy recovery, hazardous waste management and treatment, and integrated waste management.

UNIT 1 INTRODUCTION TO SOLID WASTE MANAGEMENT **12 Hrs.**

Classification of solid wastes (source and type based), solid waste management (SWM), elements of SWM, ESSWM (environmentally sound solid waste management) and EST (environmentally sound technologies), factors affecting SWM, Indian scenario, progress in MSW (municipal solid waste) management in India.Indian and global scenario of e-waste,

UNIT- 2 WASTE GENERATION ASPECTS **12 Hrs.**

Waste stream assessment (WSA), waste generation and composition, waste characteristics (physical and chemical), health and environmental effects (public health and environmental), comparative assessment of waste generation and composition of developing and developed nations, a case study results from an Indian city, handouts on solid waste compositions. E-waste generation

UNIT- 3 COLLECTION, STORAGE, TRANSPORT AND DISPOSAL OF WASTES **9 Hrs.**

Waste Collection, Storage and Transport: Collection components, storage-containers/collection vehicles, collection operation, transfer station, waste collection system design, record keeping, control, inventory and monitoring, implementing collection and transfer system, a case study. Waste Disposal: key issues in waste disposal, disposal options and selection criteria, sanitary landfill, landfill gas emission, leachate formation, environmental effects of landfill, landfill operation issues, a case study.

UNIT- 4 WASTE PROCESSING TECHNIQUES **9 Hrs.**

Purpose of processing, mechanical volume and size reduction, component separation, drying and dewatering. Source Reduction, Product Recovery and Recycling: basics, purpose, implementation monitoring and evaluation of source reduction, significance of recycling, planning of a recycling programme, recycling programme elements, commonly recycled materials and processes, a case study.

UNIT- 5 HAZARDOUS WASTE MANAGEMENT AND TREATMENT **9 Hrs.**

Identification and classification of hazardous waste, hazardous waste treatment, pollution prevention and waste minimization, hazardous wastes management in India. E-waste recycling.

Max.45 Hrs

COURSE OUTCOMES

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

CO1- Apply the basics of solid waste management towards sustainable development
CO2. Apply technologies to process waste and dispose the same.
CO3. Design working models to convert waste to energy.
CO4- Identify and classify hazardous waste and manage the hazard
CO5- Describe appropriate methods to minimize the impact to public and occupational health from solid waste related activities".
CO6- Identify and discuss the public health, regulatory, planning, technical, and economic principles that influence the solid waste management system.

TEXT / REFERENCE BOOKS

1. White, F. R., Franke P. R.,, & Hindle M., Integrated solid waste management: a life cycle inventory. McDougall,P. John Wiley & Sons. 2001
2. 2. Nicholas, P., & Cheremisinoff, P. D., Handbook of solid waste management and waste minimization technologies, Imprint of Elsevier Science. 2005

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

SBBB3014	ENVIRONMENTAL MICROBIOLOGY	L	T	P	EL	CREDITS	TOTAL MARKS
		3	0	0	0	4	100

COURSE OBJECTIVES

- This course will provide students with the ability to demonstrate their knowledge of prokaryotic biodiversity and function, and to apply this understanding to solve problems and find solutions related to current environmental issues.

UNIT 1 MICROORGANISMS IN THE ENVIRONMENT **9 Hrs.**

Microbial evolution and diversity - A historical perspective - Overview of functions and applications of microorganisms - Interconnectivity of ecosystems. Microbial metabolism and activity - Range of conditions that support life and how microorganisms are adapted to that - Extremophiles.

UNIT 2 BIOGEOCHEMICAL CYCLING, SOIL FORMATION **9 Hrs.**

Influence of microbes on carbon, nitrogen, and sulphur cycles - Influence of microorganisms on soil formation and quality - Biodegradation of different substrates by microbes - Organic matter.

Microbial diversity: DNA, genome, and metagenome. DNA sequencing: methods and examples of data/current findings - OMICS.

UNIT 3 AGRICULTURE AND SOIL MICROBIOME **9 Hrs.**

Soil microbial biodiversity and abundance; - Soil and plant microbiomes; - Soil pathogenic and beneficial microbes; - Influence of biotic and abiotic factors on food production. Plant microbiome: Benefits, function, and biotechnological applications: Importance of microorganisms for agriculture: beneficial and pathogenic; - Microbial inoculants; - Biotechnological solutions for agriculture.

UNIT 4 BIOREMEDIATION OF CONTAMINATED SOILS **9 Hrs.**

In situ, ex situ - Natural attenuation, biostimulation, bioaugmentation - Bioprospection of microorganisms

Biodegradation of plastics: Antibiotic-resistant bacteria - Conventional plastics - Bioplastics; - The biology of plastics biodegradation - Mechanisms of antibiotic-resistance

UNIT 5 BIOTECHNOLOGICAL APPLICATIONS OF MICROORGANISMS **9 Hrs.**

Synthetic biology - Biomining - Microbes and production of pharmaceuticals - Microbes on food production. Microbial Control of Crop Pests and Diseases. Microbes in human welfare: biofuel production - Microbial fermentation - Microbes role in Vermicomposting. Reclamation of waste land by microorganisms.

Max. 45 Hrs

COURSE OUTCOMES

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

CO1 - Recognize the importance of microbial communities to the functioning of diverse ecosystems.

CO2 - Compare and evaluate microbial communities based on their DNA sequences.

CO3 - Predict changes in microbial community structure according changes in biotic and abiotic factors

CO4 - Understand how plants, soil, and human microbiomes are interconnected and how they can influence each other

CO5 - Integrate their knowledge in environmental microbiology and ecosystems management to find out solutions for environmental issues

CO6 - Solve problems and find solutions related to current environmental issues such as antibiotic resistance, pollution, and global warming.

TEXT / REFERENCE BOOKS

1. Manual of environmental Microbiology. Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai. 4th edition. 2016.
2. Environmental Microbiology. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, 2014.
3. Brock Biology of Microorganisms. Madigan, M., Martinko, J.M. and Parker, J. (14 Ed.) 2015. Prentice Hall of India Pvt. Ltd., New Delhi
4. Microbiology. Prescott, L.M, Harley, J.P. and Klein, D.A. (9th Ed.) 2014. McGraw Hill Publishing Ltd., New York.
5. Soil Microbiology: Subba Rao, N.S. (4th Ed.) 2014. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

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

SBBB3015	BIOREMEDIATION	L	T	P	EL	Credits	TOTAL MARKS
		3	0	0	0	4	100

COURSE OBJECTIVES

- To understand the environmental contaminants and apply the remediation technologies.

UNIT 1 ENVIRONMENTAL CONTAMINANTS AND BIOREMEDIATION 9 Hrs.

Sources and impacts of pesticides, PCBs, PAHs, petroleum hydrocarbons; Explosives: TNT & RDX; Inorganic Pollutants: Sources and impacts of heavy metals on terrestrial and aquatic environments. Bioremediation: Advantages of Bioremediation, types of bioremediation. Monitoring the efficacy of Bioremediation. Bio-augmentation, bio-magnification and Biotransformation Bioventing. Bioremediation for controlling oil spills.

UNIT 2 REMEDIATION TECHNOLOGIES 9 Hrs.

Biosorption: Use of bacteria and fungi, Bioreaction for biosorption. Problems associated with disposal of xenobiotic compounds, Hazardous wastes. Biodegradation of xenobiotics: Persistent compounds, Degradation mechanisms, naphthalene, benzene, phenol, PCB's, propanil (Herbicide), urea. Biodegradation of petrochemical effluents.

UNIT 3 TERRESTRIAL PHYTOTECHNOLOGIES 9 Hrs.

Phytoremediation of heavy metals in soil - Basic principles of phytoremediation: Uptake and transport, Accumulation and sequestration – Phytoextraction – Phytodegradation - Phytovolatilization - Rhizodegradation - Phytostabilization – Organic and synthetic amendments in multi metal contaminated mine sites - Role of arbuscular mycorrhizal fungi in phytoremediation Aquatic Photosystems Blast filtration – Rhizoremediation – Phytofiltration - Constructed wetlands - Algal blooms - Phytohydraulics – Riparian Buffers

UNIT 4 RECLAMATION OF CONTAMINATED SITES – CASE STUDIES 9 Hrs.

Scheme of evaluation steps in a project remediation site – Phytoremediation decision tree - Mine site rehabilitation in India - Plants used for dual benefits - Canola case studies for Se phytoremediation and biofortification in California – Phytoremediation and biodiesel production from Jatropha – Phytomining

UNIT 5 TOLERANCE MECHANISMS 9 Hrs.

Phyto and bioavailability of heavy metals in soils – Role of hyperaccumulators in phytoextraction – Continuous or Natural phytoextraction, Chelate-induced phytoextraction – Assessing the efficiency of phytoextraction – Transgenic approaches to enhance phytoremediation of metal contaminated soils - Sulphur and nitrogen containing metabolites in metal defense mechanism: Phytochelatins, metallothioneins, polyamines, and amino acids.

Max. 45 Hrs

COURSE OUTCOMES

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

CO1 - Able to gain knowledge on various environmental contaminants.

CO2 - Gains knowledge on remediation technologies.

CO3 - Gains knowledge on terrestrial phytoremediation.

CO4 - Gains knowledge on aquatic phytosystems.

CO5 -. Analyze the need of reclamation of contaminated sites

CO6 - Able to calculate the tolerance level of plants and other organisms.

TEXT / REFERENCE BOOKS

1. Singh SN (2014) Biological Remediation of Explosive Residues, Springer International Publishing, Switzerland.
2. Dhir B (2013) Phytoremediation: Role of Aquatic Plants in Environmental Clean-Up, Springer India.
3. Yin X and Yuan L (2012) Phytoremdiation and Biofortification – Two sides of one coin, Springer, Netherlands.
4. Anjum NA, Ahmad I, Pereira ME, Duarte AC, Umar S and Khan NA (2012).The Plant Family Brassicaceae – Contribution Towards Phytoremediation, Springer-Verlag, Berlin Heidelberg.
5. Anjum NA, Pereira ME, Ahmad I, Duarte AC, Umar S and Khan NA (2013) Phytotechnologies – Remediation of Environmental Contaminants, CRC Press, Boca Raton, FL, USA.
6. Gupta DK (2013) Plant-Based Remediation Processes, Springer-Verlag, Berlin Heildelberg.

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