M.Sc., BIOTECHNOLOGY

Course content and Scheme of Examinations

(for the candidates admitted from 2019 onwards)

PG & RESEARCH DEPARTMENT OF BIOTECHNOLOGY

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

PUTHANAMPATTI

TIRUCHIRAPPALLI- 621 007.

Department of Biotechnology

Vision:

Attaining new heights in Biotechnology research, shaping Biotechnology into a premier precision tool of the future for creation of wealth and ensuring social justice.

Mission:

- To impart quality education for lifelong professional growth and opportunity in a wide range of careers.
- To create awareness towards socio-ethical implications of potentials of Biotechnology.

Programme Specific Objectives:

I. The graduates of Biotechnology are prepared to be creators of new knowledge leading to innovation and entrepreneurship employable in various sectors such as private government and research organizations.

II. The graduates of Biotechnology are trained to evolve new technologies in their own discipline.

III. The graduates of Biotechnology are groomed to engage in lifelong learning process by exploring their knowledge independently.

IV. The graduates of Biotechnology are framed to design and conduct experiments/ demonstrations/ create models to analyze and interpret data.

V. The graduates of Biotechnology have the ability to undertake significant research or development of projects.

VI. The graduates of Biotechnology ought to have the ability of effectively communicating the findings of Biological Sciences incorporating with existing knowledge.

Programme outcomes:

The student of Biotechnology will be able to:

A. Apply the acquired knowledge from undergraduate courses and other disciplines to identify, formulate and present solutions to technical problems related to various areas of Biotechnology.

B. Ability to apply knowledge of Botany, Zoology, Microbiology, Biochemistry and Molecular Biology to solve complex problems or processes that meet the specific needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

C. Develop confidence, improve their professional value and motivation for self-education and imbibe professional values for lifelong learning.

D. Ability to identify, formulate and solve scientific problems of multidisciplinary nature.

E. Use the techniques, skills and equipment necessary to evaluate and analyze the systems in real time environments.

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A relation between the Program Specific Objectives and the outcomes is given in the table:

PROGRAM SPECIFIC OBJECTIVES	**PROGRAMME OUTCOMES**				
	A	B	C	D	E
I	2	3	2	2	3
II	3	2	1	1	2
III	3	3	2	3	2
IV	2	3	3	1	3
V	3	2	2	3	2
VI	1	3	3	2	3

Contribution 1: Reasonable 2: Significant 3: Strong

NEHRU MEMORIAL COLLEGE (AUTONOMOUS),

PUTHANAMPATTI – 621 007, TIRUCHIRAPPALLI (Dt.)

M.Sc., BIOTECHNOLOGY Programme – Course Structure under CBCS Pattern

(for the candidates admitted from the year 2019-2020 onwards)

Sem	Course	Title of the Subject	Inst Hrs	Credit	Ex Hrs	INT	EXT	TOT
I	**CC I**	Cell and Molecular Biology	6	4	3	25	75	100
	CC II	Biochemistry	6	4	3	25	75	100
	CC III	Microbial Biotechnology	6	4	3	25	75	100
	CC IV	Principles of Genetic Engineering	6	4	3	25	75	100
	CC V	Practicals covering CC I – CC IV	6	4	6	40	60	100
II	**CC VI**	Omics Technology and Systems Biology	5	4	3	25	75	100
	CC VII	Immunology and Immunotechnology	5	4	3	25	75	100
	CC VIII	Plant Biotechnology	4	4	3	25	75	100
	CC IX	Practicals covering CC VI – CC VIII	6	4	6	40	60	100
	CEC I	To be chosen by the candidate *	6	5	3	25	75	100
	OEC	Applications of Biotechnology for Human welfare	4	4	3	25	75	100
	CC X	Bioprocess and Enzyme Technology	5	4	3	25	75	100
III	**CC XI**	Animal Biotechnology	5	4	3	25	75	100
	CC XII	Environmental Biotechnology	4	4	3	25	75	100
	CC XIII	Pharmaceutical Biotechnology	4	4	6	25	75	100
	CC XIV	Practicals covering CC X – CC XIII	6	4	3	40	60	100
	CEC II	To be chosen by the candidate**	6	5	3	25	75	100
IV	**CEC III**	To be chosen by the candidate***	6	5	3	25	75	100
	CEC IV	To be chosen by the candidate****	6	5	3	25	75	100
		Project work	18	10	_	*40	**60	100
		Total	**120**	**90**	**_**			**2000**

CC – Core Course; CEC – Core Elective Course; OEC – Open Elective Course * Viva Voce:
**** Project Evaluation**

CEC I		**CEC III**	
1.	*Bioinstrumentation	1.	***Developmental Biology
2.	*Biotechniques and Research Methodology	2.	***Nanobiotechnology
CEC II		**CEC IV**	
1.	** Elements of Bioinformatics	1.	**** IPR, Biosafety and Bioethics
2.	** Organic farming	2.	**** Marine Biotechnology
OEC	Applications of Biotechnology for Human welfare **(Open to All)**		

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
I	19PB101	CC I	Cell and Molecular Biology	6	4	25	75	100

CC I - CELL AND MOLECULAR BIOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Elucidate and demonstrate the structure and cellular functions associated with macro molecules in a cell.
2. Comprehend the process of cell communication and signaling and associate the interaction of molecules in the process of signaling.
3. Outline and examine the mechanism of DNA replication and the function of chromosomes in replication
4. Deconstruct and relate to the concept of processing of RNA and protein synthesis.
5. Assess and predict the mechanism of gene regulation

UNIT - I

Cell: Cell theory – structure of prokaryotic and eukaryotic cells. Cellular organelles – structure and functions of cell wall, plasma membrane, chloroplast, mitochondria, ribosome, endoplasmic reticulum, golgi complex, chromosomes and their organization. Cytoskeleton: microfilaments, microtubules, microbodies.

UNIT - II

Introduction to nucleic acid: DNA as the genetic material. Types and their structure. Major features of genetic code.

DNA Replication: Replication – Semi conservative, discontinuous, bi-directional, RNA replication – replicase and reverse transcriptase. DNA repair mechanism – methylase, mismatch, excision, recombination and SOS repair.

UNIT - III

Transcription and Translation: Prokaryotic and eukaryotic transcription – post transcriptional modifications. Translation – prokaryotic and eukaryotic translation – translation machinery and mechanism of initiation, elongation and termination – regulation of translation – co and post translational modifications of proteins – regulation of gene expressions (*Lac* and *Trp* operons).

UNIT - IV

Mutation: Biochemical basis of mutations, physical and chemical mutagens. Spontaneous and induced mutation – reverse, suppressed mutations

Cell Cycle: Cell division (mitosis and meiosis), growth of normal and cancer cells. Apoptosis and its significance, cell differentiation.

UNIT - V

Cell Signaling: Cell surface receptors – hormones and their receptors - signaling through receptors. Signal transduction pathways: Role of secondary messengers. Cellular communications: Cell adhesions – gap junctions. Neurotransmitters: neurotransmission – mechanism - regulation.

Oncobiology: Induction of cancer, tumor development. Oncogenes and tumor suppressor genes (P53 as the guardian of the genome), viral and cellular oncogenes.

COURSE OUTCOMES:

1. Predict the structural and functional details of various cell organelles and their properties.
2. Construct a model depicting the cell cycle and its regulatory mechanism.
3. Illustrate the major components and pathways of cell signaling.
4. Differentiate the structure, function and numerical alterations of chromosomes in prokaryotes and eukaryotes.
5. Reason out the mechanism of construction, damage and repair of DNA and interactions.
6. Examine in detail the factors affecting the regulation of RNA and protein synthesis and their properties.

TEXT BOOKS:

1.Freifelder, D., (2003). Essentials of molecular Biology.4th edition, Jones and Bartlett Publications Inc.

2.De Robertis D.P., (2001). Cell and Molecular Biology. 8th edition, Lippincott Williams and Williams.

BOOKS FOR REFERENCE:

1. Gerald Karp., (2013). Cell Biology. 7th edition Internationl Student Version, Wiley publication.

2. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Matthew P. Scott., (2012). Molecular Cell Biology, 7th edition, W.H. Freeman and Company, New York.

3. Ajay Paul., (2011).Textbook of Cell and Molecular Biology. Books and Allied Ltd., Publishers.

4. Geoffrey M. Cooper, Robert E. Hausman., (2007), The Cell - A Molecular Approach, Sinauer Associates, Inc.

5. James D Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings (2004). Molecular Biology of the Gene, 5th edition.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
I	19PB102	CC II	Biochemistry	6	4	25	75	100

CC II - BIOCHEMISTRY

COURSE OBJECTIVES:

After completion the student will be able to

1. Distinguish the role of biomolecules and their properties.
2. Comprehend the basics of nucleic acid and protein structure, classification and metabolism.
3. Outline the basic classification, metabolism and functions of lipids and endocrine hormones.
4. Illustrate and elucidate the characteristics of enzymes and their mechanism of action.
5. Explain the basics of enzyme kinetics and examine and investigate the kinetics and regulatory pathways of various enzymes.

UNIT - I

Introduction to Biochemistry: Atoms, molecules and chemical bonds. Stabilizing interactions – Van der walls, electrostatic, hydrogen bonding and hydrophobic interactions. ATP bioenergetics – energy currency. Buffer: biological buffer system – phosphate buffer system – bicarbonate buffer system - Henderson-Hasselbalch equation.

UNIT - II

Carbohydrates: Occurrence, chemical properties and classification. Optical isomerism of carbohydrates. Oligosaccharides and polysaccharides.

Vitamins and Hormones: Occurrence, general characteristics and biological significance of vitamin A, B complex, C, D, E and K. Hormones: Chemical nature - biosynthesis of growth hormone: thyroxine, insulin, oestrogen.

UNIT - III

Amino acids: Structure, classification and optical activity, acid base properties, essential and non-essential amino acids. **Proteins:** Classification of proteins. Separation, purification of protein - size, mass, polarity and solubility, assessment of purity of a protein - affinity chromatography. Ramachandran plot.

UNIT - IV

Enzymes: Nomenclature – classification - mechanism of action - factors affecting enzyme activity. Enzyme inhibitors: types with examples.

Hetero cyclic compounds and secondary metabolites: Purine and pyrimidine bases-nucleosides, nucleotides; isoprenoids, prostaglandins, leucotriens, thromboxones, alkaloids, flavonoids, terpenes.

UNIT - V

Lipids and biomembranes: Chemical nature of fatty acids. Acyl glycerols, simple, compound and derived lipids. Lipoproteins - types and biological functions – membrane lipids – their polar / non polar characters; isolation of membrane proteins, membrane bound enzymes.

COURSE OUTCOMES:

1. Outline the chemical composition and properties of biomolecules.
2. Summarize and explain the structural conformations of proteins, their properties and metabolism.
3. Illustrate nucleic acid metabolism and the classification and properties of vitamins and minerals.
4. Classify lipids based on their structure, functions and properties and explain its metabolic pathways.
5. Investigate the properties of enzymes and compare the characteristics and mechanism of action of different enzymes.

TEXT BOOKS:

1. Mary K. Campbell and Shawn O. Farrell, (2007). Biochemistry, 5th Edition, Thomson Brooks/Cole, Indian Edition.

2.Donald Voet and Judih C. Voet, (2004). Biochemistry, 3rd edition, John Wiley and Sons, Inc.

BOOKS FOR REFERENCE:

1.David Lee Nelson, Michael M. Cox, (2013). Lehninger Principles of Biochemistry, VI edition, W.H. Freeman and Company, New York.

2.William H. Elliott, Daphne C. Elliott, (2009). Biochemistry and Molecular Biology. Oxford University Press.

3.Trevor Palmer, Philip Bonner, (2007). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd edition, Horwood Publishing limited.

4.Stryer, L., (2003). Biochemistry, V edition, W.H.Freeman and Co.

5.Nicholes C. Price and Lewis Stevens, (2001). Fundamentals of Enzymology The cell and molecular biology of catalytic proteins, Oxford University Press.

6. Murray, R.K., Grannor, D.K., Mayes, P.A .and Rodwell, V.W, (2000). Harper's Biochemistry, Mc Graw Hill Pvt. Ltd., New Delhi.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
I	19PB103	CC III	Microbial Biotechnology	6	4	25	75	100

CC III - MICROBIAL BIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Distinguish and differentiate the characteristic features of various microbial classes and explain the architecture of different viruses.
2. Classify bacteria based on different characteristics and elucidate the phenomenon of bacterial growth and gene transfer.
3. Formulate novel antimicrobial drugs by investigating the properties of various antimicrobial agents.
4. Assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches.
5. Demonstrate the beneficial role of microorganisms in food processing and employ novel industrial microbes for the production of various products.

UNIT - I

Introduction: Classification and characteristic features of micro organisms - virus, bacteria, algae, fungi and protozoa – Microbial association. Concept of taxa, species, strain and nomenclature. Structure of a prokaryotic cell. Current methods of microbial identification.

Viruses – Classification of virus based on genetic material – RNA and DNA; viral host – plant viruses- CMV and TMV, animal viruses – HIV, hepatitis virus, human papilloma virus, bacterial viruses – bacteriophage.

UNIT - II

Bacteria: Classification of bacteria based on morphology, staining, nutrition and extreme environment - Bergey's manual of classification. Bacterial respiration, bacterial photosynthesis and reproduction.

Bacterial growth - measurement of growth, factors affecting growth. Media - types and preparation- methods of preservation and storage of microbes.

Gene transfer mechanism- conjugation, transformation and transduction.

UNIT - III

Algae – nitrogen fixation, cyanobacteria; **Fungi** – mushrooms, superficial mycosis, Spirulina, Candida – oral and vaginal.

Medical Microbiology- Normal biota, microbial diseases- transmitted through water, air, food, and vector.

Antimicrobial agents - physical and chemical. Antibiotics: Affecting cell membrane, nucleic acid synthesis, protein synthesis and metabolism and their side effects. Antifungal and antiviral drugs. Drug resistance.

UNIT - IV

Microbial Applications - Biofertilizers, mechanism of nitrogen fixation and its uses. Bio insecticides - advantages and mode of action – *Bacillus thuringiensis,* Baculo viruses, NPV.

Biodegradation: Xenobiotics, bioleaching, biodeterioration, bioremediation, biosurfactants, bioventing, biospraying, phytoremediation. Microbes in petroleum extraction. Sewage and waste water treatment.

UNIT - V

Microbial fermentation - Bread, beer, wine, cheese, vinegar, fermented vegetables, alcohol, acetic acid, fermented milk and other products – food spoilage and control measures.

Production of useful products through microbial fermentation: Antibiotics, vitamins, solvents, vaccines, single cell proteins, extremozymes. Biotechnological applications: biopolymer and bioplastics. Biodiesel.

COURSE OUTCOMES:

1. Explain the concept of microbial taxa, species and strains.
2. Classify viruses based on their genetic material and host.
3. Organize different bacterial strains based on classical and modern taxonomical tools.
4. Demonstrate the methods of measuring bacterial growth and gene transfer mechanisms in bacteria.
5. Produce industrial value added products using microbial fermentation at a commercial level.

TEXT BOOKS:

1.Prescott LM., Harley JP., Klein DA., (2006). Microbiology 6th edition. Mc Graw –Hill, New York.

2.Brenner, D.J., Krieg, N.R., Staley, J.T., (2005). Bergey's manual of systematic bacteriology. Vol. II, Springer :New York.

BOOKS FOR REFERENCE:

1.Gerard J. Tortora, Berdell R. Funke, Christine L. Case, (2015). Microbiology: An Introduction, 12 th edition, Pearson Education.

2.Jacquelyn G.Black, (2008). Microbiology Principles and Explorations. 7th edition.

3.Glazer and Nikaido, (2007). Microbial Biotechnology, 2nd edition, Cambridge University Press.

4.Gerard J. Tortora, Berdell R. Funke, Christian L.Case, (2006). Microbiology: An Introduction. 9th edition, Benjamin Cummings Publications.

5.Adams, Martin.R.Moss, Maurice.O, (2004). Food Microbiology. 3rd edition, Royal Society of Chemistry Cambridge.

6. Ronald M. Atlas, Richard Bartha.R., (2004). Microbial Ecology - Fundamentals and applications, Pearson education Limited.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
I	19PB104	CC IV	Principles of Genetic Engineering	6	4	25	75	100

CC IV - PRINCIPLES OF GENETIC ENGINEERING

COURSE OBJECTIVES:

After completion the student will be able to

1. Experiment with the basic tools and techniques of gene cloning in new innovative strategies.
2. Identify new vectors and make an attempt to design novel artificial vectors.
3. Examine the appropriate selection and screening technique for a specific recombinant DNA.
4. Demonstrate the specific techniques for specific genes.
5. Describe the applications of recombinant DNA technology

UNIT - I

Modifying enzymes: Host controlled restriction modification system: Nomenclature - type I - IV restriction endonucleases. DNA modifying enzymes: polymerase – ligase – helicase – gyrase – topoisomerase. RNA modifying enzymes: polymerase - reverse transcriptase. Cloning strategies: DNA cloning - sticky ends - blunt ends - homopolymer tailing - use of adapters and linkers.

UNIT – II

Types of vectors: Cloning vectors: pBR322 – pUC18 – pUC19 - shuttle and expression pET vectors. Phage vectors: viral cosmids – fosmid - phagemids. Artificial chromosomes: Yip – Yep – Yrp - YACs – BACs - MACs - HACs. Animal vectors: SV40 – adenovirus.

UNIT - III

Genomic DNA Libraries: Cloning strategies: construction of genomic DNA libraries - shotgun cloning and cDNA libraries. Screening of recombinants: antibiotic resistance – *lac Z* complementation (Blue - white selection) - fluorescent markers. Probes: radiolabelled, non-radiolabelled - DNA – RNA. Blotting: principle, mechanism and applications of Southern, Northern, Western, Dot blotting.

UNIT - IV

Biomolecular Engineering: Protein Engineering: Design of new protein – construction of novel proteins – conformation of proteins. Enzyme engineering: Design of new enzymes – construction of novel enzyme. Mutagenesis: site directed – random – dicer - DNA shuffling.

UNIT - V

Applications of Recombinant DNA Technology: Protein engineering: glycan - cell free haemoglobin. Recombinant crop production: Golden rice – glowing tobacco – flavr savr tomato. Enzyme engineering: subtilisin – protease. Antibody engineering: chemotoxin - magic bullet. Hormone engineering: humulin and growth hormone - medical - forensic applications of rDNA technology.

COURSE OUTCOMES:

1. Experiment with new molecular tools employed in rDNA technology.
2. Differentiate various types of cloning and expression vectors and integrate them in research.
3. Implement gene transfer techniques for producing transformants and select appropriate screening strategies.
4. Integrate appropriate DNA profiling tools and techniques in their research projects.
5. Design an experiment to produce recombinant proteins, vaccines and pharmaceutical compounds.

TEXT BOOKS:

1. Primrose, S.B, Twyman, R.W., (2006). Principles of Gene Manipulation and Genomics, 7th edition, Wiley Blackwell Publications.

2. Brown. T.A., (2001). Gene Cloning and DNA Analysis - An Introduction, 4th edition, Wiley Blackwell Scientific Publications.

BOOKS FOR REFERENCE:

1. Bernard R. Glick, Jack J. Pasternak, (2010). Molecular Biotechnology. ASM Press.

2. Terry Brown, (2010). Gene Cloning and DNA Analysis: An Introduction. John Wiley & Sons

3. Sandy B. Primrose, Richard Twyman, (2009). Principles of Gene Manipulation and Genomics. John Wiley & Sons.

4. James D. Watson, Amy A. Caudy, Richard M. Myers, Jan A. Witkowski, (2007). Recombinant DNA: Genes and Genomics: A short course 3rd edition, W.H.Freeman and Co Ltd.

5. Primrose S. B, (2001).Molecular Biotechnology – Panima Publications, New Delhi.

6. Helen Kreuzer, Adrianne Massey, (1996). Recombinant DNA and Biotechnology: A guide for students. ASM Press.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
I	19PB105L	CC I – CC-IV	Practicals	6	4	40	60	100

1. Mitosis (Onion root tip)
2. Isolation of DNA from plant tissue.
3. Isolation of DNA from animal tissue.
4. Separation of DNA and RNA by Agarose gel electrophoresis.
5. Bacterial Transformation.
6. Gel documentation.
7. Qualitative analysis of carbohydrates.
8. Estimation of blood glucose.
9. Determination of saponification number of oil.
10. Estimation of DNA.
11. Estimation of RNA.
12. Estimation of proteins.
13. SDS – PAGE.
14. Sterilization techniques – physical and ghemical methods.
15. Pure culture techniques – streak, pour, spread plate method.
16. Staining techniques – simple, Grams staining.
17. Effect of temperature and pH on growth of bacterial population.
18. Enumeration of microorganisms from soil, milk and water.
19. Antibiotic sensitivity test by Kirby – Bouer method.
20. Isolation of plasmid DNA.
21. Isolation of bacterial Genomic DNA.
22. Restriction digeston.
23. DNA ligation.
24. PCR amplification.
25. Southern Blotting.

BOOKS FOR REFERENCE:

1. Boyer, R., (2000). Experimental Biochemistry. Benjamin Cummings, Redwood City, California, USA.
2. Palanivelu, P., (2001). Analytical Biochemistry and Separation Techniques. Kalaimani Printers, Madurai.
3. Sadasivam. S. and A. Manickam, (2002). Biochemical methods. New Age International Private Limited Publishers, New Delhi.
4. Cappuccino, P. and D. Sherman, (2004). Microbiology-A Lab Manual. Pearson Education, Singapore.
5. Dubey, R. and E. Maheswari, (2004). Practical Microbiology. S. Chand & Co, New Delhi.
6. Goldman, E. and Green, L.H. (2008). Practical Handbook of Microbiology. 2nd edition, CRC press, London
7. Kannan, P., (2002). Laboratory Manual in General Microbiology. Palani Paramount Publishers, Palani, Tamil Nadu.
8. Murray, R., W.A Wood. and N.B. Krieg, (1984). Methods for General and Molecular Bacteriology. American Society for Microbiology, Washington.
9. Heidcamp, W.H. (1995).Cell Biology Laboratory Manual. Saint Peter, Minnesota. USA.
10. Maliga, P., (2000). Methods in Plant Molecular Biology. A Laboratory Course Manual, Cold Spring Harbour Laboratory Press, NewYork.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB206	CCVI	Omics Technology and Systems Biology	5	4	25	75	100

OMICS TECHNOLOGY AND SYSTEMS BIOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Elucidate and demonstrate the concept and types of genomics.
2. Deconstruct and relate the concept of transcriptomics.
3. Comprehend the process of proteome analysis.
4. Outline the concepts of metabolomics.
5. Assess and predict the mechanism of biological interaction and computational network.

UNIT - I

Genomics: Genome organization: prokaryotic (*E. coli*) and eukaryotic genomes (*Arabidopsis thaliana*). Mapping: Types – techniques – *in situ* hybridization – somatic hybridization – linkage analysis – Human Genome Project. Structural genomics: classical ways of genome analysis - large fragment genomic libraries. Functional genomics: DNA chip - uses in transcriptome analysis - mutants – RNA interference.

UNIT - II

Transcriptomics: RNA structure prediction: features of RNA secondary structure – *ab initio* method – comparative method – tools - transcriptomics – yeast and human transcriptome. Transcriptional analysis of gene expression: RT - PCR - EST analysis – SAGE. Non array based whole transcriptome analysis: Differential display – Yeast two hybrid system.

UNIT - III

Proteomics: Concept of proteomics: Expression proteomics – structural proteomics – functional proteomics – protein purification - protein sequencing. Tools for proteome analysis: 2D PAGE - mass spectrometry - MALDI TOF – SELDI TOF - Peptide mass fingerprinting - Protein chips. Protein-protein interactions: Protein misfolding – causes of misfolding - types of databases – primary – meta – derived databases.

UNIT - IV

Metabolomics: Multiple pathway integration: Resources for systems biology – determining protein function from sequence - functional sites through recognition. Analysis of pathways: Metabolic pathways - signaling pathway- metabolic network properties – metabolic control analysis. Systems biology approach to transcriptional modeling – applications of RNA metabolic analysis.

UNIT - V

Systems Biology: Intermolecular interactions and biological pathways: Introduction – pathway - molecular interaction database. Primary molecular interaction database: BIND – DIP - INTACT. Primary metabolic pathway: Ecocyc - KEGG. Gene prediction: methodology – neural networks - GRAIL – pattern discrimination.

COURSE OUTCOMES:

1. Simplify the concepts of genomics involving structure and organization of genes in human.
2. Construct genome maps using genome databases and predict gene functions
3. Experiment with the techniques involved in proteome analysis.
4. Integrate the Systems Biology approach to transcriptional modeling.
5. Analyze the intermolecular interactions and biological pathways.

TEXT BOOKS:

1. Rastogi, S.C., Mendiratta, N. and Rastogi, P., (2008). Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery, 2nd edition, PHI Learning Ltd., New Delhi.
2. Satya, P., (2007). Genomics and Genetic Engineering, 1st edition, New Media Publishing Agency, New Delhi.

BOOKS FOR REFERENCE:

1. Conn, P.M. (2011). Handbook of Proteomic Methods, 1st edition, Springer Pvt. Ltd., New Delhi.
2. Lesk, A.M. (2014). Introduction to Bioinformatics, 4th edition, Oxford University Press, Oxford.
3. Rastogi, S.C. (2008). Bioinformatics Concepts, Skills and Applications. 2nd edition, CBS Publishers, New Delhi.
4. Xia, X. (2007). Bioinformatics and the Cell, 1st edition, Springer-Verlag publications, New Delhi.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB207	CCVII	Immunology and Immunotechnology	5	4	25	75	100

CC VII - IMMUNOLOGY AND IMMUNOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Categorize and explain the role of major components of immune system at organ and molecular levels.
2. Compare and contrast the functions of various immune components.
3. Deconstruct and appraise the underlying mechanism of immune suppression and regulation.
4. Illustrate and investigate the types of immune response to infections and tumors.
5. Develop new diagnostic and therapeutic immunological techniques for clinical and research applications.

UNIT- I

Immune System: Cells of immune system. Lymphoid organs - primary and secondary - structure and functions.

Types of Immunity: Innate, acquired, passive, active, primary, secondary, humoral and cell mediated.

Antigen: Immunogenicity, antigenicity, immunogen, adjuvant, epitope, super antigen, allergen, hapten and carrier.

Antibody: Structures, types, distribution and biological functions. Antibody diversity and expression of heavy and light chain gene, Ig-class switching.

UNIT - II

Immune response: Cell mediated immune response - Role of T-cells - phagocytosis, macrophages and NK-cells-ADCC-influence of cytokines-Mechanism of CMI.

Major Histo Compatibility (MHC) systems: Genetics organization of MHC in mouse, HLA in human. Structure and functions of MHC molecules.

Humoral immune response: Antigen presentation T-cell receptor, B cell activation, clonal proliferation, cytokine influence, kinetics of primary and secondary immune response-regulation of antibody synthesis.

UNIT- III

Immunosuppression: Organ transplantation – types of graft, allograft rejection (pathology, mechanism and immune suppression) graft versus host reaction.

Tissue typing tests: Lympho-cytotoxicity and MLR.

Immune tolerance: Types - natural, acquired (mechanism of T and C cell) tolerance.

Autoimmunity: Theories, mechanism, disorders (organ specific and systemic).

UNIT- IV

Immune responses: Viral (HIV), bacterial (tuberculosis), parasitic (malarial) infections, congenital (SCID, LAD and CGD) and acquired immuno deficiencies.

Tumour Immunology – Tumour antigens, immune response to tumour, immune surveillance, immunodiagnosis, immunotherapy for treatment of cancer.

UNIT - V

Antigen - antibody reactions: Lattice theory – precipitation – agarose gel immunodiffusion, counter current immune electrophoresis, single radial immune electrophoresis, rocket immune electrophoresis. Agglutination – Latex agglutination and hemagglutination.

Immunotechniques: ELISA, ELISPOT, RIA, immuno blot, immuno fluorescence, flow cytometry, FISH and GISH.

Hybridoma technique: Production and applications of monoclonal, humanized and engineered antibodies.

COURSE OUTCOMES:

1. Outline and classify the types and major components involved in immune response at the cellular and molecular levels.
2. Differentiate the mechanism of cell mediated and humoral immune response.
3. Examine the structure and function of complements and MHC molecules and investigate the role of HLA complex in human.
4. Outline the basic mechanism of immune tolerance and distinguish between autoimmunity and hypersensitivity reactions.
5. Discuss in detail the concept of immune surveillance and the pattern of response to tumour.

TEXT BOOKS:

1. Kuby, J., (2007). Immunology. W.H. Freeman and Company, New York.

2. Roitt, I., (2002), Essential Immunology, 6th edition, Elsevier Science Publishing Company, New York.

BOOKS FOR REFERENCE:

1. William E. Paul, (2012). Fundamentals of Immunology, 7th edition, Lippincott Williams & Wilkins publisher.

2. Abul K. Abbas, Andrew H. Lichtman, Shiv Pallai., (2007). Cellular and Molecular Immunology 6th edition. Elsevier/ Saunders.

3. David Male, Jonathan Brostoff, David B.Roth, Ivan Roitt., (2006). Immunology 7th edition. Elsevier/ Mosby.

4. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt, (2006), 11th edition, Roitt's Essential Immunology Wiley – Blackwell.

5.Elgert K.D, (1996). Immunology-Understanding Immune System, John Wiley and sons.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB208	CC-VIII	Plant Biotechnology	4	4	25	75	100

CC VIII - PLANT BIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Develop a thorough knowledge of plant genome and become skilled in the basic practices and applications of plant tissue culture.
2. Explain and analyze the methods and tools of gene transfer in plants and the development of transgenic varieties of plants.
3. Outline the applications of gene transfer in enhancing agriculture.
4. Estimate and assess the industrial applications of plant biotechnology and make an attempt to produce enhanced market value added products.
5. Investigate the various hazards and the safety measures for using this technology.

UNIT - I

Plant Tissue Culture Techniques and preservation: Cell culture, suspension culture, organ culture, callus culture, embryo culture and applications of tissue culture, organogenesis - somatic embryogenesis and synthetic seeds, acclimatization.

Somatic Hybridization: Protoplast isolation, fusion, regeneration of hybrids. Somaclonal variation- haploid production – anther culture – pollen culture. Applications of plant tissue culture. Gene Bank – germplasm and cryopreservation.

UNIT- II

Plant viral vectors: Gene transfer techniques to transform plant cells. Expression of induced genes. *Agrobacterium* mediated transgenesis and protoplast fusion. Applications of transgenic plants - RUBISCO, chlorophyll binding proteins, heat shock genes, alcohol dehydrogenase (ADH) , seed storage proteins in legumes and cereals, Enol Pyruvyl Shikimate Phosphate Synthase (EPSPS) pathway.

UNIT - III

Agricultural applications: Mechanism of herbicide resistance, bacterial resistance, nematode resistance, pest resistance and viral resistance with suitable examples and their

applications in agriculture. Protease inhibitors, genes for other insecticidal secondary metabolities.

Stress and resistance: Fungal pathogen resistance- fungal toxin resistance. Abiotic and biotic stress resistance.

UNIT- IV

Agroindustrial applications: Production of secondary metabolites, phytochemicals, antibodies, enzymes, pharmaceutical proteins in plants, plant derived drugs for medicine, agroindustrial products

Value added products: Bioplastics, edible vaccines, food additives and their applications. Molecular markers aided breeding- GM crops and GM foods. Gene silencing technology.

UNIT - V

Terminator seeds and Biosafety: Adoption of transgenic seeds and their socioeconomic importance. Biosafety of GM food applications worldwide field trials of transgenic plants. GURT- Genetic Usage Restriction Technology.

Marketing – Rules and regulations, IPR, GATT, TRIPS, Plant Breeder's Right (PBR) and farmer's rights.

COURSE OUTCOMES:

1. Explain in detail the organization of plant genome and demonstrate the basic practices and techniques of plant tissue culture.
2. Experiment with the concept of somatic hybridization and investigate its applications.
3. Outline the methodology and applications of transgenic plants for various purposes.
4. Generate stress and pathogen resistant varieties of plants for enhanced agricultural benefits.
5. Appraise the industrial applications of plant biotechnology in the production of value added agro-industrial products.

TEXT BOOKS:

1. Mishra.SP.,(2009). Plant Tissue Culture. Ane Books Pvt Ltd.
2. Roberta Smith, (2000). Plant Tissue Culture: Techniques and Experiments. 2nd edition, Academic Press.

BOOKS FOR REFERENCE:

1. Altman. A., Paul M. Hasegawa, (2012). Plant Biotechnology and Agriculture: Prospects for the 21st Century, Academic Press.

2. Neal C. Stewart, (2008). Plant Biotechnology and Genetics: Principles, Techniques and Applications. John Wiley & Sons

3. Adrian Slater, Nigel Scott, Mark Fowler (2008) Plant Biotechnology- The genetic manipulation of plants, Oxford University Press, Oxford.

4.Rainer Fischer, Stefan Schillberg., (2006). Molecular Farming: Plant-Made Pharmaceuticals and Technical Proteins. John Wiley & Sons.

5. Bhojwani. SS, Razdan, MK. (2004) Plant Tissue Culture, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	**19PB211L**	**CC V1 – CC IX**	**Practicals**	**6**	**4**	**40**	**60**	**100**

PRACTICALS

1. Multiple sequence alignment – Clustal W.
2. Phylogenetic analysis – PHYLIP.
3. Retrieval of structures from PDB.
4. Protein structure visualization using RasMol.
5. Computer assisted drug designing.
6. Computer based ligand and Receptor interaction.
7. Determination of Blood groupings and Rh Typing
8. Preparation of serum and Plasma.
9. Total count of RBC and WBC.
10. Differential count of WBC
11. Immunodiffusion –Single and double
12. Immunoelectrophoresis – Rocket
13. ELISA
14. Western Blotting.
15. Media preparation.
16. Callus induction.
17. Preparation of synthetic seeds.
18. Embryo culture.
19. Protoplast isolation.
20. Determination of protoplast viability by Evan's blue staining method.
21. Phytochemical screening of medicinal plants.
22. Preparation of the organic plant extract by soxhlet apparatus.
23. Preparing TLC fingerprint profile of various plant extracts.
24. Demonstration of column chromatographic technique.

BOOKS FOR REFERENCE:

1.Palanivelu, P., 2001. Analytical Biochemistry and Separation Techniques, Kalaimani Printers, Madurai.

2. Sadasivam. S. and A. Manickam, 2002. Biochemical Methods, New Age International Pvt. Ltd. Publishers, New Delhi.

3. Harris, D.C. 2003. Quantitative Chemical Analysis. VI Edition, W. H. Freeman, New York.

4.Work.W., 1976. Laboratory Techniques in Biochemistry and Molecular Biology, American Elsevier, New York.

5. Hay, I. and R.Westwood, 2000. Practical Immunology. Blackwell Scientific Publications, London.

6. Maliga, P., 1995. Methods in Plant Molecular Biology- A Laboratory Course. Oxford Press, New York.

7. James, J. G. and V. B. Rao, 1998. Recombinant DNA Principles and Practice. Cold Spring Harbor Laboratory Press, New York.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB206	CEC I	Bioinstrumentation	6	5	25	75	100

CEC I – BIOINSTRUMENTATION

COURSE OBJECTIVES:

After completion the student will be able to

1. Describe the fundamental principles and working mechanism of different types of microscopes and lab instruments.
2. Associate and illustrate the principles, components and applications of various separation techniques.
3. Explicate the working principle of electrophoresis in the separation of macromolecules.
4. Explain the phenomenon of spectroscopy and the applications of analytical spectroscopic techniques in research.
5. Outline the basic concepts of radioactivity and their utilization in molecular imaging and instrumentation.

UNIT – I

Laboratory instrumentation: Principle, working mechanism, applications of laminar air flow, autoclave, incubators, weighing balances, water bath and hot air oven.

Microscopic techniques - Principles, structural components, applications and working mechanism of microscope – compound, dark field, fluorescent, phase contrast, inverted. Electron microscopes - Scanning Electron Microscopy, Transmission Electron Microscopy- Biological sample preparation for SEM and TEM. AFM - uses and image processing methods.

UNIT – II

Separation techniques: Centrifugal techniques- Basic principles of sedimentation – relative centrifugal force, frictional force, frictional co-efficient, sedimentation co-efficient, centrifuges, types - differential centrifugation and density gradient centrifugation, preparative and analytical ultracentrifuges. Biological applications of centrifugation.

Chromatographic techniques – Principles, components and application of ion exchange, affinity, paper, thin layer, HPTLC, Gas liquid, HPLC.

UNIT – III

Electrophoretic techniques: Principles and applications of electrophoresis – AGE, PAGE, SDS-PAGE, cellulose acetate, continuous flow and capillary electrophoresis, DNA sequencing gels, RNA electrophoresis, isoelectric focusing, 2D gel electrophoresis. Immunoelectrophoresis. Blotting techniques – Southern, Northern and Western blotting.

UNIT – IV

Spectroscopic techniques: UV and visible, fluorescence, gamma ray and infrared spectroscopy, atomic absorption spectroscopy, Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR), Surface plasma resonance, Mass Spectroscopy, Circular Dichroism spectroscopy and X-ray crystallography technique.

UNIT – V

Radio labeling techniques: Properties of different types of radioisotopes used in biology, detection and measurement - incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material - safety guidelines. Radioactivity detectors - GM counters, liquid and solid scintillation counters, radiation dosimeters. Autoradiography.

COURSE OUTCOMES:

1. Identify the underlying working principle of various lab instruments with their specific applications.
2. Interpret the role of centrifugal and frictional force and applications of centrifugation.
3. Integrate the use of centrifugation principle for developing new instruments.
4. Compare the principles and applications of various electrophoretic techniques and invent new applications for electrophoresis.
5. Integrate spectroscopic techniques in their research projects and utilize them to discover the structure of novel compounds.
6. Investigate the role of radiation in diagnostics and instrumentation and detection and measurement of radioisotopes in cells and tissues.

TEXT BOOKS:

1. Upadhyay, A., Upadhyay, K. and Nath, N, (2002), Biophysical Chemistry, Himalayan Publication House, New Delhi.

2. Wilson K., Walker. (2000), Practical Biochemistry– Principles and Techniques, 5th edition, Cambridge University Press, Cambridge.

BOOKS FOR REFERENCE:

1. Keith Wilson and Jhon Walker, (2010) Principles and Techniques of Biochemistry and Molecular Biology- 7th edition. Cambridge University Press, Cambridge

2. Walker, John M. Rapley, Ralph (Eds.), (2008), Molecular Bio-methods Handbook, 2nd edition, Humana Press.

3. Prescott LM., Harley JP., Klein DA., (2006). Microbiology 6th edition. Mc Graw –Hill, New York.

4. Holme, J.D. and Peck, H., (1998), Analytical Biochemistry, third edition, Wesley Longman, New York.

5. Colin Banwell, Elaine McCash, (1994), Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill Higher Education.

6. Plummer D., (1987). Introduction to Practical Biochemistry. 3rd edition. Mc Graw –Hill, New York.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB206	CEC - I	Biotechniques and Research Methodology	6	5	25	75	100

CEC I - BIOTECHNIQUES AND RESEARCH METHODOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Describe the fundamental principles and working mechanism of different types of centrifuges.
2. Illustrate the principles, components and applications of various separation techniques.
3. Explain the working mechanism of electrophoresis in the separation of macromolecules.
4. Elucidate the phenomenon of radio isotopic methods and its applications.
5. Outline the basic concepts of research report preparation.

UNIT-I

Bioinstrumentation: Basic laboratory Instruments - Principle and working mechanism of pH meter, laminar-air flow. Centrifugation: types of centrifuges, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications.

UNIT –II

Chromatographic and Electrophoretic techniques: Theory, principles and applications of paper, thin layer, gel filtration, ion exchange, affinity, gas liquid, high pressure liquid chromatography. Basic principles of electrophoresis, principle and applications of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing. Spectroscopic techniques - theory and applications of UV, visible, IR, NMR, fluorescence, atomic absorption, mass, Raman Spectroscopy.

UNIT –III

Radioisotopic Techniques: Uses of radioisotopes in life sciences, radioactive labeling, principle and applications of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and scintillation counters, autoradiography and its applications.

UNIT – IV

Research methodology: Scope and significance – types of research – process – characteristics of good research – problems in research – identifying research problems. research designs – features of good research designs, report writing – introduction, review of literature, result interpretation, bibliography.

UNIT-V

Writing Research proposal: Developing an outline of preamble, the problem, specific aims, background and significance, hypothesis to be tested, study design, setup, measurement procedures and analysis of data, displaying preliminary data in tables, graphs and charts. Report writing- prewriting considerations, thesis writing, formats of report writing and formats of publications in research journals.

COURSE OUTCOMES:

1. Discuss the role of centrifugal and frictional force and the biological applications of centrifugation.
2. Integrate the use of centrifugation principle for developing new instruments.
3. Compare the principles and applications of various electrophoretic techniques and invent new applications for electrophoresis.
4. Analyze the spectroscopic techniques in their research projects and utilize them to discover the structure of novel compounds.
5. Critically analyze the format for publishing research articles in reputed research journals.

TEXT BOOKS:

1.Keith Wilson and John Walker, (2003). Practical Biochemistry Principles and techniques. 5th edition, Cambridge university press, Cambridge.

2. Gurumani N (2006). Research Methadology for biological sciences.1st edition , MJP Publishers, Chennai.

BOOKS FOR REFERENCE:

1. Walker, John M. Rapley, Ralph, (2008). Molecular Bio-methods Handbook, 2nd edition, Humana Press.

2. Prescott LM., Harley JP., Klein DA., (2006). Microbiology 6th edition. Mc Graw –Hill, New York.

3. Holme, J.D. and Peck, H., (1998), Analytical Biochemistry, 3rd edition, Wesley Longman, New York.

4. Colin Banwell, Elaine McCash, (1994), Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill Higher Education.

5. Keith Wilson and Johnny Walker, (2010) Principles and Techniques of Biochemistry and Molecular Biology, 7th edition. Cambridge University Press, Cambridge.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB206	OEC	Applications of Biotechnology for human welfare	4	4	25	75	100

OEC - APPLICATIONS OF BIOTECHNOLOGY FOR HUMAN WELFARE

COURSE OBJECTIVES:

After completion the student will be able to

1. Describe the fundamental requirement for functioning of tissue culture laboratory.
2. Illustrate the principle of cryopreservation and its techniques.
3. Explicate the working principles of TEM and SEM.
4. Explain the phenomenon of molecular techniques used in Biotechnology.
5. Outline the basic concepts of preparation of scientific paper for publication in a journal.

UNIT: I

Cell Culture Techniques: Design and functioning of tissue culture laboratory– cell proliferation measurements – cell viability testing – culture media preparation and cell harvesting methods. Types of culture – flasks, test tube, organ and embryo culture. Biosensors and biochips applications.

UNIT: II

Cryobiology: Cryopreservation for cells, tissues and organisms, methods of cryopreservation. Cryotechniques for microscopy. Freeze drying for physiologically active substances. Germplasm storage. Pollen bank.

UNIT: III

Mounting Techniques: Permanent mounting – narcotization and killing – fixing – washing – tissue processing – staining – mounting – labeling. Histological preparation of tissues for SEM and TEM. Microphotography principles and applications.

UNIT: IV

Biotechniques: Polymerase chain reaction – Mechanism and applications. Blotting techniques – Southern, Western and Northern. Applications of RFLP and RAPD. DNA finger printing and Foot printing.

UNIT: V

Research Methodology: Preparation of index cards – reference collection – preparation of thesis. Preparation of scientific paper for publication in a journal. Internet and e-journals. Computer aided techniques for data analysis, data presentation and power point slides preparation.

COURSE OUTCOMES:

1. Implement the basic tools and techniques of animal cell culture for the development and maintenance
2. Outline the basic gene transfer techniques and produce transgenic animals.
3. Explain the procedure for histological preparation of tissues for SEM and TEM.
4. Outline the methodology followed for dissertation and thesis writing and integrate it in their research projects.
5. Scrutinize the basic research design and method of writing a research proposal and finding sponsors for their research.

TEXT BOOKS:

1. Freshney. R.I., 2001. Animal Cell Culture; A practical approach, 4th Edition, John Wiley Publication.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.

BOOKS FOR REFERENCE:

1. Anderson and Dunston.,1970. Thesis and Assignment Writing. Wiley Eastern Ltd., New Delhi.
2. John, R.W. and Masters, D., 2000. Animal cell culture: A practical Approach. IRC Press.
3. Jennie P. Mathur and David Barnes. 1998. Methods in Cell Biology, Animal Cell Culture Methods, Academic Press.
4. Lemoine N.R and Cooper D.N. 2002. Gene therapy–BIOS Scientific Publishers, Oxford Press.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB313	CC XI	Bioprocess and Enzyme Technology	4	4	25	75	100

CC XI - BIOPROCESS AND ENZYME TECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Identify and preserve industrial microbes and attempt to produce new varieties of industrial microbes for various purposes.
2. Explain the various types of fermenters and their applications.
3. Scrutinize and examine in detail, the mechanics involved in design and operation of Bioreactors.
4. Explore the different methodologies involved in recovery, purification and commercialization of fermented products.
5. Comprehend the technological aspects of producing novel engineered enzymes.

UNIT- I

Introduction: Isolation, screening and preservation of industrial micro-organisms. Nutritional group of microbes and their importance in fermentation industry. Improvement of strains for increased yield and for other desirable characters (mutation, selection and recombination). Detection and assay of fermentation products.

UNIT- II

Fermentation: Media for industrial fermentation- air and media sterilization. Kinetics of microbial growth. Types of fermenters- CSTR, tower fermenter, jet loop, air lift, bubble column, packed bed, fluidized, tubular fermenter. Types of fermentation – solid state fermentation – tray fermenter, column fermenter, and drum fermenter, submerged fermentation – batch , continuous and fed batch.

UNIT- III

Mechanics of Design and Operation of Bioreactor: Transport phenomena in bioreactor mass transfer, mass transfer co-efficient for gases and liquids. Determination of O_2 transfer coefficient. Rheological properties of inter-medium, biological heat transfer, heat transfer coefficient. Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH, online analysis of other chemical factors. Computers in bioprocess control system.

UNIT- IV

Downstream Processing: Recovery and purification of fermentation products - removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying, freeze - drying and crystallization. Effluent treatment - DOC and COD treatment, disposal of effluents.

UNIT -V

Cell and enzyme immobilization: Enzyme engineering. Industrial and medical applications of enzymes. Applications of immobilized enzymes and cells. Design of immobilized enzyme reactors. Production of enzymes, lactic acid, vinegar, hydrocarbon, single cell oil and amino acids.

COURSE OUTCOMES:

1. Examine the methods of isolation, screening and preservation of industrially important microbial strains.
2. Develop methods for improving increased yield and desirable characteristics of microbial strains.
3. Explain the importance of fermentation and illustrate various types of fermenters and their working principle.
4. Produce commercially valued fermentation products by manipulating and enhancing their recovery and purification methods.
5. Demonstrate the process and applications of immobilized cells and enzymes.

TEXT BOOKS:

1. Patel A,H., (2005). Industrial Microbiology, Mac Millan Pvt. Ltd.
2. Casida. L.E., (1999) Industrial Microbiology. New Age International Pvt. Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Cruger. W. A. Cruger, (2003). A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi.

2. Shuler. M. L. F. Kargi, (2003).Bioprocess engineering: Basic Concepts, Prentice Hall, Engelwood Cliffs.

3. Stanbury, PF., Whitaker, A. (2003) Principles of Fermentation Technology, Pergamann Press, Oxford.

4. Samuel. C. Prescott, Cecil. G. Dunn (2002) Industrial Microbiology, 1st edition, Agrobios (India) Ltd. Jodhpur.

5. Flickinger, M.C. Drew, S.W. (1999) Encyclopedia of Bioprocess Technology-Fermentation Biocatalysis and Bioseparation, (Volumes I-V), John Wiley and Sons, Inc., New York.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB314	CC XII	Animal Biotechnology	4	4	25	75	100

CCXII – ANIMAL BIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Comprehend the basic tools, practices and applications of animal cell culture.
2. Critically evaluate, select and apply the methods and tools of gene transfer for various applications.
3. Correlate the applications of gene transfer in reproductive technology to produce transgenic animals.
4. Appraise and assess the concepts and techniques involved in stem cell technology and their applications.
5. Relate the basic principles of gene therapy and explain their therapeutic applications.

UNIT- I

Animal cell culture: Preparation and sterilization of various tissue culture media - natural and serum and protein free defined media. Role of carbon dioxide, serum, growth factors in cell culture. Primary and immortal cell culture. Development and maintenance of different cell lines, laboratory based and large - scale culture, applications of animal cell culture. Cell synchronization.

UNIT- II

Vectors: Biology and methods for the construction of animal viral vectors - SV40, adeno virus, retro virus, vaccina virus, herpes virus, adeno associated virus and baculo virus. Gene transfer in cells; physical, chemical and biological methods. Molecular Pharming for production of medical and diagnostic products- regulatory proteins, blood products, hormones.

Vaccines: Recombinant vaccines (r-subunit vaccine, r-live vaccines, anti-idiotipic, edible vaccines, HIV, Malarial vaccine), Interferon and growth factor and other therapeutic proteins.

UNIT- III

Animal Biotechnology in Reproduction: Artificial insemination, super ovulation, Oestrus synchronization. In vitro maturation of animal oocytes - Methods of transferring genes into animal oocytes, eggs, embryos and specific tissues - IVF - gamete selection – *In-vitro* culture of oocyte and storage. Embryo - collection, sex selection and transfer.

Transgenic animals: Transgenic live stock production - Biotechnology in aquaculture – Transgenic fish - fish and silkworm as living bioreactors. Pheromones and pest management.

UNIT -IV

Stem cells: History of stem cells. Types, preparation and applications of embryonic, adult and umbilical cord blood stem cells. Germline stem cells and germline - derived pluripotent cells, prostate and breast stem cells, mesenchymal and cardiac stem cells. Stem cell differentiation and transplantation. Bioethics and stem cell research.

UNIT- V

Gene therapy: Types, vectors and sites of gene therapy, *ex-vivo* and *in-vivo* methods, clinical trials, treatment of genetic disorders, ethical issues, ethical committee functions. Antisense and ribozyme therapy, Protein Aptamers, Intrabodies.

Gene knockout techniques – Strategies of gene delivery - targeted gene replacement, gene correction. Chromosome engineering.

COURSE OUTCOMES:

1. Implement the basic tools and techniques of animal cell culture
2. Identify the methods used for the construction of vectors.
3. Outline the basic gene transfer techniques and produce transgenic animals.
4. Examine the role of gene transfer techniques in artificial reproductive techniques.
5. Compare and contrast the types, preparation and applications of stem cells.
6. Interpret the basic concept a key players involved in gene therapy.

TEXT BOOKS:

1. Freshney. R.I. (2000), Culture of Animal cells : Manual of Basic technique, 4th edition. John Wiley Publications.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks

2. Ranga. M.M, (2004), Animal Biotechnology, 2nd edition. Agrobios (India), Jodhpur.

BOOKS FOR REFERENCE:

1. Ashish Verma, Anchal Singh, (2013). Animal Biotechnology: Models in Discovery and Translation, Academic Press.

2. James D. Watson, Amy A. Caudy, Richard M. Myers, Jan A. Witkowski, (2006), Recombinant DNA: Genes and Genomics: A short course–III edition, W.H. Freeman and Co Ltd.

3. Primrose, SB, Twyman, R.W. (2006), Principles of Gene Manipulation and Genomics, VII edition, Wiley Blackwell.

4. Glick B.R and Pasternak Jack J, (2003), Molecular Biotechnology– Principles and applications of Recombinant DNA, III edition, American Society for Microbiology.

5. Primrose SB, (2001), Molecular Biotechnology – Panima Publications, New Delhi.

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III	**19PB315**	**CC XIII**	**Environmental Biotechnology**	**4**	**4**	**25**	**75**	**100**

CC XIII - ENVIRONMENTAL BIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Understand the causes and consequences of environmental pollution.
2. Illustrate the methods of waste water treatment and solid waste management.
3. Discuss the role of microbes in biodegradation technology.
4. Assess the concepts and techniques involved in bioremediation to solve environmental problems.
5. Acquire knowledge on genetically engineered microbes for pollution control strategy.

UNIT – I

Environmental pollution: Definition – pollutants – sources of pollutants – types of pollution. Air pollution: green house effect - global warming - ozone depletion - acid rain – Bhopal tragedy. Water pollution: eutrophication – BOD – biomagnifications – minamata episode. Soil pollution: plastic pollution – industrial effluents – pesticide and fertilizer pollution. Global environmental problems: radioactive pollution – thermal pollution – noise pollution.

UNIT - II

Pollution management: Waste water treatment: aerobic treatment – anaerobic treatment - factors affecting aerobic and anaerobic treatments. Waste management: landfills – composting – vermicompost. Biogas production: gobar gas – application. Solid waste management: types – biodegradation of contaminated soils.

UNIT - III

Biodegradation and bioconversion: Xenobiotic degradation: Biodegradation of xenobiotic compounds. Biodegradation of hydrocarbons: Organisms involved in degradation of chlorinated hydrocarbons and substituted hydrocarbons. Oil and pesticide

microbial degradation: oil pollution – pesticide pollution – microbial treatment – superbugs. Degradable product: biodegradable product – eco friendly products.

UNIT- IV

Bioremediation: Microbial remediation: bioremediation – constraints and priorities on bioremediation processes. Bioremediation types: *in situ* - *ex situ*. Industrial bioremediation: Tannery – textile – food. Phytoremediation: types – applications - bioaugmentation - bioreactors for bioremediation.

UNIT – V

Microbes in Environmental Biotechnology: Microbial leaching and mining: Extraction of metals from ores. Microbial extraction: microbes in petroleum extraction – Microbial Enhanced Oil Recovery (MEOR) - microbial desulfurization of coal. Environmental genetics: degradative plasmids, release of genetically engineered microbes in environment.

COURSE OUTCOMES:

1. Identify the causes and consequences of environmental pollution.
2. Explain the methods of waste water treatment and solid waste management.
3. Highlight the role of microbes in biodegradation process.
4. Construct the constraints and priorities on bioremediation processes.
5. Elucidate the concept of microbial mining and its applications.

TEXT BOOKS:

1. Trivedi, P.C., 2009. Phytoremediation and Environmental Biotechnology.1st edition, Pointer Publishers, Jaipur.

2. Das, M.K., 2008. Environmental Biotechnology and Biodiversity Conservation. 2nd edition, Daya Publishing House Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Allen, K., 2016. Environmental Biotechnology. 1st edition, CBS Publishers & Distributors Pvt. Ltd, New Delhi.

2. Buddolla,V., 2017. Environmental Biotechnology: Basic Concepts and Applications. 1st edition, Alpha Science International Ltd, Oxford.

3. Fulekar, M.H., 2008. Environmental Biotechnology. 1st edition, Oxford and IBH Publishing Company (P) Ltd., New Delhi.

4. Jain, M., 2014. Environmental Biotechnology. 1st edition, Narosa Publishing House, New Delhi.

5. Jogdand, S.N., 2009. Environmental Biotechnology, 5th edition, Himalaya Publishing House, Mumbai.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
II	19PB213	CC - IX	Pharmaceutical Biotechnology	4	4	25	75	100

CC IX - PHARMACEUTICAL BIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Describe the fundamental knowledge of Pharmaceutical Biotechnology.
2. Illustrate the concept of pharmacodynamics.
3. Explain the principle of pharmaceutical analytical techniques.
4. Outline the basic concepts of drug dosage and drug delivery.
5. Explain the phenomenon of biotransformation.

UNIT – I

Pharmaceuticals: Pharmaceutical products – importance of Pharmaceutical Biotechnology. Microbes in pharmaceutical industry: Applications of microbes - products. Secondary metabolites: types - pharmaceutical importance. Drug discovery: target discovery - target validation - assay development – screening - clinical trials.

UNIT – II

Pharmacodynamics and Pharmacokinetics: Pharmacodynamics: Principle - mechanism of drug action. Pharmacokinetics: ADME properties - mechanism of drug absorption - active - passive diffusion. Distribution of drugs: plasma protein binding - factors affecting drug distribution. Biotransformation of drug metabolism: phase I and phase II reactions. Excretion of drug: renal excretion – factors affecting excretion.

UNIT - III

Drug delivery: Pharmaceutical dosage: materials – formulations - manufacture of tablets. Delivery of biopharmaceuticals: oral delivery system – pulmonary delivery system. Drug delivery system: controlled drug delivery system - transdermal system - protein as drug delivery system. Drug delivery and development: liposomes – liposomal drug delivery system – advantages and disadvantages.

UNIT - IV

Analytical techniques: Chromatography techniques: principle - procedure - applications of gel filtration - ion exchange - HPLC – GC-MS. Spectrophotometry: principle – procedure - applications of flame emission - atomic absorption – fluorimetry. Pharmacogenomics: Drug interaction - applications. Personalized medicine: Definition - case studies on gene related diseases.

UNIT - V

Biotransformation: Biotransformation of therapeutic agents: production of aspirin - tissue plasminogen activator – flucanozole. Production and purification of antibiotics: streptomycin - chloramphenicol – safety – efficacy – FDA regulations. Monoclonal antibody in therapy: antibody screening – therapeutic applications of monoclonal antibodies. Gene therapy: basic approach to gene therapy – gene therapy of HIV.

COURSE OUTCOMES:

1. Explain the role of Pharmaceutical Biotechnology in pharmaceutical industries.
2. Elucidate the mechanism of drug absorption.
3. Analyze the delivery of biopharmaceuticals.
4. Highlight the analytical techniques involved in Pharmaceutical Biotechnology.
5. Discuss the process of biotransformation of therapeutic agents.

TEXT BOOKS:

1. Jogdand, S.N.,2005. Medical Biotechnology. 1st edition, Himalaya Publishing House, Mumbai.

2. Kulkarni, J.S., Pawar, A.P. and Shedbalkar, V.P., 2012. Biopharmaceutics and Pharmacokinetics, CBS Publishers and Distributers, New Delhi.

BOOKS FOR REFERENCE:

1. Nallari, P. and Rao, V.V., 2010. Medical Biotechnology. 1st edition, Oxford University Press, New York.

2. Kumar, M., 2010. Pharmaceutical Biotechnology. 1st edition, Anmol Publication Pvt. Ltd., New Delhi.

3. Walsh, G., 2011. 1st edition, CBS Publishers and Distributers, New Delhi.

4. Kulkarni, J.S., Pawar, A.P. and Shedbalkar, V.P., 2012. Biopharmaceutics and Pharmacokinetics. 1st edition, CBS Publishers and Distributers, New Delhi.

5. Wilson, K. and Walker, J., 2010. Principles and Techniques of Biochemistry and Molecular Biology.6th edition, Cambridge University Press, London.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB216	CC XI – CC XIII	Practicals	6	5	40	60	100

PRACTICALS

1. Screening of industrially important microorganisms.
2. Immobilization of enzyme (urease / ahosphatase).
3. Immobilized of Microbial cells for enzyme production (Amylase production).
4. Purification of enzymes. (any one)
5. Enzyme assays (catalase, acid and alkaline phosphatase, lipase).
6. Large scale production of citric acid.
7. Preparation of media by filtration method (DMEM, RPMI)
8. Subculturing of cells.
9. Trypsinization.
10. Assay of cytotoxicity by Haemocytometer.
11. Primary cell culture from the Rat hepatocyte.
12. Estimation of nitrate in polluted sites.
13. Estimation of chloride and sulphate in polluted sites.
14. Detection of coliforms for determination of the purity of potable water.
15. Determination of dissolved oxygen in water samples.
16. Determination of BOD and COD in sewage/ Distillery samples.
17. Isolation and identification of cellulose degrading microorganisms.

BOOKS FOR REFERENCE:

1. Aneja, K.R., 2004. Experiments in Microbiology Plant Pathology and Biotechnology. New Age International, New Delhi.
2. Freshney, R.I., 2000. Animal Cell Culture: A Practical Approach, John Wiley & Sons Publication, New York.
3. John, R.W. M., 2000. Animal Cell Culture: Practical Approaches, Oxford University Press, New Delhi.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB216	CEC II	Elements of Bioinformatics	6	5	25	75	100

CEC III – ELEMENTS OF BIOINFORMATICS

COURSE OBJECTIVES:

After completion the student will be able to

1. Examine and investigate the types of data bases and sequence submission.

2. Predict the structure of secondary databases.

3. Assess and appraise the sequence analysis.

4. Elucidate the multiple sequence analysis.

5. Understand the phylogenetic tree building methods.

UNIT - I

Introduction to Bioinformatics: Types of data and databases: Genomic DNA - complementary DNA (cDNA) - Recombinant DNA (rDNA) - expressed sequence tags (ESTs) - genomic survey sequences (GSSs). Primary Nucleotide databases: NCBI – EMBL – DDBJ. Primary protein databases: SWISS-PROT – PDB. Sequence submission: Submitting - storage – sequences annotation - databases.

UNIT - II

Structure and derived database: Structural databases: Types – dimension. Primary structure databases: Cambridge Structural database – molecular modeling database. Secondary structure databases: SCOP – CATH. Protein family ontologies: Families of structurally similar proteins. Prediction tools: Auto dock – Hex – Hyperchem.

UNIT - III

Sequence analysis: Basics of sequence analysis: Identity - similarity - homology - gap penalty. Global and local alignment: Dotplot. Scoring matrices: Basic concept of a scoring matrix - matrices for nucleic acid and proteins sequences - PAM - BLOSUM series. Database similarity search tools: BLAST - FASTA.

UNIT - IV

Multiple sequence alignment: Multiple sequence alignment: Goal – consensus – regular expressions - orthologs - paralogs. Various approaches for MSA: Progressive - hierarchical. MSA tools: PileUp - ClustalW. Algorithm and their applications : Sequence analysis - interpretation of results.

UNIT - V

Phylogenetic analysis: Concept of evolutionary trees: Basic properties - terminologies. Types of phylogenetic trees: Rooted – unrooted – gene tree - species tree – cladogram – phylogram - ultrametric tree - scaled - unscaled tree. Tree building methods: Distance based – character based methods - bootstrap indexing. Software: PHYLIP - MEGA.

COURSE OUTCOMES:

1. Simplify the basic concepts of genomics involving structure and organization of genes in human and appraise the concept of genetic and physical mapping.
2. Construct genome maps using genome databases.
3. Compare genomes by employing various tools and predict gene regulatory patterns.
4. Categorize the applications of functional genomics in determining the differential expression of genes.

TEXT BOOKS

1. Attwood, T. K. and David, J., 2009. Introduction to Bioinformatics, 4th edition, Pearson Education, New Delhi.

2. Curran, B.G., Walker, R.J. and Bhatia, S.C., 2010. Bioinformatics. 1st edition, CBS publishers, New Delhi.

BOOKS FOR REFERENCE

1. Claverie, J.M. and Notredame, C., 2011. Bioinformatics. 2nd edition, Wiley Publishing House, Hookboken, NJ.

2. Gautham, N., 2009. Bioinformatics Databases and Algorithms. 1st edition, Narosa Publications, New Delhi.

3. Krane, D. E., and Raymer, M. L., 2011. Fundamental Concepts of Bioinformatics. 5th edition, Pearson publication, New Delhi.

4. Rastogi, S.C., Mendiratta, N., Rastogi, P., 2015. Bioinformatics-methods and Applications: Genomics, Proteomics and Drug Discovery. 4th edition, PHI Learning Pvt. Ltd, New Delhi.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB216	CEC III	Organic Farming	6	5	25	75	100

ORGANIC FARMING

COURSE OBJECTIVES:

After completion the student will be able to

1. Identify the various biological and nutritional problems in India
2. Explain and assess the role organic manures and fertilizers for soil improvement and fertility.
3. Develop novel strategies for weed collection, management and control in developing agricultural farms.
4. Outline the history of organic farming and discuss the objectives and values of organic farming
5. Criticize the role of green manuring for biofertilization in enhancing crop improvement.

UNIT- I

Organic matter and soil fertility: Soil organic matter - soil fertility management - soil quality management - water management, pest management, soil biology and nutrition - Inorganic nutrition in soil. Field indicators of biological and nutritional problems.

Indian organic farming: Progress of organic farming in India, regulations, project and initiatives.

UNIT- II

Organic manures and fertilizers: Concentrated organic manures, effect of organic manures on soil properties, farms utilizing animal manures.

Types of organic fertilizers: Animal manure, biosolids, commercial organic fertilizers, phosphate rich organic manures, Inorganic fertilizers, problems of inorganic fertilizers. Irrigation - tillage, rotations and fallows.

UNIT- III

Weed management in organic farming: Cultural methods of weed control, tillage, tillage combined with irrigation, timing, cropping systems – Integration of organic farming - externalities of green revolution, lowland rice ecologies, vanishing rice lands economic sustainability issues. Form of agriculture in organic farming-standards and methods.

UNIT - IV

History of organic farming: pre-world war II, past-world war II, 21st century, economics of organic farming, benefits of organic farming - improvement in soil fertility, pest and disease management.

Values of organic farming - Objective, precautionary principle, sustainability, animal husbandry.

UNIT - V

Green manuring: Introduction, production and distribution, types of green manuring, techniques of green manuring, kind of green manuring.

Biofertilizers: Causes and effects of Rhizobium, technology, beneficial aspects of biofertilizers, important role of biofertilizers in crop production, efficient strain of bacterial biofertilizers.

COURSE OUTCOMES:

1. Implement soil fertility and quality management initiatives for improving organic farming in India.
2. Produce organic manures and fertilizers and promote their usage in agricultural lands.
3. Develop and create awareness of novel weed management strategies to improve economic sustainability of rice lands.
4. Investigate and educate others on the values of organic farming.
5. Produce and distribute green manure and biofertilizers or commercial use.

TEXT BOOKS

1. Bhupendra kumar, (2014). Biofertilizers and Organic Farming, Centrum Press, New Delhi.

2. Gaur A.C., (2006). Handbook of Organic Farming and Biofertilizers, Ambica Book Agency, Jaipur.

BOOKS FOR REFERENCE

1. Panda H, (2013). Handbook of Organic Farming and Processing, Asia Pacific Business Press Inc.

2. Ajay Sharma and Rajeshwar S. Chand, (2010). Plant Protection Practices in Organic Farming, International Book Distributors, New Delhi.

3. Dushyent Gehlot, (2010). Organic Farming: Components and Management, Agrobios (India), Jodhpur.

4. Dahama A.K., (2009). Organic Farming of Sustainable Agriculture, Agrobios (India), Jodhpur.

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB318	CEC III	Developmental Biology	6	4	25	75	100

CEC III - DEVELOPMENTAL BIOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Explain the fundamental process of fertilization at the molecular level.

2. Associate the basic concepts of a cellular communication and their role in development and formation of an embryo.

3. Illustrate and explain the stages of early and late embryonic development in mammals.

4.Discuss the post embryonic development and chromosomal mechanism of sex determination.

5.Investigate the chemical mechanisms underlying organization, induction and differentiation which lead to cell determination.

UNIT- I

Molecular perspectives of fertilization: Structure of gametes, Recognition of egg and sperm, sperm attraction, acrosome reaction, species-specific recognition, cortical reaction, activation of egg metabolism, fusion of genetic material, prevention of polyspermy. Cell surface molecules in sperm-egg recognition.

UNIT- II

Cell – cell communication in development: Cascades of induction, interactions, paracrine factors, signal transduction cascade – RTK pathway, JAK-STAT pathway, Hedgehog family, Wnt family, TGF- β superfamily. Cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission.

UNIT- III

Early mammalian development: Cleavage, gastrulation, anterior-posterior axis formation dorsal-ventral and right-left axes in mice.

Late embryonic development: Ectoderm - neural cells, neural tube, differentiation of neurons, epidermis, neural crest, mesoderm – somites, urinogenital system, heart, formation

of blood vessels, endoderm – pharynx, digestive tube, respiratory tube, extraembryonic membrane.

UNIT -VI

Post embryonic development: Amphibian metamorphosis, regeneration in salamander limbs, hydra and mammalian liver, aging – causes and genetic regulation.

Sex determination – Chromosomal sex determination in mammals. Role of SRY, SOX 9, SF1, DAX 1 and WNT4 in sex determination.

UNIT – V

Organizer and induction: Spemann's classical experiment, formation of organizer - Nieukoop center, noggin, chordin, follistain, BMP4. Wnt, FGF and retinoic acid - chemistry and mechanism. Polarity, symmetry and chemo-differentiation of egg - role of maternal contribution in early embryogenesis - masked RNA. Teratogenesis: teratogens and teratoma.

COURSE OUTCOMES:

1. Associate with the molecular perspective of fertilization and discuss the components.
2. Relate the concept and mechanism of cell-cell communication and development.
3. Discuss stem cells and their applications.
4. Interpret the various stages of embryonic development and their underlying patterns.
5. Demonstrate the method of post embryonic development and establish the role of chromosomes in sex determination.

TEXT BOOKS:

1.Vasundra Rao,1994. Developmental Biology – A modern synthesis, Oxford IBH, New Delhi.

2.Russo, V.E.A, Brodt, S., Cove, D and Ottolengthi, S., 1992. Molecular Genetic Approach. Springer Verlag, Berlin.

BOOKS FOR REFERENCE:

1. Bruce M. Carlson, (2015). Human Embryology and Developmental Biology, 5th edition, Elsevier Health Sciences publisher.

2. Scott F. Gilbert, (2014). Developmental Biology, 10 th edition, Sinauer publisher.

3. Jonathan M. W. Slack, (2012). Essential Developmental Biology, 3rd edition, John Wiley & Sons publisher.

4. Gilbert, B.F., (2006) Developmental Biology. 8th edition. Sinaur Associates Inc. Publishers Sunderland, Massachusetts USA.

5. Lewis Wolpert, (2002) Principles of development. 2nd edition. Oxford University Press, Century.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
III	19PB318	CEC III	Nanobiotechnology	6	4	25	75	100

CEC III – NANOBIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Design a method for the production and characterization of a nanoparticle.
2. Explain the applications of nanotechnology in different fields.
3. Understand the synthesis process of bio-nanomaterials
4. Analyze the ethical issues of nanotechnology.

UNIT-I

Basics of Nanotechnology: Introduction to nanotechnology: Types of nanostructures. Zero Dimensional nanostructures: Biological nanoparticles. One Dimensional nanostucture: nanorods, nanotubes and nanowires. Two Dimensional nanostructures: nanofilms. Three dimensional nanostructure: DNA and Protein based nanostructures – Self assembled monolayers – carbon dots.

UNIT – II

Synthesis of Nanoparticles: Chemical methods: Chemical reduction - photochemical method (irradiation) - electrochemical method (electrolysis). Physical methods: Physical vapour condensation (PVC) - Arc discharge method. Biological method: Synthesis of nanoparticles using bacteria, fungi, yeast and plants. Characterization of nanoparticles: Analytical and microscopic - factors affecting nanoparticle synthesis in biological method.

UNIT – III

Types of Nanomaterials: DNA Coupled Nanoparticles: Nanoparticles as carrier for genetic material – hybrid conjugates of gold nanoparticles. Peptide coupled nanoparticles: Transducers - amplifiers of biomolecular recognition events.

Biomolecular nano structures: Lipid nanoparticles - inorganic nanoparticles - anisotropic - magnetic particles - metal/metal oxide nanoparticles - surface modified nanoparticles. Nanomicroprocessor: Micro electro mechanical systems (MEMS) – Nano electro mechanical systems (NEMS).

UNIT – IV

Applications of Nanotechnology: Diagnostic applications of nanotechnology: Nanodrug delivery – liposomes- dentrimers - polymeric micelles – nanocapsules - nanotubes - advantages of nanodrug delivery. Diagnostic Nanobiotechnology: Cancer - cardiology - cardiac surgery - nanotechnology in tissue engineering. Applications of nanoparticles: Antimicrobial agent - electrochemical sensors – biosensors - medicine – healthcare - nanoparticle in agriculture. Nanodelivery systems: Pests - nutrients - plant hormones.

UNIT – V

Nanotoxicology: Ethical issues in Nanotechnology: Socio-economic challenges with reference to nano medical context. Issues: Nanomedicine – social - ethical - health implications. Nanomaterials and toxicity evaluation: Cyto-toxicity - Geno-toxicity - *in vivo* tests/assays.

COURSE OUTCOMES:

1. Examine the basic principles and techniques of nanobiotechnology and categorize their functional principles.
2. Develop strategies to produce and characterize novel nanoparticles for research purposes.
3. Outline the applications of nanotechnology in medical diagnostics and therapeutic procedures.

TEXT BOOKS

1. Arora, M.P., 2008. Emerging Nanotechnology, 1st edition, Discovery Publishing House (P) Ltd., New Delhi.
2. Knut, H., Heller, C.H. and Mehud, W.H. 2008. Nanotechnology 1st edition, Dominant Publishers and Distributors, New Delhi.

BOOKS FOR REFERENCE:

1. Pradeep, T., 2008. Nano: The Essentials Understanding Nanoscience and Nanotechnology 1st edition, McGraw-Hill, New Delhi.
2. Prasad, S.K., 2008. Progress in Nanotechnology 1st edition, Discovery Publishing House (P) Ltd., New Delhi.
3. Prasad, S.K., 2008. Molecular Nanomachines 1st edition, Discovery Publishing House (P) Ltd., New Delhi.
4. Shrivastava, S., 2013. Introductory Nanobiotechnology 1st edition, New Central Book Agency (P) Limited, West Bengal.
5. Solanki, D.D., 2008. Nanotechnology: An Introduction to the Next Big Idea 1st edition, Cyber Tech Publications, New Delhi.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
IV	19PB419	CEC IV	Intellectual Property Rights, Biosafety and Bioethics	6	4	25	75	100

CEC IV - INTELLECTUAL PROPERTY RIGHTS, BIOSAFETY AND BIOETHICS

COURSE OBJECTIVES:

After completion the student will be able to

1. Outline and explain the distinctive forms of IPR.
2. Categorize and explicate the process of patents, copyrights and the infringement.
3. Examine the procedures involved in obtaining trademarks and designs.
4. Review the different concepts involved in patenting biotechnological inventions.

UNIT: I

General accounts of patenting:

Patenting procedures: Copyrights, trade secrets, trade Mark, GATT and TRIPS. Patenting DNA materials and patenting fundamental research. Genetically modified food and food ingredients.

UNIT: II

Patenting and IPR :

International scenario in patenting products and protocols, transfer of technology. Patenting in different countries. Special application of patent laws in Biotechnology. Licensing and cross licensing, Flavr savr TM tomato as a model case.

UNIT: III

Introduction to Biosafety :

Precautionary principles, deliberate, release of genetically engineered organisms. Major risks from GMOs – Engineered microbes and bioterrorism. Laboratory biosafety level criteria – Primary, secondary, tertiary and quaternary levels. International protocols on biosafety.

UNIT: IV

Abuse of human genome sequence information :

In vitro fertilization. Frozen embryos, embryonic cell research accumulation of defective genes in future generations. Sex determination, abortion, human cloning, Organ transplantation, xenotransplantation, euthanasia.

UNIT: V

Ethical Issues: Terminator genes and seeds – National and International scenario. Views of the society on test tube baby, surrogate mother, bioweapons, human cloning. Combinational therapy.

COURSE OUTCOMES:

1. Classify and explain the distinctive forms of IPR and their enforcement measures.
2. Discuss the basic concept of obtaining Patents and their underlying regulations.
3. Explain the basic need and procedures involved in the application of trademarks.
4. Outline the basic methodology of patenting biotechnological inventions.
5. Discuss the role of IPR in protection of software and computer related inventions.

TEXT BOOKS:

1. Ganguli P, 2001, Intellectual Property Rights, Tata Mc Graw Hill Publications, New Delhi.
2. Ramesh Chandra, 2004, Issues Of Intellectual Property Rights, Isha Books.

BOOKS FOR REFERENCE:

1. Erbisch F.H. and Maredia K.M. 2000. Intellectual property in Agricultural Biotechnology. Unversity Press,
2. Department of Biotechnology 1990. Recombinant DNA safety guidelines & regulations, Ministry of science & Technology, Government of India.
3. Lemoine N.R. and Cooper D.N. 2002. Gene therapy –BIOS Scientific Publishers, Oxford Press.
4. Beier.F.K., Crespi,P.S and Straus.J, 1982. Biotechnology and patent protection, Oxford and IBH Publishing Co. New Delhi.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
IV	19PB419	CEC IV	Marine Biotechnology	6	4	25	75	100

CEC IV - MARINE BIOTECHNOLOGY

COURSE OBJECTIVES:

After completion the student will be able to

1. Identify the various marine resources and their utilization.
2. Understand the knowledge on marine organisms.
3. Develop the focus on marine algae and their products.
4. Outline the various conservation strategies of marine resources.

UNIT – I

Marine resources: Marine science: Biotechnology in marine resources. History and emergence: Marine biotechnology – aquaculture. Applications of marine resources: Pharmaceuticals – nutritional-environment remediation – biofouling – biocorrosion – bioadhesives. Molecular genetic techniques: Marine biomarkers – endocrine distruptors.

UNIT – II

Marine Molecular Biology: Developmental Biotechnology: Induced breeding – *in vitro* fertilization – cryopreservation - early embryonic development - later growth - development. Developmental processes in marine invertebrates: Sea urchin – horse shoe crab. Biotechnological methods: ELISA- FISH – PCR - Gene probes - dot immuno binding activity - monoclonal antibodies. Transgenic technology: Marine GMO's - metagenomics.

UNIT – III

Algal Biotechnology: Marine algae – types - role in Biotechnology. Single cell protein: Hydrocolloids – agar - agarose – carrageenan - alginates. Metabolites from marine microalgae: Extraction and purification of lipids and pigments. Metabolites from marine macroalgae: Extraction and purification of bioactive compounds.

UNIT – IV

Marine products: Natural products – bioactivities – therapeutics. Bioactive products: Anti-tumor promoting – anti-inflammatory - analgesic – anti-viral agents – antibiotic – cytotoxic - antimicrobial compounds. Extraction techniques: Liquid-liquid extraction - chromatography - conventional techniques for bioactive marine natural products like labile proteins - marine toxins.

UNIT – V

Marine conservation: Conservation strategies - sustainable development. Social activities - Government action - local legislation - national laws. Traditional societies: National Biodiversity Act - National Biodiversity Authority. International approaches: Conservation - sustainable development - ongoing problems - possible responses - role of conservation biologists.

COURSE OUTCOMES:

1. Explain the marine resources and their utilization.
2. Discuss the developmental processes in marine invertebrates.
3. Elucidate the procedure for extraction and purification of bioactive compounds.
4. Highlight the marine conservation strategies for sustainable development.

TEXT BOOKS

1. Felix, S., 2010. Marine and Aquaculture Biotechnology. 1st edition, Agrobios India Ltd., Jodhpur, (2010).
2. Khanna, D.R., 2010. Textbook of Blue Biotechnology. 1st edition, Discovery Publishing House Pvt. Ltd., New Delhi.

BOOKS FOR REFERENCE

1. Fernandes, R.,2009. Microbiology Handbook of Fish and Seafood. 1st edition, RSC Publishing Ltd., Cambridge.
2. Giere, O., 2009. Meiobenthology: The Microscopic Motile Fauna of the Aquatic Sediments. 2nd edition. Springer Verlag Publisher, Berlin.
3. Khanna, D.R., 2010. Textbook of Blue Biotechnology. 1st edition, Discovery Publishing House Pvt. Ltd., New Delhi,
4. Mc Cutcheon, B. and S. Mc Cutcheon., 2003. The Facts on File Marine Science Handbook . 1st edition, Checkmark Books Publisher, New York.
5. Steven, M., Colegate and Russel, J., Molyneux., 2008. Bioactive Natural Products. 2nd edition, CRC Press, London.

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Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	Internal	External	Marks
IV	19PB420P		Project Work	6	4	40	60	100

PROJECT WORK

(Dissertation and Evaluation 60 Marks & Viva Voice – 40 Marks)

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