MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI
PG - COURSES – AFFILIATED COLLEGES
Course Structure for M.Sc. Biotechnology
(Choice Based Credit System)
(with effect from the academic year 2017- 2018 onwards)

Sem (1)	Sub no. (2)	Subject status (3)	Subject Title (4)	Contact Hrs/week (5)	credits (6)
III	14	Core - 14	Plant biotechnology	6	4
	15	Core - 15	Animal biotechnology	6	4
	16	Core - 16	Stem cell biology	5	4
	17	Core - 17	Research methodology and biostatistics	5	4
	18	Core - 18 Practical - 5	Lab in Plant biotechnology and Animal biotechnology	4	2
	19	Core - 19 Practical - 6	Lab in Research methodology and biostatistics	4	2
			Subtotal	30	20
IV	20	Core - 20	Applied bioinformatics	4	4
	21	Core - 21	Proteomics and genomics	4	4
	22	Core - 22	Medical biotechnology	4	4
	23	Core - 23 Practical - 7	Lab in Applied bioinformatics	4	2
	24	Core - 24 Practical - 8	Lab in proteomics and genomics	4	2
	25	Elective - 1	Elective / Field Work / Study Tour Electives: Biomedical technology (or) Tissue engineering (or) Industrial biotechnology	3	3
	26	Core - 25	Project	7	8
			Subtotal	30	27
			Total	120	90

Preamble: The science of Biotechnology has tremendous potential for application in agriculture and medicine. The linkage between basic and applied research and new discoveries and innovations can find direct applications in agriculture and human health. The breakthroughs in modern biotechnology mainly include our ability to produce useful organisms through genetic engineering and cell fusion techniques and improve bioprocess technology to purify novel molecules generated by such processes. It also involves targeting drugs, development of delivery systems and vaccines. Considering this background, the syllabus document is essentially to be formulated which focused on diverse areas from Cell Biology, Biochemistry, Immunology and Genetics with significant laboratory practices which will enable the students to have hands on experience in doing experiments themselves.

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PLANT BIOTECHNOLOGY (Core Paper)

L	T	P	C
6	0	0	4

OBJECTIVES

1. To impart knowledge on plant tissue culture, plant molecular biology, and plant genetic engineering.
2. To make the students to understand the concepts and applications

OUTCOME

This course deals with the DNA isolation and transfer to plants and production of transgenic plants

Unit I:

Definition, scope, principle, history and importance of plant tissue culture in biotechnology and agriculture. In Vitro culture techniques:Sterilization methods, Culture media – types, composition and importance of hormones in plant tissue culture, Single cell culture and Suspension culture.

(15L)

Unit II:

Organ, Meristem tip (mericloning),Anther, Pllen, Embryo culture and their application. Organogenesis, Somatic embryogenesis and Artificial seeds. Somatic hybridization; Isolation, culture and fusion of protoplasts and its significance. Somoclonal variation and its applications,Cryopreservation – principles and application. Application of plant tissue culture in Forestry, Ayurvedic medicines and Industrial plant products.

(20L)

Unit III:

Plant Molecular Biology: Structure, organization and expression of Pant Nuclear genome, Chloroplast genome and Mitochondrial genome, Cytoplasmic male sterility. Biochemistry and molecular biology of nod and nif genes, Stress tolerant genes.

(15L)

Unit IV:

Principles and tools of genetic engineering: enzymes, cloning and vectors. Enzymes – exo and endonucleases, restriction endonuclease, DNA ligases, Reverse transcriptase, DNA Polymerase, Alkaline phosphatase. Expression vectors, bifunctional vectors. Cloning vectors: Plasmids bacteriophages, Cosmids,Insertion vectors, Ti and Ri vectors. Techniques of genetic engineering: gene cloning and plants. *Agrobacterium* mediated DNA transfer, Antisense RNA technique- Delayed fruit ripening (FlavrSavr), Gene delivery systems: Shot gun, Microinjection, Electroporation and Biolistics, Bio-farming, Plant based vaccines and Antibody production, Bt-cotton.

Molecular probes:Southern, Northern, Western blotting, RFLP, RAPD. Gene amplification: PCR (Thermocycler) 4 DNA sequencing: Maxam and Gilbert methods, Sangers method, New generation sequencing technologies. Illumina, SOLiD, 454, Helicos, SMRT.

(25L)

Unit V:

Transgenic plants: Genetic engineering plants for Virus resistance, Pest resistance (BT gene) and Herbicide tolerance. (15L)

Total: 90L

Reference Books

1. Plant Conservation Biotechnology. 1999 Erica E. Benson. Taylor and Francis, Ltd.:UK, USA.
2. Plant cell culture. A Practical approach 1994. Dixon R. A. I:L Press, Oxford, London.
3. Molecular Biology. 1990. Freifelder, D. Narosa publishing house, New Delhi.
4. Plant Biotechnology. Comprehensive Biotechnology series. 1992. Murray Moo Young. Pergamon press.
5. Plant Cell Culture Technology. 1987. Yeoman. Narosa publishing house, New Delhi.
6. Plant Tissue Culture Manual. 1992. Lindsey K. Kluwer. Academic Publishers.
7. Plant Propagation by Tissue culture. 1994. George, E.F. Exegectics Ltd. England.
8. Plant Molecular Biology. 1988. Grierson and S.N. Covey. II Edition. Blackie, New York.
9. Plant Cell and Tissue culture. 1994. Narayanaswamy, S. Tata McGraw-Hill publishing Co. New Delhi.
10. Experiments in plant Tissue Culture. 1995. Dodds. J.H. and L.W. Roberts Cambridge University Press, London.

ANIMAL BIOTECHNOLOGY

L	T	P	C
6	0	0	4

OBJECTIVES

1. To impart knowledge on animal cell culture, transgenic animals and human genome sequencing.
2. To make the students to understand the concepts and applications.

OUTCOME: This course deals with the Animal cell culture, monoclonal antibodies, invitro fertilization, Embryo transfer, Recombinant vaccines, Manipulation of growth of animals, pest management, and ethical issues related to animal biotechnology.

Unit I:

Animal cells: Collection, primary culture, celllines, cryopreservation of animal cells, culture media, transformation of animal cells, metabolism and genetics of animal cells, large scale of animal cell culture. (15L)

Unit II:

Kinetics of cell growth - logarithmic and stationary phase, growth factors, interaction among cells, inverted microscope. (15)

Unit III:

Introducing DNA in to animal cells, Microinjection, Electrophoration, viral vectors, Tissue culture in biomedical and biochemical research, monoclonal antibodies, regulatory proteins, blood products, vaccines, hormones, gene therapy and its applications. (20)

Unit IV:

A general account of commonly used animal vectors, transgenic animals, Invitro fertilization and embryo transfer, foreign gene expression eg: Silkworm and Baculoviruses (biocontrol). Biotechnology of aquaculture, Biotechnology of pest management, IPM. (25)

Unit V:

Mapping and sequencing human genome, Human genome project, and ethical , legal and social issues. Ethical issues in Animal biotechnology, Management aspects of Animal biotechnology. (15)

Total: 90L

Reference Books

1. Animal cell culture- Practical Approach,1998,Ed John R.W, Masters, OXFORD
2. Cell growth and division: A Practical Approach, 1996,Ed R. Basega,IRL Press.
3. Methods in Cell Biology, Vol.57, Animal cell culture methods, 1994. Ed. Jenni P Mather and David Barnes, Academic Press.
4. Genetic engineering of animals-1993, A. Fuhler, VCH publishers,W einhem FRG
5. Basic Biotechnology, May 2006, Edited by Colin Ratledge, 3rd edition University of Hull , Bjom Kristiansen EU Biotech consulting Norway.

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STEM CELL BIOLOGY

L	T	P	C
5	0	0	4

OBJECTIVES

To make the student gain knowledge in Stem cell basics , Growth of ES cells , Differentiation of stem cells and Application of stem cells.

PURPOSE

The course offers an opportunity the students to understand the basics of stem cells Embryonic stem cells, Adult stem cells and genetic engineering of stem cells and their applications

Unit I:

Stem Cell Basics: Stem cells, embryonic stem cells, embryonic germ cells, bone marrow stem cells, adult stem cells, differentiation. Introduction to concepts in stem cell biology – renewal, potency etc. Stem cell characterizations: Isolation and characterization, markers and their identification, growth factor requirements and their maintenance in culture. Pluripotency and reprogramming. (20)

Unit II:

Hematopoietic Stem Cell, Induced Pluripotent Stem (iPS) cell technology, epigenetic memory in iPS cells, epigenetic controls of stem cells. Early embryonic development, Lymphoid cell differentiation and maturation, cell cycle regulators in stem cells. Molecular mechanisms of self-renewal, pluri/multipotency and lineage differentiation. Molecular basis of pleuripotency and stem cell niche. (15)

Unit III:

The human umbilical cord: A source of stem cells. Isolation of mesenchymal stem cells (MSCs) from the umbilical cord, *in vitro* differentiation potential of umbilical cord mesenchymal stem cell. In vivo applications umbilical cord stem cells, cord blood stem cells transplantation – advantages and disadvantages, cord blood banking. (15)

Unit IV:

Generation and manipulation of mouse embryonic stem cells. Generation and manipulation of human embryonic stem cells, animal models of regeneration – Hydra, Planaria, earth worm, zebra fish etc. (10)

Unit V:

Cancer stem cell – origin of cancer stem cells, impact of cancer stem cell, concept on cancer therapy. Epigenetics and reprogramming in stem cell biology. Stem cell gene therapy, stem cell therapy for neurodegenerative diseases. Stem cell therapy for cardiac regeneration, clinical cell transplantation for leukemia. Ethical issues associated with stem cell biology. (15)

Total: 75L

Reference Books

1. Immunology, T.J. Kindt, R.A. Goldsby and B.A. Osborne
2. Roitt's Essential Immunology, P. Delves, S. Martin, D. Burton and I. Roitt
3. Cellular and Molecular Immunology, A.K. Abbas, A. Lichtman and J.S. Pober Immunology, C.A. Janeway, Jr, p. Travers, M. Walport and M.J. Shlomchik

RESEARCH METHODOLOGY AND BIOSTATISTICS

L	T	P	C
5	0	0	4

OBJECTIVES

1. To provide students with a grounding in knowledge of biostatistics and how to apply them in their research studies
2. To make the students to understand the basic concepts and significance

OUTCOME

This course helps to understand the basic statistical analysis, to construct a research protocol and to carry out simple analysis of collected data and interpret findings appropriately

Unit I:

Research methodomlogy: An introduction – meaning, objective and types of research. Defining research problem – selection of problems. Sampling design – random sample. Measurement and scaling techniques, error in measurement. (20)

Unit II:

Methods of data collection – primary data – interview method, questionnaire, secondary data, case study method. Online data base library. The computer and its role in research. (15)

Unit III:

Preparation of scientific documents: Research papers, review articles, format of journals – proof reading. Journals: Standard of research journals, impact factor, citation index, methods of citation. Oral presentation, poster presentation, bibliography, thesis writing (20)

Unit IV:

Measures of central tendency – mean, median, mode, dispersion – range, quartile deviation, mean deviation, standard deviation, coefficient of variation. Standard error, correlation, correlation coefficient, regression. (10)

Unit V:

Hypothesis – definition, basic concepts concerning testing of hypotheses, test of hypotheses and its limitations, significance test and fixing level of significance, Chi square test, student's t test. ANOVA – one way and two way. Use of statistical softwares. (10)

Total: 75L

Reference Books

1. Research Methodology, Kothari
2. Statistics for Life Science, M.L. Samuels and J.A. Witmer
3. Statistics, R.S.N. Pillai
4. Design and analysis of Experiments, Montgomery and C. Douglas

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L	T	P	C
0	0	4	2

LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

OBJECTIVES

To introduce the basic steps of micropropagation of plants , basic steps in animal cell culture and handling of lab animals

OUTCOME

The practical course provides knowledge about the basic techniques of micropropagation of plants and basic techniques in animal cell culture

1. Preparation of plant tissue culture media
2. Meristem culture
3. Callus induction
4. Regeneration of adventitious root/shoot from callus
5. Acclimatization
6. Direct organogenesis – shoot tip culture
7. Embry culture
8. Isolation of protoplasts – mechanical method, enzymatic method
9. Preparation of synthetic seeds
10. Isolation of plant genomic DNA
11. Cell counting and cell viability
12. Measurement of doubling time
13. Preparation of metaphase chromosomes from cultured cells
14. Isolation of DNA from animal cells
15. Demonstration of apoptosis by DNA laddering
16. Handling of lab animals

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L	T	P	C
0	0	4	2

LAB IN RESEARCH METHODOLOGY AND BIOSTATISTICS

OBJECTIVES

To have a working knowledge to carry out the basic statistical and research analysis

OUTCOME

The practical course helps to develop competency in presenting and discussing study results in a scientifically sound manner

1. Preparation of bar diagram (Single, multiple, subdivided, percentage), line diagram and pie diagram using MS EXCEL
2. Calculation of central tendency – mean, geometric mean, harmonic mean, median using MS EXCEL
3. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL
4. Calculation of correlation using MS EXCEL
5. Finding the regression equation using MS EXCEL
6. Calculation of ANOVA (One-way) using MS EXCEL
7. Calculation of t-test using MS EXCEL
8. Calculation of Chi square value using MS EXCEL
9. Defining project
10. Choosing research methods
11. Conducting background research
12. Choosing your participants
13. Preparing a research proposal
14. Preparing a manuscript for publication in journal
15. Analysing the data
16. Reporting the findings

APPLIED BIOINFORMATICS

L	T	P	C
4	0	0	4

OBJECTIVE

To strengthen the knowledge on scope of Bioinformatics, Introduction to sequence alignment and programming , Database and their uses, Protein analysis using bio informatics tools and other special topics in bio informatics.

PURPOSE

Aims at providing basic knowledge of bio informatics and its application

Unit I:

Bioinformatics – an overview, scope and applications. Algorithm – definition and examples – types of Algorithm – iterative, recursive, fast and slow algorithms. Introduction of digital computers: File management, data mining, dataware housing, organization; low-level and high-level languages; binary number system. Flow charts and programming techniques. (15)

Unit II:

DNA data bank – the EMBL nucleotide sequence data bank – genbank – DDBJ. Enzyme databases – cloning vector data bases, BLAST, FASTA, algorithm to analysis sequence data. Pairwise alignment and multiple alignment of nucleic acids and protein sequences, CLUSTAL W. (15)

Unit III:

Secondary structure prediction of RNA, homology modelling, threading. RASMOL, MOLMOL, protein docking, drug designing. Mathematical modelling of protein, access of web based bioinformatics tools. (10)

Unit IV:

Biophysics – Definition, scope and methods. Atomic structure, atomic orbital, wave functions, electronic structure of atoms, spin of particles – relationship between atomic structure and chemical properties. Molecule – different types of bonds – molecular orbital, chirality in biological systems. (10)

Unit V:

Proteins: Protein structure - primary, secondary, tertiary and quartenary, globular, fibrous proteins, Ramachandran plot. Three dimensional structure and confirmation using physical methods – ORD, CD, ESR, PAGE, SDS-PAGE, diagonal electrophoresis. DNA-protein interactions; DNA-drug interactions (10)

Total: 60L

Reference Books

1. Introduction to Computers, Balaguruswamy
2. Nucleic acid and protein sequence analysis and structural studies, M.A. Bishop and C.I. Rawlings
3. An introduction to Bioinformatics algorithms, N.C. Jones and P.A. Pevzner
4. General Biophysics, Volkones
5. Molecular Biophysics, B. Pullman and M. Voino

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PROTEOMICS AND GENOMICS

L	T	P	C
4	0	0	4

OBJECTIVES

To familiarize and expose the students to an overview of proteomics, expression, sequence analysis and recombinant DNA technology.

OUTCOME

This course offers advanced level training on gene expression and gene therapy by covering topics such as genome mapping, proteomic techniques and new targets for drug discovery.

Unit I:

Proteomics: Introduction and scope of proteomics; Protein separation techniques: ion exchange, size-exclusion and affinity chromatography; Electrophoresis techniques- Polyacrylamide gel electrophoresis, 1D and 2D gel electrophoresis, isoelectrofocusing. Fundamentals of mass spectrometry [basic theory, ionization techniques and mass analyzers, electrospray ionization (ESI)] and matrix adsorption laser dissociation ionization (MALDI). (15)

Unit II:

Reversed phase HPLC and microcapillary LC, protein and peptide separation technique, proteome database. Qualitative and quantitative proteome analysis. Shot gun proteomics for proteome profile (whole proteome and sub-proteome analysis). Expression of proteome analysis (isotope labelling and label free approaches). *In vivo* proteome analysis. (10)

Unit III:

Proteomic analysis of post translational modifications (Phosphorylation, ubiquitination, acetylation, nitration and glycosylation etc). Proteome analysis of protein-protein, protein-DNA interactions (identification of ligand receptor pairing and transcriptional regulators). Proteomics approaches for investigation of therapy resistance in cancer (identification of new factors and protein expression profiles associated with anticancer therapy resistance). (15)

Unit IV:

Genomics: Overview of genome; methods of preparing genomic DNA – shot gun cloning method, DNA sequence analysis methods – Sanger and Dideoxy method and fluorescence method; gene variation and single nucleotide polymorphism (SNPs); genetic analysis, linkage mapping, Expressed Sequenced Tags (ESTs), gene disease association.

(10)

Unit V:

Recombinant DNA technology: DNA cloning basics, Polymerase Chain Reaction (PCR), FISH, RFLP, RAPD. Human Genome Project, Genome wide association studies, metagenomics.

(10)

Total: 60L

Reference Books

1. Principles of Proteomics, R.M. Twyman
2. Handbook of Proteomic Method, P. Michael Conn
3. Proteomics – Introduction to methods and applications, A. Kraj and J. Silberring
4. Genomics, Cantor and Smith
5. Biochemistry, L. Stryer

MEDICAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES

To impart basic concepts of molecular basis of diseases, disease diagnosis, vaccinology and future prospects.

OUTCOME

To provide knowledge about biological aspects of diseases, diagnosis and vaccines

Unit I:

Molecular aspect of Diseases: Genetic: Huntington's disease, Sickle cell disease, Klinefelter syndrome, Duchenne Muscular Dystrophy, Parkinson's disease, Coronary artery diseases; Microbial: Hepatitis, Lyme disease, AIDS, Tuberculosis; Metabolic: Diabetes mellitus, Faber's disease, Muscle diseases. (15)

Unit II:

Diagnosis of diseases: Prenatal diagnosis- invasive and non-invasive techniques; Monoclonal antibodies. Protein and enzyme markers, DNA probes, Enzyme probes, Proteomics for diagnosis, Nanodiagnosticts. (10)

Unit III:

Vaccinology: Health care products: rDNA drugs and vaccines- insulin, growth hormone, factor VIII, Tissue Plasminogen Activator, Interferons, Lymphokines and Hepatitis- B vaccines. DNA based vaccines. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis. (15)

Unit IV:

Drugs and their Mechanism: Aspirin, Paracetamol, Avil, Antibiotics, Antiviral drugs, drugs for metabolic diseases, Anticancer drugs,Anti-hypertensive drugs, Bronchodilator drugs and their mode of actions. (10)

Unit V:

Future of Medical Biotechnology: Individualized medicine; Gene therapy, Nanomedicine- Nanoparticles, Nanodevices- Medical microrobotics, Nanomedicine and Nanosurgery- for cancers, neurological disorders, Stem cell therapy. (10)

Total: 60L

References Books

1. Medical Biotechnology; Albert Sasson (2006), United Nations Publications.
2. Medical Biotechnology; S.N. Jogland (2000), Himalaya Publication.
3. Medical Devices and Systems in Biomedical Engineering Handbook, Vol 2; Joseph Bronzino and Bronzino and Bronzino.
4. The Proteus effect, Ann B Parson (2006); National Academic Press
5. Biotechnology and Biopharmaceuticals (2003), Rodney J.Y. Hoan milo Gilbaldi, Wiley John and Sons.
6. Stem Cell Now: Christopher Thomas Scott (2005) Penguin group (USA).
7. Biotechnology Demystified Sharon Walker (2006) McGrow Hill Publication.

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LAB IN APPLIED BIOINFORMATICS

L	T	P	C
0	0	4	2

OBJECTIVES

To give students knowledge of bioinformatical methods to carry out molecular biological research projects. The course has emphasis on bioinformatics related to exploration of proteins and includes analyses of sequences, database searches, sequence comparison, visualization and analysis of protein structures and drug designing

OUTCOME

Through practical exercises, the course aims to give students a basic competences in the use of bioinformatical tools.

1. Pairwise alignment – global alignment of DNA and protein using Needleman – Wunch algorithm
2. Perform Local alignment of DNA and protein using Smith – Waterman algorithm
3. Multiple alignment of nucleotide and protein
4. BLAST
5. FASTA
6. CLUSTAL W
7. Protein structure viewing – RASMOL, Uniprot, SWISS PDB Viewer
8. PCR primer designing
9. Drug designing - RASMOL

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LAB IN PROTEOMICS AND GENOMICS

L	T	P	C
0	0	4	2

OBJECTIVES

To view and use the various biological databases available on the World Wide Web, retrieving the gene sequence, performing sequence similarity searching using BLAST, performing pairwise alignment between the given sequences, predicting protein structure and to identify the evolutionary relationship between sequences.

OUTCOME

1. To have basic knowledge about the methods used for genomic, proteomic and food analysis
2. To be able to use online bioinformatics tools for genomic and proteomic data analysis and mining
3. To perform database search with a free search engine and statistically validate the identified proteins

1. Biological Databases with Reference to Expasy and NCBI
2. Queries based on Biological databases
   a. Retrieve the gene sequence in FASTA format corresponding to P00519.
   b. Write about PTM involved in P53355 and comment on the residues involved in it.
   c. Retrieve any one FASTA sequence of GABA transaminase in Human, mouse, pig and chick.
   d. Comment on the secondary structure information about P68871 AND P24071.
   e. Find the disease with which PPE protein is involved?
   f. Write about NAGK gene present in Homo sapiens.
3. Sequence similarity searching using BLAST
4. Pairwise sequence alignment
5. Multiple Sequence and Phylogenetic Analysis
6. Gene prediction
7. Secondary structure prediction
8. Tertiary structure prediction

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BIOMEDICAL TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

Impart theoretical and practical knowledge and competence that will prepare the student for employment in a variety of biomedical environments

OUTCOME

1. To prepare students for career positions in the bioscience industry (biotechnology, medical devices, pharmaceuticals, life systems, project leadership or forensic pathology).
2. To allow the students to perform a research project either on the campus or with another professional laboratory site of their choosing.

Unit I:

Vaccines and Therapeutic agents – subunits of vaccines – live recombinant vaccines – attenuated vaccines – vector vaccines – anti idiotype vaccines. Monoclonal antibodies as therapeutic agents – genetically engineered immune therapeutic agents. (10)

Unit II:

Technological developments in gene therapy: Human somatic cell gene therapy, *ex vivo* gene therapy, *in vivo* gene therapy, viral gene delivery system, non viral gene delivery system. Prodrug activation therapy, nucleic acid therapeutic agents. (10)

Unit III:

Human gene therapy, human somatic cell gene therapy, accumulation of defective genes in future generations, human germ line gene therapy. Applications on gene therapy. Diagnosis of genetic diseases and prenatal diagnosis. (10)

Unit IV:

Metabolic disorder and inherited disease: Diabetes, hypertension, Alzheimer's disease, Duchenn's muscular dystrophy, Huntington's cholera, Parkinson's disease, Urolithosis, Schizopherenia, Hemophilia, Sickle Cell Anemia (5)

Unit V:

Liposomes, drug targeting, lectins, interferons, vaccines, combination therapy, antifertility drugs, antiviral drugs, anticancer agents, anti-inflammatory drugs, diagnostic kits and probes, Radiotherapy, chemotherapy and immunotherapy, IDS – technological treatment in HIV.(5)

Total: 45L

Reference books

1. Medical genetics by Robert F Mweller, Ian D Young, Churchill Livingston Publisher.
2. Molecular biotechnology- Principles and applications of recombinant DNA by Glik B R and Pasuroak J J.

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TISSUE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

To apply knowledge of science, and engineering; to design and conduct experiments, as well as to analyze and interpret data; to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

OUTCOME

1. To specify the different types of biodegradable biomaterials that can be used in tissue engineering applications
2. To discuss the complex interactions between biomaterials, cells and signals in biological systems

Unit I:

Quantitative cell and tissue biology – including tissue organization, tissue dynamics, morphogenesis, stem cells, cellulr fate processes and their co-ordination. Cell and tissue characterization – including high throughput technologies, cell and tissue properties, cell and tissue culture and gene transfer. (10)

Unit II:

Engineering methods and design – including time constant analysis, scale-up procedures, cell separations, biomaterial scaffolds, three dimensional scaffold design, laboratory scale manufacture of a cell carrier, phase separation, self assembly, gas foaming, solid free form fabrication, injectable systems, structural and functional scaffold modification, composite scaffolds. (10)

Unit III:

Clinical implementation – including conventional approaches to tissue repair, host integration and producing tissue engineering therapies (5)

Unit IV:

Tailoring of biomaterials: Exploration of traditional and novel materials including alginates, polysaccharides and fibrillar fibrin gels. Fabrication technologies and immunoisolation techniques. Bioactive hydrogels, gene delivery, growth factors and degradation of biodegradable polymers. (10)

Unit V:

Tissue engineering applications – blood cell substitutes and tissue engineering of nerves, the tendons, ligaments, cornea, cartilage and myocardium, meniscal tissues. Synthetic biology-Prospects and ethical issues. (10)

Total: 45L

Reference Books

1. Scadffolding in tissue engineering, Peter X. Ma, Jennifer H. Elisseeff
2. Introduction to Bioengineering, Yuan-Cheng Fung, Shu Chien
3. Functional Tissue Engineering, Farshid Guilak, David L. Butler, Steven A. Goldstein
4. Frontiers in Tissue Engineering, Charles W. Patrick, Antonios G. Mikos, Larry V. Mcintire

Principles of tissue Engineering, Robert Paul Lanza, Robert S. Langer, Joseph Vacanti

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INDUSTRIAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

To impart the knowledge on Historical overview of Biotechnology, production of some commercially important modern bioproducts, industrial enzymes and to develop biotechnology approaches that will yield 'green' industrial processes that are cost effective and sustainable.

OUTCOME

At the end of the course, the students would have learnt about the steps involved in the production of bioproducts and methods to improve modern biotechnology

Unit I:

Strain selection, media design and inoculums development, types of microbial products (biomass, primary and secondary metabolites, bioconversion products), strain selection and improvement methods, principles of microbial nutrition and media formulations for cell growth and product formulations (10)

Unit II:

Factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of media pH and temperature, development of inoculation for industrial fermentations. (5)

Unit III:

Bioreactors and aseptic operation: Basic design and construction of bioreactors and accessories – types of industrial reactors and modes of operations (stirred tank, air lift, bubble column, bed, packed bed). Methods of sterilization – thermal death kinetics, logarithmic and non-logarithmic), batch and continuous sterilization, air sterilization – design and air filter, aseptic operation of fermentor. (10)

Unit IV:

Immobilization Technology: Merits and demerits of cell and enzyme immobilization, methods of preparation of immobilizing agents – properties and applications of immobilized enzyme and microorganisms, biotransformations, characterization of immobilized biocatalyst (5)

Unit V:

Fermentation Technology: Various unit operations involved in upstream and downstream processing of microbial products: antibiotics, organic acids, alcoholic bevarages and industrial enzymes. Production of baker's yeast, Single Cell Protein, biofertilizers and biopesticides, microbial bioconversion (production of α-hydroxyl progesterone, L-phenyl alanine, L-sorbose etc). (15)

Total: 45L

Reference books

1. Biotechnology – the biological principles, Trevan
2. Basic Biotechnology, S. Ignacimuthu
3. Principles of Biotechnology, R.D. Old and S.B. Primrose
4. Plant Biotechnology – Recent Advances, P.C. Triveni

Project