PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

| I.  | To provide students with strong fundamentals with good scientific and technical knowledge so as to comprehend, analyze, design, and create novel products and solutions for developing novel therapeutics and enzymes. |
| II. | To prepare students to excel and succeed in Biotechnology research or industry through the latest state-of-art post graduate education |
| III. | To sensitize students about scientific temper and the necessity of bioethics, social responsibility and awareness of the environment |
| IV. | To enable the student to develop good communication and leadership skills, respect for authority, loyalty and the life-long learning needed for a successful scientific and professional career |

PROGRAM OUTCOMES (POs)

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<td>On successful completion of the Masters in Biotechnology graduates will be able to</td>
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<td>Acquire in-depth knowledge of Biological science and Bioengineering for gaining ability to develop and evaluate new ideas</td>
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<td>2.</td>
<td>Demonstrate Scientific and technological skills to design and perform research through modern techniques for the development of high throughput process and products.</td>
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<td>3.</td>
<td>Provide potential solutions for solving technological problems in various domains of Biotechnology considering the societal, public health, cultural environmental factors.</td>
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<td>Create and apply modern engineering tools for the prediction and modeling of complex bioengineering activities</td>
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<td>5.</td>
<td>Analyze Biotechnological problems and formulate intellectual and innovative vistas for research and development with self-management and team work skills towards collaborative, multidisciplinary scientific endeavors in order to achieve common goals.</td>
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<td>6.</td>
<td>Demonstrate adherence to accepted standards of professional bioethics and social responsibilities with entrepreneurial and managerial skills for the implementation of multidisciplinary projects</td>
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PEO / PO Mapping:
## MAPPING OF M.TECH. BIOTECHNOLOGY

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<td>Biofuels and Platform Chemicals</td>
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**SEMESTER II, ELECTIVE III**

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**Audit Courses - I**

REGISTRATION FOR ANY OF THESE COURSES IS OPTIONAL TO STUDENTS

<table>
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**Foundation Course (FC)**

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**Practicals**

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# PROFESSIONAL CORE (PCC)

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# EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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# RESEARCH METHODOLOGY AND IPR (RMC)

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### SUMMARY

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OBJECTIVES:
This course will help the students to
• Study the mathematical aspects of probability, determination of probability and moments.
• Study the distributions of discrete and continuous random variables and their properties.
• Obtain the covariance and correlation between jointly distributed random variables, interpret simple linear regression and fitting of curves by least square method.
• Study concepts and methods of sampling and various statistical tests in testing hypothesis on data.
• Analyze one-way, two-way and three-way classifications of analysis of variance and problems using them.

UNIT I PROBABILITY AND RANDOM VARIABLES

UNIT II STANDARD DISTRIBUTIONS
Bivariate distribution - Conditional and marginal distribution - Discrete distributions - Binomial, Poisson, Geometric distributions - Continuous distributions - Normal, Exponential and Negative exponential, Gamma distributions - Simple problems - Properties.

UNIT III CORRELATION AND REGRESSION
Correlation coefficient - Properties - Problems - Rank correlation - Regression equations - Problems - Curve fitting by the method of least squares - Fitting curves of the form ax+b , ax²+bx+c , ab^x and ax^b- Bivariate correlation application to biological problems.

UNIT IV SAMPLING AND TESTING OF HYPOTHESIS
Concept of sampling - Methods of sampling - Sampling distributions and standard error - Small samples and large samples - Test of hypothesis - Type I & Type II Errors - Critical region - Large sample tests for proportion, mean - Exact test based on normal , t , F and Chi - square distribution problems - Test of goodness of fit.

UNIT V ANALYSIS OF VARIANCE
Basic principles of experimentation - Analysis of variance - One - way, Two - way classifications - Randomized block design - Latin square design - Problems.

TOTAL: 60 PERIODS

COURSE OUTCOMES
After completion of the course the students will be able to
CO1 Mathematical basis and foundations of probability and statistics, computation of probability and moments, standard distributions of discrete and continuous random variables and standard distributions and their properties
CO2 Compute the covariance and correlation between jointly distributed variables.
CO3 Compute and interpret simple linear regression and least square methods between two variables.
CO4 Methods of sampling and application of various statistical tests in testing hypotheses on data
CO5 One-way and two-way classifications of analysis of variance, properties and assumptions, randomized block design and Latin square design problems
REFERENCES:
UNIT I  CLONING AND EXPRESSION OF GENES  9
Overview of Restriction and Modification system. Cloning vehicles: Plasmids – Host range,
Copy number control, Compatibility. λ phage – Insertional and replacement vectors, in vitro
Expression vector – Characteristics, RNA probe synthesis, High level expression of proteins,
Protein solubilization, purification and export.

UNIT II  CONSTRUCTION OF DNA LIBRARIES  9
DNA library – types and importance. cDNA library: Conventional cloning strategies – Oligot T
priming, self-priming and its limitations. Full length cDNA cloning – Capture method and Oligo
capping. Strategies for gDNA library construction – Chromosome walking, gDNA and cDNA
library. Screening strategy. Hybridization, PCR, Immuno-screening, South-Western and North-
Western. Functional cloning – Functional complementation and gain of function. Difference
cloning: Differential screening, Subtracted DNA library, differential display by PCR. Microarrays -
Applications of microarrays.

UNIT III  PCR, MUTAGENESIS AND DNA SEQUENCING  9
Polymerase Chain reaction (PCR): Principle and applications. Different types of PCR (Hot
start, touchdown, multiplex, inverse, nested, AFLP, allele-specific, assembly, Asymmetric, LATE,
Colony, in situ, long). Real-time PCR, FRET, SYBR Green assay, Taqman probes, Molecular
beacons. Mutagenesis and chimeric protein engineering by PCR, RACE, Kunkels’ method of
mutagenesis, Phage display and screening methodologies. DNA sequencing. Chemical and
Enzymatic methods. Pyrosequencing, Automated sequencing, Genome sequencing methods –
top -down approach, bottom- up approach. Next generation gene sequencing.

UNIT IV  POST TRANSCRIPTIONAL GENE REGULATION AND GENOME EDITING  9
Role of siRNA, miRNA in gene regulation: siRNA- PTGS, Quelling, origin, components of gene
silencing mechanisms, TGS, PTGS, Applications. miRNA- Identification, biogenesis, mechanism
of action. Difference between siRNA and miRNA, effect of small RNAs on chromosomal DNA.
Genome Editing tools: Genome editing- introduction, zinc finger nucleases, TALENS, CRISPR-
Cas9 systems, applications.

UNIT V  GENETIC ENGINEERING  9
Introduction of foreign genes into animal cells – Importance, DNA Microinjection, Retroviral
vectors, Transfection of Embryonic stem cells, recombination. Transgenic plants –Ti Plasmid, Co
integrate and Binary vectors, transgenic plants for disease resistance, abiotic stress resistance,
enhanced nutritional value, Viral vectors, Engineering siRNA mediated gene knock downs
(shRNA).

TOTAL : 45 PERIODS

REFERENCES:

BY4102  BIOPROCESS TECHNOLOGY  L T P C
3 0 0 3

UNIT I  BLACK BOX MODEL
Yield coefficients, black box stoichiometries, elemental balances, heat balance, degrees of reduction balances, systematic analysis of black box stoichiometries, and identification of gross measurement errors

UNIT II  DESIGN OF FERMENTATION PROCESSES

UNIT III  MODELING OF VARIOUS FERMENTATION PROCESSES
Principles of model building for biotechnological processes, unstructured models on the population level, structured models on the cellular level, morphologically structured model, genetically structured models, cybernetic model, modeling of recombinant systems.

UNIT IV  BIOREACTOR DESIGN & CONSTRUCTION
Basic design and construction of CSTR, bioreactor design of agitator / agitator motor, power consumption in aerated bioreactor, design of sparger, mixing time estimation, oxygen mass transfer capability in bioreactor, Removal of Heat in bioreactor, Main parameters to be monitored and controlled in fermentation processes.

UNIT V  CASE STUDIES IN FERMENTATION DERIVED PRODUCTS
Case studies on Production of green chemicals, algal biofuels, recombinant Insulin. Case studies on medium design, reactor design & process optimization.

TOTAL: 45 PERIODS

REFERENCES:
UNIT I  INNATE IMMUNITY
Introduction to the Immune system – Various components of the immune system – Innate
immune response - Inflammatory response. Cellular and Molecular aspects of the innate immune
system- Recognition of pathogens and activation of Toll-like receptors- complement system.

UNIT II  ADAPTIVE IMMUNITY
Antibody structure and functions – Antibody mediated and cell mediated immunity – components of
cell-mediated immunity. Antigen-processing and presentation. MHC – structure and function.
Antigen receptors and accessory molecules of T lymphocytes- B- cell development and activation,
generation of B-cell diversity – Mechanism of immunoglobulin – gene arrangement and
immunoglobulin superfamily. T-cell development – Generation of TCR diversity – Biology of
Cytokines.

UNIT III  IMMUNOREGULATION
Helper and suppressor cells, mechanism in immunity. Inflammation – mechanism and significance.
Transplantation immunology- graft rejection and HLA antigens. Role of MHC and T cells. Prevention
of graft rejection. Hypersensitivity- immediate and delayed types; mechanism and reactions.
Vaccines – types, production and uses. Immunity to virus, bacteria and parasites- genetic control of
immune response. Immunosuppression.

UNIT IV  IMMUNOLOGICAL TECHNIQUES
PBMC separation from the blood; isolation of monocytes/macrophages. Macrophage culture.
Isolation of dendritic cells. Identification of lymphocytes based on CD markers; Production of
monoclonal antibodies and Polyclonal antibodies. Principle and applications of immunoassays: RIA,
ELISA, IRMA, ELFIA, ECLIA, DELFIA, TRIFMA, SLFIA, and western blot. Precipitation reaction –
immunodiffusion, immune-electrophoresis, precipitin ring test. Agglutination tests – hemagglutination,
febrile and latex agglutination- applications. Tumor Cell imaging Techniques- In vitro and In vivo cell
tracking techniques; Immuno-electron microscopy, Immunofluorescence microscopy, Fluorochromes; Staining techniques for live cell imaging and fixed cells; Flow cytometry

UNIT V  IMMUNOTHERAPEUTICS
Recombinant Antibodies, Bispecific Antibodies, catalytic antibodies, humanized antibodies,
monoclonal antibodies: Antibody-drug conjugates (ADCs), radiolabeled antibodies, immunotoxins,
cancer vaccines (tumor cell vaccines), Antigen vaccines, dendritic cell vaccines. DNA vaccines, cell
based therapeutics.

TOTAL : 45 PERIODS

REFERENCES
8th Edition, 2018
1997
UNIT I RESEARCH DESIGN
Overview of research process and design. Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

REFERENCES:

LIST OF EXPERIMENTS
1. *Preparation of antigen and Routes of immunization (Intraperitoneal, Sub-cutaneous, Intramuscular, Intranasal, Oral – VIRTUAL DEMO)
2. *Methods of bleeding (Tail bleeding, Intravenous, intraorbital - VIRTUAL DEMO)
3. Collection of serum, storage and purification of total IgG (salt precipitation).
4. Evaluation of Antibody titre by direct ELISA
5. Evaluation of Antigen by Sandwich ELISA
6. Characterization of antigens by native and SDS-PAGE
7. Characterizations of antigens by Western blot analysis – Wet and semidry transfer
8. Conjugation of Immunoglobins (Streptavidin, colloidal gold)
9. Methods for prototype development of Immunodiagnostics (ICT card)
10. Blood smear identification of leucocytes by Giemsa stain
11. Separation of mononuclear cells by Ficoll-Hypaque
12. Separation of splenocytes and proliferation against mitogens

* Approval of IAEC is mandatory for experiments involving Live animals

TOTAL : 90 PERIODS

LIST OF EQUIPMENTS REQUIRED
Microscopes,
Purification columns,
Microplate reader,
UV spectrometer,
PAGE apparatus,
Western blot apparatus,
Centrifuge,
Haemocytometer,

SEMESTER II
BY4201 BIO SEPARATION TECHNOLOGY

UNIT I DOWNSTREAM PROCESSING IN BIOTECHNOLOGY 9
Role and importance of downstream processing in biotechnological processes – Problems and requirements of bio product purification – Economics of downstream processing in Biotechnology, cost-cutting strategies – Separation characteristics of proteins and enzymes – size, stability, properties – Flocculation and conditioning of broth – Process design criteria for various classes of bio products (high volume, low value products and low volume, high value products) – Upstream production methods affect downstream purification strategies.

UNIT II PHYSICO-CHEMICAL BASIS OF BIO-SEPARATION PROCESSES 9
Cell disruption methods for intracellular products – Physical, chemical, mechanical – Removal of insoluble, biomass and particulate debris separation techniques – Filtration at constant pressure and at constant rate – Empirical equations for batch and continuous filtration – Types of filtration - Centrifugal and cross – flow filtration – Types of filtration equipments – Centrifugation – Basic principles, design characteristics – Types of centrifuges and applications – Sedimentation

UNIT III MEMBRANE SEPARATIONS AND ENRICHMENT OPERATIONS 9

UNIT IV MECHANISM AND MODES OF CHROMATOGRAPHIC SEPARATION 9
Chromatography – Classification of chromatographic techniques – General description of column chromatography – Chromatographic terms and parameters – Practice of chromatography – Partition, normal-phase, displacement, reversed-phase, size exclusion, ion exchange, hydrophobic, affinity chromatography – Scale-up of chromatography – Process considerations in Preparative liquid chromatography and HPLC.
REFERENCES

BY4202 COMPUTATIONAL BIOLOGY LT P C
UNIT I ALGORITHMS 9
Dynamic Programming Algorithms: Needleman-Wunsch, Smith-Watermann – Heuristic Algorithms: FASTA, BLAST; statistical and Biological significance; Clustering: Hierarchical Clustering, k-Means Clustering; Phylogeny; Tree Construction: Distance-based (Neighbour-Joining, Unweighted Pair Group Method with Arithmetic Mean) and Character-based methods (small and large parsimony algorithm).

UNIT II SEQUENCE ANALYSIS 9
Nucleic acid: Reading frames, Codon Usage analysis, Translational and transcriptional signals, Splice site identification, Gene prediction methods, RNA fold analysis: Protein: Compositional analysis, Hydrophobicity profiles, Amphiphilicity detection, Moment analysis, Transmembrane prediction methods, Secondary structure prediction methods.

UNIT III COMPUTER AIDED DRUG DESIGN 9
Drug discovery process: Target identification and validation, lead optimization and validation. Analog-Based drug design: Pharmacophores (3D database searching, conformation searches, deriving and using 3D Pharmacophore, constrained systematic search, Genetic Algorithm, clique detection techniques, maximum likelihood method) and QSAR; Structure-based drug design: Docking, De Novo Drug Design (Fragment Placements, Connection Methods, Sequential Grow), Virtual screening.

UNIT IV MOLECULAR DYNAMICS AND MACHINE LEARNING 9
UNIT V  SYSTEMS BIOLOGY

TOTAL : 45+15 = 60 PERIODS

REFERENCES

Extensive Reading:
UNIT I  CELLULAR METABOLISM  

UNIT II  REGULATION, MANIPULATION AND SYNTHESIS OF METABOLIC PATHWAY  

UNIT III  ANALYSIS AND METHODS FOR THE METABOLIC FLUX  
Metabolic flux map – Fluxes through the catabolic pathways in microbes– Metabolic flux analysis for determined, over-determined and under-determined systems –Sensitivity analysis – Direct flux determination from fractional label enrichment – Applications involving complete enumeration of metabolite isotopomers – Carbon metabolite balances-GC-MS for metabolic flux analysis – genome wide technologies

UNIT IV  GENOME BASED METABOLIC MODEL DEVELOPMENT  
Development of Genomic scale metabolic model, Insilico Cells:studying genotype-phenotype relationships using constraint-based models, case studies in E. coli, S.cerevisiae metabolic network reconstruction methods, optimization of metabolic network, Identification of targets for metabolic engineering; software and databases for genome scale modeling

UNIT V  ANALYSIS OF METABOLIC CONTROL AND INDUSTRIAL CASE STUDIES  
Fundamental of Metabolic Control Analysis (MCA), MFA, and MPA and their application, Multi-substrate enzyme kinetics, Metabolic engineering examples for bio-fuel, bio-plastic and green chemical synthesis ; Study of genome scale model in various systems for the production of green chemicals using software tools

REFERENCES

TOTAL: 45 PERIODS
LIST OF EXPERIMENTS

2. Reactions of amino acids – Ninhydrin, Pthalaldehyde, Dansyl chloride – measurement using colorimetric and fluorimetric methods.
5. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect. Separation of lipids by TLC.
6. Enzyme Kinetics: Direct and indirect assays – determination of Km, Vmax and Kcat, Kcat/Km.
7. Restriction enzyme – Enrichment and unit calculation.
8. Ion-exchange Chromatography – Purification of IgG and Albumin
9. Gel filtration – Size based separation of proteins
10. Affinity chromatography – IMAC purification of His-tagged recombinant protein
11. Assessing purity by SDS-PAGE Gel Electrophoresis
12. Chemical modification of proteins – PITC modification of IgG and Protein Immobilization

TOTAL: 90 PERIODS

REFERENCES:

SEMESTER - III

LIST OF EXPERIMENTS

1. Isolation of vector Eg. Plasmid and Isolation of vector Eg. Genomic DNA
2. Electroporation to Yeast/ Bacteria
3. Isolation of RNA and cDNA synthesis
4. Primer designing and Calculation of Annealing Temperature
5. Demo on Real-time PCR/ Gradient PCR
6. Plasmid isolation and confirming recombinant by PCR and RE digestion.
7. Confirmation of the presence of insert by colony PCR
8. Induction and expression of recombinant protein
9. Western blot with ECL detection
10. Site directed mutagenesis using PCR
11. Southern blot (Non-radioactive)
12. RFLP analysis of the recombinant DNA
13. SDS-PAGE analysis of recombinant protein expression
14. Quantification of expressed recombinant protein by ELISA
LIST OF EQUIPMENTS REQUIRED

- Microscopes
- PCR
- Purification columns
- Microplate reader
- UV spectrometer
- PAGE apparatus,
- Western blot apparatus (dry/semi-dry/wet),
- Southern blot apparatus,
- centrifuge,
- Hemocytometer,

CHEMICALS : required stains, chemicals, enzymes & consumables

TOTAL : 90 PERIODS

REFERENCES


BY4312 BIOPROCESS AND DOWNSTREAM PROCESSING LABORATORY

LIST OF EXPERIMENTS

1. Enzyme immobilization studies – Gel entrapment, adsorption and cross linking immobilization.
2. Batch cultivation – E.coli – growth rate, substrate utilization kinetics, product analysis after induction, metabolite analysis by HPLC.
3. Fed batch cultivation - E.coli - growth rate, substrate utilization kinetics, product analysis after induction, metabolite analysis by HPLC.
5. Optimization techniques – Plackett Burman, Response surface methodology.
7. Cell separation methods-Centrifugation and microfiltration
9. Aqueous two phase extraction of biologicals.
10. Protein precipitation by salting –out method (ammonium sulphate).
11. Protein purification method- Column chromatography.

LIST OF EQUIPMENTS REQUIRED

- Centrifuge,
- Column for purification
- Ultrasonicator
- Homogeniser
- Microfiltration capsule
- Hot air oven, Incubator
• Laminar air flow chamber
• HPLC,

**CHEMICALS** All required chemicals & stains.

**TOTAL : 90 PERIODS**

**REFERENCES**
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications

**SEMESTER III**

BY4313 PROJECT WORK I  L T P C
0 0 12 6

**OBJECTIVES**

The course aims to enable the students to
- identify the problem/process relevant to their field of interest that can be carried out
- search databases and journals to collect and analyze relevant data
- plan, learn and perform experiments to find the solution
- prepare project report

**TOTAL : 180 PERIODS**

Individual students will identify a problem relevant to his/her field of study, collect and analyze literature, design, and carry out experiment, collect data, interpret the result and prepare the project report.

**OUTCOMES:**

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

- CO1 Identify the research/industrial problems
- CO2 Collect and analyze the relevant literature
- CO3 Design, conduct experiment and analyse the data
- CO4 Prepare project report
OBJECTIVES
The course aims to

- train students to analyze the problem/think innovatively to develop new methods/product/process
- make them understand how to find solutions/ create products economically and in an environmentally sustainable way
- enable them to acquire technical and experimental skills to conduct experiment, analyze the results and prepare project report
- enable them to effectively think about strategies to commercialize the product.

TOTAL: 360 PERIODS

Individual students will identify a problem relevant to his/her field of study, collect and analyze literature, design, and carryout experiment, collect data, interpret the result and prepare the project report.

COURSE OUTCOMES
At the end of the project the student will be able to

CO1 Formulate and analyze problems for developing new methods/solutions/processes.
CO2 Plan and conduct experiments to find solutions in a logical manner
CO3 Analyze the results, interpret and prepare project report/know the strategies for commercialization
PROFESSIONAL ELECTIVE I

BY4001 ADVANCES IN ANIMAL BIOTECHNOLOGY

UNIT I INTRODUCTION
Scope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins.

UNIT II MOLECULAR BIOLOGY
Biology of animal viral vectors- SV40, adenovirus, retrovirus, vaccinia virus, herpes virus, adenovirus associated virus and baculo virus. Applications of commercially available viral vectors and their pros and cons

UNIT III CELL CULTURE TECHNOLOGY
Culturing of cells, primary and secondary cell lines, Cell culture-Scaleup of animal cell culture-monolayer culture, suspension culture; Various bio-reactors used for animal cell culture-Roller bottle culture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, hemostat/Turbidostat; High technology vaccines; Hybridoma technology; Cell lines and their applications

UNIT IV GENETIC ENGINEERING
Gene therapy-prospects and problems, Recent advancements in Gene therapy; Knock out mice and mice model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis-preparation of probes, evaluation and applications.Recent advancements in diagnostic tool development and its diagnostic procedure

UNIT V ADVANCEMENTS AND APPLICATIONS
Rumen manipulation- probiotics embryo transfer technology, invitro fertilization, transgenesis-methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Biopharming—Transgenic animals (case study: Mice, Cows, Pigs, Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer.

TOTAL : 45 PERIODS

REFERENCES:
5. Freshney R.I. Animal Cell Culture- a practical approach, 6th ed., 2010

BY4002 PLANT GENETIC ENGINEERING AND BIOTECHNOLOGY

UNIT I PLANT GENOME AND GENE EXPRESSION
Plant genome organization – Arabidopsis and Rice nuclear genome, Endosymbiotic theory - Chloroplast and mitochondrial genome organization, Cytoplasmic male sterility; RNA editing, Regulation of gene expression, epigenetic regulations, protein targeting

UNIT II TISSUE CULTURE TECHNIQUES
Introduction to plant tissue culture, tissue culture media; Micropropagation; production of artificial seeds; Double haploid production by androgenesis and gynogenesis; triploid production by endosperm culture; Cell Suspension cultures; protoplast isolation and regeneration, somatic hybridization and cybridization; clonal variation for crop improvement; Cryopreservation; Hairy root cultures, synthetic seed technology
UNIT III   PLANT MICROBE INTERACTIONS
Types of plant microbe interactions: Pathogens, endophytes and symbionts: Molecular basis of plant pathogen interactions, gene-for-gene interactions, mechanism of pathogenesis in plants (Bacterial and fungal pathogens) – Pathogen effector molecules, Overview of plant immunity and defense: Plant defense mechanisms: preformed defense, induced defense, Plant resistant proteins, PR-proteins. Agrobacterium biology – Ti plasmid and T-DNA transfer, Symbiotic nitrogen fixation in legumes by Rhizobia: Molecular biology and biochemistry of nitrogen fixation, nif, nod genes, nitrogenase function

UNIT IV   PLANT GENETIC ENGINEERING
Methods of transformation: Microprojectile bombardment, Agrobacterium mediated transformation, cointegrate and binary vectors, Plant selectable markers, reporter genes, marker-free plants, transgenic plants for crop improvement-disease resistance, insect resistance, herbicide resistance, FlavrSavr Tomato, Golden rice, Bt. cotton, Roundup-ready crops, metabolic engineering and molecular pharming (Edible vaccines).

UNIT V   PLANT FUNCTIONAL GENOMICS AND GENOME EDITING
Plant functional genomics-Reverse genetics technique, Forward Genetics-T-DNA tagging, Transposon tagging, Activation tagging, Entrapment tagging, RNAi, gene targeting by homologous recombination in plants, Targeted genome engineering Zinc Finger Nucleases, TALENS, CrispR Cas9 system

REFERENCES:

TOTAL: 45 PERIODS

BY4003   ADVANCES IN CANCER BIOLOGY   L T P C

UNIT I   PRINCIPLES OF CANCER BIOLOGY
Cancer: Definition, causes, properties, classification, clonal nature – Cell Cycle: Regulation of cell cycle, cell proliferation and apoptosis – Signal transduction pathways – Growth factors, Apoptosis: apoptotic pathways, signal molecules, effects on receptor, signal switches – Modulation of cell cycle in cancer – Mechanism of spread

UNIT II   PRINCIPLES OF CARCINOGENESIS
UNIT III MOLECULAR ASPECTS OF CANCER AND ITS METASTASIS

UNIT IV CANCER SCREENING-DIAGNOSIS AND PREVENTION MODALITIES
Life Style, Dietary Factors and Complementary Medicines (Yoga, Meditation, Acupuncture, Exercise & Probiotics) and their Pathways, Screening Principles, Developing and Evaluating a Cancer Screening Program, Various Screening Modalities for specific types of Cancer, Genetic Counselling, Biomarkers in Tumour Clinical Practice, Circulating and Cellular Tumour Markers, In vivo Tumour Imaging, Advances in Cancer Detection - Detection of Metastasis and Micro metastasis.

UNIT V CANCER THERAPY

REFERENCES:

TOTAL: 45 PERIODS

BY4004 PHYTOCHEMISTRY L T P C 3 0 0 3

UNIT I INTRODUCTION TO PHYTOCHEMISTRY
Phytochemicals and their classification— Phytochemical screening— Physicochemical tests— Macroscopic and microscopic techniques— Traditional plant and Herbal remedies — Herbal drugs WHO guidelines— Standardization of Herbal Drugs Derivatives with Special Reference to Brazilian Regulations

UNIT II PHYTOCOMPOUNDS
Plant extract used to Bacterial, Fungal and Parasitic infection – Biological and Toxicology Properties of plant extract – Anti-MRSA and Anti-VRE activities of Phytoalexins and Phytoncides– Anti microbial and targeted screening of Plant extract – Plant derived compound against drug resistant microorganisms – Antioxidant and antitumor Plant metabolites (fruits and vegetables)– Bioactive compounds as food

UNIT III PHYTOMEDICINE
Medicinal Plants for Development of Phytochemistry and Use in Primary Health Care– Immunostimulants and adaptogen from Plants – Polyphenols for Atherosclerosis and Ischemic Heart disease – Cancer Chemopreventive agents – Lipidoxidation nitrogen Radicals– Phytochemicals in oilseeds – Flavonoids in Cardiovascular disease – Bioengineering and Breeding approaches in improving phytochemical content of plants.
UNIT IV SEPARATION TECHNIQUES AND STRUCTURE ELUCIDATION


UNIT V SECONDARY METABOLITE


TOTAL: 45 PERIODS

REFERENCES


BY4005 ADVANCES IN MOLECULAR PATHOGENESIS L T P C

UNIT I VIRAL PATHOGENESIS

Various pathogen types and modes of entry – Viral dissemination in the host – Viral virulence – Injury induced by virus – Host susceptibility of viral disease – Pattern of infection - Acute infection – Persistant infection – Latent infection – Slow infection – Methods for the study of pathogenesis – Foot and mouth disease virus, Pestiviruses, Arteriviruses, Blue tongue virus and Animal herpesviruses

UNIT II FUNGAL PATHOGENESIS

Innate humoral immunity to fungi – Acquired cellular immunity – Mucosal immunity – Intracellular pathogenesis of *Histoplasma capsulatum* – Facultative intracellular pathogen of *Cryptococcus neoformans* – Fungal interaction with leukocytes – Fungal vaccine development – Host defence against chronic disseminated *Candidiasis* – Study fungal virulence by using Genomics – Functional genomic approaches to fungal pathogenesis.

UNIT III BACTERIAL PATHOGENESIS


UNIT IV MANIPULATION OF HOST CELLS AND IMMUNE FUNCTION BY VIRAL PROTEINS

UNIT V MOLECULAR APPROACHES TO CONTROL

Classical approaches based on serotyping – Modern diagnosis based on highly conserved virulence factors, immune and DNA based techniques – New therapeutic strategies based on recent findings on molecular pathogenesis – Viral Vaccines – Immune modulators – New vaccine technology.

TOTAL: 45 PERIODS

REFERENCES:

PROFESSIONAL ELECTIVE II

BY4006 ENZYME ENGINEERING AND TECHNOLOGY LT P C 3 0 0 3

UNIT I INTRODUCTION
Introduction to enzymes, Classification, Sources, Mechanism of enzyme action. Strategies of purification of enzymes, criteria of purity, molecular weight determination and characterization of enzymes, Enzymes of biological importance - Acetyl cholinesterase, angiotensin converting enzyme (ACE), ACE Inhibitors, HMG Co A reductase inhibitors, pseudo cholinesterase, 5'-nucleotidase (5NT), glucose-6-phosphate dehydrogenase (GPD), Isoforms, immunoreactivetrypsinogen (IRT) and chymotrypsin; amylase isoenzymes

UNIT II KINETICS OF ENZYME ACTION

UNIT III IMMOBILIZED ENZYMES
Techniques of enzyme immobilization; kinetics of immobilized enzymes, effect of solute, partition & diffusion on the kinetics of immobilized enzymes, design and configuration of immobilized enzyme reactors; applications of immobilized enzyme technology, Economic argument for immobilization

UNIT IV ENZYMES IN FUNCTIONAL GROUP TRANSFORMATION

UNIT V APPLICATIONS OF ENZYMES
Enzymes in organic synthesis, Enzymes as biosensors, Enzyme for environmental application, Enzymes for molecular biology research, Enzymes for analytical and diagnostic applications,
Enzymes for food, pharmaceutical, tannery, textile, paper and pulp industries.

TOTAL : 45 PERIODS

REFERENCES:

BY4007 BIO REACTOR DESIGN AND CONTROL

UNIT I BASIC BIOREACTOR CONCEPTS
Bioreactor Operation – Batch operation, semi-continuous and fed-batch operation, Continuous Operation – Chemostat, turbidostat – Microbiological reactors, enzyme reactors – Tank-type, Column-type biological reactors – Case studies – Continuous Fermentation with Biomass Recycle, Tanks-in-series, Tubular plug flow bioreactors.

UNIT II AERATION AND AGITATION IN BIOPROCESS SYSTEMS
Mass transfer in agitated tanks – Effect of agitation on dissolved oxygen - Correlations with kLa in Newtonian and non Newtonian liquid – Power number, Power requirement for mixing in aerated and non aerated tanks for Newtonian and non Newtonian liquids – Agitation rate studies - Mixing time in agitated reactor, residence time distribution – Shear damage, bubble damage, Methods of minimizing cell damage – Laminar and Turbulent flow in stirred tank bioreactors.

UNIT III SELECTION AND DESIGN OF BIOPROCESS EQUIPMENT
Materials of construction for bioprocess plants – Design considerations for maintaining sterility of process streams processing equipments, selection, specification – Design of heat and mass transfer equipment used in bioprocess industries – Requirements, design and operation of bioreactor for microbial, plant cell and animal cell.

UNIT IV SCALE UP AND SCALE DOWN ISSUES
Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculum development, nutrient availability and supply – Bioreactor scale-up based on constant power consumption per volume, mixing time, impeller tip speed (shear), mass transfer co-efficients – Scale up of downstream processes – Adsorption (LUB method), Chromatography (constant resolution etc.), Filtration (constant resistance etc.), Centrifugation (equivalent times etc.), Extractors (geometry based rules) – Scale-down related aspects.
UNIT V  BIOREACTOR INSTRUMENTATION AND CONTROL  9


TOTAL: 45 PERIODS

REFERENCES

BY4008  THERMODYNAMICS FOR BIOLOGICAL SYSTEMS  L T P C  3 0 0 3

UNIT I  THERMODYNAMIC LAWS  9
Basic thermodynamic concepts, Energy and first Law; Reversibility and second Law; Review of Basic Postulates, equation of state and its applications, corresponding states, equilibrium criteria, Legendre Transformation and Maxwell’s relations

UNIT II  GIBBS PHASE RULE  9
Phase rule, Stability of thermodynamic systems, first order phase transitions and critical phenomenon, single component phase diagrams, thermodynamic properties from volumetric and thermal data

UNIT III  SOLUTION THERMODYNAMICS  9
Partial molar properties, Gibbs-Duhem equation, fugacities in gas and liquid mixtures, activity coefficients, ideal and Non-ideal solutions, azeotropes, Wilson, NRTL, and UNIQUAC equations, UNIFAC method.

UNIT IV  PHASE EQUILIBRIA  9
Vapour Liquid Equilibrium involving low pressure, high pressures and multi component systems,VLE in ideal and non- ideal solutions, Henry’s Law, Other phase equilibriums- SLE/LLE/VLLE.

UNIT V  CHEMICAL EQUILIBRIA  9
Criteria of chemical reaction equilibrium in thermodynamic systems, Homogeneous gas and liquid phase reactions, heterogeneous reactions – phase and chemical equilibrium

TOTAL: 45 PERIODS

REFERENCES
5. Tester, J. W., Modell, M., Thermodynamics and its Applications, Prentice-Hall, New Jersey
BY4009  BIOTECHNOLOGY IN FOOD PROCESSING  L T P C  3 0 0 3

UNIT I  FOOD PROCESSING  9
Heat Processing using steam or water (Blanching, Pasteurization) – Heat sterilization (Evaporation and distillation) – Heat processing using hot air (Dehydration, baking and roasting) – Heat processing using hot oils – Processing by the removal of heat (chilling, Freezing) – High pressure processing of foods – Pulsed electric field processing of liquids and beverages – Non-thermal processing by radiofrequency electric fields.

UNIT II  FOOD FERMENTATION  9

UNIT III  FERMENTED FOODS  9

UNIT IV  FOOD PRESERVATION TECHNIQUES  9
Spoilage of food – Microbiology of water, meat, milk, vegetables – Food poisoning – Cold preservation – Heat conservation – Ionizing radiation – High pressure – Electric field – Chemical food preservation – Combination of techniques for food preservation – Natural antioxidants – Antimicrobial enzymes – Edible coatings – Control of pH and water activity.

UNIT V  FOOD QUALITY AND CONTROL  9
Analysis of food – Major ingredients present in different product – Food additives, vitamins – Analysis of heavy metal, fungal toxins, pesticide and herbicide contamination in food – Microbial safety of food products – Chemical safety of food products – Good manufacturing practice

TOTAL: 45 PERIODS

REFERENCES
UNIT I  INTRODUCTION TO MODELING
Use of mathematical models, principles of formulation, fundamental laws, continuity equations, energy equations, equations of motions, transport equations, equation state, equilibrium, basic chemical kinetics

UNIT II  KINETICS AND BIOREACTOR MODELS
Enzyme kinetics- Microbial kinetics-Structured kinetic model-batch, fed Batch and continuous operation-Modeling of non-ideal behavior in bioreactors – Tanks-in-series, dispersion and compartment models

UNIT III  DESIGN OF BIOREACTORS
Immobilized enzyme Bioreactors; Mass transfer in immobilized bio catalytic systems-Analysis of film and pore diffusion resistances and their effect on overall reaction kinetics; Mass transfer in biological reactors-Inter phase gas-liquid mass transfer, General oxygen balances for gas-liquid transfer- Models for oxygen transfer in large scale bioreactors-Design and analysis of packed bed and membrane bioreactors

UNIT IV  MONITORING AND CONTROL OF BIOPROCESSES
Elements of feedback control- types of controller action- Proportional Controller- Proportional Integral Controller – Proportional Derivative Controller- Proportional Integral Derivative Controller-Advanced control strategies- Cascade Control - Feed Forward Control- Bioprocess adaptive control - Bioprocess control using Artificial Intelligence

UNIT V  SIMULATION OF BIOPROCESSES
Problem Structuring, Process Analysis, and Process Scheme - Implementation and Simulation-Uncertainty Analysis- Software packages for simulation of bioprocesses – MATLAB-SIMULINK, ISIM; Simulation of bioprocesses using models from literature sources

TOTAL: 45 PERIODS

REFERENCES
UNIT I    INTRODUCTION

UNIT II    ETHANOL
Ethanol as transportation fuel and additive; bioethanol production from carbohydrates; engineering strains for ethanol production from variety of carbon sources to improved productivity.

UNIT III   BIODIESEL
Chemistry and Production Processes; Vegetable oils and chemically processed biofuels; Biodiesel composition and production processes; Biodiesel economics; Energetics of biodiesel production and effects on greenhouse gas emissions - Issues of ecotoxicity and sustainability with ; expanding biodiesel production

UNIT IV    OTHER BIOFUELS
Biodiesel from microalgae and microbes; biohydrogen production; biorefinery concepts

UNIT V     PLATFORM CHEMICALS
Case studies on production of C3 to C6 chemicals such as Hydroxy propionic acid, 1,3 propanediol, propionic acid, succinic acid, glucaric acid, cis-cis muconic acid.

TOTAL: 45 PERIODS

REFERENCES
PROFESSIONAL ELECTIVE III

BY4012 MOLECULAR MEDICINE

UNIT I FUNDAMENTAL TECHNOLOGIES
Molecular cloning, Genomic Libraries, Amplification of DNA Using PCR, DNA Sequencing Technologies, Sequencing Whole Genomes, Genomics- proteomics, transcriptomics, metabolomics.

UNIT II BIOLOGY BEHIND THE TECHNOLOGY

UNIT III MOLECULAR DIAGNOSTICS
Immunological Approaches To Detect Protein Biomarkers of Disease.: Enzyme-Linked Immunosorbent Assays, Immunoassays for Infectious Disease, Protein Arrays To Detect Polygenic Diseases, DNA-Based Approaches to Disease Diagnosis: Hybridization Probes, Padlock Probes, Allele-Specific PCR, TaqMan PCR, Real-Time PCR To Detect Infectious Disease Detection of Epigenetic Markers and SNP. Detecting RNA Signatures of Disease

UNIT IV NUCLEIC ACID AND PROTEIN THERAPEUTICS
Nucleic Acid Therapeutic Agents: Targeting Specific mRNAs and DNAs, Viral Delivery Systems, Non-viral Nucleic Acid Delivery Systems, Protein Therapeutics: Pharmaceuticals, Recombinant Antibodies, Enzymes.

UNIT V VACCINES
Overview on vaccination, Subunit Vaccines, Peptide Vaccines, Dendritic Cell Vaccines, DNA Vaccines, Attenuated Vaccines, Vector Vaccines, Systems Biology and Evaluation of Vaccines

REFERENCES

UNIT I  FUNDAMENTAL OF TISSUE ENGINEERING  9

UNIT II  BIOMATERIALS FOR TISSUE ENGINEERING  9

UNIT III  DELIVERY OF MOLECULAR AGENTS AND CELL INTERACTIONS WITH POLYMERS  9
Molecular agents in tissue engineering – Controlled released of agents – Methods, in time and space – Future applications of controlled delivery – Microfluidic systems – Microfluidics and microfluidic devices – Cell interactions – Factors influencing cell interactions – Cell interactions with polymer surfaces and suspension – Cell interactions with three-dimensional polymer.

UNIT IV  BIOMATERIALS AND CONTROLLED DRUG DELIVERY  9

UNIT V  BIOPOLYMER- BASED BIOMATERIALS AS SCAFFOLDS AND STEM CELLS  9
Natural polymers – Structural and chemical properties, scaffold processing, mechanical properties and biodegradability – Biocompatibility and host response – Application of scaffolds in tissue engineering. Use of stem cells in tissue engineering – Embryonic stem cells, mesenchymal stem cells (MSC), adult stem cells, markers for detection of stem cells – Risks with the use of stem cells. Applications of macro, micro and nano sized commercially available biomaterials for stem cell therapy.

REFERENCES
UNIT I  INTRODUCTION  9

UNIT II  DOSAGE FORMS  9

UNIT III  ADVANCED DRUG DELIVERY SYSTEMS  9

UNIT IV  BIOSIMILARS  9

UNIT V  CASE STUDIES ON BIOPHARMACEUTICALS  9

TOTAL: 45 PERIODS

REFERENCES
UNIT I  NANOSCALE PROCESSES AND NANOMATERIALS  9

UNIT II  STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY  9

UNIT III  PROPERTIES AND MEASUREMENT OF NANOMATERIALS  9
Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging

UNIT IV  NANOBIOLOGY AND BIOCONJUGATION OF NANOMATERIALS  9
Properties of DNA and motor proteins; Lessons from nature on making nanodevices; Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems

UNIT V  NANOMEDICINE AND NANONSENSING  9

REFERENCES
PROFESSIONAL ELECTIVE IV

BY4015 ADVANCED GENOMICS AND PROTEOMICS L T P C
3 0 0 3

UNIT I ORGANIZATION AND STRUCTURE OF GENOMES 9

UNIT II GENOME MAPPING 9

UNIT III SEQUENCING OF GENOMES 9

UNIT IV COMPARATIVE AND FUNCTIONAL GENOMICS 9

UNIT V METAGENOMICS, PHARMACOGENOMICS AND PALEOGENOMICS 9
Metagenomics: Approaches for metagenomic analysis, Functional Metagenomics; Pharmacogenomics; Genetic variability in drug response; Clinical Applications and challenges in Pharmacogenomics; Impact of Pharmacogenomics on future drug development. Paleogenomics: Ancient DNA Extraction, Genomic analysis of aDNA, Paleogenomics Applications – case studies - insights from genomes of archaic hominins - Neanderthals and Denisovans; Woolly Mammoth; Barley; Mycobacterium tuberculosis

TOTAL: 45 PERIODS

REFERENCES
UNIT I IPR

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

UNIT III BIOSAFETY

UNIT IV GENETICALLY MODIFIED ORGANISMS
Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

REFERENCES
BY4017  PROTEIN STRUCTURE ANALYSIS  LT P C  3 0 0 3

UNIT I  PROTEOMICS AND BIOLOGICAL MASS- SPECTROMETRY  9
Over-view of strategies used for the identification and analysis of proteins; Basics of Mass-spectrometry (MS) and bimolecular analysis; One-dimensional (1-D) polyacrylamide gel electrophoresis (PAGE) of proteins; Enzymatic cleavage of proteins in solution; In-gel digestion of protein bands; Electrophoretic transfer of proteins onto membranes (PVDF).

UNIT II  MASS-SPECTROMETRY IN PROTEOMICS  9
Common ionization methods for peptide/protein analysis (MALDI and ESI); Principles of Time of Flight (TOF), Ion Trap (IT), Quadrupole (Q), Fourier Transform-Ion cyclotron Resonance (FT-ICR), and Orbitrap mass analyzers; Collision-Induced Dissociation (CID) of peptides; Introduction to iondetectors.

UNIT III  SEPARATION AND PROCESSING OF PROTEINS FOR PROTEOMICS ANALYSIS  9
Protein extraction from biological samples (Mammalian Tissues, Yeast, Bacteria, and Plant Tissues); 2-DE of proteins for proteome analysis; Difference in-gel electrophoresis (DIGE); Liquid chromatography separations in proteomics (Affinity, Ion Exchange, Reversed-phase, and size exclusion); Strategies for multidimensional liquid chromatography in proteomics; Analysis of complex protein mixtures using Nano-liquid chromatography (Nano-LC) coupled to Mass-spectrometry analysis.

UNIT IV  COMPARATIVE AND QUANTITATIVE PROTEOMICS  9
Rapid identification of Bacteria based on spectral patterns using MALDI-TOF-MS. Comparative proteomics based on global in-vitro and in-vivo labeling of proteins/peptides followed by Mass-spectrometry analysis: ICAT, iTRAQ, SILAC. Analysis of Post-translational modification (PTM) of proteins; Enrichment and analysis of phospho- and glyco-proteins; Characterization of protein interactions using yeast two-hybrid system, Co-immunoprecipitation followed by MS, and Proteinmicroarrays.

UNIT V  PROTEOMICS INFORMATICS  9
Identification of proteins by PMF and MS/MS data; Database search engines for MS data analysis (Mascot, Sequest, and others); Proteomics informatics strategies for biomarker discovery, analysis of protein functions and pathways. Applications of proteomics (Disease diagnosis, drug development, and plant biotechnology)

TOTAL : 45 PERIODS

REFERENCES

REFERENCES

BY4018 COMPUTER AIDED LEARNING OF STRUCTURE AND FUNCTION OF PROTEINS

UNIT I COMPONENTS OF PROTEIN STRUCTURE
Introduction to Proteins, structure and properties of amino acids, the building blocks of Proteins, Molecular Interactions and their roles in protein structure and function, Primary Structure – methods to determine and synthesis

UNIT II PROTEIN BIOINFORMATICS
Protein sequence and structural databases, Multiple sequence alignment, Secondary, Tertiary and Quaternary Structure of Proteins; Sequence and Structural Motifs; Protein Folding

UNIT III OVERVIEW OF STRUCTURAL AND FUNCTIONAL PROTEINS

UNIT IV PROTEIN STRUCTURAL CLASSIFICATION DATABASES
SCOP and CATH. Evolutionary relationships and Phylogenetic Studies

UNIT V PROTEIN MODIFICATIONS
Post translational modifications, Engineering of proteins, Site directed mutagenesis, Fusion Proteins, Chemical derivatization.

TOTAL : 45 PERIODS
UNIT I  GOVERNING EQUATIONS  9
Fluid flow and its mathematical descriptions; conservation laws – Continuity equations –
Momentum equation, energy equation – Navier-Stokes equations – Boundary conditions,
Solutions of Governing Equations – Finite difference method, Finite element method, Finite
Volume Method, Euler’s Equations – Non-Newtonian Constitutive Equations – Curvilinear
coordinates and Transformed equations – CFD as Research tool and Design tool – Validation
Strategies.

UNIT II  NUMERICAL ANALYSIS  9
Solving System of Algebraic equations – Gauss Elimination, Gauss-Seidel – LU-Decomposition –
Jacobi – Simpson Rule – Laplace solution – Euler’s method – R-K method – Fourier analysis of
first and second upwind.

UNIT III  COMPRESSIBLE FLOW COMPUTATION  9
Euler equations – Conservative and non-conservative from thermodynamics of compressible flow
conditions – Godunov methods – Flux vector splitting Method – Reconstruction of dependent

UNIT IV  TURBULENT FLOW COMPUTATION  9
Physical Considerations – Survey of theory and models – Relation of High – Resolution Methods
and Flow Physics – Large Eddy Simulation – Standard and Implicit – Numerical Analysis of Sub
Computational Examples – Burgers’ Turbulence – Convective Planetary Boundary Layer.

UNIT V  FINITE ELEMENT METHOD  9
Finite Element formulation – Errors, Solutions of Finite difference equations – Elliptic equations
– Parabolic Equations – Hyperbolic Equations – Burger’s Equations – Nonlinear Wave equation
(Convection Equation) – Primitive Variable method for Incompressible viscous flows; Taylor-

REFERENCES
3. Drikakis, D. and Rider, W.J., “High - Resolution Methods for Incompressible and Low-

TOTAL: 45 PERIODS

AUDIT COURSES
AX4091  ENGLISH FOR RESEARCH PAPER WRITING  L T P C
  2 0 0 0

OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
Infer the skills needed when writing the Conclusion
Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS

UNIT III TITLE WRITING SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

AX4092 DISASTER MANAGEMENT L T P C
2 0 0 0

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

AX4093 CONSTITUTION OF INDIA

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)
UNIT II PHILIPHERGY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

UNIT VI ELECTION COMMISSION
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

OUTCOMES
Students will be able to:
• Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
• Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
• Discuss the circumstances surrounding the foundation of the Congress Socialist Party(CSP) under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
• Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India, 1950(Bare Act), Government Publication.

AX4094 சுருக்க லிஸ்டின் L T P C
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UNIT I சுருக்க லிஸ்டின்
1. நூறுரிய சுருக்க லிஸ்டின்
   - கதிரை, பிள்ளை, பல்லு போன்ற
2. அக்துரை (82)
   - முன்வாச பியாகோரிக்ம் அரேஸ்ட்
3. கொடிகுடி பாலுக்குள் மலர்கல்லு போன்ற
4. புத்தரையூர் (95,195)
   - போன்ற சிற்றுத் தொடர்பு
UNIT II

1. அறநநறி வகுத்ததிருவள்ளுவர் - அறம் வலியுறுத்தல், அன்புகடகம், ஒப்புரவறிதல், ஈகக், புகழ்
2. பிற அறநூல்கள் - இலக்கியம் ஏலொதி, சிறுபஞ் மூலம், திரிகடுகம், ஆரக்பகொகவ (அதுக்காலம் வலியுறுத்தும் நூல்)

UNIT III

1. திருவள்ளுவர் காப்பியங்கள் - சிலப்பதிகொரவழக்குகரகொத்த, இன்னும் கொகத
2. பிற அறநூல்கள் - மூகப்பகொத்ததிலக்குழ, சிகறக்பகொட்டம் அறக்பகொட்டமொகியகொத்த

UNIT IV

1. சிறுபொணொற்றுப்பகட - பொறிமுல்கல்குத் தகொடுத்தது, பபகன் மயிலுக்குப் பபொர்கவதகொடுத்தது, அதியமொன் ஒளகவக்குத் தநல்லிக்கனி தகொடுத்தது, அரொர பண்புப்புகள்
2. நற்றிகணம் - அன்கனக்குரியபுன்கன்,சிறப்பு
3. திருமந்திரம் (617, 618) - இயமம் நியமம் விதிகள்
4. தர்மபுலகயநிறுவிய வள்ளலொர்
5. புறநொனூறு - சிறுவபன் வள்ளலொனொன்
6. அகநொனூறு (4) - மூலம்
7. நண்டு கலித்ததொகக (11) - மூலம்
8. புறொந்தி கண (27) - மூலம்

UNIT V

1. உருவநநறி தமிழ் - 
   - குறிப்பிட்டுப்பின் பயணி, 
   - குறிப்பிட்டுப்பின் நொத்து, 
   - பாணியல் தமிழ்ப் பத்து தமிழ், 
   - பாணியல் தமிழ்ப் பத்து தமிழ், 
   - பாணியல் தமிழ்ப் பத்து தமிழ், 
   - பாணியல் தமிழ்ப் பத்து தமிழ்.
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
4. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
5. மூலம் நொத்து தமிழ்
6. தமிழ்ப் பல்ககலக்கழகம், தஞ் ஊவூர்
7. கைதொன்றிய இலக்கியம் தமிழ் திருவள்ளு

TOTAL: 30 PERIODS

தமிழ் விளக்கம் பாதைகள் / புத்தகங்கள்

1. தமிழ் விளக்கம் கைதொன்றிய தமிழ் பல்ககலக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விளக்கம் கைதொன்றிய தமிழ் பல்ககலக்கழகம்
3. தமிழ் விளக்கம் கைதொன்றிய தமிழ் பல்ககலக்கழகம்
4. மூலம் நொத்து தமிழ் - தமிழ் பல்ககலக்கழகம், கைதொன்றிய
5. தமிழ்கல்வி கல்லறிவு - தமிழ் பல்கலைக்கழகம்
   (thamilvalarchithurai.com)
6. அறிவியல் கல்லறிவு - தமிழ் பல்கலைக்கழகம், குதிரை