### SEMESTER II

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* Common to all B.E. / B.Tech. Programmes

+ Offering English Language Laboratory as an additional subject (with no marks) during 2nd semester may be decided by the respective Colleges affiliated to Anna University Chennai.
A. CIRCUIT BRANCHES

I Faculty of Electrical Engineering
1. B.E. Electrical and Electronics Engineering
2. B.E. Electronics and Instrumentation Engineering
3. B.E. Instrumentation and Control Engineering

II Faculty of Information and Communication Engineering
1. B.E. Computer Science and Engineering
2. B.E. Electronics and Communication Engineering
3. B.E. Bio Medical Engineering
4. B.Tech. Information Technology

B. NON – CIRCUIT BRANCHES

I Faculty of Civil Engineering
1. B.E. Civil Engineering

II Faculty of Mechanical Engineering
1. B.E. Aeronautical Engineering
2. B.E. Automobile Engineering
3. B.E. Marine Engineering
4. B.E. Mechanical Engineering
5. B.E. Production Engineering

III Faculty of Technology
1. B.Tech. Chemical Engineering
2. B.Tech. Biotechnology
3. B.Tech. Polymer Technology
4. B.Tech. Textile Technology
5. B.Tech. Textile Technology (Fashion Technology)
7. B.Tech. Plastics Technology

SEMESTER III

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Total Credits : 186

### LIST OF ELECTIVES FOR B.TECH. FOOD TECHNOLOGY PROGRAMME

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AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

UNIT I
Technical Vocabulary - meanings in context, sequencing words, Articles-Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

SUGGESTED ACTIVITIES:
1. Exercises on word formation using the prefix ‘self’ - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II

SUGGESTED ACTIVITIES:
Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.

1. Listening comprehension exercises to categorise data in tables.
2. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III
Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .
SUGGESTED ACTIVITIES:
Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object – verb / object – noun)

1. Speaking exercises involving the use of stress and intonation – Group discussions – analysis of problems and offering solutions.
2. Reading comprehension exercises with critical questions, Multiple choice question.

UNIT IV
Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

SUGGESTED ACTIVITIES:
1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.

UNIT V
Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

SUGGESTED ACTIVITIES:
1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TOTAL : 60 PERIODS

TEXT BOOKS:

REFERENCES:
EXTENSIVE READING:

Note:
The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

MA2161 MATHEMATICS – II L T P C
3 1 0 4

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 12
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS 12
Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallepipeds.

UNIT III ANALYTIC FUNCTIONS 12
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

UNIT V LAPLACE TRANSFORM 12
Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TOTAL : 60 PERIODS

TEXT BOOKS:
REFERENCES:

PH2161 ENGINEERING PHYSICS – II L T P C
3 0 0 3

UNIT I CONDUCTING MATERIALS 9

UNIT II SEMICONDUCTING MATERIALS 9

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Superconductivity: properties – Types of super conductors – BCS theory of superconductivity(Qualitative) – High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

UNIT V MODERN ENGINEERING MATERIALS 9
Metallic glasses: preparation, properties and applications.
Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA


**TEXT BOOKS:**
2. Charles P. Poole and Frank J.Ownen, 'Introduction to Nanotechnology', Wiley India(2007) (for Unit V)

**REFERENCES:**

**CY2161**  
**ENGINEERING CHEMISTRY – II**  
**L T P C**  
**3 0 0 3**  

**AIM**
To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

**OBJECTIVES**
- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

**UNIT I ELECTROCHEMISTRY**
Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox - Fe²⁺ vs dichromate and precipitation – Ag⁺ vs Cl⁻ titrations) and conduct metric titrations (acid-base – HCl vs, NaOH) titrations,

**UNIT II CORROSION AND CORROSION CONTROL**
UNIT III  FUELS AND COMBUSTION  9

UNIT IV  PHASE RULE AND ALLOYS  9

UNIT V  ANALYTICAL TECHNIQUES  9

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

ME2151  ENGINEERING MECHANICS  L  T  P  C
3   1  0  4

OBJECTIVE
At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I  BASICS & STATICS OF PARTICLES  12
UNIT II EQUILIBRIUM OF RIGID BODIES 12

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

UNIT IV DYNAMICS OF PARTICLES 12

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

TOTAL: 60 PERIODS

TEXT BOOK:

REFERENCES:
UNIT I  BASIC CIRCUITS ANALYSIS  12

UNIT II  NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS  12
Network reduction: voltage and current division, source transformation – star delta conversion.
Thevenins and Newton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III  RESONANCE AND COUPLED CIRCUITS  12

UNIT IV  TRANSIENT RESPONSE FOR DC CIRCUITS  12
Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V  ANALYSING THREE PHASE CIRCUITS  12
Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL : 60 PERIODS

TEXT BOOKS:

REFERENCES:
EC2151 ELECTRIC CIRCUITS AND ELECTRON DEVICES  L T P C
(For ECE, CSE, IT and Biomedical Engg. Branches)  3 1 0 4

UNIT I  CIRCUIT ANALYSIS TECHNIQUES  12

UNIT II  TRANSIENT RESONANCE IN RLC CIRCUITS  12

UNIT III  SEMICONDUCTOR DIODES  12

UNIT IV  TRANSISTORS  12
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V  SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only)  12

TOTAL : 60 PERIODS

TEXT BOOKS:

REFERENCES:
GE2151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common to branches under Civil, Mechanical and Technology faculty)  L T P C  4 0 0 4

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS  12

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS  12

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS  12


UNIT IV DIGITAL ELECTRONICS  12
Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING  12

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL : 60 PERIODS

TEXT BOOKS:

REFERENCES:
UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS  15


UNIT II BUILDING COMPONENTS AND STRUCTURES  15
Foundations: Types, Bearing capacity – Requirement of good foundations.


TOTAL : 30 PERIODS

UNIT III POWER PLANT ENGINEERING  10

UNIT IV IC ENGINES  10
Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM  10

TOTAL: 30 PERIODS

REFERENCES:
GE2155  COMPUTER PRACTICE LABORATORY – II  L T P C
LIST OF EXPERIMENTS  0 1 2 2

1. UNIX COMMANDS  15
Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING  15
Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX  15
Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL : 45 PERIODS

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

HARDWARE
1 UNIX Clone Server
33 Nodes (thin client or PCs)
Printer – 3 Nos.

SOFTWARE
. OS – UNIX Clone (33 user license or License free Linux)
. Compiler - C

GS2165  PHYSICS LABORATORY – II  L T P C
LIST OF EXPERIMENTS  0 0 3 2

1. Determination of Young’s modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Spectrometer dispersive power of a prism.
6. Determination of Young’s modulus of the material – uniform bending.

• A minimum of FIVE experiments shall be offered.
• Laboratory classes on alternate weeks for Physics and Chemistry.
• The lab examinations will be held only in the second semester.
LIST OF EXPERIMENTS
1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using BaCl₂ vs Na₂SO₄
4. Potentiometric Titration (Fe²⁺ / KMnO₄ or K₂Cr₂O₇)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

• A minimum of FIVE experiments shall be offered.
• Laboratory classes on alternate weeks for Physics and Chemistry.
• The lab examinations will be held only in the second semester.

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELING

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building ( Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.
NOTE: PLOTTING OF DRAWINGS MUST BE MADE FOR EACH EXERCISE AND ATTACHED TO THE RECORDS WRITTEN BY STUDENTS.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:
1. Pentium IV computer or better hardware, with suitable graphics facility - 30 No.
2. Licensed software for Drafting and Modeling. – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 No.

EE2155  ELECTRICAL CIRCUIT LABORATORY  L T P C
(Common to EEE, EIE and ICE)  0 0 3 2

LIST OF EXPERIMENTS

1. Verification of ohm’s laws and kirchoff’s laws.
2. Verification of Thevenin’s and Norton’s Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
10. Frequency response of single tuned coupled circuits.

TOTAL: 45 PERIODS

EC2155  CIRCUITS AND DEVICES LABORATORY  L T P C
0 0 3 2

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET

TOTAL: 45 PERIODS
ENGLISH LANGUAGE LABORATORY (Optional)  L  T  P  C  0  0  2 - 

1. LISTENING:  5
  Listening & answering questions – gap filling – Listening and Note taking- Listening to telephone conversations

2. SPEAKING:  5
  Pronouncing words & sentences correctly – word stress – Conversation practice.

CLASSROOM SESSION  20
1. Speaking: Introducing oneself, Introducing others, Role play, Debate - Presentations:
   Body language, gestures, postures.
   Group Discussions etc
2. Goal setting – interviews – stress time management – situational reasons

EVALUATION
(1) Lab Session – 40 marks
   Listening – 10 marks
   Speaking – 10 marks
   Reading – 10 marks
   Writing – 10 marks

(2) Classroom Session – 60 marks
   Role play activities giving real life context – 30 marks
   Presentation – 30 marks

NOTE ON EVALUATION
1. Examples for role play situations:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephone conversation – Fixing an official appointment / Enquiry on availability of flight
      or train tickets / placing an order. etc.

2. Presentations could be just a Minute (JAM activity) or an Extempore on simple topics or visuals could be provided and students could be asked talk about it.

REFERENCES:

LAB REQUIREMENTS
1. Teacher – Console and systems for students
2. English Language Lab Software
3. Tape Recorders.
OBJECTIVES
The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

UNIT I FOURIER SERIES

UNIT II FOURIER TRANSFORMS

UNIT III PARTIAL DIFFERENTIAL EQUATIONS
Formation of partial differential equations – Lagrange’s linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS

LECTURES: 45 TUTORIALS : 15 TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
**FT3202 PRINCIPLES OF CHEMICAL ENGINEERING**  
(Common for IBT, Food and Pharmaceutical Technology)

**AIM**
To understand the principles of Process calculations.  
To understand principles of fluid mechanics and its application.

**OBJECTIVES**
- To perform calculations pertaining to processes and operations.  
- To apply fluid mechanics principles to applied problems.

**UNIT I BASIC PRINCIPLES OF STOICHIOMETRY**  
8
Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use – Data sources, Humidity and applications.

**UNIT II MATERIAL BALANCES**  
10
Material balance calculations for non reactive operations, once through operations, recycle operations, bypass operations. Material balance calculations for reactive processes, recycle, bypass processes – Application problems in unit operations and processes.

**UNIT III ENERGY BALANCES**  
8
Calculation of enthalpy changes, heat capacity, Latent heats, Data sources, Thermo chemical calculations. Heat of solution, Simultaneous material and energy balances.

**UNIT IV FLUID MECHANICS**  
9

**UNIT V AGITATION FLOW THROUGH PACKINGS, FLUIDZATION, FLUID TRANSPORT**  
9

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

**REFERENCES**
UNIT I  INTRODUCTION TO CHEMISTRY  13

UNIT II  INTRODUCTION TO ORGANIC SYNTHESIS  10

UNIT III  ENZYMES  5
MM kinetics – other mechanisms for enzyme action – Methods for following enzyme reactions – Analysis of Enzymatic reactions.

UNIT IV  MECHANISMS  13

UNIT V  BIOLOGICAL SUPERMOLECULES  4

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

AIM
To introduce students to the principles of cell biology to emphasize the role of organelles and their functions; signal transduction and crosstalk between the cells – towards biotechnological applications.

OBJECTIVES
- To provide to the students the fundamentals of cell biology and ability to solve problems in cell biology.
- To help students understand the pathway mechanisms.
UNIT I  CELL STRUCTURE AND FUNCTION OF THE ORGANELLES  9

UNIT II  CELL DIVISION AND CONNECTION  9
Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, Extra cellular matrix, role of matrix in cell enthore : Gap junctions, Tight junctions, Desmosomes, Hemidesmosomes.

UNIT III  TRANSPORT ACROSS CELL MEMBRANE  9
Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na⁺ / K⁺ / Ca²⁺ pumps uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists.

UNIT IV  SIGNAL TRANSDUCTION  9
Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules.

UNIT V  SIGNAL AMPLIFICATION AND CROSSTALK  9
Signal amplification and crosstalk caspases and cell death, Role of Ras and Raf in oncogenesis, introduction to gene therapy.

TOTAL: 45 PERIODS

REFERENCES

FT3205  MICROBIOLOGY  L T P C
3 0 0 3

AIM
To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.

OBJECTIVE
- To provide to the students the fundamentals of Microbiology and solve the problems in microbial infection and their control.

UNIT I  INTRODUCTION  6
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II  MICROBES- STRUCTURE AND MULTIPLICATION  12
Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III  MICROBIAL NUTRITION, GROWTH AND METABOLISM  12
Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.
UNIT IV  CONTROL OF MICROORGANISMS  6
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial,
anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically
important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY  9
Primary metabolites; secondary metabolites and their applications; preservation of food;
production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by
microorganisms; biofertilizers and biopesticides; microorganisms and pollution control;
biosensors

TOTAL: 45 PERIODS

TEXT BOOKS
Hill, 1993
Hill, 2008

REFERENCES

CY3206 PHYSICAL CHEMISTRY

AIM
To understand important concepts in physical chemistry.

OBJECTIVES
- To understand the different states of matter, theoretical principles governing the
  solid, liquid, mesomorphic and solid states and to know methods for experimental
determination of characteristic properties of the states.
- To understand the principles of thermodynamics in deciding the spontaneity of
  reactions and energy changes involved in physical and chemical processes.
- To understand the principles of photochemistry and catalysis.

UNIT I PROPERTIES OF MATTER. GASEOUS AND LIQUID STATES 12
Gaseous state  Ideal gas – Gas laws –kinetic theory – Marwell’s distribution of molecular
velocities – collision frequency -mean free path – real gas- van der Waal’s equation of state
– critical constants – law of corresponding states – liquefaction of gases (CO₂, NH₃, air, O₂
and N₂) Joule – Thomson effect - inversion temperature. Liquid state Equilibrium vapour
pressure – surface tension - viscosity-dipole moment – refractive index - optical rotation
-methods of determination - relationship to molecular structure

UNIT II PROPERTIES OF MATTER MESOMORPHIC AND SOLID STATES 9
Mesomorphic state or liquid crystals Themotropic and lyotropic mesomorphism -
classification of thermotropic liquid crystals – smectic- nematic – cholesteric – disc shaped
-polymer -- molecular arrangements in liquid crystals. Solid state crystal structure - laws of
crystallography -7 crystal systems-14 Bravais lattices - X-rays and crystal structure - Bragg’s
equation - types of crystals – molecular – covalent –ionic – metallic – lattice energy - Born-
Lande’s equation - experimental determination using Born-Haber cycle - packing in metallic
crystals - lattice-defects.
UNIT III  THERMODYNAMICS I LAW AND THERMOCHEMISTRY


C_v – at constant pressure C_p - relationship between C_p and C_v - work done In adiabatic, reversible and irreversible expansions - compressions. thermochemistry - enthalpy changes - physical and chemical processes - Kirchoffs' equation - Hess' law of constant heat summation - enthalpy of combustion - Bond calorimeter - bond energies – applications

UNIT IV  THERMODYNAMICS II AND III LAW

Spontaneous process- cyclic process – Carnot cycle - efficiency of a heat engine – entropy – concept - physical significance-changes accompanying processes – Free energy – Helmholtz – Gibbs - criteria for reversible and irreversible processes – Gibbs-Hermholtz equation-free energy and physical equilibria-Clapeyron and Clausius equation - free energy and chemical equilibria - vant Hoff reaction isotherm - standard free energy changes - Third law - Nernst heat theorem - determination of entropy from thermal measurements - residual entropy

UNIT V  PHOTOCHEMISTRY AND CATALYSIS


TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
1. Bhal, B.S.,G.D. Tuli and Arun Bhal “Essentials of Physical Chemistry”. S.Chand & Co., 2010

FT3207 FOOD CHEMISTRY L T P C
3 0 0 3

AIM
The course aims to develop the knowledge of students in the basic area of Food Chemistry. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

OBJECTIVES
On completion of the course the students are expected to
- Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
- Be able to understand and identify the non-nutritive components in food, naturally present.
- Understand and use effectively, food composition tables and databases.
- Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition
UNIT I  CARBOHYDRATES
Simple Sugars: mono and disaccharides, Hygroscopicity & solubility, optical rotation, mutarotation; sensory properties-sweetness index, caramelization, Maillard reaction; Glucose syrup, high fructose corn syrup, Dextrose Equivalent, Degree of polymerisation; Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch- amylose and amylopectin- properties, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolysates – Malto dextrins and dextrins; Pectins, gums & seaweeds- gel formation & viscosity. Fiber- Cellulose & hemicellulose; Food sources, functional role and uses in foods.

UNIT II  PROTEINS
Review of protein structure & conformation; Properties & reactions of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation & stabilization, gel formation, emulsifying effect, thickening & binding, amino acids in Maillard reaction; denaturation; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods.

UNIT III  LIPIDS
Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, isomerisation, unsaturation; Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization; Hydrolytic rancidity & oxidative rancidity; radiolysis Shortening power of fats, tenderization, emulsification, frying- smoke point, auto oxidation, polymerization; Fat replacements; Food sources, functional role and uses in foods.

UNIT IV  WATER
A. WATER
Chemistry, physical properties, free bound & entrapped water, water activity. Drinking water, mineral water, water hardness, water quality for food processing
B. MINERALS & VITAMINS
Mineral & vitamin content of foods- Food and Pharmaceutical grades; stability & degradation in foods.
C. COLOUR, FLAVOUR & AROMA COMPONENTS
Naturally occurring colours, acids, other flavour & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables & fermented products; Synthetic Colours and Naturally similar /artificial flavours, Threshold values, off flavours & food taints.
D. OTHER COMPONENTS
Naturally occurring toxic substances, protease inhibitors, bioactive components: phytates, polyphenols, saponins, phytoestrogens etc.

UNIT V  FOOD GROUPS & COMPOSITION
Food groups, proximate composition, food composition tables- uses, food composition data bases.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
IB3209  MICROBIOLOGY LAB  L T P C  0 0 4 2
(Common for IBT, Food and Pharmaceutical Technology)

EXPERIMENTS
1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques;
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
5. Microscopic Methods in the Study of Microorganisms; Staining Techniques-Simple, Differential- Gram's Staining
6. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
7. Effect of Disinfectants- Phenol Coefficient
8. Antibiotic Sensitivity Assay
9. Growth Curve in Bacteria and Yeast
10. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL: 60 PERIODS

Equipment Needed for 20 Students
Autocalve 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Lamina Flow Chamber 2
Glassware, Chemicals, Media as required

TEXT BOOKS

PH3210  PHYSICAL & ORGANIC CHEMISTRY LAB  L T P C  0 0 4 2

2. Determination of rate constants and activation energy of simple first and second order reactions.
3. General acid catalysed reactions – Catalytic coefficients and Dissociation Constants.
5. Experiments based on the principles of Electrochemistry. Applications of Thermodynamic principles and Surface Chemistry.
6. Systematic qualitative analysis of organic compounds by solubility, elemental analysis, group detection, physical constant and derivatization
7. Estimation of selected organic compounds such as aniline / phenol, formaldehyde/acetone, glucose, glycerol.
8. Neutral equivalence of acids and bases and estimations of the following functions groups-amide, ester, acid, amino nitro.
10. Preparation of simple organic compounds involving importance unit operations.

TOTAL: 60 PERIODS
REFERENCES

MA3211 PROBABILITY AND STATISTICS

AIM
This course aims at providing the required skill to apply the statistical tools in engineering problems.

OBJECTIVES
- The students will have a fundamental knowledge of the concepts of probability.
- Have knowledge of standard distributions which can describe real life phenomenon.
- Have the notion of sampling distributions and statistical techniques used in management problems.

UNIT I RANDOM VARIABLES
Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and Conditional distributions – Covariance – correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS

UNIT IV DESIGN OF EXPERIMENTS
Completely randomized design – Randomized block design – Latin square design – ² - factorial design.

UNIT V STATISTICAL QUALITY CONTROL
Control charts for measurements (=and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

L: 45, T: 15, TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
AIM
To introduce students to the principles and methods of biological instruments.

OBJECTIVE
- To provide to the students the fundamentals of instrument knowledge and their applications in biology.

UNIT I  OPTICAL SPECTROSCOPY  10

UNIT II  CHROMATOGRAPHY  10

UNIT III  STRUCTURAL ELUCIDATION  10

UNIT IV  MASS SPECTROMETRY  10

UNIT V  ELECTROCHEMICAL MEASUREMENTS  5
Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous Silicon.

TOTAL : 45 PERIODS

TEXTBOOKS

CH3213  FUNDAMENTALS OF HEAT AND MASS TRANSFER  L T P C
(Common for Food and Pharmaceutical Technology)  3 0 0 3

AIM
To understand the principles and applications of heat and mass transfer operations.

OBJECTIVES
- To understand and apply the principles in heat transfer phenomena
- To understand and apply the principles in mass transfer phenomena
- To design heat and mass transfer equipments.
UNIT I       HEAT TRANSFER  

UNIT II       DIFFUSION & MASS TRANSFER COEFFICIENTS  
Diffusion in Mass Transfer –gas, liq, solid diffusion and mass transfer-Diffusion in biological solutions-measurement of diffusion Coefficients – concept of mass transfer Coefficients-application for different situations.

UNIT III      ABSORPTION  
Interphase mass transfer and overall mass transfer Coefficients – Absorption equipments-Hydraulics of Packed Absorbers-Process Design of Packed Absorbers-Concept of height of transfer units and number of transfer units in design.

UNIT IV      DISTILLATION  
Vapour Liquid equilibrium and distillation-simple Distillation, Steam distillation, Flash distillation-Staged distillation Column-Design by Mc Cabe-Thiele method-Enthalpy-Concentration diagrams and use in Distillation Column design.

UNIT V       LIQUID EXTRACTION & LEACHING  

TOTAL:  45 PERIODS

TEXT BOOKS  

REFERENCES  

FT3214       FOOD MICROBIOLOGY   L T P C  
3 0 0 3

AIM
The course aims to develop the knowledge of students in the basic area of Food Microbiology. This is necessary for effective understanding of food processing and technology subjects as well as food safety. This course will enable students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.

OBJECTIVES
On completion of the course the students are expected to
- Be able to understand and identify the various microbes associated with foods and food groups.
- Be able to understand and identify the role of these microbes in food spoilage, food preservation.
- Understand the role of pathogens in food borne infections.
- Understand the methods used to detect pathogens in foods.
UNIT I  ROLE OF MICROBES IN SPOILAGE OF FOODS
Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products.

UNIT II  CONTROL OF MICROBES IN FOODS
Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, Benzoates, Sorbates / Propionates naturally occurring antimicrobials; Physical methods- Low and high temperatures, drying, radiation and high pressure; Tolerance of microbes to chemical and physical methods in various foods.

UNIT III  MICROBES IN FOOD FERMENTATIONS

UNIT IV  MICROBIAL AGENTS OF FOOD BORNE ILLNESS
Food borne infections and food poisoning, Microbial toxins, Gram Negative and Gram positive food borne pathogens; Toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.

UNIT V  MICROBIAL EXAMINATION OF FOODS
Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. Botulimum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  INTRODUCTION TO ENZYMES  9
Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II  KINETICS OF ENZYME ACTION  9

UNIT III  ENZYME IMMOBILIZATION  6
Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

UNIT IV  OVERVIEW OF FERMENTATION PROCESSES  9
Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT V  RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS  12
Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
• The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional Endeavour that they participate.

OBJECTIVE
• At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I       ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.
Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II       ENVIRONMENTAL POLLUTION
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III       NATURAL RESOURCES
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.
UNIT IV  SOCIAL ISSUES AND THE ENVIRONMENT


UNIT V  HUMAN POPULATION AND THE ENVIRONMENT


TOTAL : 45 PERIODS

TEXT BOOKS:

REFERENCES BOOKS:

IB3217  GENETICS

L T P C
3 0 0 3

AIM
To introduce students to the principles of classical genetics and to emphasize the role of genetics in modern biology.

OBJECTIVES
- To provide to the students the fundamentals of classical genetics and ability to solve problems in genetics.
- To help students understand sex determination mechanisms.
- To enable students appreciate genetic recombination and mapping techniques.

UNIT I  CLASSICAL GENETICS
UNIT II SEX DETERMINATION, SEX LINKAGE AND PEDIGREE ANALYSIS


UNIT III STRUCTURE OF CHROMOSOMES AND VARIATION IN CHROMOSOME STRUCTURE AND NUMBER


UNIT IV LINKAGE, CROSSING OVER AND CHROMOSOME MAPPING IN EUKARYOTES

Linkage, Crossing over, recombination, exception to Mendelian principles, frequency of recombination, evidence of crossing over, chiasmata, chromosome mapping with two-point and three-point testcrosses. Recombination mapping and map distance, linkage analysis in humans, detection of linked loci by pedigree analysis and somatic cell genetics. Human gene map.

UNIT V GENETICS OF BACTERIA AND VIRUSES


TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

CY3219 INSTRUMENTAL METHODS OF ANALYSIS LAB

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1. Precision and validity in an experiment using absorption spectroscopy.
3. Finding the molar absorbitivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxolate.
8. Estimation of Al³⁺ by flourimetry.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

TOTAL : 60 PERIODS

TEXTBOOKS

IB3220 CHEMICAL ENGINEERING LAB
(Common for IBT, Food and Pharmaceutical Technology) 0 0 4 2

1. Flow measurement a) Arifice meter b) Venturimeter, c) Rotameter
2. Pressure drop flow in pipes
3. Pressure drop in flow through packed column
4. Pressure drop in flow through fluidized beds
5. Characteristics of centrifuge pump
6. Flat and frame filter press
7. Filtration in leaf filter
8. Heat transfer characteristics in heat exchanger
9. Simple and steam distillation
10. HETP in packed distillation
11. Ternary equilibrium in liquid-liquid extraction
12. Adsorption isotherm
13. Drying characteristics in a pan dryer

TOTAL : 60 PERIODS

TEXT BOOKS

IB3302 MOLECULAR BIOLOGY 3 0 0 3

UNIT I CLASSICAL GENETICS
Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation.

UNIT II STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION
Conformation of DNA and RNA; replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organisation of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes
UNIT III TRANSCRIPTION 8
In prokaryotes and eukaryotes, features of promoters and enhancers, transcription factors, nuclear RNA splicing, ribozyme.

UNIT IV TRANSLATION 10
Elucidation of genetic code, mechanism, codon usage, suppressor mutation

UNIT V REGULATION OF GENE EXPRESSION 7
Lac and trp operon, phage life cycle, mutation and repair of DNA

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
TEXT BOOKS

REFERENCES

FT 3303 FOOD ANALYSIS

AIM
To expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.

OBJECTIVE
- To understand the principles behind analytical techniques in food analysis.
- To know the methods of selecting appropriate techniques in the analysis of food products.
- Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries.
- To familiarize with the current state of knowledge in food analysis.

PREREQUISITE
Basic knowledge in chemistry, physics and food chemistry.

UNIT I INTRODUCTION
Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis - Moisture determination by different methods; ash analysis - different methods; titrable acidity in foods; determination of crude fiber and dietary fiber.

UNIT II LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS
Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.

UNIT III SPECTROSCOPIC TECHNIQUES
Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; tintometer in color intensity determination; application of Atomic Absorption Spectrophotometer in analysis of mineral elements and fluorimeter in vitamin analysis.

UNIT IV CHROMATOGRAPHIC TECHNIQUES
Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; HPLC and GC in food analysis; FAME analysis in oils and fats.

UNIT V ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY
Basic principles; application of the technique; Brix value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars.

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

FT 3304 FOOD ADDITIVES L T P C
3 0 0 3

AIM
To expose the students to the use of different chemical additives in foods during food processing and preservation.

OBJECTIVES
- To understand the principles of chemical preservation of foods.
- To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods.
- To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods.

UNIT I FOOD ADDITIVES
Definition; their function in food processing and preservation. Preservatives – definition; natural preservatives; chemical preservatives; acidulants and low pH – organic acids and esters; sulphur dioxide and its salts; nitrites; antibiotics; surface preservation. Permitted preservatives in foods – Antioxidants; natural and chemical antioxidants; mechanism of antioxidant function; primary and secondary antioxidants; sequestrants; selection and application of antioxidants in foods; evaluation of antioxidant effectiveness – permitted antioxidants in foods.

UNIT II FOOD COLORS
Natural and synthetic colors; fake colors; inorganic pigments; application of colors in food industry; restriction on the use of colors in foods. Flavoring agents – concept of flavors in foods; natural flavors; nature identical flavors; artificial flavoring substances; restrictions on the use of flavoring agents in foods.

UNIT III EMULSIFIERS AND STABILIZERS
Definition; properties; HLB value; function of emulsifiers and stabilizers in foods; permitted emulsifiers and stabilizers used in foods; polyols – physical and chemical properties of polyols, application in food industry, permitted polyols in foods.

UNIT IV SWEETENERS
Natural and chemical sweeteners; nutritive and non-nutritive sweeteners; chemical structure & sweetness; saccharine, acesulfame K, aspartame, sucrolose; restriction on the use of sweeteners in foods; Food acids – their function and application in foods; permitted food acids; nutritive additives; enrichment of foods.
UNIT V FOOD SAFETY
Food – Safety in the use of food additives in foods; regulations and monitoring agencies; toxicological evaluation of additives; interaction of additives with food ingredients.

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
2. Clydesdale, Fergus M. “Food Additives- Toxicology Regulation and Properties”. CRC Press,

GE2023 FUNDAMENTALS OF NANOSCIENCE L T P C
UNIT I INTRODUCTION 10
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 10
Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5
Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10
Clean rooms: specifications and design, air and water purity, requirements for particular processes. Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARACTERISATION TECHNIQUES 10
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
1. Isolation of bacterial DNA
2. Isolation of plant cell and animal cell genomic DNA
3. Agarose gel electrophoresis
4. Restriction enzyme digestion
5. Competent cells preparation
6. Transformation and screening for recombinants
7. Agarose gel electrophoresis
8. Restriction enzyme digestion
9. Competent cells preparation
10. Blue and white selection for recombinants
11. Plating of phage
12. phage lysis of liquid cultures

TOTAL: 60 PERIODS

REFERENCE

FT 3308 FOOD ANALYSIS LAB L T P C 0 0 4 2

Analysis of foods and food products for chemical components, compliance to standards; detection of adulterants in foods.

Examination of typical food products including
a) Tea, coffee and cocoa,
b) Milk and milk products,
c) Edible oils and fats
d) Cereal and cereal products
e) Non alcoholic beverages and drinks
f) Spices and condiments
g) Bakery, confectionery products,
h) Sugars and sweetening agents.

TOTAL: 60 PERIODS

LAB EXPERIMENTS
1. Determination of moisture in spices powder by distillation method.
2. pH, conductivity, TDS and hardness of water
3. Determination of Peroxide Value in edible oils.
4. Isolation and identification of synthetic food colors in sweets, confectionery, beverages.
5. Determination of total fat in liquid milk.
6. Determination of protein content in ice cream
7. Determination of total sugars in soft drinks.
10. Detection of vanaspathi in ghee.
11. Detection of argemone oil in edible oil.
12. Detection of oil soluble color in spices powder.
13. Microscopic examination of wheat starch, rice starch and chicory in coffee.
LAB EXPERIMENTS
1. Studying the expansion characteristics of snack foods on frying.
2. Rancidity test for fried foods to assess primary and secondary oxidative products.
3. Determination of Vitamin C in fruit juices.
4. Estimation of synthetic Food color in sweets, confectioneries and beverages.
5. Determination of Iron content in foods.
6. Determination of Iodine content in iodized salt.
7. Detection of Annatto color in table butter.
8. Determination of Lead in spices powder.
11. Detection of anti oxidant in foods.
12. Detection of certain emulsifiers and stabilizers in foods.

TOTAL: 60 PERIODS

AIM
To understand kinetics of reaction and rate equations
To understand design principles of reactors.

OBJECTIVES
- To estimate kinetic parameter
- To apply design equations.

UNIT I KINETICS OF HOMOGENEOUS REACTIONS 10

UNIT II IDEAL REACTORS 8
Performance equations for single batch reactor, ideal CSTR, ideal PFR-Application to design.

UNIT III MULTIPLE REACTORS & NON ISOTHERMAL REACTORS 8
Multiple reactor systems – selection of suitable reactor systems for multiple reactions-recycle reactor-Principles in non isothermal reaction and reactors.

UNIT IV NON IDEAL FLOW & REACTORS 10
Non Ideal reactors- Non Ideal Flow-Tracer experiments and application-TIS model, Axial Dispersion model-for tubular reactors. Exchange volume and By Pass and dead volume models for CSTRS.

UNIT V MULTIPHASE REACTIONS & REACTORS 9

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES

IB3312 GENETIC ENGINEERING

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 4
Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

UNIT II CREATION OF RECOMBINANT MOLECULES 10
Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT III CONSTRUCTION OF LIBRARIES 15
Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT IV POLYMERASE CHAIN REACTION 10
Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, site directed mutagenesis, methods of nucleic acid sequencing- Sangers method, (Kunkel’s Method).

UNIT V APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY 6
Cloning in plants, Ti plasmid, and transgenic and knockout animals.

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES

FT 3313 SEPARATIONS PROCESS L T P C 3 0 0 3

AIM
To understand the principles involved in separation methods.

OBJECTIVES
- To understand Principles of separation methods used in the process industry.
- To appreciate different equipments developed for separation.

UNIT I SIZE REDUCTION

UNIT II FLUID – SOLID SEPARATION
Separation of solids & suspension from gas medium-screening- settling- Principles and equipments-classification-clarification.

UNIT III FILTRATION

UNIT IV MEMBRANE SEPARATION
Cross flow filtration- Membranes –Ultrafiltration-Microfiltration-Concentration Polarisation operation and equipments.

UNIT V DRYING & CRYSTALLISATION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCE
AIM
To expose the students to the principles and different methods of food processing and preservation.

OBJECTIVES
- To understand the principles of food processing and preservation.
- To understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods
- To understand the materials and types of packaging for foods

UNIT I PRINCIPLES OF MASS AND ENERGY BALANCE 9
Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes and freezing. Thermal processing; calculation of process time temperature-schedules.

UNIT II CANNING OF FOOD PRODUCTS 9
Newer methods of thermal processing; batch and continuous; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT III DRYING PROCESS FOR TYPICAL FOODS 9
Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage. freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT IV NON-THERMAL METHODS 9
Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,

UNIT V FOOD PACKAGING 9
Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  INTRODUCTION  9

UNIT II  TQM PRINCIPLES  9
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III  TQM TOOLS & TECHNIQUES I  9

UNIT IV  TQM TOOLS & TECHNIQUES II  9

UNIT V  QUALITY SYSTEMS  9

TOTAL: 45 PERIODS

TEXT BOOK:

REFERENCES:
Globalisation has brought in numerous opportunities for the teeming millions, with more focus on the students’ overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.

OBJECTIVES:
- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

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<tr>
<th>I. PC based session</th>
<th>(Weightage 40%)</th>
<th>24 periods</th>
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A. ENGLISH LANGUAGE LAB (18 Periods)

1. LISTENING COMPREHENSION: (6)
   Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering questions.

2. READING COMPREHENSION: (6)
   Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.

3. SPEAKING: (6)

   Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

B. DISCUSSION OF AUDIO-VISUAL MATERIALS (6 PERIODS)

(Samples are available to learn and practice)

1. RESUME / REPORT PREPARATION / LETTER WRITING (1)
   Structuring the resume / report - Letter writing / Email Communication - Samples.

2. PRESENTATION SKILLS: (1)
   Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples

3. SOFT SKILLS: (2)
   Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples
4. **GROUP DISCUSSION:**  
- Why is GD part of selection process? - Structure of GD – Moderator – led and other GDs - Strategies in GD – Team work - Body Language - Mock GD - Video samples

5. **INTERVIEW SKILLS:**  
- Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews - Video samples.

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<tr>
<th>II. Practice Session</th>
<th>(Weightage – 60%)</th>
<th>24 periods</th>
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<tr>
<td>1. Resume / Report Preparation / Letter writing:</td>
<td>Students prepare their own resume and report.</td>
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<td>2. Presentation Skills:</td>
<td>Students make presentations on given topics.</td>
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<td>3. Group Discussion:</td>
<td>Students participate in group discussions.</td>
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<tr>
<td>4. Interview Skills:</td>
<td>Students participate in Mock Interviews</td>
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**TEXT BOOKS**

**REFERENCES**

**LAB REQUIREMENT**
1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software
Requirement for a batch of 60 students

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<th>Sl.No.</th>
<th>Description of Equipment</th>
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<td><strong>Server</strong></td>
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<td>- PIV system</td>
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<td>- 1 GB RAM / 40 GB HDD</td>
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<td>- OS: Win 2000 server</td>
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<td>- Audio card with headphones (with mike)</td>
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<td>- JRE 1.3</td>
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<td>2.</td>
<td><strong>Client Systems</strong></td>
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<td>- PIII or above</td>
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<td>- 256 or 512 MB RAM / 40 GB HDD</td>
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<td>- OS: Win 2000</td>
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<td><strong>Collar mike</strong></td>
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<td><strong>DVD Recorder / Player</strong></td>
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FT 3318  BIO PROCESS LAB  L T P C  0 0 6 3

AIM
To enable the students to understand the concepts and operation of equipment in handling of enzymes and cultivation of microbes in industrial scale.

OBJECTIVE
- To sterilize the bioreactor
- To operate the bioreactor
- To design experiments to evaluate the performance of the bioreactor
- To develop enzyme immobilized processes.

2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michaelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – gel entrapment, cross linking
5. Preparation of bioreactor, utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
10. Estimation of kla – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TOTAL : 90 PERIODS
REFERENCES
2. Lee, James M. “Biochemical Engineering”, PHI, U.S.A.

FT3319 GENETIC ENGINEERING LAB

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<tr>
<td>1.</td>
<td>Preparation of plasmid DNA</td>
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<td>2.</td>
<td>Elution of DNA from agarose gels</td>
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<td>3.</td>
<td>Ligation of DNA into expression vectors</td>
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<td>4.</td>
<td>Transformation</td>
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<td>5.</td>
<td>Optimisation of inducer concentration for recombinant protein expression</td>
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<td>6.</td>
<td>Optimisation of time of inducer for recombinant protein expression</td>
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<td>7.</td>
<td>SDS-PAGE</td>
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<td>8.</td>
<td>Western blotting</td>
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<td>9.</td>
<td>Hybridisation with anti-sera</td>
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<td>10.</td>
<td>PCR.</td>
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TOTAL : 60 PERIODS

REFERENCE

IB3401 IMMUNOLOGY

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<tbody>
<tr>
<td>1.</td>
<td>INTRODUCTION</td>
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<tr>
<td>2.</td>
<td>Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.</td>
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<td>3.</td>
<td>CELLULAR RESPONSES</td>
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<td>4.</td>
<td>Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses.</td>
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<tr>
<td>5.</td>
<td>INFECTION AND IMMUNITY</td>
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<td>6.</td>
<td>Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; complement; immunosuppression, tolerance; allergy and hypersensitivity; AIDS and Immunodeficiencies; resistance and immunisation; Vaccines.</td>
</tr>
</tbody>
</table>
UNIT IV  TRANSPLANTATION AND TUMOR IMMUNOLOGY  8
Transplantation: genetics of transplantation; laws of transplantation; tumor immunology.

UNIT V  AUTOIMMUNITY  3
Autoimmunity, Autoimmune disorders and diagnosis.

TOTAL : 45 PERIODS

TEXTBOOKS

REFERENCES

FT 3402  FOOD SAFETY, QUALITY AND REGULATORY ISSUES  L T P C
3 0 0 3

AIM
To sensitize students about food safety and risks.

OBJECTIVES
- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

UNIT I  INTRODUCTION  15
Definition of food safety and concept of safe food; characterization of food hazards- physical, chemical and biological; adulteration, filth, plastics, pesticides, heavy metals; Changes due to food processing, trans fatty acids, pyrolytic and thermal decomposition products, urethane, mycotoxins, scrombotoxin, migration, cross-contamination, nitrates and related products, sulfites, phenolic antioxidants, non-nutritive sweeteners, colour additives, fat substitutes, chemical preservatives, veterinary drugs and antibiotics.

UNIT II  MICROBIAL HAZARDS AND NATURAL SOURCE HAZARDS  8
Allergens, goitrogens, lathyrogens, alkaloids, lectins, aflatoxins. Implementation of FSIS program for pathogen reduction; prevention of food-borne illness, dose-response, model risk assessment, management and communication; exposure assessment, monitoring; Structured model for microbial risk reduction, microbial biofilms, prevention of microbial hazards; Sanitation, antimicrobial plastics, intelligent packaging, headspace gas modification.

UNIT III  MONITORING AND REGULATION  10
HACCP, GMP; Surveillance networks, Consumer and food service operator education, function and roles of USFDA, USDA and EPA; Food Safety and Standards Act India 2006; Prevention of Food Adulteration Act, India, 1954; Responsibilities of the Food service operator, consumer protection, food audit.
UNIT IV  SPECIAL FOODS SAFETY, HEALTH CLAIMS AND LABELING  
Infant foods, formula foods, PKU, regulatory, industrial and international implications; 
fortified foods, sports nutrition, nutraceuticals, medical foods; Health claims; Labeling

UNIT V  WORLD-WIDE FOOD SAFETY ISSUES  
GM Foods, safety and labeling; International Food Standards ISO 9000 and related 
standards; Impact of food safety on global trade; Food safety in retail food businesses; 
international food service operators, institutional food service operators; application of the 
principals of modern hygiene.

TEXT BOOKS
2. Hester, R.E. and R.M. Harrison. “Food Safety and Food Quality”. Royal Society of 
3. Mortimore, Sara and Carol Wallace. “HACCP” (Food Industry Briefing Series), Blackwell 
6. Mehta, Rajesh and J. George. “ Food Safety Regulations Concerns and Trade: The 

REFERENCES
2. Lightbourne, Muriel. “ Food Security, Biological diversity and Intellectual Property 

FT 3403  FOOD PROCESS ENGINEERING I  LT P C
3 0 0 3

AIM  
The course aims to develop the knowledge of students in the area of vegetable and fruit 
processing and technology. This course will enable students to appreciate the application of 
scientific principles in the processing of these materials.

OBJECTIVES  
On completion of the course the students are expected to
- Be able to understand and identify the specific processing technologies used for 
vegetables and fruits and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies 
specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of 
processing technology used.

UNIT I  BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS  
Ability to identify all commercially important fruits and vegetables with their names in 
important Indian languages, important regions, season, basic aspects of cultivation, harvest ( 
Good Agricultural practices) permitted pesticides and stages of application, yield

UNIT II  FRESH FRUITS AND VEGETABLES  
Climatic and non climatic fruits, ripening process, phytonutrients in fruits and vegetables; 
Handling, transportation, controlled atmosphere ripening process, grading, cleaning, 
pretreatments, modified atmosphere packaging, chilling.
UNIT III  FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES  12
General pre processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance.

UNIT IV  CANNING, PUREES AND JUICES  12
Canning- General pre processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/pastes - General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance

UNIT V  FRUIT AND VEGETABLE PRODUCTS  5
Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance

TOTAL : 45 PERIODS

TEXT BOOKS

FT 3404  FOOD PROCESS ENGINEERING II  L T P C
AIM
The course aims to develop the knowledge of students in the area of animal product processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES
On completion of the course the students are expected to
• Be able to understand and identify the specific processing technologies used for meat and such foods and the various products derived from these materials.
• Understand the application of scientific principles in the processing technologies specific to the materials.
• Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I  FISH & FISH PROCESSING  8
Marine and fresh water fish, shell fish- composition and nutrition commercially important fish and shell fish, names in important Indian languages, important regions, season; spoilage factors, ship board operations, storage and transport.
Processing and Preservation-chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils; safety issues, Indian regulation and quality assurance.
UNIT II MEAT & MEAT PROCESSING
Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant. 
Structure and composition of meat, carcass chilling, ageing; storage of fresh meat- Modified atmosphere packaging, packaging of retail cuts; Processing and preservation- artificial tenderizing, chilling, freezing, curing, smoking, sausage manufacture, ready-to-eat meats and meat products; Kosher and Halal certification, safety issues, regulation and quality assurance.

UNIT III POULTRY & EGGS
Types of poultry, production, classification & designation, grading. 
Processing plant operations- slaughter, bleeding, scalding, defeathering, eviscerating, chilling, packaging; composition and nutrition, poultry meat products; safety issues, regulation and quality assurance.
Eggs- structure, composition, quality factors, storage, pasteurization, freezing and drying, egg substitutes; regulation and Quality assurance.

UNIT IV MILK AND MILK PRODUCTS
Processing of Milk – Pasteurisation, homogenisation, sterilization, HTST and UHT processes; Processing and preservation of milk products- cream, sour cream, butter, ghee, skimmed milk concentrate and skimmed milk powder, whey concentrate and whey powder, yoghurt, cheese and other products; Traditional Indian products- curd, lassi, buttermilk, khoa, kulfi, shrirkhand, icecream ; packaging of dairy products- sachets, aseptic packs; chilled and frozen storage; Food Regulation and Quality assurance.

UNIT V EXTRUDED FOOD PRODUCTS
Principle, types and design of extruders, factors affecting extrusion performance, types of extruded foods- pasta, meat substitutes, textured plant and milk proteins, specialty foods; uses and advantages of extrusion technology; packaging of extruded products; regulation and quality assurance.

TOTAL : 45 PERIODS

TEXTS BOOKS

REFERENCES
AIM
The course aims to develop the knowledge of students in the area of Cereal, pulse and oil seed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES
On completion of the course the students are expected to
- Be able to understand and identify the specific processing technologies used for cereals, pulses and oil seeds and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I CEREALS
Cereal Grains - Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice- Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products – Corn flakes, Corn starch, canned corn products, puffed product; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products

UNIT II OTHER CEREALS AND MILLETS
Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - Basic agricultural aspects, structure, composition, storage, insect control, processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III SUGARS
Honey- Composition and Quality aspects; Sugars- Manufacture of table sugar, High Fructose corn syrup and Glucose syrup; Jaggery – sources, manufacture, uses in traditional food products; stages of sugar saccharine products

UNIT IV PULSES AND LEGUMES
Basic agricultural aspects, structure, composition, storage, insect control, processing- Milling/splitting, dhal milling, products – puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein isolate, soya paneer

UNIT V OIL SEEDS AND NUTS
Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

TOTAL : 45 PERIODS

TEXTS BOOKS
REFERENCES

GE2025 PROFESSIONAL ETHICS IN ENGINEERING

UNIT I ENGINEERING ETHICS 9

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER’S RESPONSIBILITY FOR SAFETY 9

UNIT IV RESPONSIBILITIES AND RIGHTS 9

UNIT V GLOBAL ISSUES 9

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OVERVIEW (THEORY)
Organization and assignment of team; Definition of roles; Product Concepts; factors to consider; concept methodology; consumer testing; Product attributes; Concept testing approaches; Development of product specifications; Prototype development; role of ingredients and processing in defining attributes; scale up; Process flow sheet development; factors to consider in process development; process optimization; Factors to consider beyond formulation and processing - shelf life requirements; product performance testing; market positioning, Packaging and labeling, costing; Marketing: developing test market strategies

1. GROUP PROJECTS TO DEVELOP FOOD PRODUCTS AT LABORATORY SCALE (PRACTICAL)  

**Project Identification:** Products/Processes Review, Project Feasibility, Design and Product Specification  
**Project Planning:** Identifying Objectives, Identifying Tools/Methods, Use of Information/Communication Technology  
**Project Execution:** Product Trials and Standardization, Product Quality Profiling – Sensory, Microbial, Nutrient, Shelf Life, Costing, Packaging and Labeling, Product Scale up feasibility  
**Project Presentation:** Documentation and Report, Viva Voce  

TOTAL : 45 PERIODS

TEXTBOOKS

REFERENCES

FT 3409   FOOD MICROBIOLOGY, PROCESSING & PRESERVATION LAB    L T P C 0 0 6 3

1. Water  
   - Microbiological quality of water (MPN)  
   - Water activity in foods  
2. Milk and Dairy products  
   - Microbiological quality of milk  
   - Enumeration of Lactic acid bacteria from fermented foods  
   - Preparation of Yoghurt & Quality Parameters  
3. Vegetables & Fruits  
   - Yeast & Mould count from fruits  
   - Preparation of fruit syrups, squashes, sauces – Refractive index, viscosity  
   - Drying of vegetables & fruits- drying rates
• Freezing of vegetables - freezing rates

4. Cereal & Pulse Products
• Gelatinization of starch
• Viscosity of starch pastes and sauces
• Sugar syrups, caramelization

5. Edible oils
- Refractive index
- Expansion Characteristics of snack foods
- Shelf life of fried snacks,

6. Spices, Salt & Sugar
- Enumeration of spores from pepper
- Inhibitory effect of spices on microbial load in fish
- Salt & sugar tolerance of microbes

7. Flesh foods
- Enumeration & Isolation of *E. coli* from processed meat/chicken
- Thermal destruction of microbes : TDT & TDP

8. Processed & Packaged foods
- Enumeration & Isolation of *Staphylococci* from ready to eat street foods
- Effect of packaging on shelf life

9. Hygiene & Sanitation
- Effect of cleaning and disinfection on microbial load

10. Sensory Evaluation & Market testing of foods

TOTAL : 90 PERIODS

REFERENCES

FT3410 PROJECT WORK

AIM
The project work aims to train the students on systematic analysis of a problem and to enable them to bring out a solution it.

OBJECTIVE
The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.
Each student is required to submit a report on the project assigned to him/her by the department. The report should be based on the literature collected from the many sources and the actual analysis done by the student on the given project.
UNIT I
MEANING AND IMPORTANCE OF COLD CHAIN, CHART

What is cold chain? Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf-life; just-in-time deliveries; Temperature limits; in various countries- Europe, US, Australia etc; Chilling and freezing; Chilling injury, cool-chilling systems; cold-shortening; PPP and TTT concepts; Temperature monitoring; Critical temperatures; Temperature-time indicators(TTI); Time-temperature-correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain – MAS, MAP, CAS, CAP etc; Thaw indicators.

UNIT II
MICRO ORGANISMS AND THE COLD CHAIN

Microorganisms and their growth phases; response of microorganisms; Inactivation mechanism during Chilling and freezing; Rapid freezing and slow thawing; Categories (groups) of Organisms in respect of their ability to survive under Cold/Chilling environment; Cold shock proteins and cold shock response. Thawing techniques, microbial quality of thawed foods.

UNIT III
PRINCIPLES AND METHODS OF REFRIGERATION

Concepts of systems and surrounding; meaning of refrigeration; Types of refrigeration; vapour compression-the refrigerating cycle, capacity, COPetc; Power consumption, efficiency factors; Refrigeration cycle as a series of thermodynamics processes refrigeration cycle; COP, capacity – in vapour absorption refrigeration; comparative study between the above types of refrigeration; Types of refrigeratants – their advantages / disadvantages; Refrigeration load demands and their calculation; closed cycle air refrigeration (CCAR); Cryogenic refrigeration; Freezing time – their prediction models, etc. Types freezer; Blast freezer, Cryogenic tunnel freezer, spiral freezer, fluidized – bed freezer, Tumbling & rotary tunnel freezer, etc; Choosing the right freezer.

UNIT IV
SHELF-LIFE OF FOOD PRODUCTS

Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; Deterioration modes of food items; Models of quality deterioration- Kinetic model; shelf-life model; Q10/q10 model; TTT model for the remaining shelf-life; General procedure for shelf-life testing – the 11 steps procedure.

Storage of frozen foods; Basic design requirements of storage to uphold the shelf-life – size, insulation, entry-exit position, pailletization, proper air-space for air-circulation, automatic door-closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers, etc.

UNIT V
HAZARD ANALYSIS CRITICAL CONTROL POINTS (HACCP)

Definition; Purpose; origins of HACCP; Developing the HACCP plan; Preliminary steps- the five-step process-HACCP team assembly, Defining the product and its usage; Constructing the flow diagrams; On-Site confirmation of flow diagram, etc. The 7-point HACCP system: conducting a hazard analysis; Identifying CCPs; Establishing limits for each CCP; Establishing monitoring procedure for critical limits; Corrective actions to be established; Procedures-setting for verification; Establish documentation and record maintaining; Top-Management Commitment & involvement; Training of personnel; Implementation and integrating HACCP system with ISO, TQM, etc.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I INTRODUCTION
Problems in flavour research – classification of food flavours; chemical compounds responsible for flavour.

UNIT II FLAVOUR COMPOUNDS
Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.

UNIT III THE CHEMICAL SENSES
Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

UNIT IV FLAVOUR ANALYSIS
Subjective versus Objective methods of analysis; psychophysics and sensory evaluation; Instrumental analysis; sample handling and artifacts; data handling

UNIT V TEACHING FLAVOUR CONCEPTS
Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

UNIT I BIOSYNTHESIS AND SIGNIFICANCE
Phytochemicals in food, the plants as chemical factories, synthesis of isotopically labeled phytoestrogens

UNIT II ANALYSIS OF PHYTOCHEMICALS
Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; falavnols, polyphenols, tannins, saponins, lignans Multiresidue method for penicillins and cephalosporins in Bovine muscle.
UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY
In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices

UNIT IV CARATENOID
Factors affecting bioavailability, chemical and histochemical characterisation of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

UNIT V OPTIMISING PHYTOCHEMICAL
Optimising phytochemical release by process technology, Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

FT 3004 HUMAN NUTRITION L T P C
3 0 0 3

AIM
The course aims to develop the knowledge of students in the basic area of Human Nutrition. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the relationship between food and the nutrients as well as function and contribution of nutrients to health of individuals.

OBJECTIVES
On completion of the course the students are expected to
• Be able to understand the physiological and metabolic functions of nutrients.
• Be able to understand methods of nutritional assessment, RDA and Dietary Recommendations & Guidelines.
• Understand and use effectively, diet planning principles, exchange lists, food labels and nutrition facts for balanced nutrition and healthy diets.

UNIT I AN OVERVIEW OF NUTRITION
Six classes of nutrients, calculating energy values from food, using the RDA, nutritional assessment of individuals and populations, dietary recommendations; research methods in nutrition; Planning a Healthy Diet: Diet planning principles, dietary guidelines; diet planning guides such as food groups, exchange lists, personal diet analysis; food labels: serving sizes, nutrition facts, daily values, descriptive terms, health claims. Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.
UNIT II  CARBOHYDRATES: SUGARS, STARCH AND FIBER
Digestion and absorption of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, artificial sweeteners; Nutrition and Diabetes: Complications of diabetes mellitus, importance of blood sugar regulation, dietary recommendations for NIDDM and IDDM

UNIT III  LIPIDS AND PROTEINS
Lipid digestion, absorption and transport;
Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids.
Digestion and absorption of proteins; Functions of the proteins; amino acids; Protein quality, methods of assessing protein quality; Recommended intakes of proteins; protein and amino acid supplements; Protein Energy Malnutrition, Marsamus and Kwashiorkor; Chronic Energy Deficiency- short term and long term effects.

UNIT IV  METABOLISM, ENERGY BALANCE AND BODY COMPOSITION
Review of catabolic and anabolic pathways of glucose, fats and amino acids; Energy Balance and Body Composition: Energy balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviors toward weight control.

UNIT V  VITAMINS AND MINERALS
Water Soluble Vitamins: B vitamins examined individually (Thiamine, Riboflavin, Niacin, Pyridoxine, Biotin, folate and B12, choline, pantothenic acid, carnitine) and in concert; B vitamin deficiencies, toxicities, and food sources; vitamin C roles and recommended intake, deficiency, toxicity and food sources
Fat Soluble Vitamins: A, D, E, and K: Function, recommended intakes, toxicities, food sources of vitamin A, D, E, and K; vitamin E as antioxidant; beta carotene and vitamin A
Water and the Major Minerals: Water balance and recommended intakes; fluid/electrolyte balance, acid-base balance; function, recommended intakes, and regulation of sodium, potassium, and calcium.
Trace Minerals: Food sources, function, recommended intakes, toxicities, deficiencies and transport of iron and zinc; importance of selenium, copper, fluoride, and chromium.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To introduce process economics and industrial management principles to chemical engineers.

OBJECTIVE
• The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION 15
Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations; Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION 10
Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT 8
Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 4
Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL 8
Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer. Elements of quality control, role of control charts in production and quality control.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  10 +3

UNIT II  INTERPOLATION AND APPROXIMATION  8 + 3
Interpolation with unequal intervals - Lagrange interpolation – Newton’s divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton’s forward and backward difference formulae.

UNIT III  NUMERICAL DIFFERENTIATION AND INTEGRATION  9 + 3

UNIT IV  INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION  9 + 3

UNIT V  BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS  9 + 3
Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L : 45 , T : 15 , TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I RESEARCH & WRITING 9
The project/term paper, selecting a topic, using a library, compiling a working bibliography, taking notes, plagiarism, outlining, writing drafts, guides to writing.

UNIT II MECHANICS OF WRITING 9
Spelling, punctuation, numbers, titles and quotations.

UNIT III FORMAT OF A TERM/PROJECT REPORT 9
Typing, paper, margins, spacing, heading and title of paper, page numbers, tables and illustrations, corrections and insertions, binding.

UNIT IV PREPARATION OF CITATIONS 9
General guidelines, placement, arrangement, citing books, citing articles in periodicals, documenting sources, what is a document, parenthetical documentation, information required in parenthetical documentation, readability, sample references.

UNIT V ABBREVIATIONS AND REFERENCES 9
Introduction, time, common scholarly abbreviations and references words, publishers names, symbols and abbreviations used in proof-reading and correction, literary and scientific indexing.

TOTAL : 45 PERIODS

TEXT BOOK

REFERENCE

UNIT I INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT 9

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY 9
Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems- identification of gross measurement errors. Introduction to MATLAB®

UNIT III METABOLIC FLUX ANALYSIS 9
Theory, overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis.

UNIT IV METABOLIC CONTROL ANALYSIS 9
UNIT V ANALYSIS OF METABOLIC NETWORKS 9
Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

FT 3009 DAIRY PRODUCT PROCESSING L T P C 3 0 0 3

AIM
The course aims to develop the knowledge of students in the area of dairy product processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES
On completion of the course the students are expected to
- Be able to understand and identify the specific processing technologies used for milk and the various products derived from milk.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I PROCESSING OF MILK 9
Technology of milk and dairy products; Pasteurisation sterilization, HTST and UHT processes.

UNIT II MILK PRODUCTS 9
Manufacture of condensed milk, milk powder, cheese, ice-cream, butter, ghee, malted products, evaporated and dried products.

UNIT III MILK SUBSTITUTES 9
Substitutes for milk and milk products. Casein, lactose and other by-products.

UNIT IV TECHNOLOGY OF BABY FOODS 9
UNIT V QUALITY PARAMETERS

Judging and grading of milk; National and international standards of milk and milk products, in plant sanitation and hygiene.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

IB3010 PROTEIN ENGINEERING

UNIT I BONDS AND ENERGIES IN PROTEIN MAKEUP
Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II AMINO ACIDS AND THEIR CHARACTERISTICS
Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

UNIT III PROTEIN ARCHITECTURE
Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine
Super-secondary structure: Apha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites
Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.
UNIT IV  STRUCTURE-FUNCTION RELATIONSHIP
15
DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, 
Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-
membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, 
Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: 
Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and 
elastase, substrate-assisted catalysis other commercial applications.

UNIT V  PROTEIN ENGINEERING  8
Advantages and purpose, overview of methods, underlying principles with specific examples: 
thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, de 
novo protein design.

TOTAL : 45 PERIODS

TEXT BOOKS
Freeman, 1993.

REFERENCES
3. Alberghina, L. “Protein Engineering in Industrial Biotechnology”. Harwood Academic 

FT 3011  ENTREPRENEURSHIP  L T P C
3 0 0 3

UNIT I
Should You Become an Entrepreneur?  9
What Skills Do Entrepreneurs Need?
Identify and Meet a Market Need
Entrepreneurs in a Market Economy
Select a Type of Ownership

UNIT II
Develop a Business Plan

UNIT III
Choose Your Location and Set Up for Business
Market Your Business
Hire and Manage a Staff

UNIT IV
Finance, Protect and Insure Your Business
Record Keeping and Accounting
Financial Management

69
UNIT V
Meet Your Legal, Ethical, Social Obligations
Growth in Today’s Marketplace

TEXT BOOK

FT 3012 OPERATION RESEARCH

UNIT I

UNIT II

UNIT III
Sequencing and Scheduling Problems: Job sequencing – Jobs through Two Machines, Two Jobs through Machines and n Jobs through Machines. PERT and CFM techniques – Critical Path – Normal and crash time. Resource allocation – Resource Leveling and Smoothing

UNIT IV

UNIT V
Maintenance and Replacement Problems: Models for routine maintenance and preventive maintenance decisions – Replacement models that deteriorate with time and those that fail completely. (srp/rm/vec)

TEXT BOOKS
2. Gillet, Billy E. “Introduction to Operation Research”, TMH Publishing Co.,

REFERENCE
IB3014  DOWNSTREAM PROCESSING  L T P C  3 0 0 3

UNIT I  DOWNSTREAM PROCESSING  10
Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT II  PHYSICAL METHODS OF SEPERATION  6
Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III  ISOLATION OF PRODUCTS  12
Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV  PRODUCT PURIFICATION  12
Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.

UNIT V  FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS  5
Crystallization, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

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FT 3014  GENETICALLY MODIFIED FOODS  L T P C  3 0 0 3

UNIT I  GENETIC ENGINEERING AND FOODS I  9
Genetically engineered proteins, Bovine Somatotropin in Milk; Genetically engineered bacteria, Chymosin Lite beer; Tryptophan; Transgenic plants; Calgene Flavr SavrTM tomato; Methionine-enriched oil.

UNIT II  GENETIC ENGINEERING AND FOODS II  9
Frost-resistance Drought and Salinity resistance; Herbicide Resistance; Monsanto Round-UpTM Ready; Ciba Geigy BastaTM resistant crops; Insect Resistance: *Bacillus thuringiensis* toxin; Ciba Geigy, B.t. maize; Monsanto Golden Harvest Seeds; Fungal Resistance Bintje potatoes; Virus Resistance

UNIT III  PLANT PHARMACEUTICALS  9
Beta-carotene in rice; transgenic “heart-healthy” canola oil; Edible vaccines; Hepatitis B vaccine in maize; Cholera vaccine in potatoes
UNIT IV  TRANSGENIC ANIMALS  
Growth hormone gene in pigs, alpha-lactalbumin and lactoferrin in milk , Transgenic Fish , Atlantic salmon

UNIT V  ANIMAL CLONING  
Biotechnology ; Benefits, Risks and Public Perceptions; The Environment, The Third World , The Western World, Europe's Mistrust

TEXT BOOKS

GE3015  CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT  
AIM
To study the various issues related to Creativity, Innovation and New Product Development.

OBJECTIVE
• To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

UNIT I  INTRODUCTION  
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brainstorming - different techniques

UNIT II  PROJECT SELECTION AND EVALUATION  
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

UNIT III  NEW PRODUCT DEVELOPMENT  

UNIT IV  NEW PRODUCT PLANNING  
Design of prototype - testing - quality standards - marketing research - introducing new products

UNIT V  MODEL PREPARATION & EVALUATION  
Creative design - Model Preparation - Testing - Cost evaluation - Patent application

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES