Program Objectives

The primary objective of the Bachelor of Pharmaceutical Technology program is to prepare professionals with the basic skills required to work in the pharmaceutical industry with particular emphasis on the engineering aspects of drug manufacturing, pharmaceutical production, pharmaceutical development, and pharmaceutical operations. They are trained to:

1. Achieve successful professional and technical career
2. Have strong foundation in basic sciences, mathematics and process engineering
3. Have knowledge on the theory and practices in the field of Pharmaceutical Engineering and allied areas
4. Engross in life-long learning to keep themselves abreast of new developments
5. Practice and inspire high ethical values and technical standards

Program Outcome:

a) Ability to apply knowledge of Mathematics, Sciences and Engineering
b) Ability to understand, analyze and apply basic theorems and postulates in the design, optimization and scale-up of Pharmaceutical production systems
c) Ability to understand, analyze and apply physicochemical and engineering concepts in Dosage Form Design and Drug Delivery Systems.
d) Ability to understand, analyze and apply the process engineering concepts in the manufacture of Active Pharmaceutical Ingredients and in the manufacture of biologicals
e) Ability to understand and apply the scientific and engineering concepts for new drug discovery and development.
f) Ability to understand ethical and professional responsibilities
g) Ability to communicate effectively and work in interdisciplinary groups
h) Ability to review, comprehend and report technological development

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|        | Biopharmaceutics and Pharmacokinetics | ✔ | ✔ | ✔ | ✔ |
|        | Technology of Sterile Products | ✔ | | | |
|        | Professional Elective V | | | | |
|        | Professional Elective VI | | | | |

| SEM 8 | Drug Delivery Systems Lab | ✔ | | | ✔ |
|       | Medicinal Natural Products Lab | | | ✔ | ✔ |
|       | Internship Program | | ✔ | ✔ | ✔ |
|       | Project Work | ✔ | ✔ | ✔ | ✔ |
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**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

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<th>S.No</th>
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**SUMMARY**

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8 Non-Credit/Mandatory
COURSE DESCRIPTION:
This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:
- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students’ communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS
UNIT I  GREETING AND INTRODUCING ONESELF 12
Listening - Types of listening – Listening to short talks, conversations; Speaking – Speaking about one’s place, important festivals etc. – Introducing oneself, one’s family/ friend; Reading – Skimming a passage – Scanning for specific information; Writing – Guided writing – Free writing on any given topic ( My favourite place/ Hobbies/ School life, writing about one’s leisure time activities, hometown, etc.); Grammar – Tenses (present and present continuous) -Question types - Regular and irregular verbs; Vocabulary – Synonyms and Antonyms.

UNIT II  GIVING INSTRUCTIONS AND DIRECTIONS 12
Listening – Listening and responding to instructions; Speaking – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; Reading – Reading and finding key information in a given text - Critical reading - Writing –Process description( non-technical)- Grammar – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; Vocabulary – Compound words – Word formation – Word expansion ( root words).

UNIT III  READING AND UNDERSTANDING VISUAL MATERIAL 12
Listening - Listening to lectures/ talks and completing a task; Speaking – Role play/ Simulation – Group interaction; Reading – Reading and interpreting visual material; Writing- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative); Grammar – Tenses (perfect), Conditional clauses –Modal verbs; Vocabulary – Cause and effect words; Phrasal verbs in context.

UNIT IV  CRITICAL READING AND WRITING 12
Listening- Watching videos/ documentaries and responding to questions based on them; Speaking- Informal and formal conversation; Reading –Critical reading (prediction & inference); Writing –Essay writing ( compare & contrast/ analytical) – Interpretation of visual materials; Grammar – Tenses (future time reference); Vocabulary – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V  LETTER WRITING AND SENDING E-MAILS 12
Listening- Listening to programmes/broadcast/ telecast/ podcast; Speaking – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; Reading –Extensive reading; Writing- Poster making – Letter writing (Formal and E-mail) ; Grammar – Direct and Indirect speech – Combining sentences using connectives; Vocabulary – Collocation;

TEACHING METHODS:
Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:
Internals – 50%
LEARNING OUTCOMES:
- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

TEXTBOOK:

REFERENCES:

MA7151 MATHEMATICS – I

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(Common to all branches of B.E./B.Tech. Programmes in I Semester)

COURSE OBJECTIVES
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I DIFFERENTIAL CALCULUS

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES


UNIT III INTEGRAL CALCULUS

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS

UNIT V  DIFFERENTIAL EQUATIONS


TOTAL : 60 PERIODS

COURSE OUTCOMES

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXT BOOKS


REFERENCE BOOKS


PH7151 ENGINEERING PHYSICS

(Common to all branches of B.E / B.Tech programmes)

OBJECTIVE:

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I  PROPERTIES OF MATTER

Elasticity – Poisson’s ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending

UNIT II ACOUSTICS AND ULTRASONICS 9

UNIT III THERMAL AND MODERN PHYSICS 9
Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - heat conduction in solids - flow of heat through compound media - Forbe’s and Lee’s disc method: theory and experiment - Black body radiation - Planck’s theory (derivation) - Compton effect - wave model of radiation and matter - Schrödinger’s wave equation - time dependent and independent equations - Physical significance of wave function - particle in a one dimensional box.

UNIT IV APPLIED OPTICS 9

UNIT V CRYSTAL PHYSICS 9
Single crystalline, polycrystalline and amorphous materials - Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects - Burger vectors, dislocations and stacking faults - Growth of single crystals: Bridgman and Czochralski methods.

OUTCOME:
- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics.
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics.
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES:
COURSE OBJECTIVES

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

UNIT I  POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II  SURFACE CHEMISTRY AND CATALYSIS


UNIT III  PHOTOCHEMISTRY AND SPECTROSCOPY


UNIT IV  CHEMICAL THERMODYNAMICS

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van’t Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation-variation of chemical potential with temperature and pressure.

UNIT V  NANOCHEMISTRY


TOTAL : 45 PERIODS

COURSE OUTCOMES

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

TEXT BOOKS

REFERENCE BOOKS

GE7151  COMPUTING TECHNIQUES  L T P C
(Common to all branches of Engineering and Technology)  3 0 0 3

OBJECTIVES:
• To learn programming using a structured programming language.
• To provide C programming exposure.
• To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I  INTRODUCTION  9
Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II  C PROGRAMMING BASICS  9

UNIT III  ARRAYS AND STRINGS  9

UNIT IV  POINTERS  9
Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

UNIT V  FUNCTIONS AND USER DEFINED DATA TYPES  9

TOTAL : 45 PERIODS

OUTCOMES
At the end of the course, the student should be able to:
• Write C program for simple applications
• Formulate algorithm for simple problems
• Analyze different data types and arrays
• Perform simple search and sort.
• Use programming language to solve problems.

TEXTBOOKS:
REFERENCES:

ENGINEERING GRAPHICS

OBJECTIVES
- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)
- Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I        PLANE CURVES AND FREE HANDSKETCHING

UNIT II       PROJECTION OF POINTS, LINES AND PLANE SURFACES
Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III      PROJECTION OF SOLIDS
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV       PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V        ISOMETRIC AND PERSPECTIVE PROJECTIONS
Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.
COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)

Introduction to drafting packages and demonstration of their use.

OUTCOMES:
On Completion of the course the student will be able to
- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, Planes and Solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

BS7161 BASIC SCIENCES LABORATORY
(Common to all branches of B.E / B.Tech Programmes)

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE:
- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of liquids.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young’s modulus
3. Uniform bending – Determination of young’s modulus
4. Lee’s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille’s flow

OUTCOME:
Upon completion of the course, the students will be able
- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY:
(Minimum of 8 experiments to be conducted)

1. Estimation of HCl using Na₂CO₃ as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline/thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Determination of CMC.
15. Phase change in a solid.

TEXTBOOKS
COURSE OBJECTIVES

- To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES

15

PLUMBING
- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK
- Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

STUDY
- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICES

15

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator and Emergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS)

3. MECHANICAL ENGINEERING PRACTICES

15

WELDING
- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
  a. Centrifugal pump
  b. Mixie
  c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.

4. ELECTRONIC ENGINEERING PRACTICES

15

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio and Low Voltage Power supplies.

COURSE OUTCOMES

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

TOTAL : 60 PERIODS
OBJECTIVES
- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in a professional environment.

CONTENTS

UNIT I  ANALYTICAL READING  12
Listening- Listening to informal and formal conversations; Speaking – Conversation Skills(opening, turn taking, closing )-explaining how something works-describing technical functions and applications;Reading –Analytical reading, Deductive and inductive reasoning; Writing- vision statement–structuring paragraphs.

UNIT II  SUMMARISING  12
Listening- Listening to lectures/ talks on Science & Technology; Speaking –Summarizing/ Oral Reporting, Reading – Reading Scientific and Technical articles; Writing- Extended definition –Lab Reports – Summary writing.

UNIT III  DESCRIBING VISUAL MATERIAL  12
Listening- Listening to a panel discussion; Speaking – Speaking at formal situations; Reading – Reading journal articles - Speed reading; Writing-data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

UNIT IV  WRITING/ E-MAILING THE JOB APPLICATION  12
Listening- Listening to/ Viewing model interviews; Speaking –Speaking at different types of interviews – Role play practice (mock interview); Reading – Reading job advertisements and profile of the company concerned; Writing- job application – cover letter – Résumé preparation.

UNIT V  REPORT WRITING  12
Listening- Viewing a model group discussion; Speaking –Participating in a discussion - Presentation; Reading – Case study - analyse -evaluate – arrive at a solution; Writing– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

TEACHING METHODS:
Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.
Interactive sessions.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

LEARNING OUTCOMES
- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

TEXTBOOK:
REFERENCES:

MA7251 MATHEMATICS – II  L  T  P  C
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(Common to all branches of B.E./B.Tech. Programmes in II Semester)

COURSE OBJECTIVES
- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I MATRICES
12

UNIT II VECTOR CALCULUS
12
Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION
12
Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, $az$, $\frac{1}{z}$, $z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION
12

UNIT V LAPLACE TRANSFORMS
12
Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXT BOOKS

REFERENCE BOOKS

PH7257 PHYSICS OF MATERIALS (Common to Chemical, Ceramic, Food, Leather, Textile, Apparel, Industrial Biotechnology, Pharmaceutical and PET)

OBJECTIVE:
- To make the students to understand the basics of phase diagrams and various materials preparation techniques
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

UNIT I PREPARATION OF MATERIALS

UNIT II ELECTRICAL AND SUPERCONDUCTING MATERIALS
Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - Quantum free electron theory – applications of Schrodinger wave

UNIT III SEMICONDUCTING MATERIALS

UNIT IV DIELECTRIC AND MAGNETIC MATERIALS

UNIT V NEW MATERIALS AND APPLICATIONS

OUTCOME:
On completion of the course, the students will be able to
• acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
• familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
• gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
• realize with theories and applications of dielectric and ferromagnetic materials
• familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

REFERENCES:

GE7153 ENGINEERING MECHANICS

OBJECTIVE:
The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

UNIT I  STATICS OF PARTICLES  12

UNIT II  EQUILIBRIUM OF RIGID BODIES  12

UNIT III  DISTRIBUTED FORCES  16
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.
Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV  FRICTION  8

UNIT V  DYNAMICS OF PARTICLES  12
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. 

L – 45 + T – 15 TOTAL: 60 PERIODS

OUTCOMES:
- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

TEXT BOOK

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

OBJECTIVE
• To provide to the students the fundamentals of Microbiology, the scope of microbiology and solve the problems in microbial infection and their control,

UNIT I INTRODUCTION TO MICROBIOLOGY
9
History (scientists and discoveries) and scope of microbiology (Primary and secondary metabolites), classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

UNIT II MICROBES- STRUCTURE AND REPRODUCTION
9
Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (cyanophyta, rhodophyta) and fungi (Neurospora), life history of actinomycetes (Streptomyces), yeast (Sacharomyces), mycoplasma (M. pneumoniae) and bacteriophages (T4 phage, λ phage).

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM
9
Nutritional classification of microorganisms based on carbon, energy and electron sources. Definition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth: (counting chamber, viable count method, counting without equipment, different media used for bacterial culture (defined, complex, selective, differential, enriched) the mathematics of growth-generation time, specific growth rate.

UNIT IV CONTROL OF MICROORGANISMS
9
Physical and chemical control of microorganisms. Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Disinfection sanitization, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant. Host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL MICROBIOLOGY AND MICROBIAL ECOLOGY
9
Microbes involved in preservation (Lactobacillus, bacteriocins), spoilage of food and food borne pathogens (E.coli, S.aureus, Bacillus, Clostridium). Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); biogas; bioremediation (oil spillage leaching of ores by microorganisms, pollution control); biofertilizers, biopesticides. Biosensors.

TOTAL: 45 PERIODS

TEXT BOOKS
AIM
To enable students learn the fundamentals of Biochemical Processes and Biomolecules.

OBJECTIVES
• To ensure students have a strong foundation in the structure and reactions of Biomolecules.
• To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
• To correlate Biochemical processes with Biotechnology applications.

UNIT I  INTRODUCTION TO BIOMOLECULES  
Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules, chemical nature of water, pH and biological buffers.

UNIT II  STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES  
Carbohydrates (mono, di, oligo & polysaccharides) mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate.


UNIT III  METABOLISM CONCEPTS  

UNIT IV  INTERMEDIARY METABOLISM AND REGULATION  
Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V  CASE STUDIES  
Case study on overproduction of primary and secondary metabolites - glutamic acid, threonine , lysine, methionine, isoleucine, propionic acid and ethanol.

TOTAL: 45 PERIODS

TEXT BOOKS
IB7262  MICROBIOLOGY LABORATORY  L T P C 0 0 4 2

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., Microscopic identification of yeast/mould
6. Staining Techniques Simple, Differential- Gram’s Staining, spore/capsule staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria and Yeast
11. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL : 60 PERIODS

Equipment Needed for 20 Students
Autoclave 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

IB7261  BIOCHEMISTRY LABORATORY  L T P C 0 0 4 2

AIM
To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

EXPERIMENTS
1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer—titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates—distinguishing reducing from non-reducing sugars and keto from aldo sugars.
7. Protein estimation by Biuret and Lowry’s methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).

Equipment Needed for 20 Students

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TEXT BOOKS
1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCES

MA7358 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS

**OBJECTIVES:**
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z-transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

**OUTCOMES:**
The students can able to solve the partial differential equations, find the Fourier series analysis and solve the problems by using Fourier transform and Z transform techniques.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS**

UNIT II  
FOURIER SERIES  
12
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval’s identity – Harmonic Analysis.

UNIT III  
APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION  
12
Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT IV  
FOURIER TRANSFORM  
12

UNIT V  
Z – TRANSFORM AND DIFFERENCE EQUATIONS  
12

TOTAL : 60 PERIODS

TEXT BOOKS:

REFERENCES:

PM7302  
HUMAN PHYSIOLOGY  
L T P C  
3 0 0 3

OBJECTIVES:
To develop understanding about the structure (gross and histology) and functions of various organs of the human body; describe the various homeostatic mechanisms and their imbalances of various systems; identify the various tissues and organs of the different systems of the human body and appreciate coordinated working pattern of different organs of each system.

UNIT I  
FOUNDATIONS OF PHYSIOLOGY, HOMEOSTASIS  
7

UNIT II  
NERVOUS AND MUSCULO-SKELETON SYSTEM  
12
Anatomy and physiology of brain, blood-brain barrier, spinal cord, structure and types of the neuron, synapses neurotransmitters, organization of spinal and cranial nerves, central and peripheral nervous system, autonomic nervous system, receptors membrane potentials – graded
potentials and action potentials, physiology of vision, audition, olfaction, taste and skin; anatomy and physiology of muscular system, types of muscle tissue – skeletal, smooth, cardiac, contraction, muscle fibre regulation, Osseous system - structure, composition and functions of the Skeleton, classification of joints, types of movements of joints and their disorders

UNIT III  GASTROINTESTINAL AND RENAL SYSTEM
Anatomy and physiology of the gastrointestinal tract (secretion, motility, digestion and absorption), structure and function of the liver, spleen, gall bladder, pancreas; the renal system structure – Anatomy and physiology kidney; structure of the nephron and network of blood capillaries urinary tract, formation of urine, concentration of urine; regulation of acid-base balance; the chemical acid-base buffer systems of body fluids and disease conditions

UNIT IV  CARDIOVASCULAR AND RESPIRATORY SYSTEM
Anatomy and physiology of the heart, lungs, cardiac cycle; circulation of blood, heart rate, blood pressure, ECG and heart sounds, lymphatic vessel, systemic and portal circulation; vascular system – arteries, arterioles, capillaries, venules. Anatomy of respiratory tract, mechanism and dynamics of respiration, lung volumes, transport of oxygen and carbon dioxide, disorders like cyanosis

UNIT V  ENDOCRINE AND REPRODUCTIVE SYSTEM
Anatomy and physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands, endocrine control of growth and metabolism; pineal, thymus, testes, ovaries, structure and physiology of reproductive systems, sex hormones, physiology of fertilization, menstruation, menopause, spermatogenesis and oogenesis, pregnancy and parturition and clinical disorders

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

PM7303  PHARMACEUTICAL CHEMISTRY  L T P C
  3 0 0 3

OBJECTIVES:

- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry
- To provide the basic functional group identification, chemical bonding with their mechanism and also to understand the basic principles involved in the identification and estimation of pharmaceutical substances.

UNIT I  STRUCTURE AND PROPERTIES
Molecular orbital theory, hybrid orbitals, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intra molecular and inter molecular hydrogen bonding.
UNIT II CHEMISTRY OF ALIPHATIC AND AROMATIC COMPOUNDS

Characteristics of organic compounds, structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides (Mechanism of SN1, SN2, E1 and E2). Huckel rule, structures of benzenoid and non-benzenoid compounds, mechanism of aromatic electrophilic and nucleophilic substitution, general mechanism of an aromatic electrophilic substitution reaction. Alcohols, ethers, epoxides, amines, aldehydes, ketones, carboxylic acids and functional derivatives of carboxylic acids.

UNIT III PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES

Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals, lead and modifications with suitable examples.

UNIT IV STUDY OF INORGANIC COMPOUNDS IN PHARMACOPOEIA

Method of preparation, assay, identification test, test for purity, official preparation, storage conditions and belonging to the following categories. Gastrointestinal agents and related compounds – Acidifiers, Antacids, Adsorbents and Protectives, Saline cathartics; Topical Agents – Protectives, Astringents, Anti-microbials topical agents.

UNIT V PHARMACEUTICAL AIDS AND CO-ORDINATION COMPOUNDS

Definition, principles and properties of various agents such as – Sodium bisulphate, Sodium meta bisulphate, Sulphur dioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium carboxy methyl cellulose, Sodium methyl paraben Theory of co-ordination compounds with special reference to application in Pharmacy such as – EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to

- Identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- Identify and estimate the purity of drugs and its application.
- Involve in the development and synthesis of new drug molecule.

TEXT BOOKS:

REFERENCES:
1. Indian Pharmacopoeia (I.P.) 2007

PM7305 STOICHIOMETRY AND CHEMICAL PROCESS CALCULATIONS

OBJECTIVE:
To introduce the basic calculation techniques, both computerized and by hand, for analyzing and designing chemical processing equipment with the help of Data sources containing relevant physical and chemical properties.

UNIT I STOICHIOMETRY

Introduction – Units and dimensions – Stoichiometric principles – Composition relations – Density and specific gravity.

UNIT II IDEAL GASES AND VAPOR PRESSURE

UNIT III HUMIDITY AND SOLUBILITY

UNIT IV MATERIAL BALANCE

UNIT V ENERGY BALANCE
Thermo chemistry – Calculation of heat of reaction at other temperatures – Hess’s law of summation – Heat of formation, reaction, mixing, combustion – Mean specific heat – Theoretical flame temperature.

OUTCOMES:
The student will be able to
- Carry out design calculations for processes involving separation operations.
- Carry out material and energy balance calculations for reaction and separation processes by hand or using a computer package as appropriate.
- Analyze the behavior of recycle processes, performing approximate material balances by hand, and setting up calculations for rigorous solution by computer.

TEXT BOOKS:

REFERENCES:

PM7301 CHEMICAL ENGINEERING THERMODYNAMICS FOR PHARMA TECHNOLOGISTS L T P C 3 0 0 3

OBJECTIVE:
To provide the knowledge on fundamentals of thermodynamics and the operation design of various thermodynamics systems.

UNIT I FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS

UNIT II ENTROPY AND THE SECOND LAW OF THERMODYNAMICS
The Clausius inequality – Entropy – Causes of entropy change – Entropy change of

UNIT III REFRIGERATION, VAPOUR AND COMBINED POWER CYCLES

UNIT IV PVT RELATIONS AND THERMODYNAMIC RELATIONS

UNIT V PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA

OUTCOMES:
The student will be able to
- Demonstrate the knowledge on various laws of thermodynamics and its concepts to assess the feasibility in thermodynamic process.
- Analyze and solve problems in thermodynamic systems and select appropriate thermodynamic processes and solutions to meet the specified needs.

TEXT BOOKS:

REFERENCES:

PM7304 PHYSICAL PHARMACEUTICS

OBJECTIVES:
- To provide the fundamentals such as power characters and rheology.
- To provide the knowledge about the stability.

UNIT I MICROMERITICS AND POWDER RHEOLOGY
Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement of particle shape, specific surface, methods for determining surface area.
permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT II SURFACE, INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY 10
Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface. Newtonian system, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

UNIT III DISPERSION SYSTEMS 10

UNIT IV DIFFUSION & DISSOLUTION 5

UNIT V KINETICS AND DRUG STABILITY 10
General considerations and concepts, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Accelerated stability study, expiration dating.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Deal the manufacturing problems in pharmaceutical formulations.
- Acquire the knowledge of drug stability and expiry date determination

TEXT BOOKS:

REFERENCES:

PM7312 PHYSIOLOGY LABORATORY L T P C 0 0 4 2
OBJECTIVES
- To learn the gross histology, structure and functions of various organs of the human body and perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body

LIST OF EXPERIMENTS
1. Study of different systems with the help of models (axial skeleton, appendicular skeleton, cardiovascular system, respiratory system, digestive system, urinary system, nervous system, special senses, reproductive system)
2. Principles of mounting tissue, examination, preservation,
3. Microscopic study of different tissues, epithelial, muscular, connective tissue, nervous tissue
4. Determination of bleeding and clotting time
5. Determination of R.B.C. count of blood
6. Estimation of Haemoglobin
7. Enumeration of W.B.C. count of blood
8. Determination of differential count of blood
9. Determination of Erythrocyte Sedimentation Rate
10. Blood group determination
11. Heart rate and blood pressure recording
12. Identification of human bones and joints, anatomic features
13. Determination of vital capacity

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Microscope
2. Pippette aids
3. Haemocytometer
4. B.P. meter

TEXT BOOKS:

REFERENCES:
1. Ranade V.G. Text book of practical physiology, Latest edition, Publisher: PVG, Pune
2. Best and Tailor’s “Physiological basis of Medical Practice”.

PM7311 PHYSICAL PHARMACEUTICS LABORATORY L T P C 0 0 4 2

OBJECTIVES:
- To practice the determination of fundamental properties of dosage forms.
- To study the kinetics and stability aspects of preparations.

LIST OF EXPERIMENTS
1) Determination of latent heat, vapor pressure, critical point.
2) Studies on polymorphs, their identification and properties.
3) Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
4) Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
5) Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
6) Study of rheological properties of various types of systems using different viscometers.
7) Study of different types of colloids and their properties.
8) Preparation of various types of suspensions and determination of their sedimentation parameters.
9) Preparation and stability studies of emulsions.
10) Studies on different types of complexes and determination of their stability constants.
11) Determination of half-life, rate constant and order of reaction.
12) Preparation of pharmaceutical buffers and determination of buffer capacity.
13) Experiments involving tonicity adjustments.

OUTCOMES:
On completion of the course the students able to
- Characterize and evaluate the properties of powders by using suitable methods.
- Plan and carryout the stability studies and determine the stability of various dosage forms.
- Calculate the rate constants and determine the various order of reactions involved in the pharmaceutical systems and process.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
- Optical Microscope
- Sieve shaker and sieve set
- Andreasen pipette
- Stalagmometer
- Ostwald’s viscometer, Brookfield viscometer
- Stability chamber
- Specific gravity bottle
- Bulk density apparatus

TEXT BOOKS:
1. CVS Subrahmanyam, SG VasanthaRaju, Laboratory Manual of Physical Pharmacy, II\textsuperscript{nd} Ed., Vallabh Publications / Prakashan, 2009

REFERENCES:

MA7357 PROBABILITY AND STATISTICS

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OBJECTIVES:
- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

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 TESTS OF SIGNIFICANCE

UNIT IV DESIGN OF EXPERIMENTS
Completely randomized design – Randomized block design – Latin square design - \(2^2\) - factorial design - Taguchi’s robust parameter design.

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

TOTAL : 60 PERIODS

TEXT BOOKS:

REFERENCES:

PM7404 PHARMACEUTICAL ANALYSIS

AIM
To provide the student with a basic understanding of the format of the pharmacopoeial monograph and the major physical and instrumental methods used in the monographs to specify standards, the scope, advantages and disadvantages together with a brief account of the regulatory framework such as The Drugs and Cosmetics Act 1940 and an introduction to the ICH Guidelines.

UNIT I INTRODUCTION, PHYSICAL METHODS, GRAVIMETRY
Introduction to Pharmaceutical Analysis, Definition, Significance, Qualitative and quantitative analysis, Drugs and Cosmetics Act 1940, Pharmacopoeia, Typical monograph and ICH Guidelines. Physical methods: Melting point, Boiling point, refractive index, optical rotation, density, specific gravity, Gravimetry, Thermogravimetry - uses, limitations, advantages, and method of determination for each method.

UNIT II ACID-BASE TITRATIONS
Introduction, definitions of titration, analyte, acid base theory- Arrhenius, Bronsted-Lowry, Lewis acid, Acid-base strength, conditions for use of titrimetry, precision, accuracy, ion product of water, Henderson-Hasselbalch equation, uses, limitation, pH, buffer, effective range, acid-base indicators, theory of, effective range and choice of, titration curves for acid-base titration, mixed solvents, non-aqueous titration, pharmacopoeial applications.

UNIT III OTHER TITRATIONS
Precipitation titration, Solubility Product, Argentimetric titrations, Mohr’s method, Vollhard’s method, examples in pharmacopoeia, complexometric titration, indicators for, redox titrations, oxidation, reduction - definitions, half reactions and half equations, common oxidising and reducing agents used in volumetric analysis, redox equivalent weights, reduction potential, significance of reduction potential, standard reduction potentials, titrations with potassium permanganate, iodimetry, iodometry, iodine displacement reactions, phenol estimation, iodine absorbing substance in penicillins.

UNIT IV ULTRAVIOLET SPECTROSCOPY
Theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert’s law, Derivation and deviations, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption.
spectra. Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors-Barrier layer cell, Photo tube, Photomultiplier tube, Photodiode. Applications.

UNIT V CHROMATOGRAPHY
Thin Layer Chromatography TLC, Rf, definition, How to run a TLC, Adsorbents, solvents, elutropics, series, uses, limit test for impurities using TLC- known impurity, unknown impurity, HPLC High Performance Liquid Chromatography, technique, advantages, basic HPLC, Columns, Detectors, Qualitative analysis and Quantitative Analysis, Packing materials, Normal and reversed phase, Solvents, HPLC terms, retention factor, symmetry factor, resolution, theoretical plate.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING

OBJECTIVES:
To the study of nature and the facts about environment.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

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, characteristics 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 – soil 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

OUTCOMES:
Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

REFERENCES:
1. R.K. Trivedi, ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances

TOTAL: 45 PERIODS

PM7403 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I CHEMISTRY OF NUCLEIC ACIDS & DNA REPPLICATION

12

UNIT II TRANSCRIPTION

12

UNIT III TRANSLATION

12

UNIT IV BASICS OF RECOMBINANT DNA TECHNOLOGY

12
Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic hosts, Introduction of recombinant DNA in to host cells and selection methods. Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT V SEQUENCING AND AMPLIFICATION OF DNA

12
Maxam Gilbert’s and Sanger’s methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES

PM7401 FLUID FLOW OPERATIONS

OBJECTIVES:
- To provide the basic fundamental knowable about the flow properties of different type of fluids and its momentum balance.
- To provide the knowledge about the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.

UNIT I PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE

UNIT II MOMENTUM BALANCE AND ITS APPLICATIONS

UNIT III FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS

UNIT IV FLOW OF FLUIDS THROUGH SOLIDS

UNIT V TRANSPORTATION AND METERING

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand fundamental concepts in fluids, such as density, viscosity, pressure and temperature.
- Apply the mass, energy and momentum balance equations in fluid flow problems.
- Analyze and solve the problems involving laminar and turbulent frictional flow, fluid
- drag on particles, packed beds and pumps involving Newtonian and non-Newtonian fluid flow in chemical engineering equipments.

TEXT BOOKS:
REFERENCES:

PM7402 FUNDAMENTALS OF HEAT AND MASS TRANSFER IN PHARMACEUTICAL TECHNOLOGY L T P C 3 0 0 3

UNIT I CONDUCTION 9

UNIT II CONVECTION 9

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

UNIT IV RADIATION 9

UNIT V MASS TRANSFER 9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

PM7411 ANALYTICAL METHODS AND INSTRUMENTATION LABORATORY L T P C 0 0 4 2
1. **Standardization** of analytical weights and calibration of volumetric apparatus.

2. **Acid Base Titrations** – Preparation and standardization of acids and bases, some exercise related with determination of acids and bases separately in mixture form, some official assay procedure e.g. boric acid should also be covered.

3. **Oxidation reduction titrations** – Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc., some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2,6,-di chlorophenol indophenol, ceric ammonium sulphate be designed.

4. **Precipitation Titrations** ;Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to MohrsVolhards and Fajans methods.

5. **Gravimetric Analysis** :Preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.

6. **Non-aqueous Titrations** ;Preparation and standardization of perchloric acid and sodium/potassium/lithium methoxides solutions, Estimations of some pharmacopoeial products.

7. **Complexometric titrations** ;Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations.

8. Separation & identification of amino acids by paper chromatography

9. Separation & identification of alkaloids by TLC

10. UV spectrometric determination of Ibuprofen

**EQUIPMENTS REQUIRED:**
1. Hot air oven
2. pH meter
3. UV-Visible spectrophotometers
4. Weighing balance
5. Water bath

TOTAL: 60 PERIODS

**REFERENCES**

**PM7412 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB L T P C**

**LIST OF EXPERIMENTS**
1. Isolation of total and plasmid DNA from bacteria.
2. Isolation of total DNA from plant and animal cells/tissues.
3. Restriction enzyme digestion of DNA.
5. Elution of DNA from Agarose gels.
6. Polymerase Chain Reaction [PCR].
7. Ligation of DNA into expression vector.
9. Induction of recombinant protein expression
10. SDS-PAGE.
11. Western blotting.
OBJECTIVES:

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

UNIT I: SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING

- Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II: IDEAL REACTORS

- Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III: IDEAL FLOW AND NON IDEAL FLOW

- RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV: GAS-SOLID, GAS-LIQUID REACTIONS

- Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V: FIXED BED AND FLUID BED REACTORS

- G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

OUTCOMES:

The student will be able to

- Write the rate equation for any type of reaction.
- Design reactors for heterogeneous reactions and optimize operating conditions.
- Relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

TEXT BOOKS:


REFERENCES:

4. Richardson, J.F. and Peacock, D.G., “Coulson Richardson - Chemical Engineering”,
AIM

To know the basics of medicinal chemistry, biochemical and molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of medicinal agents.

UNIT I  PRINCIPLES OF MEDICINAL CHEMISTRY  6
History/development of medicinal chemistry, Physicochemical properties in relation to biological action – Ionization, Drug distribution and pKa values, hydrogen bonding, protein binding, chelation, optical and geometrical isomerism, steric effect, redox potential and surface activity. Prodrugs – concepts/application of prodrug design. Introduction to QSAR.

UNIT II  MEDICINAL CHEMISTRY OF DRUGS ACTING ON CNS AND ANS  15
Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of selected drugs belonging to the class of General anaesthetics, local anaesthetics, Anxiolytics, Sedatives and Hypnotics, Antipsychotics, Anticonvulsants/antiepileptics, CNS stimulants and Psychedelics, Analgesics, Morphine and related drugs, adrenergic neurotransmitters, sympathomimetic agents, adrenergic antagonists, cholinergic receptors drugs and related agents, cholinergic blocking agents, ganglionic blocking agents and neuromuscular blockers.

UNIT III  MEDICINAL CHEMISTRY OF ANTINFECTIVE AGENTS  15
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, design and synthesis of selected drugs belonging to the class of sulphonamides and sulphones, antibiotics like penicillins and cephalosporins, amino glycosides, tetracyclines, unclassified antibiotics – chloramphenic and its prodrugs, peptide antibiotics, novobiocin and mupirocin, antiviral agents, anti-HIV agents, local anti-infective agents, anti-fungal agents, anti-tubercular agents, anti-protozoal agents, anthelmintics, anti-scabious and anti pedicular agents, anti malarials

UNIT IV  MEDICINAL CHEMISTRY OF DRUGS ACTING ON CVS AND RENAL SUSTEMS  12
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, design and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers, cardiac glycosides, anti arrythmic drugs, anti-hypertensive agents, anti-hyperlipidemic agents, anti platelet inhibitors, anti-coagulants and anti-thrombolytics. Diuretics and Anti-diuretics.

UNIT V  MEDICINAL CHEMISTRY OF ANTICANCER DRUGS  12
Chemistry and nomenclature, structure basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, design and synthesis of selected drugs belonging to the class of antimetabolites, DNA alkylating agents, antibiotic anticancer agents, hormonal anticancer agents, antitubulin inhibitors.

TOTAL: 60 PERIODS

TEXT BOOKS
1. Ashutoshkar’s Medicinal Chemistry.
2. Patric Medicinal chemistry

REFERENCES
1. Burger’s medicinal chemistry Vol I to IV.
2. W.A. Foye, Medicinal Chemistry
3. Wilson and Giswold, Medicinal Chemistry
4. Indian/British Pharmacopoeia

OBJECTIVE:
To provide the basic engineering fundamentals and design concepts of various unit operations such as filtration, centrifugation, crystallization, refrigeration, air-conditioning and evaporation.

UNIT I  MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION  12
Overview of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass, Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, Industrial dermatitis, Accident records, etc.

UNIT II  FILTRATION AND CENTRIFUGATION  12

UNIT III  CRYSTALLIZATION  12

UNIT IV  HUMIDITY CONTROL, REFRIGERATION AND AIR- CONDITIONING  12
Basic concepts, definition, wet bulb and adiabatic saturation temperatures, psychrometric chart and measurement of humidity, application of humidity measurement in pharmaceutical industry. Equipments for dehumidification operations, principle and applications of refrigeration and air conditioning.

UNIT V  EVAPORATION  12
Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and Mathematical problems on evaporation.

TOTAL : 60 PERIODS

OUTCOMES:
The student will be able to
- Understand the various categories of materials used in pharmaceutical industry.
- Understand the fundamental concepts of filtration, centrifugation, crystallization, refrigeration and air-conditioning, apply their applications in pharmaceutical industry.

TEXT BOOKS:

REFERENCES:

PM7502  PHARMACOLOGY AND CHEMOTHERAPY  L T P C  4 0 0 4
AIM
To know in detail the classification, therapeutic use, mechanism of action, metabolism, adverse effects of medicinal agents pertaining to nervous system, cardiovascular system, urinary system and respiratory system.
UNIT I PHARMACOLOGICAL PRINCIPLES 9

UNIT II DRUGS OF AUTONOMIC NERVOUS SYSTEM AND CENTRAL NERVOUS SYSTEM 15
Autonomic and somatic nerve transmission, parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuron blocking agents, ganglionic agonists and antagonists agents, neuromuscular blocking agents, local anaesthetic agents. Nerve conduction/transmission in the C.N.S, general anaesthetics, sedatives, hypnotics, anti-anxiety agents and centrally acting muscle relaxants, Psychopharmacological agents – Anti-psychotics, antidepressants, neuroleptics, anti-maniacs and hallucinogens, thymoleptics, anti-epileptic drugs, Anti-parkinsonism drugs, analgesics, antipyretics, anti-inflammatory (NSIADs) and anti-gout drugs, narcotic analgesics and antagonists, C.N.S. stimulants, drug addiction and drug abuse.

UNIT III DRUGS OF CARDIOVASCULAR SYSTEM AND RENAL SYSTEM 12
Cardiac glycosides, anti-hypertensive drugs, anti-anginal and vasodilator drugs including calcium channel blockers and beta adrenergic antagonists, Anti-arrhythmic drugs, anti hyper lipidemic drugs, Drugs used in the therapy of shock. Fluid and electrolyte balance, Diuretics and Anti-diuretics,

UNIT IV DRUGS OF GASTROINTESTINAL TRACT AND RESPIRATORY SYSTEM 12
Antacids, anti-secretory and anti-ulcer drugs, Laxatives and Anti-diarrhoal drugs, Appetite stimulants and suppressants, Emetics and anti-emetics. Anti-asthmatic drugs including bronchodilators, leukotriene inhibitors, anti-tussives and expectorants, Respiratory stimulants. Histamine and anti histamine.

UNIT V CHEMOTHERAPY 12
General principles of chemotherapy, Sulfonamides, Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, macrolides, Quinolones, fluoroquinolones and other antibiotics. Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy and immuno suppressive agents

TOTAL : 60 PERIODS

TEXT BOOKS
2. Satoskar, Pharmacology and Therapeutics, Popular Prakashan Ltd, 2015
4. Mycek M.J., Gerlnet S.B and Perper M.M. Pharmacology, Lippincott’s Illustrated

REFERENCES
2. Goodman and Gilman’s, The Pharmacological basis of therapeutics.
4. B. Lammer, Chronopharmacology

PM7512 UNIT OPERATIONS IN PHARMA INDUSTRIES LAB L T P C 0 0 4 2

OBJECTIVE:
To gain the practical knowledge on fluid flow operations and Heat Transfer

LIST OF EXPERIMENTS
1. To relate Reynolds Number and Friction factor.
2. Experiment on Orifice meter.
3. Experiment on Venturi meter.
4. To evaluate the performance of centrifugal pump.
5. To characterize the behavior of Fluidized bed.
6. Performance of packed bed (Gas- Liquid).
7. To determine the conduction parameters using composite wall.
8. To determine individual heat transfer film coefficient in forced convection.
9. To determine condensing heat transfer coefficient in vertical condenser.
10. To determine overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
11. To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
12. To determine overall heat transfer coefficient of shell and tube heat exchanger.
13. To determine overall heat transfer coefficient of plate type heat exchanger by parallel flow.

TOTAL: 60 PERIODS

OUTCOMES:
The student will demonstrate ability to

- Select and operate the suitable instruments for the measurement of flow rate and rate of heat exchange.
- Differentiate laminar and turbulent flows
- Calculate and analyse the performance of various pumps and heat exchangers.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Venturimeter
2. Orifice meter
3. Packed bed
4. Turbulent flow
5. Rectangular notch
6. Triangular notch
7. Drag on sphere
8. Centrifugal pump
9. Laminar flow

TEXT BOOKS:

REFERENCES:

PM7511 MEDICINAL CHEMISTRY AND PHARMACOLOGY LABORATORY

OBJECTIVE
To study the methods involved in the synthesis of prototype medicinal agents

Part I Medicinal Synthetic Chemistry Experiments
1. Study on stereo-chemistry of some selected drugs with models and in-silico viewer
3. Synthesis of antimicrobial drugs and its analysis (Eg. Hexamethylenetetramine)
4. Synthesis of anticonvulsant drugs involving minimal steps (Eg. phenytoin) and its analysis.
5. Synthesis of sulphonamide drugs (Eg. Suphacetamide) and its analysis
6. Synthesis of anthelmintic drugs and its analysis (Eg. Benzimidazoles)
7. Synthesis of antiseptic organic compounds (Eg. Iodoform) and its analysis

Equipments required:
1. Weighing balance
2. pH meter
3. Rotary evaporator
4. Refluxing and distillation units
5. Hot air oven
6. UV-Visible spectrophotometers

OUTCOME
Students will be able to experimentally evaluate the synthetic outlines require for drugs synthesis

TEXT BOOKS

REFERENCE BOOKS
1. Wilson and Gisvold’s Text book of Organic, Medicinal and Pharmaceutical Chemistry,
4. Indian Pharmacopoeia

Part II Pharmacology Experiments

OBJECTIVE
- To learn and understand the pharmacological aspects of drugs action
- To correlate and apply the knowledge for drug development and evaluation.

OUTCOME Students will be familiar with various animal handling techniques and to study the pharmacological effects in different in-vitro, in-situ, in-vivo, in-silico organ systems

1. Evaluation of pyrogens by in vitro LAL test (Limulus amebocyte lysate) test
2. Bioassay experiments - study of effects of various drugs on isolated frogs tissues (heart, muscle etc..) e.g Ach, adrenaline, effect of adrenergic and cholinergic blockers, effect of ions (through audiovisual demonstration)
3. Introduction to humane handling of animals for research (Eg. Mice, Rats, Jirds/Gerbils, rabbits)
4. Study of physiological salt solutions and laboratory appliances used in experimental pharmacology.
5. Routes of drug administration in animal models (through audiovisual demonstration)
6. Experiments to study analgesic/anti-inflammatory effects of drugs
7. Experiments to study local/general anaesthetic effects of drugs
8. Experiments to study antiparasitic drugs (in-vitro /in-vivo methods using nematodes)
9. Experiments to study anticancer drugs by cytotoxic assay (MTT assay)

Equipments Required :
1. Animal House facility
2. UV-Visible spectrophotometers
3. Simulation softwares

REFERENCES
1. The Pharmacological basis of therapeutics – Goodman and Gilman’s.
7. Pharmacological experiments on intact preparations by Churchill Livingstone.

GE7652 TOTAL QUALITY MANAGEMENT

L T P C
3 0 0 3

AIM
To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES
- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality – Definition of TQM-- Basic concepts of TQM —Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES

UNIT III TQM TOOLS & TECHNIQUES I

UNIT IV TQM TOOLS & TECHNIQUES II

UNIT V QUALITY MANAGEMENT SYSTEM

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to apply TQM concepts in a selected enterprise.
Ability to apply TQM principles in a selected enterprise.
Ability to apply the various tools and techniques of TQM.
Ability to apply QMS and EMS in any organization.

TEXT BOOK:

REFERENCE BOOKS:

FT7651 CREATIVITY, INNOVATION AND NEW FOOD PRODUCT DEVELOPMENT

OBJECTIVES:
To study the various issues related to 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 - brain storming - 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 PLANNING
Design of prototype - testing - quality standards - marketing research - introducing new products

UNIT IV NEW PRODUCT DEVELOPMENT

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

TOTAL: 45 PERIODS

OUTCOMES:
To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To provide the knowledge on fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization.
- To provide the concept of basic fermentation processes and its control systems during scale up operations.

UNIT I  INTRODUCTION TO ENZYMES  9

UNIT II  STERILIZATION KINETICS  9
Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment- batch and continuous.

UNIT III  METABOLIC STOICHIOMETRY AND ENERGETICS  9
Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT IV  KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION
UNSTRUCTURED KINETIC MODELS  9

UNIT V  BIOREACTOR SCALE – UP  9
Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – Mass transfer Coefficient - methods for the determination of mass transfer coefficients; mass transfer correlations. Power requirements of Bioreactors. Scale-up considerations on heat transfer oxygen transfer, power consumption and impeller tip speed.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization
- Understand the concept of basic fermentation processes and its application during scaleup operations.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To provide the knowledge on the principles of solid dosage forms formulation and development
- To inculcate the concepts involved in trouble shooting and improvement of solid dosage forms

UNIT I  PREFORMULATION CRITERIA
Study of physical/physicochemical properties of drugs like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, organoleptic properties and their effect on formulation, stability and bioavailability. Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemisation, polymerization etc., and their influence on formulation. Stability Studies: Basic concepts, design and objectives of short term and long term stability studies.

UNIT II  FORMULATION AND MACHINERY
Classification of different types of tablets, tablets equipments, granulation technology on large scale by various techniques. Tablets tooling, different types of tablets compression machinery, processing problem of tablets and evaluation of tablets. Coating of tablets: Types of coating, Sugar coating, film forming materials, formulation of coating solution, equipment for coating, film defects and evaluation of coated tablets.

UNIT III  ADDITIVES AND EXCEPIENTS
Disintegrants, Lubricants, Glidants and Anti adherents, Surfactants and Colors in Tablets, Swellable and Rigid Matrices – Controlled Release Matrices with Cellulose Ethers, Carrageenans in Solid Dosage Form Design, Direct Compression and the Role of Filler-binders

UNIT IV  FORMULATION CHALLENGES
orally disintegrating tablets and related tablet formulations, formulation challenges – multiple vitamin and mineral dosage forms, botanicals formulation into oral solid dosage forms, specialty tablets formulation for slow oral dissolution, osmotic systems, tableting of multi particulate modified release systems

UNIT V  CAPSULES
Advantages & disadvantages of capsule dosage form, extraction of gelatin, production of hard gelatin capsules, size of capsules and method of capsule filling. Soft gelatin capsule, Nature of capsule shell & capsule content, importance of base adsorption, minimum gm factors in soft capsules, production, quality control, stability testing and storage of capsule dosage forms.

OUTCOMES:
The student will be able to
- Understand the principle of manufacturing tablets and capsules
- Understand and appreciate the various strategies of making efficacious solid dosage forms

TEXT BOOKS

REFERENCES:
2. Indian Pharmacopoiea, British Pharmacopoiea, United States Pharmacopoiea

HS7551 EMPLOYABILITY SKILLS

COURSE DESCRIPTION
This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

COURSE OBJECTIVES
• To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
• To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
• To make them employable graduates

CONTENTS

UNIT I READING AND WRITING SKILLS
Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files - preparing job applications - writing covering letter and résumé - applying for jobs online - email etiquette – writing official letters (placing an order, letters to consumers, etc. ) writing reports – collecting, analyzing and interpreting data

UNIT II SOFT SKILLS
Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills - persuasive skills – sociability skills – interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills -

UNIT III PRESENTATION SKILLS
Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—presenting the visuals effectively – 5 minute presentation

UNIT IV GROUP DISCUSSION SKILLS
Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying – GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mock GD

UNIT V INTERVIEW SKILLS

TOTAL: 45 PERIODS
LEARNING OUTCOMES
- Students will be able to make presentations and participate in group discussions with high level of self-confidence.
- Students will be able to perform well in the interviews
- They will have adequate reading and writing skills needed for workplace situations

REFERENCES:

EXTENSIVE READING

WEB RESOURCES
1. www.humanresources.about.com
2. www.careerride.com

PM7611 BIOPROCESS ENGINEERING LABORATORY L T P C 0 0 4 2

OBJECTIVES:
- To provide the concept of design and procedures to evaluate the performance of the bioreactor in bioprocess.
- To provide the basic concepts of an enzyme immobilized processes in bioprocess.

LIST OF EXPERIMENTS
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michiels 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: 60 PERIODS

OUTCOMES:
- The student will be able to apply the knowledge of biocatalysis in scaling up the commercial processes using bioreactors.
- The student will also be able to produce, analyze and interpret data from bioprocesses.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Bio reactor (Fermentor)-lab scale
2. Microbial shaker incubator

57
3. Cooling centrifuge
4. Refrigerator
5. Incubator

REFERENCES:

PM7612 TECHNOLOGY OF DOSAGE FORMS LABORATORY

LIST OF EXPERIMENTS
1. Pre formulation studies on prepared granules
2. Preparation and evaluation of suspensions
3. Preparation and evaluation of emulsions
4. Preparation and evaluation of creams
5. Preparation and evaluation of ointments
6. Preparation and evaluation of injections
7. Manufacture and evaluation of granules
   - ordinary compressed tablet- wet granulation
   - tablets prepared by direct compression
   - soluble tablet
   - chewable tablet
8. Formulation and filling of hard gelatin tablets
9. Manufacture of parenterals
   - Ascorbic acid injection
   - Calcium gluconate injection
   - Sodium chloride injection
   - Dextrose and sodium chloride injection/infusion
10. Preparation of microcapsules
    - Non-solvent method
    - Salt-addition method

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Water bath
2. Mortar and pestle
3. Blender
4. Mixer
5. Magnetic stirrer
6. Pharmaceutical sieves
7. Capsule filling machine manual
8. Tablet punching machine manual
9. Cooling centrifuge
10. Refrigerator
11. Air dryer
12. Incubator

REFERENCES
1. Pharmaceutical dosage forms: Tablets volume – 3 by Liberman and Lachman
2. Pharmaceutical dosage forms: Parenteral medications Vol-1, 2 by Liberman and Lachman
3. Pharmaceutical dosage forms: Disperse systems Vol-1, by Liberman and Lachman
4. Remington’s Pharmaceutical Sciences (RPS).
5. Modern Pharmaceutics by Banker and Gilberts.
OBJECTIVES

• To develop the knowledge on various legal regulations and governing bodies involved in the trade and practice of pharmaceutical and biopharmaceutical industries
• To enrich beginners in the principles involved in the practice of GMP, biosafety and ethical guidelines

UNIT I REGULATORY ASPECTS 10
Drugs & Cosmetics Act - Schedules particularly M, NPPA, Aspects of GMP, Magic Remedies Act, Prevention of Food Adulteration Act, Pharmacopoeias, Drug control, FDA, ICH

UNIT II GOOD MANUFACTURING PRACTICE FOR PHARMACEUTICALS 5
Introduction, WHO guidelines, practice of GMP- Procedure (SOP’S), Building, Equipment, Personnel, Components, Documentation, Containers, Labeling, Laboratory Control, Distribution Records, Recovery & Reprocessing

UNIT III INTELLECTUAL PROPERTY RIGHTS AND ETHICAL ISSUES IN PATENTING LIFE FORMS 9
What are patents, know-how, copyright, trademark, service mark, design, Conditions for patentability; Indian Patent Act; Opposition and Infringements of patents: Case study on patenting indigenous products (e.g. Neem, turmeric), DNA, Microbes, Transgenic Plants and Animals Industrial property, TRIPS, WTO, treaties, Budapest Convention. Application process for a patent and the post application process.

UNIT IV ETHICAL ISSUES IN HEALTH AND DISEASE, TRANSGENIC TECHNOLOGY 12
Animal experimentation: concerns of welfare, Justification of use of animals in research; use of alternatives; Human experimentation-Nuremberg code and Helsinki declaration; Assisted Reproductive Technologies, Pre-implantation genetic diagnosis, Surrogacy, Use of Embryos; Therapeutic and Reproductive Cloning-Ethical, Legal and Social Issues; genetic testing and Genetic Screening, Types of Testing, Clinical Utility and Validity of Tests, Testing processes, Social stigma, discrimination, misuse of data; HGP & ELSI, case study; Somatic and Germline gene therapy; Organ transplantation and Xeno transplantation; Eugenics and Euthanasia.

UNIT V BIOSAFETY, BIODIVERSITY AND ETHICS OF GMO, TRANSGENICS 9
Genetically modified foods; genetically modified organisms; effect on biodiversity; guidelines for testing, transplantation and release-Cartagena Protocol on Biosafety Considerations; Transgenic animals for food and drugs; Terminator technology, GURTS and farmer’s rights; Environmental Issues; DBT, NIH and Paul Berg guidelines on the use and release of transgenics. Biosafety and biodiversity: Classification of microorganisms based on safety, Biosafety levels, Risk groups, Risk Assessment and Management, Spill Protocols, Biosafety Containment guidelines; Biodiversity – Need and Methods for Protection; Convention for preservation of biodiversity and farmer’s rights; patenting of biodiversity: ethical issues

OUTCOMES:
• The student will be able to understand the legal requirements of product development and manufacturing.
• The student will also be able to understand the ethical responsibility involved in industrialization of pharmaceutical products

TOTAL: 45 PERIODS
TEXT BOOKS
   “Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related

REFERENCES
1. Abraham, John and Smith, Helen Lawton, “Regulation of the Pharmaceutical Industry”,
2. Weinberg, Sandy “Good Laboratory Practice Regulations”, IIIrd Rev. Edition, Marcel Dekker

PM7703 TECHNOLOGY OF SEMI SOLID DOSAGE FORMS AND DISPERSIONS

OBJECTIVES:
- To provide the knowledge on the principles of semi solid dosage form formulation and
  development
- To inculcate the concepts involved in trouble shooting and improvement of semi-solid
  dosage forms

UNIT I INTRODUCTION TO MONPHASIC SYSTEMS
Preformulation, formulation, evaluation, large scale manufacture and packaging along with focus
on equipments for liquid dosage forms; monophasic solution for oral applications – syrups, elixirs,
Liquids for cutaneous application – Lotions, liniments, paints and collodions. Layout design and
Unit operations related to above dosage forms

UNIT II INTRODUCTION TO BIPHASIC SYSTEMS
Definitions – colloids, phases, interfaces, emulsions – Properties and Production, micro emulsions,
vesicles, and liposomes, foams, Biphasic suspensions and emulsions Topicals formulations:
ointments, creams, gels suppositories, study of physical/physicochemical properties, study of
chemical properties of emulsion and suspensions and their influence on formulation

UNIT III PRODUCTION AND CHARACTERIZATION EMULSIONS AND SUSPENSIONS
Manufacture and properties of colloidal suspensions and dispersions, rheology, HLB calculation,
solubility parameters, log p, LSER, M numbers, Blenders, manufacturing equipments for
suspensions and emulsions, cosmetics emulsions and formulations, packaging and stability
studies

UNIT IV ADDITIVES AND FORMULATION
Types of additives used, vehicles, stabilizers, preservatives, emulsifying agents, solubilizers,
pigments, colors and dyes, flavours, manufacturing, packaging and evaluation of solutions,
suspensions and emulsions; Definitions, types, mechanisms of drug penetration through skin,
factors influencing penetration, semisolid bases and their selection. General
formulation/manufacture of semisolids, clear gels, evaluation and packaging

UNIT V PHARMACEUTICAL AEROSOLS
Definition, propellants, general formulation, manufacturing, packaging methods, pharmaceutical
applications and evaluation

OUTCOMES:
The student will be able to
- Understand the principle of manufacturing liquid, semi-solid formulations
- Understand and appreciate the various strategies of manufacture of emulsions and
  suspensions based dosage forms

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES
1. Remington’s Pharmaceutical Sciences (RPS).
2. Modern Pharmaceutics by Banker and Gilberts.
3. Theory and Practice of Industrial Pharmacy by Lachman

PM7701 BIOPHARMACEUTICS AND PHARMACOKINETICS L T P C 3 0 0 3

OBJECTIVES:
- To provide the knowledge on the principles of physicochemical properties of drugs, dosage forms and routes of administration
- To inculcate the concepts involved in the relationship between the drug, its dosage form and the route by which it is administered governs bioavailability

UNIT I INTRODUCTION TO BIOPHARMACEUTICS 7
Definition and Role in Product Development, Explanation of the Terms: Bioavailability, and Bioequivalence, Equivalence Types: Chemical, Clinical, Therapeutic, Generic, and Pharmaceutical Alternatives. Bio-equivalency testing studies

UNIT II PRINCIPLES OF DRUGS DISSOLUTION 11

UNIT III PRINCIPLES OF DRUG ABSORPTION AND BIO-AVAILABILITY 11

UNIT IV PHARMACOKINETICS 11
Principles of Pharmacokinetics, Concepts of Compartmental Model, Characteristics of One Compartment Model and One Compartment Model – based Pharmacokinetic Derivations (involving the concepts of (a.) Experimentally Determined Rates, (b) Methods of Residuals and (c.) Trapezoidal Rule for the following modes of Drug Administration: Intra-Venous Administration (Plasma Level & Urinary Excretion Data) - Single Dose, Absorption Based Administration (Single Dose) - Absorption Rate Constant (ka), Elimination Rate Constant (K) & Elimination Half life (t½), AUC, Cmax, and tmax. Apparent Volume of Distribution (Vd) & Renal Clearance (Q).

UNIT V MULTIPLE DOSAGE REGIMENS 5
Concept, Accumulation, Persistent and elimination factors. Calculation of dosage regimen following repetitive IV and oral administration

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the principle of pharmacokinetics and bio availability
- Understand and learn the strategies to improve the same during dosage form development
TEXT BOOKS

REFERENCES

PM7704 TECHNOLOGY OF STERILE PRODUCT

OBJECTIVES:
- To provide the knowledge on the principles of parenteral dosage form formulation
- To present the concepts involved in the manufacture of sterile products

UNIT I INTRODUCTION TO PARENTERAL PRODUCTS 12
Pre formulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment. Formulation details, containers and closures and their selection; Prefilling treatment, washing the container and closers, preparation of solution and suspension, filling, closing of ampoules, vials infusion fluids, lyophilization, preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products.

UNIT II ASEPTIC TECHNIQUES IN PARENTERALS 9
Aseptic techniques: Source of contamination, methods of prevention, design of aseptic area, laminar flow bench, air handling units, services and maintenance; Stability evolution of sterile pharmaceutical dosage forms; special precautions on blood products, glandular products, medical sutures, ligatures

UNIT III EAR NASAL AND OPHTHALMIC DRUG DELIVERY 12
Nasal and ocular drug delivery overview, membrane transport processes in the eye, nasal and ocular drug transfer following systemic drug administration, ocular pharmacokinetics and pharmacodynamics ocular penetration enhancers, corneal collagen shields for ocular drug delivery, the noncorneal route in ocular drug delivery, ocular iontophoresis, mucoadhesive polymers in ophthalmic drug delivery, dendrimers, new experimental therapeutic approaches for degenerative diseases of the retina, gene, oligonucleotide, and ribozyme therapy in the eye

UNIT IV FORMULATION ADDITIVES 5
Buffers, density modifiers, isotonicity modifiers, viscosity enhancers, preservatives irrigations additives

UNIT V PARENTERAL REGULATIONS AND VALIDATIONS 7
cGMP regulations of parenteral drugs, Risk assessment and mitigation in aseptic processing, Development challenges and validation of fill and finish processes for bio-therapeutics, Excipients for parenteral dosage forms: regulatory considerations and controls, Parenteral product specifications and stability, The management of extractables and leachables in pharmaceutical products, Process analytical technology and rapid microbiological methods, Quality assurance
OUTCOMES:
The student will be able to

- Understand the principle of manufacturing parenteral products
- Understand and appreciate the various strategies of manufacture and regulations of sterile products

TEXT BOOKS
1. Pharmaceutical Dosage Forms Parenteral Medications, Third Edition Volume 3, Sandeep Nema, John D. Ludwig, Informa Healthcare is a trading division of Informa UK Ltd

REFERENCES
1. Remington’s Pharmaceutical Sciences (RPS).
2. Modern Pharmaceutics by Banker and Gilberts.
3. Theory and Practice of Industrial Pharmacy by Lachman

PM7711 DRUG DELIVERY SYSTEMS LABORATORY L T P C
0 0 4 2

OBJECTIVE
Understand and analyse the factors influencing the formulation of novel drug delivery Systems, choose right choice of excipients for the right delivery systems, characterize and interpret the results of marketed products.

LIST OF EXPERIMENTS
1. Preparation of transdermal films
2. Preparation of microspheres
3. Preparation and evaluation of matrix tablets using various polymers
4. Study on diffusion of drugs through various polymeric membranes
5. Preparation of solid dispersions
6. Study of in vitro dissolution of various sustained release formulations of marketed products
7. Preparation of Liposomes.
8. Preparation of polysaccharide particle based drug delivery

TOTAL: 60 PERIODS

EQUIPMENTS REQUIRED
1. Weighing balance
2. pH meter
3. Rotary evaporator
4. Hot plate
5. Phase contrast microscope

OUTCOME
On successful completion students able to

- Comprehend various classes of excipients involved in formulation of novel drug delivery systems.
- Formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.
- Perform various quality control tests for the marketed products.

REFERENCES
3. Theory And Practice Of Industrial Pharmacy by Liberman & Lachman
4. Pharmaceutics-the science of dosage form design by M.E. Aulton, Churchill livingstone, Latest edition

PM7713 MEDICINAL NATURAL PRODUCTS LABORATORY

OBJECTIVE
The lab course is to teach the main concepts, definitions, terminology in Medicinal Natural Products and to study features of various medicinally important plants and natural products.

Standardization of plant drugs using following methods
(a) Morphology, microscopic quantitative microscopy, details microscopic study of drugs

Macroscopic Identification-1: Adhatoda, Datura, Cinnamon, Clove, Coriander
Macroscopic Identification-2: Arjuna, Liquorice, Ashwagandha, Turmeric, Cardamom
Microscopic Identification-1: Adhatoda, Datura, Tulsi or suitable specimens
Microscopic Identification-2: Arjuna, Liquorice, Ashwagandha or suitable specimens

(b) Physical constants like: specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation, etc for the above drugs. Analysis of natural fibres used for pharmaceutical applications: Cotton, Silk, Wool, Jute

(c) Phytochemical methods identification tests for various classes of phytoconstituents.

Equipment Required
Microscope, Soxlet apparatus, water bath, camera lucida, photochemical reagents, chromatographic plates and matrices

TOTAL: 60 PERIODS

OUTCOME
The students will be familiar with pharmaceutically relevant natural product terminologies, medicinal and photochemical importance of various plants and natural products.

REFERENCES

PM7012 PHARMACOGNOSY

OBJECTIVE
Study about the general pharmacognosy and drug containing various active substances, classify, identify and understand the medicinal compounds derived from plant sources and relate to therapeutic applications

UNIT I
Definition, history, scope and development of pharmacognosy. Sources and Classification of drugs : Biological, marine, geographical and plant tissue cultures as sources of drugs. Alphabetical, morphological, taxonomical, pharmacological and chemical Classification. Cultivation, collection, processing and storage of crude drugs. Factors influencing cultivation of medicinal plants, types of...

UNIT II
Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.

UNIT III
An Introduction to chemical constituents of drugs: their isolation, classification and properties & systematic pharmacognostic study of following:
a) Carbohydrates and derived products: Agar, Gum Acacia, Gum tragacanth, Honey, Isapgol, pectin, Starch.
b) Lipids: Bees wax, Castor oil, Coca butter, Cod-liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice bran oil, shark liver oil and wool fat.
c) Resins and resin combinations: Colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of Peru, Balsam of Tolu, Benzoin, Turmeric.
d) Tannins and tannins containing drugs: Gambir, black catechu, gall and myrobalan.
e) Volatile oils: General methods of obtaining volatile oils from plants. Study of volatile oils of Mentha, Coriander, Cinnamon, Cassia, Caraway, Dill, Clove, Fennel, Nutmeg, Cardamom, Lemon grass oil, Eucalyptus, Sandalwood, palmarosa and citronella.

UNIT IV

UNIT V
Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing Alkaloids: Quinine, reserpine, morphine, papaverine, ephedrine, ergot, Belladona, vinca alkaloids, atropine, Cinchona, Ipecac, Rauwolfia, Nuxvomica.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT III  CLINICAL RESEARCH MODULE II  8
Clinical trial set up; Trial Master Files and study filling, Data Management. Review of the EU Clinical Trial Directive; How to prepare for Regulatory Inspections or Audit; Fraud in clinical research

UNIT IV  ADVANCED CLINICAL RESEARCH MODULE  9
Project Management; How to develop a proactive approach to supporting clinical trials Building a successful working relationship with your manager(s) and the rest of the clinical research team; Team effectiveness: working as an effective clinical research team; Working in partnership with CROs. Legal aspects of clinical research; Laboratory tests Communication skills, Cross-cultural communication with other offices and departments internationally. Time management and optimising your effectiveness

UNIT V  REGULATORY AFFAIRS AND SAFETY MODULE  9
Regulatory requirements for international clinical research - Regulatory requirements for Biotechnology products, medical devices and veterinary products; Health economics; Safety reporting; Responding to drug safety alerts Post marketing surveillance

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

PM7001  CHEMISTRY OF NATURAL PRODUCTS  L T P C
3  0  0  3

OBJECTIVES
To learn, classify and understand chemistry and structural aspects of medicinal compounds from various natural sources and relate to therapeutic applications

UNIT I  STRUCTURAL BASIS OF NATURAL PRODUCTS  9
Chemical and spectral approaches to simple molecules of natural origin. Identification of natural products by chromatographic and spectroscopic methods and application of I.R., N.M.R. and Mass spectroscopy in the structural elucidation of organic compounds. Concept of stereoisomerism taking examples of natural products Eg. citral, menthol, camphor, ephedrine, atropine etc.; standardization of traditional drug formulations, chromatographic study of some herbal constituents

UNIT II  GLYCOSIDES  8
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation, medicinal properties and structural elucidation of sennosides, cardinolides and bufadienolides, digoxin and digitoxin, introduction to scillaren A and ouabain.

UNIT III  ALKALOIDS  12
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation and structural elucidation of Pyridine alkaloids, Tropane alkaloids, Quinoline and Isoquinoline alkaloids, Phenanthrine alkaloids, Indole alkaloids, Imidazole alkaloids, Alkaloidamines, Glycoalkaloid, Xanthine alkaloid
UNIT IV  TERPENES AND FLAVONOIDS  
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation, medicinal properties and structural elucidation, flavonoids, quercetin; Terpenes—special isoprene rule, mono, diterpenes, triterpenoids and sesquiterpenes, and structural elucidation of citral, carvone, menthol and camphor; Steroids – cholesterol, colour reactions, reactions of steroids, stigmasterol, β-Sitotsterol, bile acids, ergosterol, diosgenin, solasodine, hecogenin

UNIT V  STUDY OF TRADITIONAL DRUGS  
Classification of indigenous drugs traditional drugs, common vernacular names, botanical source, chemical constituents, uses and marketed formulations with ingredients like – Amla, Satavari, Bhilwua, bael, bach, rasna, punarnava, gokhru, shankhupusphi, brahmiadusa, arjuna, lahsun, guggul, gymnema, neem ,tulsi, Shilajit and Spirulina

TOTAL: 45 PERIODS

TEXT BOOKS
2. Organic Chemistry of Natural Products (Vol.-1 & 2) by Gurdeep Chatwal.

REFERENCES
1. Pharmacognosy by Brady and Tyler.E.

PM7015  SPECIAL TOPICS IN MEDICINAL CHEMISTRY  L T P C  3 0 0 3

UNIT I  PRODRUGS AND METABOLIC CHANGES OF DRUGS  6

UNIT II  MEDICINAL CHEMISTRY OF HORMONES, STEROIDS AND RELATED DRUGS  12
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, design and synthesis of selected drugs belonging to the class of hypoglycemic agents, synthetic hypoglycemic agents, glucocorticoids, mineralocorticoids, oestrogen, progestogens, Androgens, chemistry of natural hormones and synthetic derivatives including contraceptives, insulin and its preparation, oxytocin and vasopressin, thyroid and antithyroid drugs, medicinal chemistry of Diagnostic drugs and reagents:

UNIT III  MEDICINAL CHEMISTRY OF ANTIHISTAMINIC AGENTS, ANTIULCER AGENTS, ASTHMA AND EICOSANOIDS  12

UNIT IV  MEDICINAL CHEMISTRY OF RADIOPAQUES, LIFESTYLE AND OVER THE COUNTER DRUGS  9

UNIT V  MEDICINAL CHEMISTRY OF VITAMINS, PROTEINS, ENZYMES  6

TOTAL : 45 PERIODS

TEXT BOOKS
1. Ashutoshkar’s Medicinal Chemistry.
2. Patric Medicinal chemistry

REFERENCES
1. Burger’s medicinal chemistry Vol I to IV.
2. W.A. Foye, Medicinal Chemistry
3. Wilson and Giswold, Medicinal Chemistry
4. Indian/British Pharmacopoeia

PM7016 SPECIAL TOPICS IN PHARMACOLOGY

AIM
To know in detail the classification, therapeutic use, mechanism of action, metabolism, adverse effects of medicinal agents pertaining to Endocrine System, Haemopoietic system and drugs for dermatology, ocular and Protozoal, Helminthic And also know the principles of Immunopharmacology and toxicology.

UNIT I DRUGS ACTING ON THE ENDOCRINE SYSTEM
Hypothalamic and pituitary hormones, Thyroid hormones and anti-thyroid drugs, Parathormone, Calcitonin and Vitamin D, Insulin, Oral hypoglycaemic agents and glucagon. ACTH and corticosteroids, Androgens and anabolic steroids, Estrogens, progesterone and oral contraceptives, Drugs acting on the uterus. Chronopharmacology – Definition of rhythms and cycles. Biological clock and their significance leading to chronotherapy

UNIT II DRUGS ACTING ON THE HEMOPHOIETIC SYSTEM

UNIT III MISCELLANEOUS DRUGS

UNIT IV PRINCIPLES OF TOXICOLOGY
Definition of poison, general principles of treatment of poisoning, Heavy metals and heavy metal antagonists, Definition for acute, sub acute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies.

UNIT V IMMUNOPHARMACOLOGY
Cell and biochemical mediators involved in allergy, immunomodulation and inflammation, Classification of hypersensitivity reactions and diseases involved Therapeutic agents for allergy, asthma COPD and other immunological diseases with emphasis on immunomodulators.

TOTAL : 45 PERIODS

TEXT BOOKS
1. Satoskar, Pharmacology and Therapeutics
2. Tripathi, K.D. Medical Pharmacology
3. Mycek M.J., Gerlant S.B and Perper M.M. Pharmacology, Lippincott’s Illustrated
REFERENCES
2. Goodman and Gilman’s, The Pharmacological basis of therapeutics.
4. B. Lammer, Chronopharmacology

CH7751 TRANSPORT PHENOMENA

AIM
To give an overview of mass, momentum and energy transport, present the fundamental equations and illustrate how to use them to solve problems.

OBJECTIVES
To describe mass, momentum and energy transport at molecular, microscopic and macroscopic level, to determine velocity, temperature and concentration profiles

UNIT I MOMENTUM TRANSPORT
Viscosity, temperature effect on viscosity of gases and liquids, Newton’s law, mechanism of momentum transport, shell balance method, pressure and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW
Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT
Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier’s law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow, with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV EQUATIONS OF CHANGE FOR NONISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS
Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS
Diffusivity, temperature and pressure effect, Fick’s law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow: stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COLLOIDS AND INTERFACIAL PHENOMENA

UNIT I: INTRODUCTION TO INTERFACE AND COLLOIDAL SCIENCE
Examples of surface and colloidal phenomena in industry and nature, Historical perspective. Areas where future research is needed, nature of interfaces, Surface free energy, Work of cohesion and adhesion, Surface activity and surfactant structures, Physical and chemical interactions between atoms and molecules interactions between surfaces and particles, Surface tension.

UNIT II: ADSORPTION

UNIT III: CAPILLARITY
Capillary flow, Driving forces, Interfacial tension, Contact angle, Laplace expression for pressure difference across a curved interface, Capillary flow and spreading processes, Contact angle effects, Some practical capillary systems such as wetting in woven fibers and papers, repellency control, detergency, enhanced oil recovery

UNIT IV: ELECTROSTATIC FORCES AND ELECTRICAL DOUBLE LAYER
Sources of interfacial charge, Electrostatic theory, Coulomb’s law, Boltzmann’s distribution and the Electrical double layer, Double layer thickness, Specific ion adsorption and the sterno layer, Overview of electrokinetic phenomena (Electro-osmosis and Electrophoresis).

UNIT V: COLLOIDS AND COLLOIDAL STABILITY

TOTAL: 45 PERIODS

TEXT BOOK AND REFERENCES

COMPUTER AIDED DRUG DESIGN

UNIT I: STEREOCHEMISTRY AND DRUG DESIGN
Structurally Rigid Groups – Conformation – Configuration.

UNIT II: STRUCTURE, ACTIVITY RELATIONSHIP

UNIT III: QUANTITATION STRUCTURE – ACTIVITY RELATIONSHIP
Partitional parameters – partition coefficients – heplo substituent constants – electronic parameters – Hammet constant steric parameters – Hansch analysis

UNIT IV   DOCKING
Docking ligands to macromolecules – Docking algorithms - Dock – AUTODOCK

UNIT V   MOLECULAR SIMULATIONS
Molecular dynamic simulations – GROMACS – GROMOS – AMBER

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
The course is aimed to impart basic knowledge about crystal structures, phase diagrams and properties of materials.

OBJECTIVES
On completion of the course the students are expected to
- Have a basic understanding about crystal structures and various laws related to structures.
- Have learnt about various properties.
- Have basic knowledge about phase diagrams

UNIT I CRYSTAL STRUCTURE 9

UNIT II PHASE DIAGRAMS 9
Gibb’s Phase rule – thermodynamic criteria for phase stability – phase diagrams - single, binary and ternary phase diagrams – lever rule – applications of phase diagrams

UNIT III MECHANICAL PROPERTIES 9

UNIT IV ELECTRICAL AND ELECTRONIC PROPERTIES 9

UNIT V MAGNETIC, THERMAL AND OPTICAL PROPERTIES 9

TOTAL : 45 PERIODS

REFERENCES
UNIT I BASIC CONCEPTS OF POLYMERS

UNIT II CHAIN POLYMERISATION

UNIT III STEP GROWTH POLYMERSIATION
Kinetics of poly condensation reactions – copolymerization – co-polymer equation – copolymer compositions from 1H-NMR, FT-IR, UV spectra and chemical methods –Monomer reactivity ratios-Mayo-Lewis and Fineman-Ross methods- significance of reactivity ratios-Sequence length– Metathetical, Group transfer, Electrochemical and Ring-opening polymerisation

UNIT IV POLYMERIZATION TECHNIQUES
Polymerisation techniques– homogeneous and heterogeneous polymerisation – bulk (liquid, gas and solid monomers), solution, suspension and emulsion polymerisation –merits and demerits – interfacial, and melt poly condensation.

UNIT V MOLECULAR WEIGHT AND ITS DISTRIBUTION AND POLYMER PROPERTIES
Number, weight and viscosity average molecular weights of polymers– determination of constants in Mark Houwink’s equation. Poly dispersity index and molecular weight distribution – Molecular weight determination by GPC and viscometry; Polymer dissolution, thermodynamics of polymer dissolution –solubility parameter – Fractionation of polymers fractional precipitation and fractional dissolution methods. Effect of structure on mechanical, chemical, thermal, electrical and optical properties

TOTAL: 45 PERIODS

TEXT BOOK AND REFERENCES
Surface Chemistry of materials, Tissue Reaction, Wound Kinetics, biocompatibility, Various Techniques used for sterilization

UNIT II  
**TYPES OF MATERIALS AND THEIR TESTING**  
9  
Metals, Ceramics, treated natural materials. Testing with Tissue Culture, Testing with Soft Tissues and Testing at non Thrombogenic surface

UNIT III  
**BIOMEDICAL IMPLANTS**  
9  
Cardiac Implants, Orthopedic Implants, Neural and Neuro Muscular Implants, Trans cutaneous Implants, Intraocular lenses

UNIT IV  
**FUNDAMENTALS OF TISSUE ENGINEERING**  
9  
Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development. Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent. Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space. Cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.

UNIT V  
**APPLICATIONS OF TISSUE ENGINEERING**  
9  
Artificial organs, synthetic components, Replacement in Tissue structure or Functional Tissue engineering cartilage, Skin, and nerve regeneration.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


**REFERENCES**


PM7010  
**MOLECULAR MODELING AND DRUG DESIGN**  
L T P C  
3 0 0 3

**OBJECTIVES**

To learn, and understand the principles of ligand properties and prerequisites of computer aided ligand design; To plan and select in-silico approaches and tools; To execute effectively and analyse results of in-silico docking experiments for research in drug development

UNIT I  
**INTRODUCTION TO THE DRUG DISCOVERY/DEVELOPMENT**  
9  
Definition of Drug Discovery, Stages of drug discovery, Strategic Issues in drug discovery and Development, Chemistry, ligand sources – Natural, (Plants, Animals, Microorganisms), synthetic and semi-synthetics, graphical and structure viewers, structure file formats, protein databases, validation, advantage and limitations of various models, chemiinformatic databases

UNIT II  
**CRYSTALLOGRAPHY METHODS OF MODEL DEVELOPMENT**  
9  
Overview of protein crystallography, protein crystals, diffraction data, electron density data, phases, judging the molecular models, other diffraction methods for model building, tools for studying macromolecules

UNIT III  
**EMPIRICAL FORCE FIELDS MOLECULAR MECHANISMS**
Bond Stretching-Angel Bending-Torsional terms-Out of Plane bonding motions-Electrostatic interactions- Van Der Waals interactions-Effective pair Potentials-Hydrogen Bonding-Simulation of liquid water

UNIT IV  COMPUTER SIMULATION METHODS  12
Calculation of thermodynamic properties-Phase space-Practical aspects of computer simulation-Boundaries monitoring Equilibrium-Long range process-Analysing results of simulation and estimating errors; molecular dynamics simulate on methods, simulation- Constant dynamics-Time dependent properties-Molecular Dynamics at constant temperature and pressure, Monte Carlo Simulation Methods

UNIT V  MOLECULAR MODELLING METHODS  6
Molecular modelling in drug discovery-Deriving and using 3D Pharma cores-Molecular docking-Structure Based methods to identify lead components-Denovo ligand design

TOTAL: 45 PERIODS

TEXT BOOKS
3. Crystallography made crystal clear by Gale Rhodes

REFERENCES
1. COOT manuals
2. CCPSi suite manuals

PM7011  NUTRACEUTICALS  L T P C  3 0 0 3

OBJECTIVES
• To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
• To understand the role of Nutraceuticals and functional food in health and disease

UNIT I  INTRODUCTION AND SIGNIFICANCE  6
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes

UNIT II  ANALYSIS OF PHYTOCHEMICALS  11
Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; falavnols, polyphenols, tannins, saponins, lignans, Chitin; Caratenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

UNIT III  ASSESSMENT OF ANTIOXIDANT ACTIVITY  11
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 naturalphenolics from electrotropological state indices, Optimising phytochemical release by processes technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources

UNIT IV  ROLE IN HEALTH AND DISEASE  11
Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.
UNIT V SAFETY ISSUES
Health Claims, regulations and safety issues- International and national.

TOTAL: 45 PERIODS

TEXT BOOKS
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006
5. Tipnis, H.P. “Bioavailability and Bioequivalence : An Update” New Age International,

REFERENCES
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

UNIT I INTRODUCTORY CONCEPTS
Scaling in biology: basic review of the various sizes, time, and energy scales found in biological systems from organisms to atoms Microfabrication techniques: extensive review of the fundamentals of microfabrication technology: photolithography, electron beam lithography, micromachining, micromolding, and soft lithography

UNIT II MICROPATTERNING NON-CONVENTIONAL MATERIALS
Review of self-assembled monolayers, chemical grafting of biomolecules and thin polymeric layers; approaches to patterning those materials as well as cells

UNIT III MEMS APPLICATIONS
Microelectromechanical sensing of cell behavior: Introduction to bioelectricity, interaction of cells with electric fields, microphysiometer. Microengineered biosensors: Introduction to massively parallel measurements, implantable electrodes, microtweezers, immuno sensors. The frontiers of BioMEMS: Nanolithography, biomimetic nanodevices. Laboratory exercises will reinforce critical concepts provided in lectures.

UNIT IV MICROFLUIDICS AND NANOFLUIDICS
Microengineering fluid flows: Introduction to microfluidics and Nanofluidics, properties of biological fluids in microchannels, mathematical modeling of fluid flow, Applications in Drug delivery system design

UNIT V TISSUE MICROENGINEERING AND APPLICATIONS
Introduction to biomimetic substrates, micro scaffolds, cellular co-cultures Micro fabrication techniques that enable the control of cell-substrate, cell-cell, and cell-medium interactions, Introduction to enzymatic assays, DNA microarrays, optical detection methods amenable to miniaturization. Applications in controlled and targeted drug delivery

TOTAL: 45 PERIODS

TEXT BOOK AND REFERENCES
PM7017 VACCINE TECHNOLOGY

AIM
To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of bio-molecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I IMMUNOLOGICAL CONCEPTS IN VACCINOLOGY 9
Short history of vaccination, requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterisation and location of APC, MHC and immunogenicity, Rationale vaccine design based on clinical requirements: Hypersensitivity, Immunity to Infection, Autoimmunity, Transplantation, Tumor immunology, immunodeficiency, mechanism of adjuvant action, Scope of future vaccine strategies

UNIT II CLASSIFICATION OF VACCINES AND ITS PREPARATIONS 10
Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries, Transfusion of immuno-competent cells; Cell based vaccines

UNIT III VACCINE RESEARCH AND DESIGN 9
Fundamental research to rational vaccine design, Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Fundamentals of Immune recognition , implications for manipulating the T-Cell repertoire, Targetting Dendritic cells ; a rational approach for Vaccine development , Cellular basis of T-Cell memory , Rational design of new vectors , CpG adjuvant activity, Transcutaneous immunisation , Vaccination studies and recent advances in Malaria, Tuberculosis , HIV

UNIT IV COMPUTATIONAL TOOLS FOR VACCINE DESIGN 8
Antigen Sequence analysis, Epitope Mapping, Predictions of Immunogenic peptides of T-Celland B-Cells. Prediction of HLA binding peptides, Comparative Genomics as a tool for vaccine design, introduction to online epitope databases

UNIT V ANIMAL TESTING, COMMERCIALISATION, QUALITY CONTROL 9
Quality control and regulations in vaccine research, In-vitro experimental validations for predictions of vaccines by software , Animal testing , Rational design to clinical trials, Large scale production , Commercialisation, ethics.

TOTAL : 45 PERIODS

TEXTBOOKS

REFERENCES
OBJECTIVES:
To learn about basis of nanomaterial science, preparation method, types and application

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

UNIT III NANOMATERIALS
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO₂, MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dotspreparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES
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

UNIT V APPLICATIONS

TOTAL : 45 PERIODS

OUTCOMES:
Upon completing this course, the students
• Will familiarize about the science of nanomaterials
• Will demonstrate the preparation of nanomaterials
• Will develop knowledge in characteristic nanomaterial

TEXT BOOKS
REFERENCES

CH7072 INSTRUMENTATION AND PROCESS CONTROL L T P C 3 0 0 3

AIM
To familiarize the students with concepts of process dynamics and control leading to control system design.

OBJECTIVE
To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION 6
Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 11
Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 10
Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.

UNIT IV FREQUENCY RESPONSE 9
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings.

UNIT V ADVANCED CONTROL SYSTEMS 9
Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

IB7071 BIOCONJUGATE TECHNOLOGY AND APPLICATIONS L T P C 3 0 0 3

UNIT I FUNCTIONAL TARGETS 9
Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycol conjugates – modification of nucleic acids and oligo nucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 9
Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III  BIOCONJUGATE REAGENTS  9

UNIT IV  ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION  9
Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V  BIOCONJUGATE APPLICATIONS  9

TOTAL: 45 PERIODS

TEXT BOOK AND REFERENCE

IB7072  BIOLOGICAL SPECTROSCOPY  L T P C
3 0 0 3

OBJECTIVES:
• To deliver the knowledge of spectroscopic techniques and its functions
• To provide the technical information of spectroscopy for biological applications

UNIT I  OPTICAL ROTATORY DISPERSION 5

UNIT II  NUCLEAR MAGNETIC RESONANCE 10

UNIT III  MASS SPECTROMETRY 10
Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT IV  X-RAY DIFFRACTION 10

UNIT V  SPECIAL TOPICS AND APPLICATIONS 10
Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the student would be able understand Basics of optical rotary dispersion methods and nuclear magnetic resonance
• Principles and applications of mass spectrometry and X-ray diffraction
• About the microscopic techniques and applications
• And apply the spectroscopic techniques for various biological applications
UNIT I  BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS  
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. 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).

UNIT II  PROTEIN ARCHITECTURE  

UNIT III  TERTIARY STRUCTURE  
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  
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, bacterio rhodopsin 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  PROTEOMICS  
Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.

TOTAL: 45 PERIODS
REFERENCES

IB7751 BIOINFORMATICS LT P C
3 2 0 4

UNIT I
Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II
Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III
Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV

UNIT V
Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

TOTAL : 75 PERIODS

TEXT BOOKS
1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by
6. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall,O’Reilley Media

REFERENCE BOOK
UNIT I OVERVIEW OF DOWNSTREAM PROCESSING
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 SEPARATION
Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS
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
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
Crystallization, drying and lyophilization in final product formulation.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

UNIT I INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY
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
Theory, over determined 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
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 inter metabolite, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Metabolic Engineering: Principles and Methodologies  Gregory N. Stephanopoulos ,

REFERENCES

GE7071  DISASTER MANAGEMENT  L T P C  3 0 0 3

OBJECTIVES:
- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To enhance awareness of institutional processes in the country and
disaster response in areas where they live, with due sensitivity.

UNIT I  INTRODUCTION TO DISASTERS  9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II  APPROACHES TO DISASTER RISK REDUCTION (DRR)  9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III  INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT  9
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV  DISASTER RISK MANAGEMENT IN INDIA  9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.
UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context,
- Disaster damage assessment and management.

TEXTBOOKS:

REFERENCES
1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy

GE7074 HUMAN RIGHTS L T P C 3 0 0 3

OBJECTIVES:
- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I

UNIT II

UNIT III
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V

TOTAL : 45 PERIODS

OUTCOME:
Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

IB7753 IMMUNOLOGY

OBJECTIVES:
• To discuss the structure, functions and integration of immune system.
• To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
• To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I INTRODUCTION TO IMMUNE SYSTEM
Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptns, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex

UNIT II HUMORAL AND CELLULAR IMMUNITY
Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions

UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS
Inflammation; protective immune responses to virus, bacteria, fungi and parasites; tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy

UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY
Immune tolerance, Immuno deficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Autoimmune disorders and diagnosis

UNIT V APPLIED IMMUNOLOGY
Monoclonal antibodies, engineering of antibodies; Classification of Vaccines, methods of vaccine development, immunodiagnostic methods (Immuno diffusion ELISA, FACS), immuno modulatory drugs

OUTCOMES:
• The students after completing the course would be aware of immune system structure and functions.
• The students would be aware of immunity to various pathogens
• The students would be aware of the principles behind the production of therapeutic/diagnostic molecules.
• The students would be aware of the concepts and mechanism behind tumour development, allergy and hypersensivity reactions.

TEXT BOOKS:
1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., XIIth edition 2011. 52

REFERENCES:
OBJECTIVES:
- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I  FUNDAMENTALS OF PRODUCT DEVELOPMENT  9

UNIT II  REQUIREMENTS AND SYSTEM DESIGN  9

UNIT III  DESIGN AND TESTING  9

UNIT IV  SUSTENANCE ENGINEERING AND END-OF-LIFE (EoL) SUPPORT  9

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

**TEXTBOOKS:**
1. Book specially prepared by NASSCOM as per the MoU.

**REFERENCES:**