PROGRAMME OBJECTIVES:

The aim of this programme is to enable the students to learn basic and advanced facts in Pharmaceutical technology and to develop an understanding of the biological-efficacy of drugs.

- This programme will provide students with a solid foundation in Chemical engineering, Pharmaceutics, Pharmaceutical Chemistry, Pharmacology and Pharmacognosy as per the requirement of Pharmaceutical Industries, and also to pursue higher studies.
- This programme will facilitate the students to acquire knowledge in fields such as genetic engineering, protein engineering and recombinant DNA technology enabling their application through pharmacogenomic approaches. It will also empower the students to have advanced focus on the molecular pathogenesis of infectious diseases and necessary pharmacological approach.
- This programme will aid the students to know the significance of Bioethical standards and an extensive understanding of the regulatory guidelines of Drugs and its dosage forms aided by the advantages and risks in the statistical evaluation of Drugs through Clinical trials. It will also help the students to know about the pharmacokinetics of drug, its metabolism and its immunopharmacological response through in-depth understanding about the Human physiology.

PROGRAMME OUTCOME:

Graduates of the program will be having fundamental knowledge in biosciences, chemical engineering and strong background in pharmaceutical technology and be able to use these tools in industry and/or institutes where ever necessary.
## ANNA UNIVERSITY, CHENNAI
**AFFILIATED INSTITUTIONS**
**R -2013**
**B. TECH. PHARMACEUTICAL TECHNOLOGY**
**I – VIII SEMESTERS CURRICULUM AND SYLLABUS**

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**B. TECH. PHARMACEUTICAL TECHNOLOGY**

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OBJECTIVES:
- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I
9+3
Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one’s place, important festivals etc. – Introducing oneself, one’s family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one’s leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II
9+3
Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III
9+3
Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV
9+3
Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V
9+3
Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
Learners should be able to
• speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
• write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
• read different genres of texts adopting various reading strategies.
• listen/view and comprehend different spoken discourses/excerpts in different accents

TEXTBOOKS:

REFERENCES:

EXTENSIVE Reading (Not for Examination)

WEBSITES:

TEACHING METHODS:
• Lectures
• Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
• Discussions
• Role play activities
• Short presentations
• Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

EVALUATION PATTERN:

Internal assessment: 20%
3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like
• Project
All the four skills are to be tested with equal weightage given to each.

- Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6151 MATHEMATICS – I

OBJECTIVES:
- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 9+3

UNIT II SEQUENCES AND SERIES 9+3

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3
Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

UNIT V MULTIPLE INTEGRALS 9+3

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
• This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

REFERENCES:

PH6151 ENGINEERING PHYSICS – I

OBJECTIVES:
• To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I CRYSTAL PHYSICS
Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS

UNIT III QUANTUM PHYSICS

UNIT IV ACOUSTICS AND ULTRASONICS

9
Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

UNIT V        PHOTONICS AND FIBRE OPTICS  9
Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

OUTCOMES:
• The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXT BOOKS:
1. Arumugam M. Engineering Physics. Anuradha publishers, 2010

REFERENCES:
1. Searls and Zemansky. University Physics, 2009
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
UNIT II CHEMICAL THERMODYNAMICS  
Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van’t Hoff isotherm and isochore (problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY  

UNIT IV PHASE RULE AND ALLOYS  

UNIT V NANOCHEMISTRY  
Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications

TOTAL :45 PERIODS

OUTCOMES:
• The knowledge gained on polymer chemistry, thermodynamics, spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
The students should be made to:
• Learn the organization of a digital computer.
• Be exposed to the number systems.
• Learn to think logically and write pseudo code or draw flow charts for problems.
• Be exposed to the syntax of C.
• Be familiar with programming in C.
• Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION 8

UNIT II C PROGRAMMING BASICS 10

UNIT III ARRAYS AND STRINGS 9

UNIT IV FUNCTIONS AND POINTERS 9

UNIT V STRUCTURES AND UNIONS 9
Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

OUTCOMES:
At the end of the course, the student should be able to:
• Design C Programs for problems.
• Write and execute C programs for simple applications.

TEXTBOOKS:

REFERENCES:

GE6152 ENGINEERING GRAPHICS

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OBJECTIVES:
- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To 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 HAND SKETCHING
Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

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 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 one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of above 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.

COMPUTER AIDED DRAFTING (Demonstration Only)
Introduction to drafting packages and demonstration of their use.

TOTAL : 75 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- perform free hand sketching of basic geometrical constructions and multiple views of objects.
• do orthographic projection of lines and plane surfaces.
• draw projections and solids and development of surfaces.
• prepare isometric and perspective sections of simple solids.
• demonstrate computer aided drafting.

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.

GE6161 COMPUTER PRACTICES LABORATORY  L T P C
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OBJECTIVES:
The student should be made to:
• Be familiar with the use of Office software.
• Be exposed to presentation and visualization tools.
• Be exposed to problem solving techniques and flow charts.
• Be familiar with programming in C.
• Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:
1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
• Apply good programming design methods for program development.
• Design and implement C programs for simple applications.
• Develop recursive programs.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:
Standalone desktops with C compiler 30 Nos.
(or)
Server with C compiler supporting 30 terminals or more.

GE6162 ENGINEERING PRACTICES LABORATORY

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 & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:
(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE
Welding:
(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example –
   Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 10
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
   4. Measurement of electrical quantities – voltage, current, power & power
      factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

IV ELECTRONICS ENGINEERING PRACTICE 13
1. Study of Electronic components and equipments – Resistor, colour coding
   measurement of AC signal parameter (peak-peak, rms period, frequency) using
   CR.
2. Study of logic gates AND, OR, EOR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose
   PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

OUTCOMES:
• ability to fabricate carpentry components and pipe connections including plumbing
  works.
• ability to use welding equipments to join the structures.
• ability to fabricate electrical and electronics circuits.

REFERENCES:
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
   (e) Hand Drilling Machine 2 Nos
   (f) Jigsaw 2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
9. Study-purpose items: centrifugal pump, air-conditioner One each.

ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos
   (b) Digital Live-wire detector 2 Nos

ELECTRONICS

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I

OBJECTIVES:
- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.
LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. (a) Determination of Wavelength, and particle size using Laser
(b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of Young’s modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster’s Bridge

OUTCOMES:
• The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee’s Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster’s bridge set up
   (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY- I

OBJECTIVES:
• To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
• To acquaint the students with the determination of molecular weight of a polymer by vacometry.

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. Determination of DO content of water sample by Winkler’s method.
2. Determination of chloride content of water sample by argentometric method.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of acids in a mixture using conductivity meter.
5. Estimation of iron content of the water sample using spectrophotometer.
   (1,10- phenanthroline / thiocyanate method).
7. Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:
• The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

REFERENCES:

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
  1. Iodine flask - 30 Nos
2. pH meter - 5 Nos
3. Conductivity meter - 5 Nos
4. Spectrophotometer - 5 Nos
5. Ostwald Viscometer - 10 Nos

Common Apparatus: Pipette, Burette, conical flask, porcelain tile, dropper (each 30 Nos.)

HS6251 TECHNICAL ENGLISH II

OBJECTIVES:
- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT I

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using ‘emoticons’ as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. ‘can’) - Homophones (e.g. ‘some’, ‘sum’); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one’s friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises),Recording students' dialogues.

UNIT III

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. ‘rock’, ‘train’, ‘ring’); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play
and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

OUTCOMES:
Learners should be able to
• speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
• write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
• read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
• listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXTBOOKS:

REFERENCES:

EXTENSIVE Reading (Not for Examination)

Websites
2. http://owl.english.purdue.edu

TEACHING METHODS:
• Lectures
Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
• Long presentations using visual aids
• Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
• Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%
3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like
• Project
• Assignment
• Report
• Creative writing, etc.
All the four skills are to be tested with equal weightage given to each.
✓ Speaking assessment: Individual presentations, Group discussions
✓ Reading assessment: Reading passages with comprehension questions graded following Bloom’s taxonomy
✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom’s taxonomy.

End Semester Examination: 80%

MA6251 MATHEMATICS – II

OBJECTIVES:
• To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
• 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 the 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 VECTOR CALCULUS 9+3
Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 9+3
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III LAPLACE TRANSFORM 9+3
Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and

UNIT IV          ANALYTIC FUNCTIONS  9+3
Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w = z+k, kz, 1/z, z², e² and bilinear transformation.

UNIT V          COMPLEX INTEGRATION  9+3
Complex integration – Statement and applications of Cauchy’s integral theorem and Cauchy’s integral formula – Taylor’s and Laurent’s series expansions – Singular points – Residues – Cauchy’s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:
- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

REFERENCES:
particle in a box (in one dimension) – electrons in a metal – Density of energy states –
effect of temperature on Fermi energy – carrier concentration in metals – Superconducting
Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I
and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III  ELECTRONIC MATERIALS  9
Elemental and compound semiconductors - Origin of band gap in solids (qualitative) -
Concept of effective mass of electron and hole – carrier concentration in an intrinsic
semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature –
electrical conductivity – band gap determination – carrier concentration in n-type and p-type
semiconductors (derivation) – variation of Fermi level with temperature and impurity
concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient –
LED and Solar cells.

UNIT IV  INSULATING AND MAGNETIC MATERIALS  9
Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space
charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric
loss – different types of dielectric breakdown – classification of insulating materials and their
applications - Introduction to magnetic materials - Domain theory of ferromagnetism,
Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites,

UNIT V  CERAMIC AND NEW MATERIALS  9
Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics –
Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys –
Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological
fluids - Sensors and Actuators – polymer semiconductors – photoconducting polymers –
liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials –
hydroxyapatite – PMMA – Silicone.

REFERENCES
Imprints, 2006

GE6253  ENGINEERING MECHANICS  L T P C
3 1 0 4

OBJECTIVES:
• To develop capacity to predict the effect of force and motion in the course of carrying
out the design functions of engineering.

UNIT I  BASICS AND STATICS OF PARTICLES  12
Introduction – Units and Dimensions – Laws of Mechanics – Lami’s theorem, Parallelogram
and triangular Law of forces – Vectorial representation of forces – Vector operations of
forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular
components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space
– Equivalent systems of forces – Principle of transmissibility.

UNIT II  EQUILIBRIUM OF RIGID BODIES  12
Free body diagram – Types of supports –Action and reaction forces –stable equilibrium –
Moments and Couples – Moment of a force about a point and about an axis – Vectorial
representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III  PROPERTIES OF SURFACES AND SOLIDS  12

UNIT IV  DYNAMICS OF PARTICLES  12

UNIT V  FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS  12
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

OUTCOMES:
• ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
• ability to analyse the forces in any structures.
• ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

REFERENCES:
OBJECTIVES

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

UNIT I  BIOCHEMICAL ORGANIZATION AND BIOENERGETICS  10
Scope of clinical biochemistry, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, the concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics and biological oxidation - general concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation and oxidative phosphorylation

UNIT II  BIOMOLECULES  12

UNIT III  BIOENERGETICS  5
High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, Calculation of ATP during oxidation of glucose and fatty acids.

UNIT IV  MACROMOLECULES, VITAMINS, HORMONES, ENZYMES  10
Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and inhibition, coenzyme significance and enzymes of clinical importance

UNIT V  BIOCHEMISTRY OF CLINICAL DISEASES  8
Diabetes mellitus, atherosclerosis, fatty liver, and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests

TOTAL: 45 PERIODS

TEXTBOOKS

REFERENCES
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  7
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 PULMONARY SYSTEM  9
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  10
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

BT6211 BIOCHEMISTRY LABORATORY

L T P C
0 0 4 2

OBJECTIVES
• 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.

LIST OF EXPERIMENTS
1. Preparation and measurement of pH of standard buffers (phosphate, carbonate, borate, TRIS etc.).
2. Qualitative analysis of carbohydrates (monosaccharides, disaccharides, polysaccharides etc.)
3. Enzymatic hydrolysis of glycogen by α and β amylase
4. Qualitative analysis of proteins
5. Qualitative analysis of lipids (triglycerides, cholesterol, phospholipids etc.)
6. Quantitative analysis of proteins (Lowry's method, Bradford, UV)
7. Quantitative analysis of carbohydrates (Benedict's method etc.) lipids
8. Quantitative analysis of lipids (Benedict's method etc.)
9. Quantitative estimation of blood glucose
10. Acid hydrolysis and action of salivary amylase on starch
11. Estimation of chloride, glucose, ammonia and creatinine in urine.
12. Quantitative analysis of urea in serum
13. Quantitative analysis of serum bilirubin
14. Quantitative estimation of serum cholesterol by Libermann Burchard's method
15. Isolation and assay of glycogen from the liver and skeletal muscle of mice

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. UV-Visible Spectrophotometers
2. pH meter
3. Centrifuge

TEXT BOOKS:
1. Gupta R.C. and Bhargavan S. Practical Biochemistry.

REFERENCES:
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. Pippete aids
3. Haemocytometer
4. B.P. meter

TEXT BOOKS:

2. Tortora Gerard J. and Nicholas P. Principles of anatomy and physiology Publisher Harpercollins college New York.

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”.
4. Chatterjee C.C., Human Physiology.
OBJECTIVES:
To the study of nature and the facts about environment.
- To finding and implementing 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 Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II Environmental Pollution
Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry; Mitigation procedures- Control of particulate and gaseous emission, Control of SO2, NOx, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – 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 overutilization of surface and ground 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. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; 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. Introduction to Environmental Biochemistry: Proteins –
Biochemical degradation of pollutants, Bioconversion of pollutants.
Field study of local area to document environmental assets – river / forest / grassland / hill /
mountain.

UNIT IV     SOCIAL ISSUES AND THE ENVIRONMENT
From unsustainable to sustainable development – urban problems related to energy – water
conservation, rain water harvesting, watershed management – resettlement and
rehabilitation of people; its problems and concerns, case studies – role of non-governmental
organization- environmental ethics: Issues and possible solutions – 12 Principles of green
chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation –
consumerism and waste products – environment production act – Air act – Water act –
Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and
Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly
products (Ecomark), enforcement machinery involved in environmental legislation- central
and state pollution control boards- disaster management: floods, earthquake, cyclone and
landslides. Public awareness.

UNIT V     HUMAN POPULATION AND THE ENVIRONMENT
Population growth, variation among nations – population explosion – family welfare
– women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role
of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

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 environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconception
- Development and improvement in std. of living has lead to serious environmental
  disasters

TEXT BOOKS:

REFERENCES:
1. R.K. Trivedi, ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and
3. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India PVT LTD, New Delhi,
   2007.
   (2005)

MA6468     PROBABILITY AND STATISTICS

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

UNIT I  
**RANDOM VARIABLES**  
9 + 3
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II  
**TWO - DIMENSIONAL RANDOM VARIABLES**  
9 + 3
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III  
**TESTING OF HYPOTHESIS**  
9 + 3
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV  
**DESIGN OF EXPERIMENTS**  
9 + 3
One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - $2^2$ factorial design.

UNIT V  
**STATISTICAL QUALITY CONTROL**  
9 + 3
Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

**TOTAL (L:45+T:15): 60 PERIODS**

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

**TEXT BOOKS:**

**REFERENCES:**
To inculcate understanding of the properties and principles of medicinal agents that originate from organic and inorganic sources and their application in pharmaceutical industry
To provide the basic functional group identification, chemical bonding with their mechanism.
To provide the basic principles involved in the identification and estimation of pharmaceutical substances.

UNIT I  STRUCTURE AND PROPERTIES  9
Molecular orbital theory, hybrid orbitals, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding.

UNIT II  CHEMISTRY OF ALIPHATIC AND AROMATIC COMPOUNDS 10
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 nonbenzenoid 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 9
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 12
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 10
Definition, principles and properties of various agents such as – Sodium bisulphate, Sodium metabisulphate, Sulphurdioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium carboxy methyl cellulose, Sodium methylparaben 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
OBJECTIVES:
To enable the students to

- Acquire fairly good knowledge about the microbial pathogens and its impact upon health.
- Learn and understand the conceptual and experimental basics of microbiology to continue to develop a scientific attitude towards problem solving and the creation and testing of hypothesis to gain a greater appreciation, analyze logically about the interconnectedness of the general principles and concepts of microbiology in pharmaceutical sciences.

UNIT I INTRODUCTION 6
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining. Sterilization: Detail study of different methods of sterilization including their merits and demerits.

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

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12
Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CLINICAL MICROBIOLOGY 6
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

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

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to

- Describe about the fundamental concepts, principles and clinical and environmental applications of Microbiology with special reference to Pharmaceutical Industries.
- Solve problems in the context of this understanding of microorganisms and the role they play in health and disease.

TEXT BOOKS:
REFERENCES:

PY6303 FLUID FLOW OPERATIONS L T P C
3 0 0 3

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 9

UNIT II MOMENTUM BALANCE AND ITS APPLICATIONS 9

UNIT III FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS 9

UNIT IV FLOW OF FLUIDS THROUGH SOLIDS 9

UNIT V TRANSPORTATION AND METERING 9

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:

PY6304 MASS TRANSFER OPERATIONS

OBJECTIVES:
- To provide the fundamentals of diffusion and the analogies of mass transfer, leading up to mass transfer coefficients and their use in solving the problems.
- To provide the basic concepts of mass transfer operations for separation processes.
- Apply this knowledge to design a mass transfer equipment

UNIT I DIFFUSION
Diffusion in fluids: Molecular and eddy diffusion measurement and calculation of diffusivities – Ordinary diffusion in multi component gaseous mixtures – Interphase mass transfer – Mass transfer coefficients – Theories of mass transfer.

UNIT II ABSORPTION

UNIT III DISTILLATION

UNIT IV LEACHING
Solid-liquid extraction – Description of leaching operations and technologies – Applications of leaching – Preparation of solid – Methods of operation and classification of equipment – Solid-liquid equilibrium in leaching – Multi stage cross current and counter current leaching – Calculation of composition and number of stages.

UNIT V DRYING
Drying – Principle and definitions – Estimation of drying rates – Drying rate curve – Critical and equilibrium moisture content – Calculation of drying time under constant drying conditions – Different types of dryers.

OUTCOMES:
The student will be able to
- Calculate the rate of mass transfer and its coefficients.
- Design mass transfer equipment for separation process.

TEXT BOOKS:
REFERENCES:

PY6311 PHARMACEUTICAL CHEMISTRY LABORATORY

OBJECTIVES:
- To provide practical knowledge on the preparation and quality control of fine chemicals and bulk drugs by physical, chemical and qualitative analysis.

LIST OF EXPERIMENTS
1. Limit test for chlorides, sulphates, iron in some pharmacopoeial compounds
2. Determination of physical constants – melting point, boiling point and viscosity
3. Preparation and identification tests of the following official (IP) compounds:
   a. Magnesium sulphate, Calcium Carbonate
4. Preparation and identification tests of the following official (IP) compounds:
   Ferrous Sulphate, Boric acid
5. Synthesis of compounds involving benzylation, acetylation, bromination, reduction & oxidation:
   1. Picric acid
   2. Aniline
   3. Acetanilide
   4. Aspirin

TOTAL: 60 PERIODS

OUTCOMES:
- Able to understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results.
- Able to perform chemical synthesis of organic compounds.
- Able to carry out quality control tests for fine chemicals and bulk drugs

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Melting point apparatus
2. Analytical balance
3. Oswald Viscometer
4. Reflux condenser
5. Electric water bath
6. Heating mantle

TEXTS BOOKS:
OBJECTIVES:
- To conduct experiments on microbial isolation and identification techniques, microbe quantification, antibiotic sensitivity assay and growth curve of microbes.

LIST OF EXPERIMENTS
1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques.
2. Culture Media-Types and Use.
3. Preparation of Nutrient broth and agar
4. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: 
5. Pour plates, streak plates, spread plates, slants and stabs.
7. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram’s, flagellar Staining and endospore staining.
9. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC in agar plates
10. Effect of Disinfectants- Phenol Coefficient
11. Antibiotic Sensitivity Assay
12. Growth Curve in Bacteria and Yeast
13. Effect of pH, Temperature, UV radiation on Growth Bacteria
14. Isolation of clinically important pathogens – Urine, Blood, Serum and Sputum

OUTCOMES:
- Students can able to handle the pathogenic microorganism with proper aseptic procedure in and out of the laboratory setting.
- The student will be able to explain the roles of microbes in elemental cycles on earth and waste decontamination methods based on microbial activities and thus its application in commercial industry.
- Students can able to produce the primary and secondary metabolites through microbial fermentation techniques.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Hot air oven
2. Autoclave
3. Incubator
4. Laminar flow hood
5. Colony counter
6. Calorimeter
7. Antibiotic zone reader
8. Antibiotic zone reader scale
9. Microbial shaker incubator
10. Refrigerator
11. -20°C deep freezer  
12. Compound Microscope  
13. Multipoint inoculator  
14. Micro plate reader  
15. Lyophilizer  
16. Liquid nitrogen(Cryo preservation)  
17. UV-visible spectrophotometer

TEXT BOOKS:

PY6401 UNIT OPERATIONS IN PHARMACEUTICAL INDUSTRY L T P C  
3 1 0 4

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

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 9  
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 9  

UNIT III CRYSTALLIZATION 9  

UNIT IV HUMIDITY CONTROL, REFRIGERATION AND AIR-CONDITIONING 9  
Basic concepts, definition, wet bulb and adiabatic saturation temperatures, psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy. Equipments for dehumidification operations, principle and applications of refrigeration and air conditioning.

UNIT V EVAPORATION 9  
Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and Mathematical problems on evaporation.

TOTAL (L:45 + T:15) : 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:**

**PY6402**  
**HEAT TRANSFER**  
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**OBJECTIVE:**
To provide the knowledge of various modes of heat transfer, calculations and applications of the different modes to design of heat transfer equipments.

**UNIT I**  
**FUNDAMENTAL CONCEPTS AND CONDUCTIVE HEAT TRANSFER**  
9

**UNIT II**  
**CONVECTIVE HEAT TRANSFER AND BOUNDARY LAYER THEORY**  
9
Heat transfer coefficient – Forced convection – Free convection – Dimensional analysis and empirical correlation – Physical significance of dimensionless groups – Concept of hydrodynamic and thermal boundary layers.

**UNIT III**  
**THERMAL RADIATION**  
9

**UNIT IV**  
**DESIGN OF HEAT EXCHANGERS**  
9
Heat exchangers – Types and variation in design – Overall heat transfer coefficient – LMTD – Correction factors for multiple pass heat exchanger – Illustrative examples – Number of transfer units and effectiveness of heat exchangers.

**UNIT V**  
**HEAT TRANSFER IN EVAPORATORS**  
9

**TOTAL : 45 PERIODS**

**OUTCOMES:**
The student will be able to
• Identify different types of heat exchange equipment and understand the Principles of heat flow in fluids.
• Understand the various modes of heat transfer and detailed calculations of conduction, steady state and unsteady state.
• Test performance and measure heat transfer parameters in designing heat transfer equipment.

TEXT BOOKS:

REFERENCES:

PY6403 CELL AND MOLECULAR BIOLOGY

OBJECTIVES:
• To provide the molecular processes of DNA replication, transcription and translation in cells.
• To provide the basic concepts of protein and nucleic acid structure and its function in both prokaryotic and eukaryotic organisms.

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES

UNIT II CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS
Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, immortalization of cells and its applications.

UNIT III CHEMISTRY OF NUCLEIC ACIDS & DNA REPLICATION
Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Structure of DNA: Primary, Secondary, Tertiary, DNA supercoiling; Overview of Central dogma; Organization of prokaryotic and eukaryotic chromosomes; DNA replication: Proteomics, Fidelity, Inhibitors and Overview of differences in prokaryotic and eukaryotic DNA replication; Telomere replication in eukaryotes.

UNIT IV TRANSCRIPTION & TRANSLATION

UNIT V MUTAGENESIS, MUTATION AND MUTANTS
Biochemical basis of mutants, Mutagenesis-Base analogue mutagens, Chemical mutagens, Mutagenesis by intercalating substances, Site specific mutagenesis, Restriction Polymorphism to detect mutant sites in humans

**TOTAL : 45 PERIODS**

**OUTCOMES:**
The student will be able to
- Understand the various levels of gene regulation and protein function including signal transduction and cell cycle control.
- Interpret the outcome of experiments that involve the use of recombinant DNA technology and other common gene analysis techniques.
- Relate properties of cancerous cells to mutational changes in gene function.

**TEXT BOOKS:**

**REFERENCES:**

**PY6404 PHYSICAL PHARMACEUTICS**

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

**UNIT I MICROMERITICS AND POWDER RHEOLOGY**
10
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
Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy. Suspensions and Emulsions : Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions ; types, theories, physical stability.

**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.

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:

UNIT V PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA 9

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
- Select appropriate thermodynamic processes and solutions to meet the specified needs.

TEXT BOOKS:

REFERENCES:

PY6406 PHARMACOLOGY

OBJECTIVES:
- To provide the general pharmacological principles.
- To make understand the pharmacology of different types of drugs acting on various physiological systems.

UNIT I GENERAL PHARMACOLOGY 9
Routes of administration, Pharmacokinetics, Pharmacodynamics, Receptors, Mechanism of action of drugs, Factors modifying drug action, adverse drug reaction, drug interactions, Bioassay of drugs, drug discovery and development.

UNIT II PERIPHERAL AND CENTRAL NERVOUS SYSTEM 12
Mechanism of action, Pharmacology of parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking agent, general anaesthetics, antipsychotics, antidepressants, antiepileptic, analgesics, antipyretic, anti-inflammatory (NSAIDS), CNS stimulants.

UNIT III CARDIOVASCULAR PHARMACOLOGY 9
Classification, Mechanism of action, Pharmacology of cardiac glycosides, anti anginal, antihypertensive agents, vasodilators including calcium channel blockers, anti arrhythmic and anti hyperlipidemic agents.
UNIT IV  ANTIMICROBIAL PHARMACOLOGY  10
General principles of chemotherapy, sulphonamides, antibiotics – penicillins, cephalosporins, chloramphenicol, macrolides, fluoroquinolones. Chemotherapy of tuberculosis, leprosy, fungal, viral diseases, malignancy and immunosuppressive agents.

UNIT V  GASTROINTESTINAL PHARMACOLOGY  5
Classification, Mechanism of action, Antacids, anti ulcer drugs, laxatives and anti diarrhoeal, emetics and antiemetics.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the various principles of general pharmacology.
- Understand the pharmacology and mechanism of action of various categories of drugs such as nervous, cardiovascular, gastrointestinal and antimicrobial agents.

TEXT BOOKS:

REFERENCES:

PY6411  FLUID FLOW OPERATIONS AND HEAT TRANSFER LABORATORY  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:

PY6412 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.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course the students able to
- Characterize and evaluate the properties of powders by using suitable methods.
- Plan and carry out 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 Subrahmanyan, SG Vasantha Raju, Laboratory Manual of Physical Pharmacy, 2 Ed., Vallabh Publications / Prakashan, 2009

REFERENCES:

PY6501

BIOCHEMICAL ENGINEERING

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
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 scale up operations.

TEXT BOOKS:

REFERENCES:

PY6502 ANALYTICAL METHODS OF PHARMACEUTICALS

OBJECTIVES:
• To provide the concept of pharmacopoeia monograph.
• To provide the fundamental and principles of various analytical instruments and its technique used in pharmaceutical industry.

UNIT I PHYSICAL METHODS 9
Pharmaceutical Analysis- Qualitative and quantitative analysis – Significance-Pharmacopoeia, 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 TITRATIONS 9
Acid base theory- Arrhenius, Bronsted-Lowry, Lewis acid- base indicators, theory of, effective range and choice of, titration curves for acid-base titration, mixed solvents, non-aqueous titration, pharmacopoeial applications . Precipitation titration, Argentimetric titrations, Mohr’s method, Vollhard’s method, examples in pharmacopoeia, complexometric titration, redox titrations, half reactions and half equations, redox equivalent weights, reduction potential, significance of reduction potential, standard reduction potentials, iodimetry, iodometry, iodine displacement reactions.

UNIT III ULTRAVIOLET SPECTROSCOPY 9
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 IV INFRARED AND NMR SPECTROSCOPY 9
Principles of vibrational spectroscopy – Instrumentation and sampling technique – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications.

UNIT V CHROMATOGRAPHY 9
Thin Layer Chromatography Adsorbents, solvents, elutropic 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, Solvents, retention factor, symmetry factor, resolution, theoretical plate.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
• Understand the various techniques in the field of Pharmaceutical Analysis.
• Choose proper analytical method for qualitative and quantification of the pharmaceutical substances.

TEXT BOOKS:

REFERENCES:

PY6503 REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES L T P C
3 0 0 3

OBJECTIVE:
To provide the concept of the pharmaceutical industrial manufacturing practices, quality attributes of pharmacy products and patenting activities.
UNIT I  REGULATORY CONCEPTS  9
Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT II  REGULATORY ASPECTS  9
Pharmaceuticals – Bulk drug manufacture – Biotechnology derived products.

UNIT III  INTELLECTUAL PROPERTY RIGHTS  9

UNIT IV  ICH GUIDELINES  9
Quality guidelines – Impurities in new drug substances (Q3A R) – Impurities in new drug products – Validation of analytical procedures text and methodology (Q2 R1).

UNIT V  QUALITY AUDIT AND SELF INSPECTIONS  9
SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

TOTAL: 45 PERIODS

OUTCOMES:
The student will
- Familiarise with the pharmaceutical industrial manufacturing practices, quality attributes of pharmacy products, patenting activities, etc.,
- Understand the various quality guidelines of pharmaceutical products, patenting activities and the significance of its documentation.

TEXT BOOKS:

REFERENCES:

PY6504  MEDICINAL CHEMISTRY  L T P C
3 1 0 4

OBJECTIVE:
To provide the basic knowledge such as physicochemical properties, classification, structure activity relationship and mechanism of action of various medicinal agents.

UNIT I  PRINCIPLES OF MEDICINAL CHEMISTRY  9
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.

UNIT II  MEDICINAL CHEMISTRY OF DRUGS ACTING ON ANS AND CNS  9
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 sympathomimetic agents, adrenergic antagonists, Antipsychotics, Anticonvulsants, Analgesics.

UNIT III MEDICINAL CHEMISTRY OF ANTI-INFECTIVE AGENTS 9
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, and synthesis of selected drugs belonging to the class of sulphonamides, penicillins and cephalosporins, aminoglycosides and tetracyclines.

UNIT IV MEDICINAL CHEMISTRY OF DRUGS ACTING ON CVS 9
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides.

UNIT V MEDICINAL CHEMISTRY OF ANTIHISTAMINIC AGENTS AND EICOSANOIDSB 9
Classification, structure basis of mechanism of action, structure activity relationship including drugs acting on Histamine receptors, eicosanoids biosynthesis, drug action mediated by eicosanoids, design of eicosanoid drugs, antipyretics, anti-rheumatoid drugs and non-steroidal anti-inflammatory drugs.

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:
The student will be able to
• Understand the molecular basis, biochemical, physiochemical properties and synthesis of medicinal agents.
• Understand the mechanism of action, structure activity relationship including stereo chemical aspects of the medicinal agents acting on various physiological systems.

TEXT BOOKS:

REFERENCES:

BT6561 BIOPROCESS 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 – Michalis 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

- Bio reactor (Fermentor)-lab scale
- Microbial shaker incubator
- Cooling centrifuge
- Refrigerator
- Incubator

REFERENCES:

BT6562 ANALYTICAL METHODS OF PHARMACEUTICALS LABORATORY

OBJECTIVES:
To carry out analytical experiments related to titrimetric, chromatographic and spectrophotometric techniques.

LIST OF EXPERIMENTS

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 Mohrs Volhards 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 pharmacopeial 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

TOTAL: 60 PERIODS

OUTCOMES:

Student will be able to perform

- Preparation and standardization of various assay reagents with respect to chemical and drug analysis
- Separation and quantification of chemicals, drugs and metabolites by chromatographic and spectral techniques.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. UV spectrophotometer
2. Hot air oven
3. Digital weighing balance
4. Digital pH meter

REFERENCES:


GE6757 TOTAL QUALITY MANAGEMENT

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OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Benchmarking - Reason to benchmark, Benchmarking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II

UNIT V QUALITY SYSTEMS

TOTAL: 45 PERIODS

OUTCOME:
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXTBOOK:

REFERENCES:

PY6601 PHARMACEUTICAL DOSAGE FORMS

OBJECTIVE:
To provide the concepts of various parameters involved in the formulation and development of various dosage forms.

UNIT I PREFORMULATION STUDIES AND MONOPHASIC LIQUID DOSAGE FORMS

53

UNIT II BIPHASIC SYSTEMS AND SEMI SOLID DOSAGE FORMS 9

UNIT III SOLID DOSAGE FORMS 9

UNIT IV PARENTERAL PRODUCTS 9

UNIT V PHARMACEUTICAL AEROSOLS 9
Components of aerosol package – Formulation, Stability testing, Manufacture, Quality control and Testing of pharmaceutical aerosols

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:
The student will be able to
- Understand the factors influencing the development of various dosage forms.
- Understand the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.

TEXT BOOKS:

REFERENCES:
PY6602    PROCESS EQUIPMENT DESIGN    L T P C
                                                         3 1 0 4

OBJECTIVE:
To provide the basic concepts and principles in designing of equipments used in heat transfer, evaporation, distillation and drying.

UNIT I    HEAT EXCHANGERS    9
Design of shell and tube heat exchangers - Double pipe heat exchangers.

UNIT II    EVAPORATORS    9
Design of single and multiple effect evaporators

UNIT III    DISTILLATION    9
Design of distillation columns- sieve and bubble cap towers

UNIT IV    ABSORPTION COLUMNS    9
Design of absorption columns- plate and packed columns

UNIT V    DRYERS    9
Design of batch and continuous dryers

TOTAL (L:45 +T:15 ) : 60 PERIODS

OUTCOMES:
The student will be able to
• Understand the basic concepts and principles in designing of equipments.
• Understand the basic design of equipments used in heat transfer such as evaporation, distillation and drying.

TEXT BOOKS:

REFERENCES:

BT6703    CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT    L T P C
                                                     3 0 0 3

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

UNIT I    INTRODUCTION    9
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    9
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

UNIT III    NEW PRODUCT DEVELOPMENT    9

UNIT IV NEW PRODUCT PLANNING 9
Design of prototype - testing - quality standards - marketing research - introducing new products

UNIT V MODEL PREPARATION & EVALUATION 9
Creative design - Model Preparation - Testing - Cost evaluation - Patent application

OUTCOME:
On completion of the course, students will have gained knowledge on various issues related to Patents, Quality, Creativity, Innovation, New Product Development, Planning and Evaluation.

TEXT BOOKS:

REFERENCES:

PY6611 PHARMACEUTICAL DOSAGE FORMS LABORATORY

OBJECTIVE:
To study, the basic principles in formulating liquid, semisolid, solid and parenteral dosage forms and their evaluations.

LIST OF EXPERIMENTS
1. Preparation of solutions
2. Preparation of suspensions
3. Evaluation of suspensions
4. Preparation of emulsions
5. Evaluation of emulsions
6. Preparation of creams
7. Evaluation of creams
8. Preparation of ointments
9. Evaluation of ointments
10. Preformulation studies on prepared granules
11. Manufacture and evaluation of granules - wet granulation and dry granulation methods
12. Preparation of tablets
   a. Tablets prepared from wet and dry granules
   b. Tablets prepared by direct compression
   c. Chewable tablet
13. Formulation and filling of hard gelatin tablets
14. Preparation and evaluation of parenterals
   a. Ascorbic acid injection
   b. Calcium gluconate injection
   c. Sodium chloride injection
d. Dextrose and sodium chloride injection/infusion

TOTAL: 60 PERIODS

OUTCOMES:
- Acquire knowledge to prepare and evaluate various liquid, semi solid, solid dosage forms.
- Application of the knowledge to formulate new dosage forms.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Tablet punching machine – Mini press
2. Automatic capsule filling machine
3. pH meter
4. Reverse osmosis water treatment plant
5. Stability chamber

REFERENCES:
1. Pharmaceutical Dosage Forms: Parenteral Medications, Volume I, Kenneth E. Avis, Herbert A. Lieberman (Editor), Leon Lachman (Editor)
3. The Theory and Practice of Industrial Pharmacy By Lachman and Lieberman (3rd Edition)

GE6674 COMMUNICATION AND SOFT SKILLS- LABORATORY BASED L T P C
0 0 4 2

OBJECTIVES:
To enable learners to,
- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

UNIT I LISTENING AND SPEAKING SKILLS 12
Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

UNIT II READING AND WRITING SKILLS 12
Reading different genres of tests ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 12
International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.

UNIT IV INTERVIEW SKILLS 12
Different types of Interview format- answering questions- offering information- mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.
UNIT V SOFT SKILLS

Motivation - emotional intelligence - Multiple intelligences - emotional intelligence - managing changes-time management-stress management-leadership straits-team work - career planning - intercultural communication - creative and critical thinking

TOTAL: 60 PERIODS

Teaching Methods:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

Lab Infrastructure:

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<td>LCD Projector with MP3/CD/DVD provision for Audio/video facility</td>
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Evaluation:

Internal: 20 marks
Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks

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<th>Component</th>
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<tr>
<td>Online Test</td>
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<td>Interview</td>
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<td>Presentation</td>
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<td>Group Discussion</td>
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Note on Internal and External Evaluation:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics.
4. Discussion – topics of different kinds; general topics, and case studies.

OUTCOMES:

At the end of the course, learners should be able to

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

REFERENCES:

2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.
4. Interactive Multimedia Programs on Managing Time and Stress.

Web Sources:

- [http://www.slideshare.net/rohitjsh/presentation-on-group-discussion](http://www.slideshare.net/rohitjsh/presentation-on-group-discussion)
- [http://www.washington.edu/doit/TeamN/present_tips.html](http://www.washington.edu/doit/TeamN/present_tips.html)
- [http://www.oxforddictionaries.com/words/writing-job-applications](http://www.oxforddictionaries.com/words/writing-job-applications)
- [http://www.kent.ac.uk/careers/cv/coveringletters.htm](http://www.kent.ac.uk/careers/cv/coveringletters.htm)
- [http://www.mindtools.com/pages/article/newCDV_34.htm](http://www.mindtools.com/pages/article/newCDV_34.htm)

BT6604 CHEMICAL REACTION ENGINEERING

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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.

TOTAL : 45 PERIODS

OUTCOMES:
The student will be able to
- Write the rate equation for any type of reaction.
- Design reactors for heterogeneous reactions and optimise operating conditions.
- Relate and calculate the conversions, concentrations and rates in a reaction.
- An ability to identify, formulate and solve chemical engineering problems.

TEXT BOOKS:

REFERENCES:

PY6701    ADVANCED DRUG DELIVERY SYSTEM  L T P C  
3 1 0 4

OBJECTIVES:
To enable the students to
- Understand the properties of polymer and its significance in drug delivery systems.
- Interpret physicochemical properties of the drug with the drug delivery system modules.
• Apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies.

UNIT I POLYMERS 9
Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymer Characterisation - Various classes of controlled release systems.

UNIT II SUSTAINED RELEASE FORMULATIONS 9
Introduction, concept, advantages and disadvantages. Physicochemical and biological properties of drugs relevant to sustained release formulations.

UNIT III TRANSDERMAL DRUG DELIVERY SYSTEMS 9

UNIT IV TARGETED DRUG DELIVERY SYSTEMS 9

UNIT V DRUG DELIVERY LARGE MOLECULES 9
Delivery system for Peptides and Proteins – Delivery of nucleic acids – Antibodies and siRNA.

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:
The student will be able to
• Understand the properties and importance of polymer in novel drug delivery systems.
• Understand the application of polymer in sustained release, topical and targeted drug delivery systems.

TEXT BOOKS:
2. Junginger H.E “Drug Targeting and Delivery- concepts in dosage form design” EllisHarwood series in Pharmaceutical Technology

REFERENCES:

PY6702 BIOPHARMACEUTICS AND PHARMACOKINETICS L T P C
3 0 0 3

OBJECTIVES:
• To teach important parameters involved in drug disposition and its principles in living systems.
• To make the students to understand how the drug disposition takes place in the invitro and invivo conditions.

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

UNIT III  PRINCIPLES OF DRUG ABSORPTION AND BIO-AVAILABILITY

UNIT IV  PHARMACOKINETICS
Principles of Pharmacokinetics, Concepts of Compartmental Model, Characteristics of 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
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
- Narrate the various factors influencing the drug disposition, various pharmacokinetic parameters.
- Design and interpret the dissolution studies for various dosage forms.

TEXT BOOKS:

REFERENCES:

PY6711  ADVANCED DRUG DELIVERY SYSTEMS LABORATORY

OBJECTIVES:
To enable the students to
- 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. Evaluation of Transdermal Films
3. Preparation of Microspheres
4. Characterization of Microspheres
5. Preparation of matrix tablets using various polymers
6. Evaluation of matrix tablets using various polymers
7. Preparation of solid dispersions
8. Evaluation of solid dispersions
10. Preparation of Liposomes
12. Preparation of polysaccharide particle based drug delivery

TOTAL : 60 PERIODS

OUTCOMES:

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.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Tablet Punching Machine
- Magnetic stirrer with hot plate
- Mechanical stirrer
- Dissolution apparatus
- Disintegration tester
- Rotary evaporator

PY6712 BIOPHARMACEUTICS AND PHARMACOKINETICS LABORATORY

OBJECTIVE:
To impart the knowledge of the rate and extent of drug absorption and distribution,

LIST OF EXPERIMENTS

1. In-vitro disintegration study of the given tablet.
2. In-vitro dissolution study of the given uncoated tablet dosage form using various dissolution media.
3. In-vitro dissolution study of the given sustained released tablet dosage form using various dissolution media.
4. To study the effect of formulation on drug release (Tablet, Solution, suspension etc.).
5. To determine the % protein binding of the given drugs. and the effect of protein binding on drug bioavailability.
6. To calculate the various Pharmacokinetic parameters from the given blood data of I.V bolus injection (one compartment model).
7. To calculate various Pharmacokinetic parameters from the given urinary excretion data of I.V bolus injection using both methods (Rate of elimination & sigma minus method one compartment model).
To determine the various Pharmacokinetic parameters from the given blood data of oral dosage form.

OUTCOMES:
On completion of the course the students able to
- Perform disintegration and dissolution studies for the conventional and modified dosage forms.
- Estimate various pharmacokinetic parameters using plasma and urine drug level data.
- Predict the effects of dosage form design and routes of drug administration on drug levels in body.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
- pH Meter
- Disintegration test apparatus
- Dissolution test apparatus
- Cooling Centrifuge
- Ultra Violet Spectrophotometer
- HPLC

REFERENCES:

OBJECTIVE:
- To provide an opportunity to learn basic management concepts essential for business..

UNIT I INTRODUCTION

UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUP DYNAMICS 9

UNIT V MODERN CONCEPTS 9

TOTAL : 45 PERIODS

OUTCOME :
• Students gain knowledge on the basic management principles to become management(s) professional.

TEXTBOOKS:

REFERENCES:

PY6001 PHARMACEUTICAL PRODUCTION MANAGEMENT L T P C 3 0 0 3

OBJECTIVE:
To make understand the process involved in the pharmaceutical industries and its management.

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9

UNIT II FORMULATION PRODUCTION MANAGEMENT 9

UNIT III PRODUCTION, PLANNING, SCHEDULING AND FORECASTING 9
Production systems – Production department Personnel – Production process, routing, loading and Scheduling – Despatching of records – Production control.

UNIT IV MATERIAL MANAGEMENT 9

UNIT V HUMAN RESOURCE MANAGEMENT 9

OUTCOMES:
The student will be able to
• Identify the various factors influencing for choosing a suitable location for pharmaceutical plant and its construction.
• Handle and execute various process of pharmaceutical product manufacturing and manage the materials and human resources.

TEXT BOOKS:

REFERENCES:

PY6002 UNIT PROCESS IN ORGANIC SYNTHESIS

OBJECTIVE:
To provide the basic concepts and fundamental principles of various process in organic synthesis.

UNIT I SULFONATION AND SULFATION 9
Sulfating – Sulfonating agents – Applications – Chemical and physical factors in sulfonation and sulfation – Thermodynamics mechanism – Kinetic considerations – Industrial equipments and techniques – Sulfonation of benzene – Aniline.

UNIT II NITRATION 9

UNIT III AMINATION BY REDUCTION 9
Methods of reduction – Bechamp method – Reduction mechanism – Preparation of aniline, p-phenylene daimine – Catalytic hydrogenation process – Catalyst involved in the reduction

UNIT IV HALOGENATION  

UNIT V OXIDATION  

TOTAL : 45 PERIODS

OUTCOMES:  
The student will be able to  
• Understand the nature of different chemical agents involved in sulfonation, nitration, reductive amination, halogenation and oxidation reaction.  
• Understand and apply the principles of thermodynamics and kinetics in various commercially important chemical reactions.

TEXT BOOKS:  

REFERENCES:  
techniques – Sampling – Analytical methods – Limits and acceptance criteria, documentation.

UNIT IV  STABILITY TESTING  9
Reasons for stability testing – Modes of degradation – Shelf lives and expiration dates – Possible strategies to improve shelf lives – Stability testing of new drug substances and products (Q1A) – Photo stability testing of new substances and products (Q1B) – Validation on analytical procedures (Q2A).

UNIT V  GMP FOR BIOLOGICAL PRODUCTS  9

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Determine the shelf-life, impurity profile and expiry date for the API and finished products through stability studies.
- Understand the role of cleanliness in manufacturing high purity products and reducing adverse products.
- Understand regulatory practices and administrative functions adopted in the pharmaceutical organizations.

TEXT BOOKS:

REFERENCES:

PY6004  GENETIC ENGINEERING AND PHARMACOGENOMICS  L T P C 3 0 0 3

OBJECTIVES:
To enable the student to know about genetic engineering and pharmacogenomics principles and application in human genome associated diseases. To provide the knowledge about the influence of genetic variation on drug response.

UNIT I  BASICS OF RECOMBINANT DNA TECHNOLOGY  9
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 host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II  DNA LIBRARIES  9
Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.
UNIT III  SEQUENCING AND AMPLIFICATION OF DNA
Maxim Gilbert's and Sanger's methods of DNA sequencing. PCR: Inverse, Nested, AFLP-, Allele specific, Assembly, Asymmetric, Hot start, inverse, Colony, single cell, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV  HUMAN GENOME AND ASSOCIATION STUDIES IN PHARMACOGENOMICS
Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions: A template for the future of whole genome-based pharmacological science, Viability and ADR in drug response: contribution of genetic factor, Multiple inherited genetic factors influence the outcome of drug treatments, Plasma binding proteins, Drug targets.

UNIT V  PHARMACOGENOMICS AND DRUG DESIGN WITH CASE STUDIES
Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization incorporation of pharmacogenomics principles, cases studies for CVS, CNS, immunomodulators, antioxidants etc.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the influence of genetic variation on drug response in patients by correlating gene expression or single-nucleotide polymorphisms with a drug's efficacy or toxicity.
- Achieve an overview of advanced principles and techniques of human genetic engineering.

TEXT BOOKS:

REFERENCES:

PY6005  PHARMACOGNOSY  L T P C
3 0 0 3

OBJECTIVES:
To study about the general pharmacognosy and drug containing various active substances.
To study, classify, identify and understand the medicinal compounds derived from plant sources and relate to therapeutic applications.
UNIT I  GENERAL PHARMACOGNOSY  9
Definition, history, scope and development of pharmacognosy. Sources and Classification of
drugs : sources of drugs. Classification. Cultivation, collection, processing and storage of
 crude drugs. Factors influencing cultivation of medicinal plants, types of soil and fertilizers of
common use. Pest management and natural pest control agents. Plant hormones and their
applications. Polyploidy, mutation and hybridization with reference to medicinal plants.

UNIT II  QUALITY CONTROL OF CRUDE DRUGS  6
Quality control of crude drugs : Adulteration of crude drugs and their detection by
organoleptic, microscopic, physical, chemical and biological methods of evaluation.

UNIT III  DRUGS CONTAINING CARBOHYDRATES, LIPIDS, RESINS, TANNIN
AND VOLATILE OIS  12
An Introduction to chemical constituents of drugs: their isolation, classification and properties
& systematic pharmacognostic study. Carbohydrates and derived products : Agar, Gum
Acacia, Gum tragacanth, Honey, Isapgol, pectin, Starch. Lipids : Bees wax, Castor oil, , Cod-
liver oil, Hydnocarpus oil, Lard, Linseed oil, , shark liver oil and wool fat. Resins and resin
combinations : Colophony, Podophyllum, , Cannabis, Capsicum, Myrrh, Asafoetida, Balsam
of Peru, Balsam of Tolu, Benzoin, Turmeric. Tannins and tannins containing drugs : Gambier,
black catechu, gall and myrobalan. Volatile oils: Mentha, Coriander, Cinnamon, Cassia,
Caraway, Dill, Clove, Fennel, Nutmeg, Cardamom, Lemon grass oil, Eucalyptus,
Sandalwood.

UNIT IV  DRUGS CONTAINING SAPONIN, ANTHROQUINONE AND CARDIAC
GLYCOSIDE  9
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 glycosides. Saponins:
glycyrrhiza, ginseng, Dioscorea, sarsaparilla and senega. Cardioactive sterols : digitalis,
squill, strophanthus and thevetia. Anthraquinone cathartics: Aloe, Senna, rhubarb and
cascara. Psoralea, , gentian, chirata, quassia.

UNIT V  DRUGS CONTAINING ALKALOIDS AND DERIVED PRODUCTS  9
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 Alkaloids and its derived compounds:
Cinchona, Ipecac, Opium, Ergot, Rauwolfia, Nuxvomica Belladona, Ephedra and Vinca.

TOTAL : 45 PERIODS

OUTCOMES:
The student will be able to understand
- Various sources of natural drugs.
- Classification and identification of drugs of natural origin and detection of its
  adulterant.
- Plant derived important constituents and its therapeutic uses.

TEXT BOOKS:
   2005.

REFERENCES:
**GE6084  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:**

**PY6006  CHEMISTRY OF NATURAL PRODUCTS**  
**L T P C**  
3 0 0 3

**OBJECTIVE:**
To provide the knowledge about the natural products, isolation and characterization of their active substances from their botanical source.

**UNIT I  STRUCTURAL BASIS OF NATURAL PRODUCTS**  

**UNIT II  GLYCOSIDES**  
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties of cardiacides and bufadienolides, digoxin and digitoxin.

**UNIT III  ALKALOIDS**  
12
Classification, chemistry, general methods of extraction, isolation, chemical tests, and structural elucidation of Pyridine alkaloids, Tropane alkaloids, Quinoline and Isoquinoline alkaloids, Phenanthrine alkaloids, Indole alkaloids, Imidazole alkaloids, Alkaloid amines, Glycoalkaloid, Xanthine alkaloid

UNIT IV  TERPENES AND FLAVONOIDS  8
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties and structural elucidation, flavonoids, quercetin; Terpenes— special isoprene rule, and structural elucidation of citral, carvone, menthol and camphor.

UNIT V  STUDY OF TRADITIONAL DRUGS  8
Classification of indigenous drugs traditional drugs, common vernacular names, botanical source, chemical constituents, uses and marketed formulations with ingredients like – Amla, Satavari, Bhilwua, guggul, gymnema, neem ,tulsi, Shilajit and Spirulina

TOTAL : 45 PERIODS

OUTCOMES:
The student will be able
- To classify extract, isolate and characterize the natural products by chemical tests.
- To understand the classification, metabolic pathways, metabolites and their structural elucidation.

TEXT BOOKS:
1. O.P. Agarwal, Chemistry of Natural Products (Vol.-1 & 2),41st edition,Goel publishing house, 2013

REFERENCES:

PY6007  PHARMACEUTICAL PACKAGING TECHNOLOGY  L  T  P  C
3 0 0 3

OBJECTIVE:
To provide the importance of packaging technology and its requirements in pharmaceutical products.

UNIT I  PHARMACEUTICAL PACKAGING  9
Status – Scope in pharmaceutical industry – Classification of packaging material – Primary and secondary packaging – Functions of packaging.

UNIT II  PRIMARY PACKAGING MATERIAL  9
Glass containers – Metals containers – Fiber and paper board for bulk – Films and foils for lamination – Equipments used in strip and blister packaging.

UNIT III  SECONDARY PACKAGING MATERIALS  9

UNIT IV QUALITY CONTROL OF PACKAGING MATERIALS 9
Specifications – Quality control tests – Methods and evaluation of packaging of materials – Labels and labeling – Sterilization of containers.

UNIT V STABILITY AND REGULATIONS 9
Stability of Packaging materials – Law and regulations governing packaging.

OUTCOMES:
The student will be able to
- Understand the various categories of packaging materials used in pharmaceutical industry.
- Choose proper packaging materials for different pharmaceutical dosage forms.

TEXT BOOKS:

REFERENCES:

PY6008 SAFETY AND RISK MANAGEMENT L T P C 3 0 0 3

OBJECTIVE:
To provide comprehensive knowledge about the safety management, safety procedures and handling techniques of the chemicals in Industry.

UNIT I INDUSTRIAL SAFETY 9
Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

UNIT II HAZARD IDENTIFICATION AND CONTROL 9

UNIT III RISK MANAGEMENT 9

UNIT IV SAFETY PROCEDURES 9

UNIT V   SAFETY IN HANDLING AND STORAGE OF CHEMICALS  9
Safety measures in handling and storage of chemicals – Fire chemistry and its control – Personnel protection – Safety color codes of chemicals

OUTCOMES:
The student will be able to
- Understand the various aspects of industrial safety, hazard identification and control.
- Understand the various risk management systems in chemical industry.
- Understand the safety procedure and handling of chemicals used in the various process.

TEXT BOOKS:

REFERENCES:

PY6009   COMPUTER AIDED DRUG DESIGN  L T P C
3 0 0 3

OBJECTIVES:
The course aims to provide students with an understanding of the process of drug discovery and development through in-silico methods right from the identification of novel drug targets to the introduction of new drugs into clinical practice.
The objective of this course is to present the appropriate tools for such a modeling ranging from molecular mechanics, molecular dynamics over computer graphics, data visualization, De Novo Design and chemometrics to computer assisted synthesis design based on artificial intelligence.

UNIT I   MOLECULAR MECHANICS  9
Introduction to CADD, Techniques and Concepts Used In CADD. Molecular Recognition, Molecular Docking and Role of Solvents. Concept of Force Field in MM, molecular dynamics, molecular simulation, montecarlo, quantum mechanics semi empirical and empirical methods, applicability and limitations of a MM approach.

UNIT II   MOLECULAR MODELLING  9
Historical overview, Graphical representation of molecules, technologies and models, simplified representation, molecular surfaces, Corey-Puling-Koltun (CPK) / Vander Waals surface, Solvent accessible and excluded surface, Conolly surface, Electron Density Surface, Molecular volume, Molecular superimposition, molecular similarity, molecular skin, molecular shape descriptors and mapping of information on molecular surfaces.

UNIT III   CHEMOMETRICS  9
Origin and current status, multivariate data, definition and classification of data, preprocessing, distance between objects, latent variables, linear methods, projection of multivariate data, Principal Component Analysis, Multiple Linear Regression, Principle Component Regression, Partial Least Squares, nonlinear methods, Modelling methods,
Classification methods, Linear discriminant analysis, validation tools, cross validation, bootstrapping, statistical indices

UNIT IV 2-D QSAR
9

UNIT V 3-D-QSAR: COMFA & CoMSIA
9
Introduction to 3-D QSAR, Comparative Molecular Field Analysis (CoMFA) methodology, steps in CoMFA analysis, derivation of CoMFA model, CoMFA coefficient maps, validation of results with relevant examples from recent literatures, CoMFA applications in drug design. Comparative Molecular Similarity Analysis (CoMSIA) : Introduction and Case studies

TOTAL : 45 PERIODS

OUTCOMES:
The student able to
- Have an in-depth overview over the state-of-the art methods and techniques nowadays applied in CADD.
- Choose the appropriate for a given problem like, lead optimization, structure based design, investigation of ligand receptor interaction.
- Perform, understand, and interpret the results of the calculations and bring them in a publication ready form.

TEXT BOOKS:
2. Structure based Drug Design Pandi Veerapandian, Taylor and Francis
3. Smith and Williams Introduction to Principles of Drug Design and Action Edited by H. John Smith, Taylor and Francis
4. Textbook of Drug Design and Discovery Edited by PovlKrogsgard-Larson, Taylor and Francis
5. Molecular Modeling: Principles and Applications, Andrew R. Leach

REFERENCES:
1. Burger’s Medicinal Chemistry and Drug Discovery
2. Comprehensive Medicinal Chemistry. Vol IV.

PY6010 EXPERIMENTAL DESIGN AND BIOSTATISTICS
L T P C
3 0 0 3

OBJECTIVES:
- To introduce the fundamentals of statistics, logical application, and interpretation of statistical models. Emphasis will be placed on gaining a conceptual understanding of the statistical tests and their application to pharmaceutical research.
- To provide foundations on design of experiments and statistical analysis of experimental data obtained from laboratory and/or industrial processes.

UNIT I 9
Introduction: Definition of Bio-Statistics, Application of Bio-statistics, classification and sampling of data, objects of classification, frequency of distribution, methods of sampling, Tabulation of data, difference between Classification and Tabulation.

UNIT II 9
Measures of Central Tendency and Dispersion: Mean, median, mode, percentiles, range, variance, standard deviation, coefficient of variation measures skewness and kurtosis.
Methods of sampling: Simple Random sampling with and without replacement. Sampling distribution and standard deviation of sample mean.
Standard distributions: Binomial, Poisson, normal, exponential.

UNIT III 9
Correlation and regression: scatter plot, correlation coefficient, properties, rank correlation.
Linear regression: Fitting of line and plane of regression.
Analysis of Variance: ANOVA principle, assumptions of ANOVA, ANOVA of one way classified data, Analysis of 2 way classified data, non parametric tests, ANOVA and multiple regressions for biological data.
Testing of Hypothesis: chi square test, test of fit, uses of chi square test.

UNIT IV 9
Design of experiments: Statistical principles in experimental design - blocking, complete randomization; Factorial design, optimization of pharmaceutical formulations
Factor Effect Analysis: Analysis of individual factor and interaction effects; Response surface methodologies
Advanced topics: Variable selection; Fractional factorial design; Robustness

UNIT V 9
Experimental design in clinical trials: Introduction, Principles of experimental design and analysis, parallel design, cross over design, split plot design, interim analysis. Monte carlo simulation and bootstrapping.

TOTAL : 45 PERIODS

OUTCOME:
The student will be able to understand the art of statistical data analysis combined with systematic approaches to experimental design.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To understand the basics and properties of biomaterials.
- To study the clinical applications of biomaterials in tissue engineering.

UNIT I INTRODUCTION
Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE
Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS
Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS
Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells. Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS

TOTAL : 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the basics characters and current developments in biomaterials.
- Understand the tissue types, tissue components, tissue repairing techniques and wound healing sequence for the tissue architecture.
- Understand the various types, sources of stem cells with characteristics and the potency, plasticity of stem cells.
- Understand the major clinical applications (spinal cord injury, heart disease, orthopedic applications etc.) of stem cell therapy.

TEXT BOOKS:

REFERENCES:
based tissue repair.

GE6083 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
- To develop rudimentary ability to respond to their surroundings with potential 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 stake-holders- 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

PY6012 DOWNSTREAM PROCESSING

OBJECTIVE:
To introduce the student to the downstream processing and purification of biological products of relevance to the pharmaceutical, technical and food industries.

UNIT I BIO PRODUCTS AND BIOSEPARATION-OVERVIEW

UNIT II PHYSICAL METHODS OF SEPARATION
- Unit operations for solid-liquid separation – filtration - Conventional and cross flow filtration, Filter media and equipment. Sedimentation – Principle, methods, production centrifuges, ultracentrifugation, flocculation, membrane separation –ultrafiltration and reverse osmosis, dialysis,

UNIT III ISOLATION OF PRODUCTS
- Extraction- liquid-liquid extraction, solvent extraction principles, extraction process, aqueous two-phase extraction and its applications. Adsorption- Equilibrium and isotherms-adsorption column dynamics-fixed bed adsorption and agitated –bed adsorption.

UNIT IV PRODUCT PURIFICATION
- Classification of Chromatographic techniques – chromatographic terms and parameters 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  9
Precipitation of proteins, methods selective denaturation of unwanted proteins, Crystallization principles, batch crystallizers, crystallization of proteins, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

OUTCOMES:
The students will be able to
- Acquire theoretical knowledge of unit operations: Filtration, Centrifugation, Protein precipitation, Crystallisation, Drying, distillation, absorption, liquid-liquid extraction taking into account economic, and technical concerns.
- Calculate dimensions and choosing the internal structure of separation equipment for simple separation applications.
- Gain knowledge of the structure and function of biological macromolecules and its separation

TEXT BOOKS:

REFERENCES:

GE6081  FUNDAMENTALS OF NANOSCIENCE  L T P C
3 0 0 3

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

UNIT I  INTRODUCTION  8
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  9
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  12
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 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 dots-preparation, 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


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

TOTAL : 45 PERIODS

TEXT BOOKS:

REFERENCES:

BT6013      BIOCONJUGATE TECHNOLOGY AND APPLICATIONS

OBJECTIVES:
To enable the students

- To understand the concepts of bioconjugate technology and its applications.
- To understand the chemical properties of bioconjugates
- To study the importance/role of biological products in body functions.

UNIT I      FUNCTIONAL TARGETS

UNIT II      CHEMISTRY OF ACTIVE GROUPS
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

UNIT IV      ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION
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 BIOCONEJUGATE APPLICATIONS

TOTAL : 45 PERIODS

OUTCOMES:
The student will be able to

- Understand the characters and functions of bioconjugate materials.
- Understand the various chemical reactions involved in the modifications of bioconjugates.
- Understand the major applications of bioconjugates.

TEXT BOOK:

PY6013 TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS

OBJECTIVE:
To enable the students about the plant design, Production technique and process Chemistry involved in the Fine chemicals and Bulk drug industry.

UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS
Concept of fine and Bulk drugs and their salient features – Evolution of process – Process chemistry – Research and development strategies in pharmaceutical industries.

UNIT II PRODUCTION, PLANNING AND CONTROL

UNIT III BASE CHEMICAL PRODUCTION
Industrial Production of following base chemicals – Mineral acids (sulphuric acid, nitric acid, phosphoric acid) – Naphthalene – Ammonia – Caustic soda – Industrial alcohol – Butyl alcohol – Benzene – Phenol.

UNIT IV DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION

UNIT V BULK DRUGS

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to

- Understand the principle of plant design in bulk drug industry.
- Understand the knowledge of base chemicals, drug intermediates and bulk drugs.
• Understand kinetics, thermodynamics and plant construction material for the production of bulk drugs and fine chemicals.

**TEXT BOOKS:**

**REFERENCES:**

**PY6014 HERBAL TECHNOLOGY**

**OBJECTIVES:**
- To enable to students to know about the various technologies used in herbal preparations.
- To teach the fundamental of various systems of herbal medicines, screening and its standardization.

**UNIT I INDIAN SYSTEMS OF MEDICINE**

**UNIT II IN-VITRO CULTURE OF MEDICINAL PLANTS**
Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plat tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

**UNIT III EXTRACTION, ISOLATION AND ANALYSIS OF PHYTO PHARMACEUTICALS**

**UNIT IV SCREENING METHODS FOR HERBAL DRUGS**
Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Cardiac glycosides – Analgesic activity – Antipyretic activity – Anti cancer activity – Evaluation of hepatoprotective agents – Anti ulcer drugs.

**UNIT V STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS**

**TOTAL : 45 PERIODS**

**OUTCOMES:**
The student will be able to
- Understand the various Indian systems of medicine
- Understand the screening and characterization of herbal products.
TEXT BOOKS:

REFERENCES:

PM6603 WATER TREATMENT AND MANAGEMENT

UNIT I INTERNAL TREATMENT PROCESS 9

UNIT II EXTERNAL TREATMENT PROCESS 9

UNIT III BOILER WATER AND COOLING WATER 9

UNIT IV WASTE WATER TREATMENT 9

UNIT V WATER MANAGEMENT IN INDIA 9

OUTCOMES:
The student will be able to
- Understand the relationship between the natural water cycle and human water use, principles of water resources planning and total water management;
- Understand the physical, chemical, and biological processes necessary for designing and managing drinking water treatment processes and water conveyance and distribution systems.
Understand the physical, chemical, and biological processes necessary for designing and managing primary, secondary, tertiary and advanced wastewater treatment processes and solids handling systems.

**TEXT BOOKS:**

**REFERENCES:**

**PY6016 BIOINFORMATICS AND COMPUTATIONAL BIOLOGY**

**OBJECTIVE:**
To provide an advanced learning of the core principles and basics of Bioinformatics and enable students to acquire a specialized knowledge and perceptive of the selected aspects.

**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, Pairwise 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, *ab initio* approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

**UNIT IV**

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

OUTCOME:
The student will be able to understand the principles and limitations of bioinformatics and Computational Biology.

TEXT BOOKS:
1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.

REFERENCES:
2. Bioinformatics Sequence and Genome Analysis by David W.Mount, Cold Spring Harbor Laboratory Press.
3. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

PC6601 PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

OBJECTIVE:
To introduce of open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION
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
Laplace transformation and its application in process control. 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
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
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controllers Z-N tuning rules, C-C tuning rules.

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

TOTAL : 45 PERIODS
OUTCOME:
Students will understand and discuss the importance of process control in process operation and the role of process control engineers. They know the design of modern hardware and instrumentation needed to implement process control.

TEXT BOOKS:

REFERENCES:

PY6017 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.

TOTAL: 45 PERIODS

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: