DEPARTMENT OF BIOTECHNOLOGY
ANNA UNIVERSITY, CHENNAI

VISION:

The Department of Biotechnology is committed to evolve as a world class science and technology centre by integrating quality and ethics in teaching and research.

MISSION:

The mission of the department is

- To provide students a unique and multidisciplinary learning experience that will foster the young minds to develop as a researcher, entrepreneur etc.
- To enhance academic and industrial collaborative research initiatives for the development of biotechnological, food and therapeutic products.
- To emphasise and equip the students towards innovative industrial and research updates.
- To serve the society with utmost commitment, integrity, enthusiasm, and dedication.
1. PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

The primary objective of the Bachelor of Pharmaceutical Technology program is to prepare professionals with the basic skills required to work in the pharmaceutical industry (bulk and formulation) with emphasis on the engineering, regulatory, quality control and research aspects of drug manufacturing, pharmaceutical production, pharmaceutical development, and pharmaceutical operations. The program objective also tends to focus on imparting fundamental knowledge on drug chemistry, mechanism and allied disciples that will be relevant in upholding and supporting the primary objectives and aims to train them for the following goals,

I. To generate trained undergraduates with state of the art knowledge in pharmaceutical technology and allied subjects in an ambience of motivation that could stimulate growth and excellence.

II. To create undergraduates who are trained and synchronized with the requirements of the pharmaceutical industry and adapt readily to national healthcare programmes.

III. To create professionals with outstanding caliber who would be an asset in various areas including education, research, industry and government.

IV. To mould students to emerge as future leaders of the pharmaceutical industry and as an entrepreneur.

V. To sensitize students to local and global needs of environment protection and sustainability.

2. PROGRAM OUTCOMES (POs):

After going through the four years of study, our Pharmaceutical Technology Undergraduates will exhibit ability to

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<tr>
<th>Graduate Attribute</th>
<th>Program Outcome</th>
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<tr>
<td>PO1 Pharmaceutical Technology Knowledge</td>
<td>Acquaint and apply the knowledge of mathematics, basic sciences, chemical engineering, and formulation sciences in pharmaceutical technology.</td>
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<tr>
<td>PO2 Problem Analysis</td>
<td>Explore, identify, formulate and analyze problems in pharmaceutical technology for reaching substantiated conclusions using principles of mathematics, natural sciences, and pharmaceutical engineering/sciences.</td>
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<tr>
<td>PO3 Design/development of solutions</td>
<td>Derive solutions for pharmaceutical technology problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, societal and environmental considerations.</td>
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<tr>
<td>PO4 Conduct investigations of complex Problems</td>
<td>Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, to provide valid conclusions.</td>
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<td>PO5</td>
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<td>PO6</td>
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<td>PO8</td>
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3. PROGRAM SPECIFIC OUTCOMES (PSOs):
By the completion of Pharmaceutical Technology Undergraduates Program the student will have following Program Specific outcomes

I. Foundations of Pharmaceutical Chemistry: Ability to understand the basics in the general chemistry, organic chemistry and inorganic chemistry pertaining to pharmaceutical bulk and formulation industries and provide relevant theoretical background.

II. Foundations of Medicinal Chemistry and Pharmacology & chemotherapy: Ability to encompass drug design, drug synthesis, and the evaluation of drug efficacy and drug safety.

III. Applications of Dosage Form technology: Ability to use knowledge in various domains of Dosage Form Technology to develop new Dosage Form which will provide solution to the current problem of drug delivery. To provide fundamental understanding on various unit processes and chemical engineering principles that will have relevance in pharmaceutical bulk and formulation industries and make the students ready for industrial employment.

IV. Applying the knowledge and training in Pharmaceutical technology to pursue higher studies and research. Develop as entrepreneurs and technocrats to furnish policies related to pharmaceutical industries.
4. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

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5. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
ANNA UNIVERSITY, CHENNAI  
UNIVERSITY DEPARTMENTS  
B. TECH. PHARMACEUTICAL TECHNOLOGY  
REGULATIONS – 2019  
CHOICE BASED CREDIT SYSTEM CURRICULUM AND  
SYLLABI FOR I TO VIII SEMESTERS  
(Applicable to students admitted from the Academic Year 2022-2023 onwards)

**SEMESTER I**

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**ENGINEERING SCIENCE COURSES (ESC)**

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**HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)**

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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OBJECTIVES

- To build lexical competency and accuracy that will help learners to use language effectively.
- To learn various reading strategies that will enable learners to comprehend the different modes of reading materials of varied levels of complexity.
- To comprehend the linguistic aspects of various rhetorical structures and functions of Technical English and use them effectively in writing.

UNIT I  INTRODUCING ONESELF  9
Theory:
Reading: Descriptive passages (From Newspapers / Magazines) – Writing: Writing a coherent paragraph (Native Place, School Life) – Grammar: Simple present tense, Present continuous tense – Vocabulary development: One word substitution.

UNIT II  DIALOGUE WRITING  9
Theory:
Reading: Reading a print interview (Comprehension and inference questions) - Writing: Writing a checklist - Dialogue writing – Grammar: Simple past tense – Question formation (Wh-Questions, ‘Yes’ or ‘No’ Questions, Tag Questions) – Vocabulary Development: Lexical items relevant to the theme of the given unit.

UNIT III  FORMAL LETTER WRITING  9
Theory:

UNIT IV  WRITING LETTERS OF COMPLAINT  9
Theory:

UNIT V  WRITING DEFINITIONS AND PRODUCT DESCRIPTION  9
Theory:

LEARNING OUTCOMES:
On completion of the course, the students will be able to:

- Use appropriate language structures and lexical items in authentic contexts.
- Read both general and technical texts and comprehend their denotative and connotative meanings.
- Write different kinds of formal documents with grammatical and lexical appropriate.

Assessment Pattern

- Two written internal assessments to test learner’s progress in grammar, vocabulary, reading and writing skills.
- End Semester exam to be tested in two parts: Theory exam for three hours and listening and speaking skills for two hours.
OBJECTIVES
The course aims to,
- develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- familiarize the students with differential calculus.
- familiarize the student with functions of several variables. This is needed in many branches of engineering.
- make the students understand various techniques of integration.
- acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I  MATRICES  12

UNIT II  DIFFERENTIAL CALCULUS  12

UNIT III  FUNCTIONS OF SEVERAL VARIABLES  12

UNIT IV  INTEGRAL CALCULUS  12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V  MULTIPLE INTEGRALS  12
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals

TOTAL : 60 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
- CO1 use the matrix algebra methods for solving practical problems.
- CO2 apply differential calculus tools in solving various application problems.
- CO3 use differential calculus ideas on several variable functions.
- CO4 apply different methods of integration in solving practical problems.
- CO5 apply multiple integral ideas in solving areas, volumes and other practical problems.
TEXT BOOKS:

REFERENCES:
OBJECTIVES

The course aims to,

- make the students in understanding the importance of mechanics.
- equip the students on the knowledge of electromagnetic waves.
- introduce the basics of oscillations, optics and lasers.
- enable the students in understanding the importance of quantum physics.
- elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS


UNIT II ELECTROMAGNETIC WAVES

Gauss’s law – Faraday’s law - Ampere’s law - The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS


UNIT IV BASIC QUANTUM MECHANICS

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of the wave function - Normalization - Particle in an infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch’s theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to,

CO1  understand the importance of mechanics.
CO2  express the knowledge of electromagnetic waves.
CO3  know the basics of oscillations, optics and lasers.
CO4  understand the importance of quantum physics.
CO5  apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS:

REFERENCES:

CY5151  ENGINEERING CHEMISTRY        LT PC
(Common to all branches of Engineering and Technology)   3 0 0 3

OBJECTIVES
The course aims to,

- introduce the basic concepts of polymers, their properties and some of the important applications.
- impart knowledge on the basic principles and preparatory methods of nanomaterials.
- facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I  POLYMER CHEMISTRY  9
UNIT II  NANOCHEMISTRY

UNIT III  PHOTOCHEMISTRY AND SPECTROSCOPY

UNIT IV  ENERGY CONVERSIONS AND STORAGE
Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H2-O2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V  WATER TECHNOLOGY

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.

CO2 identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3 identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.

CO4 recognize different forms of energy resources and apply them for suitable applications in energy sectors.

CO5 demonstrate the knowledge of water and their quality in using at different industries.
TEXT BOOKS:

REFERENCES:
OBJECTIVES

The course aims to,

- know the basics of algorithmic problem solving.
- develop python programs with conditionals and loops.
- define python functions and use function calls.
- use python data structures - lists, tuples, dictionaries.
- do input/output with files in python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING


Suggested Activities:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS


Suggested Activities:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:

- Tutorials on the above activities.
• Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON


Suggested Activities:
• Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
• External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:
• Tutorials on the above activities.
• Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES


Suggested Activities:
• Implementing Python program by importing Time module, Math package etc.
• Creation of any package (student’s choice) and importing into the application.

Suggested Evaluation Methods:
• Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:
• Developing modules using Python to handle files and apply various operations on files.
• Usage of exceptions, multiple except blocks - for applications that use delimiters like age, range of numerals etc.
• Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods:
• Tutorials on the above activities.
• Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
CO1 develop algorithmic solutions to simple computational problems.
CO2 develop and execute simple Python programs.
CO3 write simple Python programs for solving problems.
CO4 decompose a Python program into functions.
CO5 represent compound data using Python lists, tuples, dictionaries etc.
CO6 read and write data from/to files in Python programs.

TEXT BOOKS:

REFERENCES:

GE5154 தமிழ் மொழி L T P C 1 0 0 1
அகத்தது மகாகணித்துப்படிகள்

1. ೈஸிய பிறப்பு நகரங்கள்
2. முதல் அவர்கள்
3. மற்றும் நடுகல்

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
UNIT I  LANGUAGE AND LITERATURE  3

UNIT II  HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE  3

UNIT III  FOLK AND MARTIAL ARTS  3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV  THINAI CONCEPT OF TAMILS  3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V  CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE  3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் மொழியால் – மாசைகள் பல்லாப்பிரிவு – கோயில். பெரிய புராணம் – கலைக் கல்வியியல் (சங்கத் தொடர்பு: தமிழ்நாடு பல்கலைக்கழகம்: மாசைகள் பல்லாப்பிரிவு – கலைக் கல்வியியல்)
2. கலைக்கலை – பல்லாப்பிரிவு விளக்கம் (சங்கத் தொடர்பு: பிள்மளை பொடும் நகரிகம்சு). நொகரிகம்: பிள்மளை பொடும் நகரிகம்சு.
3. சிறைகள் – கலைக்கலைக் கலைகளிலிருந்து கலைக்கலை இயற்கையை பிள்மளை பொடும் நகரிகம்சு: (சங்கத் தொடர்பு: பிள்மளை பொடும் நகரிகம்சு)
4. புராணவியல் – முதல் கலைக்கலை (சங்கத் தொடர்பு: பிள்மளை பொடும் நகரிகம்சு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
OBJECTIVES
The course aims to,

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

LIST OF EXPERIMENTS
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young’s modulus
3. Uniform bending – Determination of young’s modulus
4. Lee’s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wavelength of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of the width of the groove using laser.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box - Determination of Band gap of a semiconductor.
13. Photoelectric effect
14. Michelson Interferometer.
16. Melde’s string experiment

TOTAL: 30 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 determine various moduli of elasticity and also various thermal and optical properties of materials.

CO2 determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY (Minimum of 8 experiments to be conducted)

OBJECTIVES
The course aims to
• Inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
• Induce the students to familiarize with electroanalytical techniques such as pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
• Demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

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

TOTAL: 30 PERIODS

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

CO 1 analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.

CO 2 determine the amount of metal ions through volumetric and spectroscopic techniques

CO 3 determine the molecular weight of polymers by viscometric method.

CO 4 quantitatively analyse the impurities in solution by electroanalytical techniques

CO 5 design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS
1. Laboratory Manual- Department of Chemistry, CEG, Anna University (2014).
GE5161  PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

OBJECTIVES

The course aims to,

- understand the problem solving approaches.
- learn the basic programming constructs in Python.
- articulate where computing strategies support in providing Python-based solutions to real world problems.
- use Python data structures - lists, tuples, dictionaries.
- do input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:

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

**CO1** develop algorithmic solutions to simple computational problems

**CO2** develop and execute simple Python programs.

**CO3** structure simple Python programs for solving problems.

**CO4** decompose a Python program into functions.

**CO5** represent compound data using Python data structures.

**CO6** apply Python features in developing software applications.
OBJECTIVES:
- To improve the communicative competence of learners
- To help learners use language effectively in academic/work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students’ English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I  INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION  6
Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions( filling out a bank application for example).

UNIT II  NARRATION AND SUMMATION  6
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III  DESCRIPTION OF A PROCESS / PRODUCT  6
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product-explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

UNIT IV  CLASSIFICATION AND RECOMMENDATIONS  6
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V  EXPRESSION  6
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website-describing processes

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

ASSESSMENT PATTERN
- One online / app based assessment to test listening /speaking
- End Semester ONLY listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.
OBJECTIVES

- To comprehend various reading materials relevant to technical context and understand the main and supporting ideas of the reading materials.
- To write effective job applications along with detailed CV for internship or placements.
- To explore definitions, essay and report writing techniques and practice them in order to develop associated skills.

UNIT I  TECHNICAL COMMUNICATION  6

Theory:
Reading: Reading the Interview of an Achiever and Completing Exercises (Skimming, Scanning and Predicting) – Writing: Writing a Short Biography of an Achiever Based on Given Hints – Grammar: Asking and Answering Questions, Punctuation in Writing, Prepositional Phrases

UNIT II  SUMMARY WRITING  6

Theory:
Reading: Reading Technical Essays/ Articles and Answering Comprehension Questions – Writing: Summary Writing – Grammar: Participle Forms, Relative Clauses

UNIT III  PROCESS DESCRIPTION  6

Theory:
Reading: Reading Instruction Manuals – Writing: Writing Process Descriptions – Writing Instructions – Grammar: Use of Imperatives, Active and Passive Voice, Sequence Words

UNIT IV  REPORT WRITING  6

Theory:
Reading: Reading and Interpreting Charts/Tables and Diagrams – Writing: Interpreting Charts/Tables and Diagrams, Writing a Report – Grammar: Direct into Indirect Speech, Use of Phrases

UNIT V  WRITING JOB APPLICATIONS  6

Theory:
Reading: Reading a Job Interview, SOP, Company Profile and Completing Comprehension Exercises – Writing: Job Applications and Resumes And Sops – Grammar: Present Perfect and Continuous Tenses.

TOTAL : 30 PERIODS

LEARNING OUTCOMES

On completion of the course, the students will be able to:

- Read and comprehend technical texts effortlessly.
- Write technical reports and job application for internship or placement.
- Learn to use language effectively in a professional context.

Assessment Pattern

- Two written internal assessments to test learner’s progress in grammar, reading and writing skills.
- End Semester exam to be tested in two parts: Theory exam for three hours and listening and speaking skills along with vocabulary for two hours.
OBJECTIVES
The course aims to,

- acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- acquaint the students with Differential Equations which are significantly used in Engineering problems.
- make the students 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 12

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

UNIT III COMPLEX INTEGRATION 12

UNIT IV DIFFERENTIAL EQUATIONS 12

UNIT V LAPLACE TRANSFORMS 12

TOTAL: 60 PERIODS
OUTCOMES:
At the end of the course the students will be able to,

**CO1** calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.

**CO2** construct analytic functions and use their conformal mapping property in application problems.

**CO3** evaluate real and complex integrals using Cauchy's integral formula and the residue theorem.

**CO4** apply various methods of solving differential equations which arise in many application problems.

**CO5** apply Laplace transform methods for solving linear differential equations.

TEXT BOOKS:

REFERENCES:
OBJECTIVES
The course aims to,

- provide a good platform to pharmaceutical engineering students to understand, model and appreciate the concept of dynamics involved in pharmaceutical systems.
- prepare them to carry out experimental investigation and analysis at later stages of graduation

UNIT I  ENERGY AND THE FIRST LAW OF THERMODYNAMICS  
Concept of heat work and energy- forms of energy- forms of work- first law of thermodynamics-energy balance equation – batch system energy balance – internal energy and enthalpy changes-application problems – enthalpy changes in chemical and biochemical reactions -application problems- effect of temperature on chemical reactions (Kirchoff’s law) Open systems-Simple applied problems

UNIT II  THERMODYNAMIC PROPERTIES OF FLUIDS  

UNIT III  FREE ENERGY  
Helmholtz free energy, Gibbs free energy, Reversible process, Maxwell Relations for fundamental properties, Eqns for ΔG, ΔS, ΔH and Cp-Cv relationship for actual gases. Phase equilibria for single component, VLE and clausius clapeyron eqn, Latent heat of phase transformation.

UNIT IV  THERMODYNAMICS OF PHYSICAL PROCESSES  

UNIT V  THERMODYNAMICS OF CHEMICAL PROCESSES  
Acid–Base Equilibria, Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions, Electrical Work – Oxidation–Reduction Reactions, Electrochemical Cells, pH Measurement, Noncovalent Binding Equilibria. Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, thermodynamics and stoichiometry of Product Formation.

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to

CO1 understand the laws of thermodynamics and its pharmaceutical applications

CO2 appreciate the concepts and fundamentals of thermodynamics of fluids and chemical process

CO3 learn the concepts of free energy and physical process in thermodynamics and apply the ideas in pharmaceutics and formulation development process

TEXT BOOKS:

REFERENCES:
<table>
<thead>
<tr>
<th>Course Outcome Statements</th>
<th>Programme Outcomes (PO)</th>
<th>Programme Specific Outcomes (PSO)</th>
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<td></td>
<td>1</td>
<td>2</td>
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<tr>
<td><strong>CO 1</strong> understand the laws of thermodynamics and its</td>
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<td>pharmaceutical applications</td>
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<tr>
<td><strong>CO 2</strong> appreciate the concepts and fundamentals of</td>
<td>-</td>
<td>2</td>
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<tr>
<td>thermodynamics of fluids and chemical process</td>
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<tr>
<td><strong>CO 3</strong> learn the concepts of free energy and physical</td>
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<tr>
<td>process in thermodynamics and apply the ideas in</td>
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<tr>
<td>pharmaceutics and formulation development process</td>
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<tr>
<td><strong>Overall CO</strong></td>
<td>-</td>
<td>1</td>
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</tbody>
</table>

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- understand the basic concepts of electric circuits, magnetic circuits and wiring.
- understand the operation of AC and DC machines.
- understand the working principle of electronic devices and circuits.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING
9
Electrical circuit elements (R, L and C) - Dependent and independent sources – Ohm’s Law-Kirchhoff’s laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS - Average values - sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires - Earthing - Methods - Protective devices.

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS
9

UNIT III ELECTRICAL MACHINES
9

UNIT IV BASICS OF ELECTRONICS
9
Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics - Rectifier circuits - Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES
9
Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

IB5251 MICROBIOLOGY LT PC 3 0 0 3

OBJECTIVES
The course aims to,
- provide the students the knowledge of how to identify different microbes
- make them aware about the requirements for microbial growth and their lifecycle
- help them understand the different types of physical and chemical control of microbial growth
- make them realize the interaction between microbes and their hosts and also how to design antimicrobials
- make them realize the applications of microbial metabolism in various industries.

UNIT I INTRODUCTION TO MICROBIOLOGY 6
History (scientists and discoveries), classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospores staining.

UNIT II MICROBIAL NUTRITION, GROWTH AND METABOLISM 8
Nutritional classification of microorganisms based on carbon, energy and electron sources Definition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth: (counting chamber, viable count method, counting without equipment, different media used for bacterial culture (defined, complex, selective, differential, enriched), Biochemical test for identification (citrate utilization, catalase, coagulase, IMViC), Mathematics of growth-generation time, specific growth rate.
UNIT III CONTROL OF MICROORGANISMS

Sterilization, Physical control of microorganisms dry and moist heat, pasteurization, tyndallization; radiation, ultrasonication, filtration. and chemical control of microorganisms (phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes, sterilizing gases) Disinfection, antiseptics and fumigation. Determination of phenol coefficient of disinfectant. Host- microbe interactions (types of interaction, gnotobiotic, host defense and pathogen defense); anti-bacterial (class I, II, III), antifungal and antiviral agents; mode of action and resistance to antibiotics.

UNIT IV MICROBES- STRUCTURE AND REPRODUCTION

Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (Cyanophyta), and fungi (Streptomyces, Saccharomyces), mycoplasma (M. pneumoniae) and bacteriophages (T4 phage, lambda phage)

UNIT V INDUSTRIAL MICROBIOLOGY AND MICROBIAL ECOLOGY

Microbes involved in preservation (Lactobacillus, bacteriocins), spoilage of food and food borne pathogens (E.coli, Clostridium). Primary and secondary metabolites, Industrial use of microbes (production of penicillin, vitamin B-12); bioremediation (oil spillage); biofertilizers, biopesticides.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 identify different microorganisms and to design a medium for microbial growth

CO2 Control microorganisms using various physical and chemical agents

CO3 Gain knowledge of how the various drugs interact with the microbial metabolism

CO4 learn the applications of microbial metabolism and their primary, secondary metabolites in various fields

TEXT BOOKS:


REFERENCES:

### Course Articulation Matrix

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<td><strong>CO1</strong></td>
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<td>Identify different microorganisms and to design a medium for microbial growth</td>
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<td><strong>CO2</strong></td>
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<tr>
<td>Control of microorganisms using various physical and chemical agents</td>
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<td><strong>CO3</strong></td>
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<tr>
<td>Knowledge of how the various drugs interact with the microbial metabolism</td>
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<td><strong>CO4</strong></td>
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<tr>
<td>The applications of microbial metabolism and their primary and secondary metabolites in various fields</td>
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<tr>
<td>Overall CO</td>
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</tbody>
</table>

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,

- enable students learn the fundamentals of the life processes at the molecular level
- explain the structure, function and interrelationships of bio-molecules and their deviation during disease process
- introduce them to metabolic pathways of the major biomolecules in health and diseases

UNIT I PRINCIPLES OF BIOCHEMISTRY, CARBOHYDRATES AND LIPIDS 9
Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules, chemical nature of water, pH and biological buffers, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, the concept of free energy.

Carbohydrates – classification, mutarotation, glycosidic bond, properties. starch, glycogen, dextrin, inulin, cellulose, Proteoglycans, glycosaminoglycans, hyaluronic acid.

Lipids – Classification, properties. sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, cholesterol, lipoproteins, biosynthesis porphyrin, bile pigments, fatty acids and ketone bodies

UNIT II PROTEINS, NUCLEIC ACIDS AND VITAMINS 9
Proteins and amino acids – Classification, properties, of amino acids, reactions - deamination, transamination and decarboxylation, Functions, biosynthesis and structure of amino acids and proteins, essential amino acids


Vitamins – classification, coenzyme, chemical nature and properties, hormones.

UNIT III ENZYMES 5
Enzymes, introduction to biocatalysts, Nomenclature, Classification, Mechanism of action, Enzyme and substrate specificity, sensitivity, stereospecificity, Inhibitors, Enzyme kinetics.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION 15

Bioenergetics - High energy compounds, electronegative potential of compounds, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.
UNIT V CASE STUDIES IN THE BIOCHEMISTRY OF HUMAN DISEASES

Biochemical understanding of disease process – Diabetes mellitus, atherosclerosis, fatty liver, obesity, hormonal disorders, aging, inborn errors of metabolism.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 have a strong foundation in the structure and reactions of biomolecules.
CO2 introduce them to metabolic pathways of the major biomolecules and relevance to disease
CO3 correlate biochemical processes relevant with pharmaceutical and clinical applications.

TEXT BOOKS:


REFERENCES:

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<td><strong>CO 1</strong> ensure students have a strong foundation in the structure and reactions of Biomolecules</td>
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<tr>
<td><strong>CO 2</strong> introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions</td>
<td>2</td>
<td>3</td>
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<tr>
<td><strong>CO 3</strong> correlate Biochemical processes relevant with pharmacetical and clinical applications.</td>
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<td>3</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
TEXT-CUM-REFERENCE BOOKS

1. Tamil Language - Grammar and Composition (Dr. M. Valarmathi)
2. Classical Tamil Grammar (Dr. S. Singaravelu)
3. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi)
4. Social Life of Tamils (Dr. K. K. Pillay)
5. Historical Heritage of the Tamils (Dr. S. V. Subatamanian)
6. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu)
7. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE5252 TAMILS AND TECHNOLOGY

UNIT I WEAVING AND CERAMIC TECHNOLOGY
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலொறு – மக்களும் பணையும் – தினசரி. பிள்மள (ஏராலும்: தமிழ்ஷுலாம் பொடும் மறந்தும் கல்வி பொருள் குழந்தை).
2. கொண்டுதோடு குழந்தை – பாண்டசம் (திருச்சுராய்).
3. கீழடியில் மவமகநீதிகமனர் மீன்கை துருவூர் தெருகையில் (ஏராலும்: கொண்டுதோடு குழந்தை)
4. பட்டான்டியா – அண்டி கருவைகள் தெருகையில். (ஏராலும்: கொண்டுதோடு குழந்தை)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

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OBJECTIVES
The course aims to,
- make the students aware of the various lab protocols
- make them aware of the safety measures involved while doing experiments
- equip the students to handle microbes confidently.

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

TOTAL: 60 PERIODS

Equipment needed for 20 Students
- Autoclave 1
- Hot Air Oven 1
- Incubators 2
- Light Microscopes 4
- Incubator Shaker 1
- Colorimeter 2
- Laminar Flow Chamber 2
- Glassware, Chemicals, Media as required

OUTCOMES:
At the end of the course the students will be able to,
- **CO1** know how to identify an organism by microscopic examination
- **CO2** quantify microbes and confirmation of the identity by biochemical tests.
- **CO3** know how to use the various equipment in the lab and also the importance of biosafety lab
TEXT BOOKS:


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<tr>
<td>CO 2 quantify microbes and confirmation of the identity by biochemical tests</td>
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<td>-</td>
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<tr>
<td>CO 3 Know how to use the various equipment in the lab and also the importance of various biosafety measures used in lab</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.).
- make students to learn the basic units of measurements and standardisation of various buffer solutions

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

TOTAL: 60 PERIODS

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

OUTCOMES:
At the end of the course the students will be able to,

CO1 learn various qualitative and quantitative techniques
CO2 describe various types of biochemical reaction
CO3 evaluate the novelty of the experiment
TEXT BOOKS:

REFERENCES:

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<td>Overall CO</td>
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GE5262 COMMUNICATION LABORATORY

OBJECTIVES
- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

UNIT I
Speaking: Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life-discussing past events-Writing: writing emails (formal & semi-formal).

UNIT II
Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures-talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons-understanding common technology terms-Writing: - writing different types of emails.
UNIT III 12
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages-making comparisons-discussing likes and dislikes-discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV 12
Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-example: discussing rental arrangements-understanding technical instructions Writing: writing instructions-writing a short article.

UNIT V 12
Speaking: describing things relatively-describing clothing-discussing safety issues-making recommendations-talking about electrical devices-describing controlling actions Writing: job application(Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES
- Speak effectively in group discussions held in a formal/semi formal contexts.
- Write emails and effective job applications.

Assessment Pattern
- One online/app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.
OBJECTIVES
The course aims to,

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

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

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

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

UNIT IV FOURIER TRANSFORM 12

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12

TOTAL : 60 PERIODS

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

CO1 learn about partial differential equations
CO2 learn about fourier series analysis
CO3 learn about the problems using Fourier transform and Z transform techniques
TEXT BOOKS:

REFERENCES:
   Delhi, 4th edition 2011.
   Ltd, New Delhi, 2007.

PM5301 PHYSICAL PHARMACEUTICS L T P C
3 0 0 3

OBJECTIVES
The course aims to,
- acquire the fundamental principles and concepts involved in pharmaceutical powders,
  liquid flow, dispersions, drug diffusion, dissolution, complexation and protein binding.
- provide the knowledge about kinetics and drug stability

UNIT I MICROMERITICS AND POWDER RHEOLOGY
9
Particle size and distribution, particle number, methods for determining particle volume,
optical microscopy, sieving, sedimentation, Dynamic light scattering (DLS) technique,
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 AND INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY
9
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 the
interface. Newtonian system, Law of flow, kinematic viscosity, effect of temperature on
viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in
formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

UNIT III DISPERSION SYSTEMS
9
Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications
of colloids in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended
particles, settling in suspension, theory of sedimentation, effect of Brownian movement,
sedimentation of flocculated particles, sedimentation parameters, wetting of particles,
controlled flocculation, flocculation in structured vehicles, rheological considerations,
emulsions; types, theories, physical stability.
UNIT IV DIFFUSION, DISSOLUTION, COMPLEXATION & PROTEIN BINDING


UNIT V KINETICS AND DRUG STABILITY

General considerations and concepts of drug reaction kinetics; zero order, first order and pseudo first order, half-life determination. Influence of temperature, light, catalytic species, solvent and other factors, Stabilization of drugs, Accelerated stability study – shelf-life

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1  know the fundamental properties of pharmaceutical solids
CO2  understand the surface, interfacial phenomena and the rheology of liquids
CO3  understand the principles, characteristics and applications of pharmaceutical dispersions.

TEXT BOOKS:


REFERENCES:

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<td>know the fundamental properties of pharmaceutical solids</td>
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<td>understand the surface, interfacial phenomena and the rheology of liquids</td>
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<td>understand the principles, characteristics and applications of pharmaceutical dispersions</td>
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OBJECTIVES
The course aims to,

- learn about the basic calculation techniques used in process industries
- learn the laws about the behavior of gases, liquids and solids, for analysing and designing chemical processing equipment with the help of data sources containing relevant physical and chemical properties.

UNIT I UNITS AND DIMENSIONS
Fundamental and derived units, conversion, dimensional consistency of equations, conversions of equations, Dimensional and dimensionless constants, mass and volume relations, Stoichiometric and composition relations.

UNIT II IDEAL GASES AND VAPOUR PRESSURE
Ideal gas law, Dalton's Law, Amagat's Law and Average molecular weight of gaseous mixtures. Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law.

UNIT III HUMIDITY AND SOLUBILITY
Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization and adiabatic saturation temperature.

UNIT IV MATERIAL BALANCE

UNIT V ENERGY BALANCE

TOTAL: 45 PERIODS

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

CO1 have a clear idea of various types of unit systems and they will be able to convert units from one form to another.

CO2 have sound strategy for solving and developing mathematical relations for material and energy balance calculations for reaction and separation processes.

CO3 analyze the behavior of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.
**TEXT BOOKS:**


**REFERENCES:**


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<td>3 1 1 2 1 - - - - 1 2</td>
<td>2 1 1 - 3 1</td>
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<tr>
<td><strong>CO 2</strong> Have sound strategy for solving and developing mathematical relations for material and energy balance calculations for reaction and separation processes.</td>
<td>3 3 3 2 1 3 1 - - 3 1</td>
<td>3 3 1 2 2 2</td>
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CO 3
Analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.

Overall CO

3 3 2 2 2 3 1 - 3 1 3 1 2 2 2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)

PM5303 HUMAN ANATOMY AND PHYSIOLOGY

OBJECTIVES
The course aims to,
- develop an 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


UNIT II NERVOUS AND MUSCULO-SKELETON SYSTEM

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 the muscular system, types of muscle tissue – skeletal, smooth, cardiac, contraction, muscle fibre regulation, Osseous system - structure, composition and functions of the Skeleton, classification of joints, types of movements of joints and their disorders

UNIT III GASTROINTESTINAL AND RENAL SYSTEM

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

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

UNIT V ENDOCRINE AND REPRODUCTIVE SYSTEM

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

TOTAL: 45 PERIODS

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

CO1  study the different physiological process in human system
CO2  study the anatomy of different bones and connective tissues
CO3  study the underlying physiological process in different organ

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OBJECTIVES

The course aims to,

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

UNIT I CHEMISTRY OF HETEROCYCLIC COMPOUNDS  
Classification of heterocyclic compounds, nature and nomenclature, preparation and important reactions of pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole, pyridine, pyrimidine, indole, quinoline, isoquinoline, acridine, phenothiazine, azepines, diazepines, quinolones and quinazolines and structural examples of medicinal compounds and examples prototype pharmaceutical compounds

UNIT II PROTOTYPE REACTIONS  

UNIT III PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES  
Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals, lead and modifications with suitable examples

UNIT IV STUDY OF INORGANIC COMPOUNDS IN PHARMACOPOEIA  
Method of preparation, assay, identification test, test for purity, official preparation, storage conditions and belonging to the following categories. Gastrointestinal agents and related compounds – Acidifiers, Antacids, Adsorbents and Protectives, Saline cathartics; Topical Agents – Protectives, Astringents, Antimicrobial topical agents.

UNIT V PHARMACEUTICAL AIDS AND COORDINATION COMPOUNDS  
Definition, principles and properties of various agents such as – Sodium bisulphate, Sodium metabisulphite, Sulphur dioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium carboxymethyl cellulose, Sodium methyl paraben. Theory of coordination compounds with special reference to application in Pharmacy such as – EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline.

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to,

CO1 identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.

CO2 identify and estimate the purity of drugs and its application.

CO3 be involved in the development and synthesis of new drug molecule.

TEXT BOOKS:

REFERENCES:
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<thead>
<tr>
<th>Course Articulation Matrix</th>
<th>Programme Outcomes (PO)</th>
<th>Programme Specific Outcomes (PSO)</th>
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<td><strong>Course Outcome Statements</strong></td>
<td>1 2 3 4 5 6 7 8 9 1 0 1 1 1 2</td>
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<tr>
<td><strong>CO 1</strong> Identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.</td>
<td>3 - 1 - - - - - - - - - - 2</td>
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<tr>
<td><strong>CO 2</strong> Identify and estimate the purity of drugs and its application.</td>
<td>2 - - - - - - - - - - - - - - - - - - - - 2</td>
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<td>3 2 - 2</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,

- understand the principles of characterizing pharmaceutical powders.
- determine various physico-chemical properties involved in formulation design.
- learn the basics of physico-chemical characterization of pharmaceutical additives used in liquid/semi-solid dosage forms

LIST OF EXPERIMENTS
1) Determination of particle size and particle size distribution using sieving method.
2) Determination of particle size and particle size distribution using Microscopical method.
3) Determination of bulk density, true density and porosity.
4) Determine the angle of repose
5) Determine the angle of repose with effect of lubricant.
6) Determination of surface area of powders.
7) Determination of surface tension of given liquids by drop count and drop weight method.
8) Determination of critical micellar concentration (CMC) of surfactants.
9) Study of rheological properties of various types of systems using different viscometers.
10) Preparation of various types of suspensions and determination of their sedimentation parameters.
11) Preparation and stability studies of emulsions.
12) Determination of half-life, rate constant and order of reaction.

TOTAL: 60 PERIODS

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

OUTCOMES:
At the end of the course the students will be able to,

CO1 Characterize and evaluate the properties of powders by suitable methods.
CO2 Carry out the stability studies and determines the stability of various dosage forms
CO3 Calculate the rate constants involved in the pharmaceutical systems and process
TEXT BOOKS:

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<tr>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- learn the gross histology, structure and functions of various organs of the human body
- perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of the 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. Pipettes and tips
3. Haemocytometer
4. Sphygmomanometer
5. Spirometer
6. Hemoglobinometer

OUTCOMES:
At the end of the course the students will be able to,

CO1 explain physiological processes in detail and to an appropriate level
CO2 analyze physiological process
CO3 interpret the underlying mechanism of disease progression
TEXT BOOKS:

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OBJECTIVES:

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: 10 Hours
- Create and format a document
- Working with tables
- Working with Bullets and Lists
- Working with styles, shapes, smart art, charts
- Inserting objects, charts and importing objects from other office tools
- Creating and Using document templates
- Inserting equations, symbols and special characters
- Working with Table of contents and References, citations
- Insert and review comments
- Create bookmarks, hyperlinks, endnotes footnote
- Viewing document in different modes
- Working with document protection and security
- Inspect document for accessibility

MS EXCEL: 10 Hours
- Create worksheets, insert and format data
- Work with different types of data: text, currency, date, numeric etc.
- Split, validate, consolidate, Convert data
- Sort and filter data
- Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.)
- Work with Lookup and reference formulae
- Create and Work with different types of charts
- Use pivot tables to summarize and analyse data
- Perform data analysis using own formulae and functions
- Combine data from multiple worksheets using own formulae and built-in functions to generate results
- Export data and sheets to other file formats
- Working with macros
- Protecting data and Securing the workbook

MS POWERPOINT: 10 Hours
- Select slide templates, layout and themes
- Formatting slide content and using bullets and numbering
- Insert and format images, smart art, tables, charts
- Using Slide master, notes and handout master
- Working with animation and transitions
- Organize and Group slides
- Import or create and use media objects: audio, video, animation
- Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

OUTCOMES:
On successful completion the students will be able to
• Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
• Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
• Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects

SEMESTER IV

GE5251  ENVIRONMENTAL SCIENCES  L T P C
3 0 0 3

OBJECTIVES

The course aims to,

• introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
• impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
• facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
• familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
• inculcate the effect of population dynamics on human and environmental health and inform about human rights, value education and the role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

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

UNIT II ENVIRONMENTAL POLLUTION

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

UNIT III NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies
– Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT


UNIT V HUMAN POPULATION AND THE ENVIRONMENT


TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 recognize and understand the functions of environment, ecosystems and biodiversity and their conservation

CO2 identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.

CO3 identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development

CO5 demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse the effect of population dynamics on human value education, consumerism and the role of technology in environmental issues.

TEXT BOOKS:


REFERENCES:

OBJECTIVES

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To apply the small/large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate factorial dependence.
- To monitor a process and detect a situation when the process is out of control.

UNIT I  RANDOM VARIABLES  12
Discrete and continuous random variables – moments – moment generating functions – binomial, poisson, geometric, uniform, exponential, gamma, weibull and normal distributions – functions of a random variable.

UNIT II  TWO-DIMENSIONAL RANDOM VARIABLES  12

UNIT III  TESTS OF SIGNIFICANCE  12
Type I and Type II errors – tests for single mean, proportion, difference of means (large and small samples) – tests for single variance and equality of variances – chi-square test for goodness of fit – independence of attributes – non-parametric tests: test for randomness and rank – sum test (wilcoxon test).

UNIT IV  DESIGN OF EXPERIMENTS  12
Completely randomized design – randomized block design – latin square design – factorial design – taguchi's robust parameter design.

UNIT V  STATISTICAL QUALITY CONTROL  12
Control charts for measurements ( and R charts) – control charts for attributes (p, c and np charts) tolerance limits – acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES

CO1 To analyze the performance in terms of probabilities and distributions achieved by the determined solutions
CO2 To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis
CO3 To apply the basic principles underlying statistical inference(estimation and hypothesis testing)
CO4 To demonstrate the knowledge of applicable large sample theory of estimators and tests To obtain a better understanding of the importance of the methods in modern industrial processes.

TEXT BOOKS:

REFERENCES:
OBJECTIVES
The course aims to,
- make the students understand and impart knowledge on the fluid statics and dynamics
- incorporate different expressions involved in fluid flow and fluid flowing over immersed solids
- learn the concepts involved in heat transfer by conduction, convection and radiation

UNIT I FLUID PROPERTIES & FLUID MECHANICS

UNIT II FLOW OF FLUID THROUGH PACKINGS

UNIT III CONDUCTION HEAT TRANSFER

UNIT IV CONVECTION HEAT TRANSFER
Forced and natural convection – Dimensional analysis, Dimensionless numbers, Convection heat transfer coefficient, Correlations for flow over plate, through tubes, over spheres and cylinders, Agitated systems, Packed columns, condensation phenomena, Film and drop wise condensation over tubes. Boiling of solutions – individual, overall heat transfer coefficients and solving related problems.

UNIT V RADIATION HEAT TRANSFER AND HEAT TRANSFER EQUIPMENTS
OUTCOMES:
At the end of the course the students will be able to
CO1 understand the rheological behavior of fluids and its applications
CO2 understand mass balance in fluid flow operations and also calculation of drag coefficient for fluid flow past solid objects
CO3 understand the basic concepts on conduction, convection and radiation involved in heat exchanger equipment and furnace wall

TEXT BOOKS:

REFERENCES:
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<tr>
<td><strong>CO1</strong></td>
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<tr>
<td>Understand the rheological behavior of fluids and its applications</td>
<td>2</td>
<td>2</td>
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<tr>
<td><strong>CO2</strong></td>
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<tr>
<td>Understand mass balance in fluid flow operations and also calculation of drag coefficient for fluid flow past solid objects</td>
<td>1</td>
<td>2</td>
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<tr>
<td><strong>CO3</strong></td>
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<tr>
<td>Understand the basic concepts on conduction convection and radiation involved in heat exchanger equipment and furnace wall</td>
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<td>1</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- enable students understand the structure and function of the eukaryotic cell and its organelles.
- present the concepts on the genetic information flow in the eukaryotic cell and account for how genes are regulated.
- expose students to the application of recombinant DNA technology in biotechnological research.
- train students in strategizing research methodologies employing cloning, construction of DNA libraries.
- illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.

UNIT I  CELLULAR BIOLOGY  9

UNIT II  MOLECULAR GENETICS  10

UNIT III  RECOMBINANT DNA TECHNOLOGY  10

UNIT IV  SEQUENCING AND AMPLIFICATION OF DNA  8
Amplification of DNA; Types of PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Site directed mutagenesis. Organization and structure of genomes, Maxam Gilbert’s and Sanger Coulson’s and automated methods of DNA sequencing, Next generation sequencing technologies, Genetic maps and Physical maps.

UNIT V  GENOME ANALYSIS AND GENOMICS  8
Gene therapy and Transgenic technology, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Web resources for Genomics, Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to
CO1  have an overview about the structure and functions of prokaryotic and eukaryotic cells
CO2  have an overview of nucleic acids and the central dogma of life and its significance
CO3  understand the basic tools and techniques involved in recombinant DNA technology

TEXT BOOKS:

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<td>have an overview about the structure and function of prokaryotic and eukaryotic cells</td>
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<tr>
<td>have an overview of nucleic acids and the central dogma of life and its significance</td>
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<tr>
<td>CO 3</td>
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<td>understand the basic tools and techniques involved in recombinant DNA technology</td>
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OBJECTIVES
The course aims to,
- provide the student with a basic understanding of the format of the pharmacopoeial monograph and instrumentation of various equipments.
- enable students to understand the principles of spectrophotometry and chromatography

UNIT I INTRODUCTION
Pharmacopoeia, monograph, precision, accuracy, Titrations- non aqueous, redox and complexometric titrations. Thermal methods analysis- Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC)

UNIT II ULTRAVIOLET SPECTROSCOPY AND FLUORIMETRY
Introduction to spectroscopy, colorimeter, Ultraviolet Spectroscopy- theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert’s law - derivation and deviations, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra. Instrumentation and applications. Fluorimetry – theory, types of fluorescence, factors affecting fluorescence, quenching of fluorescence, instrumentation and applications.

UNIT III IR AND NMR SPECTROSCOPY
Infrared spectroscopy – principle, types of vibrations, instrumentation, applications.
NMR spectroscopy- principle, instrumentation, shielding and deshielding, chemical shift and applications, Principles of H-NMR and C-NMR.

UNIT IV ATOMIC ABSORPTION AND MASS SPECTROSCOPY
Atomic absorption spectroscopy- Principle, instrumentation and applications. Advantages and limitations of Atomic absorption spectroscopy.
Mass Spectroscopy - Principles, instrumentation, Ionization techniques - chemical ionization (CI), electron impact ionization (EI), fast atom bombardment (FAB), matrix assisted laser desorption ionization (MALDI), Types of peaks, Applications, LC-MS/MS, GC-MS/MS

UNIT V CHROMATOGRAPHIC TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
CO1 acquire knowledge related to assay standardization of different drugs
CO2 characterize and analyze different sources of analytes
CO3 quantify and study different drug moiety using advanced methods

TEXT BOOKS:
6. B.K. Sharma, “Instrumental Method of Chemical Analysis”, Krishna’s Education
7. Dr. S. Ravi Sankar “Text of pharmaceutical analysis” 4th edition, Rx Publications.2010

REFERENCES:
2. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, “Principles of Instrumental

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<tr>
<td>CO 3 quantify and study different drug moieties using advanced methods</td>
<td>3</td>
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OBJECTIVES
The course aims to,

- carry out analytical experiments related to spectroscopic and chromatographic techniques.
- enable students to learn the principles of analysis for pharmaceutical applications

LIST OF EXPERIMENTS
1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Experiments involving titrimetric methods (permanganometry, iodometry, iodimetry, complexometry, non aqueous).
3. Experiments involving gravimetric analysis.
4. Determination of impurities by limit test: chloride, sulphate, iron, arsenic.
5. Determination of $\lambda_{\text{max}}$.
7. Quantitative and qualitative analysis of drug molecule using standard comparison method by UV/Vis spectroscopy.
8. Quantitative analysis by fluorimetry.
9. Analysis of drug molecule using standard comparison method by HPLC.
10. Interpretation of IR, NMR spectra.
11. Separation of components using paper, TLC and column chromatography.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Hot air oven
2. pH meter
3. UV-Visible spectrophotometer
4. HPLC
5. Fluorimetry
6. Arsenic limit test apparatus
7. Water bath
8. Weighing balance

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

- **CO1** study and analyse the monograph of different drugs.
- **CO2** characterize and analyze different sources of impurities.
- **CO3** quantify and interpret drug moieties using advanced methods.
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<td>characterize and analyze different sources of impurities</td>
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OBJECTIVES
The course aims to,

- understand the principle of nucleic acid isolation.
- understand the principles of PCR and their uses in genetic engineering.
- gain a thorough knowledge about nucleic acid hybridization.
- learn the history of DNA sequencing and current methods and gene synthesis

LIST OF EXPERIMENTS
1. Preparation of Genomic DNA
2. PCR amplification of gene from the genomic DNA
3. Preparation of plasmid DNA
4. Detection of Plasmid DNA by Agarose gel electrophoresis
5. Restriction Digestion of the vector and Insert
6. Ligation and Transformation of E. coli
7. Lysate PCR confirmation.
8. Restriction & gel elution of DNA fragments
9. Electroporation of Yeast
10. SDS-PAGE analysis of purified protein
11. Western blot confirmation of expressed protein (anti his)
12. Quantification of proteins.
13. RNA isolation
14. cDNA preparation from RNA
15. Site directed mutagenesis
16. Southern hybridization experiment

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS
- PCR machine
- Electrophoretic assemblies for DNA and protein separations
- ELISA reader
- Ultracentrifuge
- Laminar air flow cabinets
- Cooling centrifuge

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

- **CO1** experience basic techniques of DNA isolation and manipulation
- **CO2** experience in selecting genetically transformed organisms for downstream analysis
- **CO3** experience basic techniques involved in analysis of gene expression at nucleic acids and proteins level
REFERENCES:

Course Articulation Matrix

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES

The course aims to,

- teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- explain the TQM Principles for application.
- define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION

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

UNIT II TQM PRINCIPLES


UNIT III TQM TOOLS & TECHNIQUES I


UNIT IV TQM TOOLS & TECHNIQUES II

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM

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

**CO1** apply TQM principles in a selected enterprise.

**CO2** understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

**CO3** understand Taguchi’s Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

**CO4** apply QMS and EMS in any organization.

TEXT BOOKS:

REFERENCES:

PM5501 MEDICINAL CHEMISTRY LT PC 3 0 0 3

OBJECTIVES
The course aims to,
- impart comprehensive understanding of the chemical basis of drug action including physicochemical and steric properties of drug.
- study the classification, chemical nomenclature, generic names and synthesis of various medicinal agents.
- understand the structure activity relationship, biochemical/molecular basis of the mechanism of action and uses of drugs.

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

UNIT II MEDICINAL CHEMISTRY OF DRUGS ACTING ON CNS AND ANS 9
Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties and synthesis of selected drugs belonging to the class of General anaesthetics, local anaesthetics Anxiolytics, Sedatives and Hypnotics, Antipsychotics, Anticonvulsants/antiepileptics, CNS stimulants and Psychedelics, Analgesics, Morphine and related drugs., adrenergic neurotransmitters,
sympathomimetic agents, adrenergic antagonists, cholinergic receptors drugs and related agents, cholinergic blocking agents, ganglionic blocking agents and neuromuscular blockers.

UNIT III MEDICINAL CHEMISTRY OF ANTI-INFECTIVE AGENTS

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of sulphonamides and sulphones, antibiotics like penicillins and cephalosporins, aminoglycosides, tetracyclines., unclassified antibiotics – chloramphenicol and its prodrugs, peptide antibiotics, novobiocin and mupirocin, antiviral agents, anti-HIV agents, local anti-infective agents, anti-fungal agents, anti-tubercular agents, antiprotozoal agents, anthelmintics, anti-scabious and anti pedicural agents, antimalarials

UNIT IV MEDICINAL CHEMISTRY OF DRUGS ACTING ON CVS AND RENAL SYSTEMS

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers, cardiac glycosides, antiarrhythmic drugs, anti-hypertensive agents, anti-hyperlipidemic agents, anti platelet inhibitors, anti-coagulants and anti-thrombolytics. Diuretics and Anti-diuretics.

UNIT V MEDICINAL CHEMISTRY OF ANTICANCER DRUGS

Chemistry and nomenclature, structure basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of antimetabolites, DNA alkylating agents, antibiotic anticancer agents, hormonal anticancer agents, anti-tubulin inhibitors.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 gain an appreciation of the importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs, understand how changes in the chemical structure of drugs affect efficacy.

CO2 obtain a working knowledge of chemical structures and nomenclature, to develop the ability to suggest suitable techniques to synthesize different drug molecules.

CO3 understand how current drugs were developed and demonstrate the importance of chemistry in the development and application of therapeutic drugs.

TEXT BOOKS:


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<td>1 2 3 4</td>
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<td><strong>CO 1</strong></td>
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<tr>
<td>Gain an appreciation of the importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs, understand how changes in the chemical structure of drugs affect efficacy.</td>
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<td>Obtain a working knowledge of chemical structures and nomenclature, to develop the ability to suggest suitable techniques to synthesize different drug molecules.</td>
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<tr>
<td><strong>CO 3</strong></td>
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<tr>
<td>Understand how current drugs were developed and demonstrate the importance of chemistry in the development and application of therapeutic drugs.</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- provide the basic fundamentals and various unit operations such as size reduction, separation, filtration, centrifugation, crystallization and evaporation.
- understand the design concepts and equipment selection for various unit operations.

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION
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, etc., the cases of above operations prevalent in pharmaceutical bulk and formulation industries.

UNIT II SIZE REDUCTION & SEPARATION
Properties and characterization of particulate solids — Introduction to storage and conveying of solids - Analysis and technical methods for size determination of powders - Size reduction equipment – Screening equipment; the cases of above operations prevalent in pharmaceutical bulk and formulation industries.

UNIT III CRYSTALLIZATION
Characters of crystals like purity, size, shape, geometry, habit, forms, size and its factors- Solubility curves- Supersaturation theory and its limitations- nucleation mechanism and crystal growth- crystallisers- Swenson Walker crystalliser - Caking of crystals and its prevention and numerical problems on yields; the cases of above operations prevalent in pharmaceutical bulk and formulation industries.

UNIT IV FILTRATION AND CENTRIFUGATION

UNIT V MIXING
Mixing of powdered materials – Mechanism of random mixing and interactive mixing. Sampling techniques, size and mixing indices. Factors affecting the mixing process. Types, characteristics and operation of mixers.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
- CO1 have a comprehensive understanding of the principles and equipment for filtration and centrifugation and membrane processes
- CO2 understand the principles of equipment selection and design of size reduction and size enlargement processes
- CO3 have a thorough understanding of theory and equipment selection for mixing, crystallization, drying and evaporation in pharmaceutical industry

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,

- provide students with the practical laboratory skills of medicinal chemistry
- demonstrate the effect of the different synthetic methodology.
- clarify theoretical concepts of chemical synthesis of drug molecules.

LIST OF EXPERIMENTS:
1. Determination of melting point.
3. Determination of partition coefficient of any medicinal compound by shake flask method.
4. Synthesis and characterization of the following drugs:
   a. Phenacetin, Antipyrine, Benzocaine
   b. Uramil, Tolbutamide
   c. Phenothiazine
   d. Isoniazid, Sulphasalazine
   e. Aspirin from salicylic acid
   f. Paracetamol from p-aminophenol
   g. Benzotriazole
   h. 2-Phenyl Indole
   i. 7-hydroxy-4 methyl coumarin
4. Synthesis and characterization of the following drugs:
5. Any other relevant experiments based on theory.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS
- Water bath
- Hot air oven
- Vacuum filtration unit
- Reflux condenser
- Distillation unit

OUTCOMES:
At the end of the course the students will be able to,

CO1 develop the ability to suggest suitable techniques to synthesize different drug molecules

CO2 learn a variety of synthetic techniques including purification methods and should gain the ability to design a synthetic scheme for a proposed drug molecule

CO3 demonstrate how to conduct chemical reactions within medicinal chemistry context and scientific report
REFERENCES:


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<td>learn a variety of synthetic techniques including purification methods and should gain the ability to design a synthetic scheme for a proposed drug molecule</td>
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Overall CO 3 2 1 2 2 3 1 2 1 2 2 - 2 3 3 1

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- enhance the understanding of measurement techniques of fluid flows.
- impart practical knowledge on various unit operations.

LIST OF EXPERIMENTS
1. Co-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 the overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
11. To determine the overall heat transfer coefficient of double pipe heat exchanger by counter flow.
12. To determine the overall heat transfer coefficient of shell and tube heat exchanger.
13. To determine the overall heat transfer coefficient of plate type heat exchanger by parallel flow.

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

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 select and operate the suitable instruments for the measurement of flow rate and rate of heat exchange
CO2 differentiate laminar and turbulent flows
CO3 calculate and analyse the performance of various pumps and heat exchangers
TEXT BOOKS:

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OBJECTIVES
The course aims to,
- provide the knowledge on the principles of solid dosage forms formulation and development
- inculcate the concepts involved in troubleshooting and improvement of solid dosage forms

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

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

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

UNIT IV INTRODUCTION TO SEMISOLID DOSAGE FORMS

UNIT V PASTES, GELS SUPPOSITORY

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to
CO1 understand various preformulation characteristics of solid/ semi-solid dosage forms
CO2 understand formulation and evaluation techniques of tablets and capsules
CO3 have knowledge on basic requirements to formulate and evaluate semi-solid dosage forms
TEXT BOOKS:

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OBJECTIVES
The course aims to,
- introduce the principles of Mass Transfer Operations
- impart knowledge about various mass transfer operations equipments and its design concepts

UNIT I DIFFUSION AND MASS TRANSFER 9
Eddy Diffusion - Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Mass Transfer Theories & Analogies. Co current and counter current operations; Also cases and processes relevant in pharmaceutical bulk and formulation industries

UNIT II GASLIQUID OPERATIONS 9
Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Industrial absorbers; Design principles of absorbers - HTU, NTU concepts; Solving design problems; The cases of above processes prevalent in pharmaceutical bulk and formulation industries

UNIT III VAPOUR LIQUID OPERATIONS 9
V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabe-Thiele & Ponchon-Savarit Principles – design of distillation columns – solving design problems ; Industrial distillation equipments, HETP, HTU and NTU concepts. The cases of above processes prevalent in pharmaceutical bulk and formulation industries

UNIT IV EXTRACTION OPERATIONS 9
L-L equilibria, Solvent characteristics –Staged and continuous extraction – Spray, packed and mechanically agitated contactors- Pulsed and centrifugal extractors – supercritical extraction – solving problems - Solid-liquid equilibria, Leaching Principles – leaching equipments. The cases of above processes prevalent in pharmaceutical bulk and formulation industries

UNIT V SOLID FLUID OPERATIONS 9
Adsorption equilibria – Nature of adsorbents; Batch and fixed bed adsorption – Adsorbers – steady state moving bed adsorber and unsteady state moving adsorbers – break through curves. Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers. The cases of above processes prevalent in pharmaceutical bulk and formulation industries

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1  demonstrate and classify the use of accurate engineering correlations of diffusion and mass transfer coefficient to model a separation process

CO2  get a basic knowledge to design and develop different equipments.

CO3  perceive knowledge about gas absorption, humidification, crystallization, adsorption and drying

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**TEXT BOOKS:**

**REFERENCES:**

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<td>CO 2 get a basic knowledge to design and develop different equipments.</td>
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<td>CO 3 perceive knowledge about gas absorption, humidification, crystallization, adsorption and drying</td>
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OBJECTIVES

The course aims to,

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

UNIT I GENERAL PHARMACOLOGY

Routes of administration, Pharmacokinetics, Pharmacodynamics, Factors modifying drug action, adverse drug reactions, drug interactions, Bioassay of drugs, drug discovery and development.

UNIT II PERIPHERAL AND CENTRAL NERVOUS SYSTEM

Mechanism of action, Pharmacology of parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking agents, general anaesthetics, antipsychotics, antidepressants, antiepileptic, analgesics, antipyretic, anti-inflammatory (NSAIDS) and CNS stimulants.

UNIT III CARDIOVASCULAR PHARMACOLOGY

Classification, Mechanism of action, Pharmacology of cardiac glycosides, antianginal, antihypertensive agents, vasodilators including calcium channel blockers, antiarrhythmic and anti-hyperlipidemic agents.

UNIT IV GASTROINTESTINAL PHARMACOLOGY

Classification, Mechanism of action, Antacids, antiulcer drugs, laxatives, antidiarrhoeal, emetics, antiemetics, appetite stimulants and suppressants.

UNIT V CHEMOTHERAPY AND ANTIMICROBIAL AGENTS

General principles of chemotherapy, sulphonamides, antibiotics – penicillins, cephalosporins, chloramphenicol, macrolides, fluoroquinolones. Chemotherapy of tuberculosis, leprosy, fungal, viral diseases, malignancy and immunosuppressive agents.

TOTAL: 45 PERIODS

OUTCOMES:

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

- CO1 understand the various principles of general pharmacology
- CO2 understand the pharmacology of various categories of drugs acting on nervous, cardiovascular and gastrointestinal systems
- CO3 understand the principles of chemotherapy and pharmacology of antimicrobial agents

TEXT BOOKS:


REFERENCES:

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<td><strong>CO1</strong> Understand the various principles of general pharmacology</td>
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<tr>
<td><strong>CO2</strong> Understand the pharmacology of various categories of drugs acting on nervous, cardiovascular and gastrointestinal systems</td>
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<td><strong>CO3</strong> Understand the principles of chemotherapy and pharmacology of antimicrobial agents</td>
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OBJECTIVES
The course aims to,
- learn and understand the pharmacological aspects of drugs action
- correlate and apply the knowledge for drug development and evaluation.

LIST OF EXPERIMENTS
1. Experiments on humane handling of animals for research (Eg. Mice, Rats, Jirds/Gerbils, rabbits, chickens)
2. Preparation and study of physiological salt solutions and laboratory appliances used in experimental pharmacology.
3. Bioassay experiments - study of the effects of various drugs on isolated tissues (heart, muscle etc., from abattoir specimens or nematodes) e.g Ach, adrenaline, effect of adrenergic and cholinergic blockers, effect of ions (through direct/audiovisual demonstration)
4. Experiments of drug evaluation using zebrafish model (Eg. Teratogenic effects, etc.,)
5. Experiments of drug evaluation using C.elegans model
6. Evaluation of pyrogens by *in vitro* LAL test (Limulus Amebocyte Lysate) test (or Limulus clotting factor C)
7. Routes of drug administration in animal models (through direct/audiovisual demonstration)
8. Experiments to study general anaesthetic effects of drugs
9. Experiments to study analgesic effects of drugs
10. Experiments to study local anaesthetic effects of drugs
11. Experiments to study anti-inflammatory effects of drugs
12. Experiments to study antiparasitic drugs (*in-vitro*/*in-vivo* methods using nematodes)
13. Experiments to study anticancer drugs by cytotoxic assay (MTT assay)

TOTAL: 60 PERIODS

Equipments Required :
1. Animal House facility
2. UV-Visible spectrophotometer
3. Simulation softwares
4. Fish tanks, *E.coli* cultures *C.elegans*
5. Relevant consumables and drugs

OUTCOMES:
At the end of the course the students will be able to,
- **CO1** be familiar with various animal handling techniques
- **CO2** study the pharmacological effects in different *in-vitro, in-situ, in-vivo, in-silico* organ systems
- **CO3** learn evaluation of drug effects through physiological models
**TEXT BOOKS:**
2. Pharmacological experiments on intact preparations by Churchill Livingstone.1970

**REFERENCES:**
3. https://zfin.org/ (The Zebrafish Information Network)
4. https://www.wormbase.org (Explore Worm Biology facilitating insights into nematode biology for research)

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- study the basic principles of formulating prototype dosage forms such as liquid, semisolid, solid and parenteral dosage forms
- learn various methods of characterizing and evaluating the dosage forms

LIST OF EXPERIMENTS
1. Preparation of solutions
2. Preparation of creams
3. Evaluation of creams
4. Preparation of ointments
5. Evaluation of ointments
6. Preformulation studies on prepared granules
7. Manufacture and evaluation of granules - wet granulation, dry granulation methods
8. Preparation of tablets
   a. Tablets prepared from wet and dry granules
   b. Tablets prepared by direct compression
9. Formulation and filling of hard gelatin capsules
10. Preparation and evaluation of parenterals
    a. Ascorbic acid injection
    b. Calcium gluconate injection
    c. Sodium chloride injection

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Tablet punching machine – Mini press
2. Automatic capsule filling machine
3. pH meter
4. Dissolution apparatus
5. Liquid filling Machine
6. Mortar/pestle

OUTCOMES:
After the completion of the course the students will be able to,

CO1  acquire knowledge to prepare and evaluate various liquid, semi solid dosage forms
CO2  acquire knowledge to prepare and evaluate solid dosage forms and parenteral dosage forms
CO3  apply the knowledge to formulate new dosage forms
**TEXT BOOKS:**

2. Indian Pharmacopoeia, Indian Pharmacopoeia commission, Ghaziabad, 2016.

**REFERENCES:**


**Course Articulation Matrix**

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<td><strong>CO 3</strong> Apply the knowledge to formulate new dosage forms</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES

The course aims to,

- learn important parameters involved in drug disposition and its principles in living systems.
- make the students to understand how the drug disposition takes place in the *in vitro* and *in vivo* conditions.
- understand the concepts of bioavailability and bioequivalence of drug products and their significance.

UNIT I DRUG ABSORPTION AND DISTRIBUTION


UNIT II ELIMINATION


UNIT III BIOAVAILABILITY AND BIOEQUIVALENCE

Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT IV PHARMACOKINETICS

Introduction to Pharmacokinetics, Pharmacokinetic models. One compartment open model- Intravenous Bolus Injection – Intravenous infusion - Extra vascular administrations. Determination of pharmacokinetics parameters and their significance - 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 AND NONLINEAR PHARMACOKINETICS


TOTAL: 45 PERIODS

OUTCOMES:

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

- **CO1** study the various factors influencing the drug disposition, various pharmacokinetic parameters.
- **CO2** design and interpret the bioavailability and bioequivalence of dosage forms.
- **CO3** identify the factors affecting the rate of drug absorption.
TEXT BOOKS:

REFERENCES:

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<tr>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims 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.

UNIT I SUSTAINED RELEASE FORMULATIONS 10
Introduction, concept advantages and disadvantages. Physicochemical and biological properties of drugs relevant to sustained release formulations.

UNIT II TRANSDERMAL DRUG DELIVERY SYSTEMS 8
Permeation through skin, factors affecting permeation, basic components of TDDS, formulation approaches used in development of TDDS and their evaluation, permeation enhancers.

UNIT III PARENTERAL CONTROLLED RELEASE DRUG DELIVERY SYSTEMS 7
Approaches for injectable controlled release formulations and development of Implantable drug delivery systems.

UNIT IV TARGETED DRUG DELIVERY SYSTEMS 12
Concept. Advantages and disadvantages, biological processes and events involved in drug targeting, nanoparticles, liposomes, resealed erythrocytes, microspheres, and monoclonal antibodies.

UNIT V FUTURE DIRECTIONS OF DRUG DELIVERY AND TARGETING 8
Plasmid based Gene therapy, Protein delivery system, Nucleic acids delivery, Integrating Drug Discovery and delivery and New Generation Technology.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to
- CO1 understand the properties and importance of polymer in novel drug delivery systems
- CO2 apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies
- CO3 understand the application of polymer in sustained release, topical and targeted drug delivery systems.

TEXT BOOKS:
REFERENCES:

2. Theory And Practice Of Industrial Pharmacy by Liberman & Lachman, 2014
3. Pharmaceutics-the science of dosage form design by M.E.Aulton, Churchill livingstone, 2001

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<tr>
<td>CO 1 Understand the properties and importance of polymer in novel drug delivery systems</td>
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<td>2 1 1 3 3</td>
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<tr>
<td>CO 2 Apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies</td>
<td>3 1 2 2 3 - 1 - - - - -</td>
<td>2 1 1 3 3</td>
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<tr>
<td>CO 3 Understand the application of polymer in sustained release, topical and targeted drug delivery systems.</td>
<td>2 1 1 - 3 - 1 - - - - -</td>
<td>2 1 - 3 3</td>
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<tr>
<td>Overall CO</td>
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<td>2 1 1 3 3</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES

The course aims to,

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

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

EQUIPMENTS REQUIRED

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

OUTCOMES:

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

CO1 comprehend various classes of excipients involved in formulation of novel drug delivery systems.

CO2 formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.

CO3 perform various quality control tests for the marketed products.

TEXT BOOKS:

REFERENCES:
2. Theory And Practice Of Industrial Pharmacy by Liberman & Lachman,2014
3. Pharmaceutics-the science of dosage form design by M.E.Aulton, Churchill livingstone, 2001

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<tr>
<td><strong>CO 1</strong></td>
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<tr>
<td>Comprehend various classes of excipients involved in formulation of novel drug delivery systems.</td>
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<td>2 2 2 3 1</td>
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<tr>
<td><strong>CO 2</strong></td>
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<tr>
<td>Formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.</td>
<td>3 2 3 2 - 1 - - - -</td>
<td>2 3 2 2 3 3</td>
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<tr>
<td><strong>CO 3</strong></td>
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<tr>
<td>Perform various quality control tests for the marketed products organ.</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

● understand the principles of pharmaceutical dosage form kinetics
● Impart the knowledge of the rate and extent of drug absorption and distribution.

LIST OF EXPERIMENTS
1. In-vitro dissolution study of the given sustained release dosage form using various dissolution media.
2. Study the effect of formulation on drug release (Tablet, Solution, suspension etc.).
3. Determination of effect of pH on the partition coefficient of drug(s)
4. Determination of protein binding of the given drug(s) and the effect of protein binding on drug bioavailability.
5. In-vitro drug absorption study using everted small intestine sac technique.
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).
8. To determine the various Pharmacokinetic parameters from the given blood data of oral dosage form.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

● pH Meter
● Dissolution test apparatus
● Cooling Centrifuge
● Ultra Violet Spectrophotometer
● HPLC

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

CO1 perform dissolution studies for the modified dosage forms
CO2 estimate various pharmacokinetic parameters using plasma and urine drug level data
CO3 predict the effects of dosage form design and routes of drug administration on drug levels in body

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<td>Perform dissolution studies for the modified dosage forms</td>
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<td><strong>CO 2</strong></td>
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<tr>
<td>Estimate various pharmacokinetic parameters using plasma and urine drug level data</td>
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<tr>
<td><strong>CO 3</strong></td>
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<td>Predict the effects of dosage form design and routes of drug administration on drug levels in body</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- encourage the students to get connected with any industry/ laboratory/research institute.
- acquire knowledge on solving practical problems, gaining work experience and skills.
- learn to work in an academic/ industrial/research environment.

The students individually undergo training in reputed companies/research institutes/ organizations for the specified duration.

OUTCOMES:
At the end of the course the students will be able to,

CO1 learn to work in an industry/academia/research institute
CO2 gain experience to work as an individual as well as a team member.
CO3 acquire practical knowledge and enhance their technical skills

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<tr>
<td>CO1 learn to work in an industrial/academia/research institute</td>
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<tr>
<td>CO2 gain experience to work as an individual as well as a member of a team</td>
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<tr>
<td>CO3 Acquire practical knowledge and enhance skills</td>
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<td>Overall CO</td>
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OBJECTIVES
The course aims to,
- make the students identify project/problems relevant to their field of interest that can be carried out.
- make them equipped to search databases and journals to collect relevant data and learn methods to develop understanding and formulate solutions.
- plan, learn and perform experiments to verify the solutions.

OUTCOMES:
At the end of the course the students will be able to,
CO1 gain knowledge in the identification of field of interest.
CO2 equip the students to search and think about logical solutions.

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<td>Identification of field of interest</td>
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<td>CO 2</td>
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<tr>
<td>Equip the students to</td>
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<td>search and think about</td>
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<td>logical solutions</td>
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OBJECTIVES
The course aims to,

- train students to analyze a problem
- make them understand how to find solutions innovatively
- enable them to acquire technical and experimental skills to validate the solution, analyze the results and communicate.

COURSE OUTCOMES:
At the end of the course the students will be able to,

CO1  formulate and analyze a problem
CO2  plan experiments to find solutions in a logical manner
CO3  analyze the results, interpret and communicate.

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<td>CO1 Formulate and analyze a problem</td>
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<tr>
<td>CO2 Plan experiments to find solutions in a logical manner</td>
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<td>CO3 Analyze the results, interpret and communicate</td>
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OBJECTIVES
The course aims to,

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

UNIT I GLYCOSIDES 12
Introduction to primary and secondary metabolites. Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing glycosides. Anthraquinone glycosides: Aloe, Senna, rhubarb and cascara. Cardiac glycosides: digitalis, squill, strophanthus and thevetia. Saponins: glycyrrhiza, ginseng, dioscorea.

UNIT II ALKALOIDS 12
Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing Alkaloids : vinca, atropa belladonna ephedra, ergot, cinchona, ipecac, rauwolfia, opium.

UNIT II OTHER SECONDARY METABOLITES 12
Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing Flavonoids: Lignans, Tea, Ruta. Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander, isolation techniques involved.

UNIT IV QUALITY CONTROL OF CRUDE DRUGS 12
Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation. WHO guidelines for quality control of herbal drugs.

UNIT V BASICS OF PHYTOCHEMISTRY 12
Modern methods of extraction, application of latest techniques like Spectroscopy and chromatography in the isolation, purification and identification of crude drugs

LIST OF EXPERIMENTS

1. Organoleptic characters of clove, fennel, ginger, cinnamon, nux vomica, ipecac etc
2. Histology of clove, fennel, ginger, cinnamon, nux vomica, ipecac etc
3. Experiments to perform the ash value, extractive value, refractive index swelling index etc
4. Extraction of active components using soxhlet apparatus
5. Isolation of volatile oil
6. Phytochemical analysis of crude drugs

TOTAL: 60 PERIODS
EQUIPMENTS REQUIRED
- Microscope, polarimeter, soxhlet apparatus, water bath, hot air oven, rotary vacuum evaporator, camera lucida, phytochemical reagents, Chromatographic plates, UV spectrophotometer, HPLC, HPTLC.

OUTCOMES:
At the end of the course the students will be able to,
- CO1 study the physiological characteristics of medicinal plants
- CO2 separate and characterize the phytoconstituents
- CO3 learn about the evaluation and isolation of various crude drugs

TEXT BOOKS:

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<td><strong>CO 2</strong> separate and characterize the phytoconstituents</td>
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<td><strong>CO 3</strong> learn about the evaluation and isolation of various crude drug</td>
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OBJECTIVES
The course aims to,

- give an opportunity to learn the different types and designs of clinical trials, requirements for conducting clinical trials, an opportunity to conceptualize, conduct, manage and report clinical trials
- teach the students on conceptualizing, designing, conducting, managing, and reporting of clinical trials.
- focus on global scenario of pharmacovigilance in different methods that can be used to generate safety data.
- teach the students in developing drug safety data in pre-clinical, clinical phases of drug development and post market surveillance

UNIT I REGULATORY PERSPECTIVES OF CLINICAL TRIALS 9

UNIT II CLINICAL TRIALS- TYPES AND DESIGN 9
Experimental Study- RCT and Non RCT, Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management.

UNIT III CLINICAL TRIAL DOCUMENTATION 9

UNIT IV BASIC ASPECTS/TERMINOLOGIES OF PHARMACOVIGILANCE 9
History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance.

UNIT V METHODS, ADR REPORTING, TOOLS FOR PHARMACOVIGILANCE 9

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to,

CO1 explain the regulatory requirements for conducting clinical trials and demonstrate the types of clinical trial designs

CO2 explain the responsibilities of key players involved in clinical trials and execute safety monitoring, reporting, close-out activities etc.

CO3 explain the principles of pharmacovigilance and detect new adverse drug reactions and their assessment

TEXT BOOKS:

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<tr>
<td>CO 2 Explain the responsibilities of key players involved in clinical trials and Execute safety monitoring, reporting, close-out activities etc.</td>
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<tr>
<td>CO 3 Explain the principles of Pharmacovigilance and Detect new adverse drug reactions and their assessment</td>
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OBJECTIVES
The course aims to,
- learn, classify and understand the chemistry and structural aspects of medicinal compounds from various natural sources
- understand the structural elucidation principles of compounds from natural sources and relate their therapeutic applications

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

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

UNIT III ALKALOIDS
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation and structural elucidation of Pyridine alkaloids, Tropane alkaloids, Quinoline and Isoquinoline alkaloids, Phenanthrene alkaloids, Indole alkaloids, Imidazole alkaloids, Alkaloid amines, Glycoalkaloid, Xanthine alkaloid

UNIT IV TERPENES AND FLAVONOIDS
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation, medicinal properties and structural elucidation, flavonoids, quercetin; Terpenes—special isoprene rule, mono, diterpenes, triterpenoids and sesquiterpenes, and structural elucidation of citral, carvone, menthol and camphor; Steroids – cholesterol, colour reactions, reactions of steroids, stigmasterol, β-Sitosterol, bile acids, ergosterol, diosgenin, solasodine, hecogenin

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

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
CO1 classify extract, isolate and characterize the natural products by chemical tests
CO2 understand the classification, metabolic pathways, metabolites and their structural elucidation

CO3 explore the therapeutic applications of various molecules from natural sources

TEXT BOOKS:

REFERENCES:

### Course Articulation Matrix

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<td><strong>CO1</strong> classify, extract, isolate and characterize the natural products by chemical tests</td>
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<td><strong>CO2</strong> understand the classification, metabolic pathways, metabolites and their structural elucidation</td>
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<td><strong>CO3</strong> explore the therapeutic applications of various natural sources</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- know the basics of medicinal chemistry, principles of drug design, biochemical and molecular basis of the mechanism of action
- understand the structure-activity-relationship including stereo chemical aspects, physicochemical properties and synthesis of medicinal agents

UNIT I PRODRUGS AND METABOLIC CHANGES OF DRUGS


UNIT II MEDICINAL CHEMISTRY OF HORMONES, STEROIDS AND RELATED DRUGS

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of hypoglycemic agents, synthetic hypoglycemic agents, glucocorticoids, mineralocorticoids, oestrogens, progestogens. Androgens, chemistry of natural hormones and synthetic derivatives including contraceptives, insulin and its preparation, oxytocin and vasopressin, thyroid and antithyroid drugs, medicinal chemistry of Diagnostic drugs and reagents:

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


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


UNIT V MEDICINAL CHEMISTRY OF VITAMINS, PROTEINS, ENZYMES


TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
CO1 understand the molecular basis, biochemical, physicochemical properties and synthesis of medicinal agents
CO2 understand the mechanism of action and structure activity relationship
CO3 understand the stereochemical aspects of the medicinal agents acting on various physiological systems

TEXT BOOKS:

REFERENCES:
4. Indian/British Pharmacopoeia 2018
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,
- know in detail the classification, therapeutic use, mechanism of action, metabolism, adverse effects of drugs pertaining to GIT, endocrine system, haemopoietic system.
- know and learn the principles of chemotherapy and toxicology.

UNIT I PHARMACOLOGY OF GASTROINTESTINAL TRACT AND ENDOCRINE SYSTEM 12

UNIT II CHEMOTHERAPY 12

UNIT III DRUGS ACTING ON THE HAEMOPOIETIC SYSTEM 7
Haematinics, Anticoagulants, vitamin K and haemostatic agents, Fibrinolytic and antiplatelet drugs, Blood plasma volume expanders. Autacoids – Histamine, 5-HT and their antagonists, Prostaglandins, Thromboxanes and Leukotrienes, Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin

UNIT IV PRINCIPLES OF TOXICOLOGY 7
Definition of poison, general principles of treatment of poisoning, Heavy metals and heavy metal antagonists, Definition for acute, sub acute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies.

UNIT V IMMUNOPHARMACOLOGY 7
Cell and biochemical mediators involved in allergy, immunomodulation and inflammation, Classification of hypersensitivity reactions and diseases involved Therapeutic agents for allergy, asthma, COPD and other immunological diseases with emphasis on immunomodulators

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
CO1 learn the mechanism of drug action and its relevance in the treatment of different diseases.
CO2 comprehend the principles of toxicology and treatment of various poisonings, locate and isolate different organs/tissues from the laboratory animals
CO3 demonstrate the various receptor actions using isolated tissue preparation
**TEXT BOOKS:**

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OBJECTIVES
The course aims to,

- introduce the concept of simultaneous mass, momentum and energy transport
- develop velocity, temperature and concentration profiles for various systems involving turbulent flow

UNIT I MOMENTUM TRANSPORT 7
Viscosity, temperature effect on viscosity of gases and liquids, Newton’s law, mechanism of momentum transport, shell balance method, pressure and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW 8
Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT 10
Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier’s law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow, with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV EQUATIONS OF CHANGE FOR NON ISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS 10
Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS 10
Diffusivity, temperature and pressure effects, Fick’s law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow: stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1  learn the fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes

CO2  understand the mechanism of fluids in motion under different conditions

CO3  learn non isothermal system and temperature distribution in turbulent flows
TEXT BOOKS:

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- focus on surface and colloidal phenomena in industry
- understand the basics of surfactant structures, Capillarity systems like wetting agents, emulsifiers and stabilisers.

UNIT I INTRODUCTION TO INTERFACE AND COLLOIDAL SCIENCE 9
Examples of surface and colloidal phenomena in industry and nature, Historical perspective. Areas where future research is needed, nature of interfaces, Surface free energy, Work of cohesion and adhesion, Surface activity and surfactant structures, Physical and chemical interactions between atoms and molecules interactions between surfaces and particles, Surface tension.

UNIT II ADSORPTION 9

UNIT III CAPILLARITY 9
Capillary flow, Driving forces, Interfacial tension, Contact angle, Laplace expression for pressure difference across a curved interface, Capillary flow and spreading processes, Contact angle effects, Some practical capillary systems such as wetting in woven fibers and papers, repellency control, detergent, detergency, enhanced oil recovery

UNIT IV ELECTROSTATIC FORCES AND ELECTRICAL DOUBLE LAYER 9
Sources of interfacial charge, Electrostatic theory, Coulomb’s law, Boltzmann’s distribution and the Electrical double layer, Double layer thickness, Specific ion adsorption and the stern layer, Overview of electrokinetic phenomena (Electro-osmosis and Electrophoresis).

UNIT V COLLOIDS AND COLLOIDAL STABILITY 9
Working definition of colloids, Practical applications of colloids and colloids phenomena, mechanisms of colloid formation, Sources of colloidal stability, Steric or entropic stabilization, Coagulation kinetics, DLVO theory and its applications. Emulsion formation, Classification of emulsifiers and stabilizers, Flocculation and coalescence. Adsorption at liquid-liquid interfaces, general considerations of emulsion formation and stability. Mechanistic details of stabilization, Solubility parameters, Hydrophilic-Lipophilic balance. Phase inversion temperature, Association colloids such as micelles, ionic and nonionic surfactants. Kraft temperature, Critical micelle concentration, Microemulsions

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 learn the fundamentals of colloidal classification and interface adsorption

CO2 understand the concept behind the interfacial charge and the physics involved in interfacial adsorption

CO3 understand the basics of electrokinetic phenomena and various colloid parameters
TEXT BOOKS:

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES

The course aims to,
- learn about modern techniques of drug design, which include quantitative structure activity relationship (QSAR)
- learn about prodrug concept, combinatorial chemistry and Computer aided drug design (CADD)
- learn about planning and selection of In-silico approaches and tools

UNIT I STEREOCHEMISTRY AND DRUG DESIGN 9
Structurally Rigid Groups – Conformation – Configuration, Introduction to Drug Discovery and Development: Stages of drug discovery and development, Drug properties and Databases, Introduction to Virtual Screening

UNIT II STRUCTURE ACTIVITY RELATIONSHIP 9

UNIT III QUANTITATIVE STRUCTURE – ACTIVITY RELATIONSHIP 9
QSAR- Pharmacophore based approach, Scaffold hopping , Target based design, Partitional parameters – partition coefficients – hep substutent constants – electronic parameters – Hammet constant steric parameters – Hansch analysis

UNIT IV DOCKING 9
Docking ligands to macromolecules – Structure based and ligand based approaches, Scoring functions, Docking algorithms – Introduction to AUTODOCK

UNIT V MOLECULAR SIMULATIONS 9
Introduction to Molecular Dynamic Simulations – Force Field, Energy Minimisation, Introduction to GROMACS – Setup, run MD Simulation of a Protein and Analyse the results

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 understand various stereo chemical aspects of drug binding
CO2 understand Quantitative Structure Activity Relationship
CO3 perform and analyse various In-silico docking and MD Simulations experiments in drug research

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<td>Understand Quantitative Structure Activity Relationship</td>
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<td>perform and analyse various in-silico docking and MD Simulations experiments in drug research</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,

- Define, learn, and understand the principles of experimental design
- Plan and select statistical tools; To execute effectively and analyze results of experimental data

UNIT I FUNDAMENTALS OF STATISTICS 9
Define Statistics, intuitive biostatistics, relevance to research, preparation of data, analysis of data, frequency tables, graphical techniques, measuring variability, identify measure central tendency and variability, probability, tools in statistics, selection of various statistics tools

UNIT II PRINCIPLES OF EXPERIMENTAL DESIGN 9
Designing an experiment, controlled experiments, natural and quasi-experiments, population definitions, sampling unit, types of variables, treatment structure, design structure, collecting and analyzing data, types of effects, randomization, replication, blocking, orthogonality, factorial design, completely randomized design, randomized complete block design,

UNIT III CORRELATION AND REGRESSION 9
Correlation and regression: Graphical presentation of two continuous variables; Pearson’s product moment correlation coefficient; its statistical significance; Multiple and partial correlations; Linear regression: Regression line; Coefficient of determination; Interval estimation and hypothesis testing for population slope; Introduction to multiple linear regression models; Probit and logit transformations.

UNIT IV PARAMETRIC TESTS 9
Estimation and Hypothesis testing: Point and interval estimation including fiducial limits; Concepts of hypothesis testing and types of errors; Student-t and Chi square tests; Sample size and power; Experimental design and analysis of variance: Completely randomized, randomized blocks; Latin square and factorial designs; Post-hoc procedures

UNIT V NON-PARAMETRIC TESTS 9
Non-parametric tests: Sign; Mann-Whitney U; Wilcoxon matched pair; Kruskal wallis and Friedman two way anova tests. Spearman rank correlation; Statistical techniques in pharmaceutics: Experimental design in clinical trials; Parallel and crossover designs; Statistical test for bioequivalence; Dose response studies; Statistical quality control.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 understand the fundamentals of statistical data analysis
CO2 understand various tools for statistical analysis
CO3 learn the principles of systematic approaches to experimental design and statistical validation of results
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,

- impart basic knowledge about crystal structures
- learn the basics of phase diagrams and properties of materials.

UNIT I CRYSTAL STRUCTURE 9

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

UNIT III MECHANICAL PROPERTIES 9

UNIT IV ELECTRICAL AND ELECTRONIC PROPERTIES 9

UNIT V MAGNETIC , THERMAL AND OPTICAL PROPERTIES 9

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 have a basic understanding about crystal structures and various laws related to structures
CO2 have learnt about various properties
CO3 have basic knowledge about phase diagrams
TEXT BOOKS:

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<tr>
<td>CO 2 Have learnt about various properties</td>
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<td>CO 3 Have basic knowledge about phase diagrams</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,
- make the students learn about host defense against pathogens and virulence factors.
- study about the virulence factors and life cycle in different pathogens.
- provide basic information on molecular pathogenesis of infectious diseases

UNIT I INTRODUCTION
Molecular Koch’s postulates, Concepts of disease, Virulence, Optimal virulence, Horizontal and vertical transfer of virulent gene, Virulent factors, Evolution of bacterial pathogens, Biofilms, Quorum sensing molecules, Multidrug resistance mechanisms, Plasmid-mediated resistance.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES
Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)
Virulence, virulence factors, virulence- associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival E.coli pathogens: EnterotoxigenicE.coli (ETEC), labile & stable toxins, Enteroto- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohemorrhagic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteraggregative E.coli (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitic parous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantadine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS
Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS
Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
CO1 obtain the knowledge on the interaction of host and the pathogens.
**CO2** help the students to know evasion strategies of pathogen against host defence

**CO3** help the students to understand how to develop preventive measures and develop the probable treatment strategies for infectious diseases.

**TEXTBOOKS:**


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<td>CO2 help the students to know evasion strategies of pathogen against host defence</td>
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<td>CO3 help the students to understand how to develop preventive measures and develop the probable treatment strategies for infectious diseases</td>
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OBJECTIVES
The course aims to,

- familiarize the fundamentals of polymers and its properties.
- impart knowledge in chain polymerization, Step growth polymerizations and copolymerization and techniques of polymerization in an industrial aspect.

UNIT I BASIC CONCEPTS OF POLYMERS

UNIT II CHAIN POLYMERISATION

UNIT III STEP GROWTH POLYMERIZATION

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

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

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 understand the classification and will have knowledge in factors affecting polymerization, reactions of polymerization.
CO2: Learn synthesis and characterization techniques of polymers.
CO3: Have knowledge in the kinetics of polymerization using various catalysts.

**TEXT BOOKS:**

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OBJECTIVES
The course aims to,

- enable the students to learn the fundamentals of tissue engineering and tissue repair
- acquire knowledge on biomaterials and its applications

UNIT I INTRODUCTION
Introduction to tissue engineering: Basic definition-current scope - cell numbers and growth rates- measurement of cell characteristics –morphology- number viability- motility and functions. Measurement of tissue characteristics - appearance- cellular component-EOM component- physical properties.

UNIT II TISSUE ARCHITECTURE
Tissue types and Tissue components, Tissue repair and Engineering -wound healing and sequence of events - 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- Scaffolds & tissue engineering - Types of biomaterials-biological and synthetic materials- Biopolymers-Applications – Modifications - Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS

UNIT V CLINICAL APPLICATIONS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 understand the components of the tissue architecture
CO2 get familiarized with the stem cell characteristics and their relevance in medicine
CO3 gain awareness about the properties and broad applications of biomaterials
CO4 know the role of tissue engineering and stem cell therapy in organogenesis

TEXT BOOKS:
REFERENCES:


### Course Articulation Matrix

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<tr>
<td><strong>CO1</strong> Understand the components of the tissue architecture</td>
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<td><strong>CO2</strong> Get familiarized with the stem cell characteristics and their relevance in medicine</td>
<td>2 2 2 2 2 1 3 1 - - 3 1 3 3 2 1</td>
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<td><strong>CO3</strong> Gain awareness about the properties and broad applications of biomaterials</td>
<td>1 2 2 2 2 2 2 2 1 - 3 - 1 3 2 1</td>
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<td><strong>CO4</strong> Know the role of tissue engineering and stem cell therapy in organogenesis</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,

- learn the principles of computer aided bio-molecular docking and simulation.
- plan and select *in-silico* approaches and tools.
- execute and analyse the results of *in-silico* molecular dynamics simulation and docking experiments for research in drug development.

UNIT I INTRODUCTION TO THE DRUG DISCOVERY/DEVELOPMENT
9

UNIT II CRYSTALLOGRAPHY METHODS OF MODEL DEVELOPMENT
9
Introduction to Crystallography, Protein crystals, Collecting X-ray Data, Diffraction, Coordinate systems in crystallography, Electron Density maps, Obtaining a model, Judging the molecular models, Other diffraction methods for model building, Tools for studying macromolecules.

UNIT III MOLECULAR MODELING AND MOLECULAR MECHANICS
9

UNIT IV COMPUTER SIMULATION METHODS
12
Introduction to Molecular Dynamics Simulation and Monte Carlo Simulation Methods, History of Molecular Dynamics, Calculation of thermodynamic properties, System Preparation, Energy Minimisation, Periodic Boundary conditions, Hydrogen Bonding, Running Molecular Dynamics Simulation of a Protein, Analysis of Molecular Dynamics Simulation.

UNIT V MOLECULAR DOCKING METHODS
6
Introduction to Molecular docking, Structure Based methods to identify lead components, Denovo ligand design, Simulation and docking case studies.

TOTAL: 45 PERIODS

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

CO1 understand the basic concepts of Molecular Modeling and MD Simulation
CO2 choose appropriate tools and methods for Molecular Modeling and Drug design
CO3 apply MD Simulation and Molecular docking methods for Biological problems
TEXT BOOKS:

REFERENCES:
2. Visualisation Tools : PyMol or VMD Manual, [https://pymol.org](https://pymol.org)
4. AUTODOCK Manual, autodock.scripps.edu

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<td><strong>CO 1</strong> Understand the basic concepts of Molecular Modeling and MD Simulation</td>
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<td>2 2 1 3</td>
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<tr>
<td><strong>CO 2</strong> Choose appropriate tools and methods for Molecular Modeling and Drug design</td>
<td>2 3 2 3 3 - - - - - - -</td>
<td>2 2 1 3</td>
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<tr>
<td><strong>CO 3</strong> Apply MD Simulation and Molecular docking methods for Biological problems</td>
<td>2 2 3 3 3 - - - - - - -</td>
<td>2 3 1 3</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)

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OBJECTIVES
The course aims to,
- understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- understand the role of Nutraceuticals and functional food in health and disease and their regulations.

UNIT I INTRODUCTION AND SIGNIFICANCE 5
Introduction to Nutraceuticals and its role in health benefits Dietary supplements, importance, definition, classification, list and specifications of dietary supplements in Indian pharmacopoeia (IP) and USP. Current status and challenges in the optimization of herbal drugs as nutraceuticals in India.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS 12
Phytochemicals as nutraceuticals: Classification, occurrence and characteristic features (chemical nature medicinal benefits) of following a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, lutein b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Resveratrol d) Flavonoids- Rutin , Naringin, Quercetin, Anthocyanidins, catechins, Flavones e) Prebiotics / Probiotics,Fructo oligosaccharides, Lactobacillus f) Phyto estrogens : Isoflavones, daidzein, Geelustin, lignans g) Tocopherols.

UNIT III FREE RADICALS IN HEALTH AND DISEASE 9

UNIT IV MECHANISM OF ANTIOXIDANT DEFENSE 9

UNIT V REGULATIONS IN NUTRACEUTICALS 8
Nutraceuticals and functional food regulations in India. FSSAI regulations in the production of nutraceuticals. FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. AYUSH – Regulation of claims pertaining nutraceuticals - Overview of regulations in other Asian countries - China, Japan and Europe. Nutraceuticals in Herbal pharmacopoeia. USDA and FDA regulations in USA. European food regulations (EFSA).

TOTAL : 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to,

CO1 learn the effect of nutraceuticals in health and disease.
CO2 learn the underlying mechanism of lifestyle diseases.
CO3 learn the nutritional supplements in health and disease.

TEXT BOOKS:

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
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<tr>
<td><strong>CO 1</strong></td>
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<tr>
<td>Study the role of nutraceuticals in health and disease</td>
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<tr>
<td><strong>CO 2</strong></td>
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<tr>
<td>Study the underlying mechanism of lifestyle diseases</td>
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<tr>
<td><strong>CO 3</strong></td>
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<tr>
<td>Learn Nutritional supplements and its health benefits</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- enable students to understand the basic concepts in scaling in biology, Microfabrication techniques.
- equip students with the understanding of chemical grafting of biomolecules, Miroelectromechanical sensing of cells, biomimetic nanodevices, tissue microengineering and its industrial application.

UNIT I  INTRODUCTORY CONCEPTS  9
Scaling in biology: basic review of the various sizes, time, and energy scales found in biological systems from organisms to atoms Microfabrication techniques: extensive review of the fundamentals of microfabrication technology: photolithography, electron beam lithography, micromachining, micromolding, and soft lithography

UNIT II  MICROPATTERNING NON-CONVENTIONAL MATERIALS  9
Review of self-assembled monolayers, chemical grafting of biomolecules and thin polymeric layers; approaches to patterning those materials as well as cells.

UNIT III  MEMS APPLICATIONS  9
Microelectromechanical Sensing of cellbehavior: Introduction to bioelectricity, interaction of cells with electric fields, microphysiometer. Microengineered biosensors: Introduction to massively parallel measurements, implantable electrodes, micro tweezers, immunosensors. The frontiers of BioMEMS: Nanolithography, biomimetic nanodevices. Laboratory exercises will reinforce critical concepts provided in lectures.

UNIT IV  MICROFLUIDICS AND NANOFLUIDICS  9
Microengineering fluid flows: Introduction to microfluidics and Nanofluidics, properties of biological fluids in microchannels, mathematical modeling of fluid flow. Applications in Drug delivery system design

UNIT V  TISSUE MICROENGINEERING AND APPLICATIONS  9
Introduction to biomimetic substrates, microscaffolds, cellular co-cultures Microfabrication techniques that enable the control of cell-substrate, cell-cell, and cell-medium interactions, Introduction to enzymatic assays, DNA microarrays, optical detection methods amenable to miniaturization. Applications in controlled and targeted drug delivery

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1  be aware of scaling up concepts for Industrial Applications.
CO2  have knowledge in microfabrication technology.
CO3  learn the principles of designing microengineered biosensors, fluidics and their application in drug delivery systems and biomimetic substrate.
TEXT BOOKS:

REFERENCES:

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<tr>
<td><strong>CO 1</strong> be aware of scaling up concepts for</td>
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<td>Industrial Applications</td>
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<td><strong>CO 2</strong> have knowledge in microfabrication</td>
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<tr>
<td>technology</td>
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<tr>
<td><strong>CO 3</strong> learn the principles of designing</td>
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<tr>
<td>microengineered biosensors, fluids and their</td>
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<td>application in drug delivery systems and</td>
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<td>biomimetic substrate</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,
- develop understanding and provide scientific basics of the life processes at the molecular level
- understand the structure-function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

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

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

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

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

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

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
- CO1 gets a basic idea of types and preparation of vaccine
- CO2 design recombinant vaccines and novel methods of reverse vaccinology
- CO3 gain knowledge about validation, testing and quality control of vaccines
TEXTBOOKS:

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<td>CO 2 Design recombinant vaccines and novel methods of reverse vaccinology</td>
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<tr>
<td>CO 3 Gain knowledge about validation, testing and quality control of vaccines</td>
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<td>Overall CO</td>
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(1, 2 and 3 are correlation levels with weightings as slight (Low), moderate (Medium) and substantial (High) respectively)
OBJECTIVES
The course aims to,
- learn about basis of nanomaterial and its preparation
- learn about characterization and applications in other fields

UNIT I INTRODUCTION
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nanoparticles- quantum dots, nanowires-ultra- thin films - multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

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

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

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
- CO1 gain knowledge gain in nanoparticle preparation methods.
- CO2 test and characterize methodologies of nanoparticles.
- CO3 use the fundamentals in various applications of nanoscience in Pharmaceutical Technology.
TEXT BOOKS:

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<td>CO 1 Gain knowledge gain in nanoparticle preparation methods</td>
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<td>CO 2 Test and characterization methodologie s of nanoparticles</td>
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<td>CO 3 use the fundamentals in various applications of nanoscience in Pharmaceutical Technology</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,
- familiarize the students about concepts of process dynamics and control leading to control system design.
- introduce dynamic response of open and closed loop systems, 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, Volumetric Flow Rate and mass flow rate (for liquids and solids), viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

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

UNIT III CLOSED LOOP SYSTEMS  
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 controller settings.

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

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

**CO1** draw block diagrams for a process and devise simple but effective plant wide control strategies using appropriate techniques

**CO2** design and tune process controllers and specify the required final elements to ensure that well-tuned control is achieved

**CO3** analyse the performance of control loop systems

**CO4** understand the principle behind cascade, feed-forward and Smith predictor controllers

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<tr>
<td><strong>CO 1</strong></td>
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<td>Draw block diagrams for a</td>
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<td>process and devise simple</td>
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<td>Design and tune process</td>
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<td>Analyse the performance</td>
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<td>of control loop systems</td>
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<td><strong>CO 4</strong></td>
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<td>Understand the principle</td>
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OBJECTIVES
The course aims to,

- explain about the principles involved in the different functional targets and its modification
- study about the applications of conjugate technology in Immunology and enzyme technology

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 BIOCONJUGATE APPLICATIONS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 familiarise with the various conjugates available in the pharmaceutical and biotechnological industry

CO2 design and develop efficient conjugates

CO3 apply the knowledge gained about bioconjugates in various fields
TEXT BOOKS:

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<td>CO 1 familiarize with the various conjugates available in the</td>
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<td>pharmacutical and biotechnological industry</td>
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<td>CO 2 design and develop efficient conjugates</td>
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<tr>
<td>CO 3 apply the knowledge gained about bioconjugates in various</td>
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<td>fields</td>
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OBJECTIVES
The course aims to,

- instruct the students on various spectroscopic and microscopic techniques that are used in research and practice in biotechnology.
- understand the concepts of spectroscopy in biological systems

UNIT I CIRCULAR DICHLORISM (CD) AND OPTICAL ROTATORY DISPERSION (ORD) 4

UNIT II FLUORESCENCE AND RAMAN SPECTROSCOPY 11

UNIT III NUCLEAR MAGNETIC RESONANCE 6

UNIT IV MASS SPECTROMETRY 5
Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT V X-RAY DIFFRACTION 7

UNIT VI SPECIAL TOPICS 12
Electron microscopy – transmission and scanning electron microscopy; CryoElectron Microscopy – scanning tunneling and atomic force microscopy (AFM); Fluorescence Correlation Spectroscopy (FCS); FRAP; Two-photon Microscopy; STED and STORM microscopies.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 understand the principle of spectroscopic techniques widely used in many quantitative experiments

CO2 understand the central techniques associated with the elucidation of structure and composition molecules in natural and life sciences

CO3 comprehend the high-resolution imaging techniques to assess surface and intracellular complexity.
TEXTBOOKS:

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<td>Overall CO</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- provide fundamental knowledge on the existence of various structures of proteins and how these structures relate to their functions.
- understand the building blocks and other factors contributing to the structures.
- learn about the methods for characterization of proteins

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 10
Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander waals interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE 10

UNIT III TERTIARY STRUCTURE 5
Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 10
DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications.

UNIT V PROTEOMICS 0
Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.
Computer exercise on the above aspects

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 learn the existence of various levels of protein structure
CO2 learn the building blocks of proteins and other factors contributing to protein structures
CO3 learn how these protein structures relate to protein functions
TEXT BOOKS:

REFERENCES:

### Course Articulation Matrix

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<td><strong>CO 1</strong></td>
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<tr>
<td>Learn the existence of various levels of protein structures</td>
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<td><strong>CO 2</strong></td>
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<tr>
<td>Learn the building blocks of proteins and other factors contributing to protein structures</td>
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<td><strong>CO 3</strong></td>
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<tr>
<td>Learn how these protein structures relate to protein functions</td>
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<td><strong>Overall CO</strong></td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- introduce the student to biological data resources, algorithms and alignment tools
- understand about machine learning techniques and neural networks in the analysis of biological data

UNIT I BIOLOGICAL DATABASES AND SEQUENCE ANALYSIS 9
Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological database, Genome specific databases, Data file formats, Data life cycle, Sequence Analysis, Pairwise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment.

UNIT II ALGORITHMS FOR SEQUENCE ALIGNMENT 9
Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSI BLAST and PHI BLAST algorithms, Functional annotation.

UNIT III NEXT GENERATION SEQUENCING, DATA ANALYSIS AND APPLICATIONS 9
Genome sequencing, Assembling the genome, Next Generation Sequencing, Data formats, Exome sequencing, RNA-seq and its applications.

UNIT IV PHYLOGENETICS, MOLECULAR MODELLING AND DOCKING 9
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, Molecular docking principles and applications.

UNIT V MACHINE LEARNING, OTHER BIOINFORMATICS APPLICATIONS 9

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 get acquainted with various bioinformatics algorithms and tools.
CO2 acquire skills to perform phylogenetic studies, molecular docking, analyze next generation sequencing data and interpret results.
CO3 acquainted with machine learning techniques.

TEXT BOOKS:

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<td><strong>CO 1</strong> Get acquainted with various bioinformatics algorithms and tools</td>
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<td><strong>CO 3</strong> Acquainted with machine learning techniques</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- understand the fundamentals of biological product recovery, isolation separation purification and formulation
- acquire in-depth knowledge and hands-on training on design and optimization of Downstream process operations and equipment

UNIT I DOWNSTREAM PROCESSING

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

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

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

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

OUTCOMES:
At the end of the course the students will be able to,
- CO1 have a comprehensive understanding of the physicochemical properties of biotechnological products and economics of downstream processing
- CO2 acquire knowledge about equipment selection and design of mechanical separation process for recovery of biotechnological products
- CO3 identify and optimize the suitable bioprocess isolation process at laboratory and pilot scale
- CO4 have a thorough understanding of chromatographic separation processes and equipment selection
- CO5 have complete knowledge of stability of biotechnology products and should be capable of formulation and stabilization for enhanced shelf-life

TOTAL : 45 PERIODS
**TEXT BOOKS:**


**REFERENCES:**


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<td>CO 1 Have a comprehensive understanding of the physicochemical properties of biotechnological products and economics of downstream processing</td>
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<tr>
<td>CO 2 Acquire knowledge about equipment selection and design of mechanical separation process for recovery of biotechnologic al products</td>
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<tr>
<td>CO 3 Identify and optimize the suitable bioproduct isolation process at</td>
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<td>CO 4</td>
<td>laboratory and pilot scale</td>
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<td>CO 5</td>
<td>Have a thorough understanding of chromatographic separation processes and equipment selection</td>
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<td>Overall CO</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES

The course aims to,

- impart knowledge about basics of metabolic design and pathway analysis.
- understand about quantification of metabolism with focus of pathways leading to industrially relevant products.

UNIT I BASICS OF METABOLIC DESIGN AND PATHWAY ANALYSIS 9

Basic principles of metabolic design, thermodynamics of pathway, redox balancing, transport of substrates, enzyme candidates, substrate and product transport and choice of appropriate genetic strategies.

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY 9

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, lumping of reaction rates, analysis of overdetermined systems using black box model- identification of gross measurement errors. Introduction to MATLAB®

UNIT II METABOLIC FLUX ANALYSIS 9

Theory of determined overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling.

UNIT IV METABOLIC CONTROL ANALYSIS 9

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Experimental determination of flux control coefficients and other coefficients. Theory of large deviations

UNIT-V ANALYSIS OF METABOLIC NETWORKS 9

Stoichiometric Network Analysis, Elementary mode analysis, extreme pathways. Control of flux distribution at a single branch point, grouping of reactions, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn pathway analysis by understanding material balances and stoichiometry.
CO2 understand the basics of metabolic flux and control analysis.
CO3 perform theoretical analysis of metabolic networks and experimental validation.

TEXT BOOKS:

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<tr>
<td>CO 1 learn pathway analysis by understanding material balances and stoichiometry</td>
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<td>3 1 2 1 1</td>
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<td>CO 2 understand the basics of metabolic flux and control analysis</td>
<td>2 2 1 1 - 2 1 - 1 - 1 2 3 2 - 1</td>
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<tr>
<td>CO 3 perform Theoretical analysis of metabolic networks and experimental validation</td>
<td>1 2 3 2 1 - 1 - 1 - 1 2 2 1 3</td>
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<td>Overall CO</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES
The course aims to,
- learn to do in detail process and mechanical design
- learn engineering drawing of different chemical engineering equipment

UNIT I INTRODUCTION TO PLANT LAYOUTS
Design of Plant Layout, Pipelines and Pipe Layouts, Schematics and Presentation Materials of Construction and Selection of process equipment

UNIT II FUNDAMENTALS OF DESIGN EQUATIONS AND DRAWING
Fundamental principles, general design equations and drawing considerations of Heat Exchangers, Condensers, reboilers.

UNIT III DESIGN CONSIDERATIONS OF EQUIPMENTS
General design and drawing considerations of Cooling Tower, cooling coil, evaporators, Dryers, economic evaluation.

UNIT IV PROCESS EQUIPMENT DESIGN
Process equipment design of Absorption column, Distillation Column, bubble cap tray column, Extraction Column, Adsorption column.

UNIT V BIOREACTOR AND FERMENTOR DESIGN
Packed Bed Reactors, Plug flow reactor, Continuous stirred tank reactor, Pressure Vessel, Storage Vessel and Fermenter.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 apply the skills in thermal design of heat transfer equipment like shell and tube, double pipe heat exchangers and evaporators, and assessing thermal efficiency of the above equipment in practice.

CO2 apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns.

CO3 acquire knowledge for designing the process equipment generally used in the bioprocess industries.

CO4 examine and analyse a problem, and finding a design method and mechanical specifications to accomplish a particular process objective.

TEXT BOOKS:

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<tr>
<td>CO1 Apply the skill in thermal design of heat</td>
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<tr>
<td>transfer equipment like shell and tube,</td>
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<td>double pipe heat exchangers and evaporators,</td>
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<td>and assessing thermal efficiency of the above</td>
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<td>equipment in practice.</td>
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<tr>
<td>CO2 Apply the concepts involved in phase</td>
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<td>separation and design of distillation,</td>
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<tr>
<td>Extraction and absorption columns</td>
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|   | acquire knowledge for designing the process equipment generally used in the bioprocess industries | 1 | 2 | 2 | 2 | 1 | 2 | 2 | - | - | 2 | 3 | - | 1 |
|   | Examine and analyse a problem, and finding a design method and mechanical specification s to accomplish a particular process objective | 1 | 2 | 1 | 1 | - | - | 1 | 3 | 1 | 2 | 2 | - | 2 | 1 | 2 | 1 |
| Overall CO | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | - | - | 2 | 1 | 2 | 2 | 2 | 1 |

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)
OBJECTIVES

The course aims to,

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

UNIT I INTRODUCTION TO IMMUNE SYSTEM

Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex.

UNIT II HUMORAL AND CELLULAR IMMUNITY

Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions: precipitation, Agglutination, complement fixation, IFT, RIA, ELISA.

UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS

Inflammation; protective immune responses to viruses, bacteria, fungi and parasites; tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy.

UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY

Immune tolerance, Immunodeficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Autoimmune disorders and diagnosis.

UNIT V APPLIED IMMUNOLOGY

Monoclonal antibodies, engineering of antibodies; Classification of Vaccines, methods of vaccine development, immunodiagnostic methods (Immunodiffusion ELISA, FACS), immunomodulatory drugs.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand about immune system structure and functions.
CO2 learn about immunity to various pathogens.
CO3 understand the principles behind the production of therapeutic/diagnostic molecules.

TEXT BOOKS:

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<tr>
<td>CO1 Understand about immune system structure and functions</td>
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<tr>
<td>CO2 Learn about immunity to various pathogens</td>
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<tr>
<td>CO3 Understand the principles behind the production of therapeutic/diagnostic molecules</td>
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<td>Overall CO</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- make the students understand the basics of development.
- make out the differences in the developmental pathways of different organisms.
- make them aware how the basic developmental pathways are regulated by biotic and abiotic factors.

UNIT I HISTORY AND BASIC CONCEPTS OF DEVELOPMENT

UNIT II EARLY DEVELOPMENT IN INVERTEBRATE / VERTEBRATE MODELS
Drosophila, C.elegans, Xenopus, Mouse/ human. Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates.

UNIT III LATE DEVELOPMENT IN INVERTEBRATE / VERTEBRATES
Organogenesis—development of central nervous system in vertebrates, vulval formation in C.elegans.

UNIT IV GERM CELL SPECIFICATION & MIGRATION
Germlasm and determination of primordial germ cells, germ cell migration (drosophila, vertebrates), Gamete maturation (amphibians, mammal) Medical aspects in developmental biology (genetic errors in human development, teratogenesis) developmental therapies.

UNIT V APPLICATIONS
Overview of plant development, Medical implications of developmental biology - genetic errors/ teratogenesis/ stem cell therapy etc.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,
- CO1 learn the basics of developmental biology
- CO2 learn the differences in the developmental pathways of different organisms.
- CO3 learn the influence of biotic and abiotic factors on developmental pathways
TEXT BOOKS:

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<tr>
<td>CO 1 Learn the basics of developmental biology</td>
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<td>CO 2 learn the differences in the developmental pathways of different organisms</td>
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<tr>
<td>CO 3 learn the influence of biotic and abiotic factors on developmental pathways</td>
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OBJECTIVES
The course aims to,

- create awareness about biosafety and containment guidelines
- assess the risk analysis and the stringency requirements

UNIT I NEED FOR BIOSAFETY 9
Introduction; the history and incidence of laboratory-acquired infections (LAI), incidents of secondary transmission from the laboratory, Outline the types of laboratory accidents leading to LAIs, Explain the role of aerosols in LAIs, Illustrate the importance of biosafety and biocontainment in minimizing the risk of LAIs

UNIT II BIOLOGICAL SAFETY CABINETS 9
Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; recommended Biosafety Levels for Infectious Agents and Infected Animals, The classes and types of biological safety cabinets (BSC), Understand the principles of HEPA filtration, Explain the practices for safely working in a BSC, Identify other laminar flow devices and their limitations for use with microorganisms. Outline the certification process for BSCs

UNIT III BIOSAFETY GUIDELINES 9
Biosafety guidelines - Government of India; Definition of GMOs and LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMO

UNIT IV GENETICALLY MODIFIED ORGANISMS AND REGULATIONS 9
Biosafety for human health and environment, - Global scenario of transgenic microorganisms and plants. Ecological risk of engineered microorganisms/plants and remedial measure. Components of a risk assessment for microorganisms, Outline factors affecting risk assessment (agent, host, environment, behavioural). Risk Assessment; Risk Analysis; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol

UNIT V BIOCONTAINMENT AND CERTIFICATION 9
Describe the progression of building a new biocontainment laboratory from conceptualization through to certification. Outline the concepts to be addressed during the laboratory programming phase, architectural and engineering biocontainment features, key security features and control systems, commissioning and certification process and understand the difference between them.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 get familiarize with the concept of biosafety
CO2 work in a GLP accredited laboratory and their standards
CO3 familiarize themselves with the concept of GMO
TEXTBOOKS:
5. NIH guidelines for research involving recombinant or synthetic nucleic acid molecules, 2013.

REFERENCES:

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<tr>
<td>Get familiarized with the concept of biosafety</td>
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<tr>
<td>work in a GLP accredited laboratory and their standards</td>
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<tr>
<td>familiarize themselves with the concept of GMO</td>
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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- understand the concept of nutrition, malnutrition and their effects during health and sickness.
- learn the scope of Nutrition in the light of genomic science and develop methods to enhance the outcome of therapy.

UNIT I CONCEPT OF NUTRIGENOMICS AND NUTRIGENETICS
Introduction to Nutrition and its effect on genes, including biology and protein synthesis, up regulation of genes, down regulation of genes, heritability risk due to genetic factors, The Influence of Dietary Components on Gene Expression, The role of genes in the determination of nutritional requirements.

UNIT II NUTRITION AND DISEASE
Genetic Susceptibility to Common Diseases and Diet Intakes Medical Genomics and Cancer, Effects of Genes and Nutrition on Inflammation and Reactive Oxygen Species, Epigenetics and how the Environment can Shape Energy Balance through Genes, Bioactive Compounds and Gene Transcription. Role of nutritional factors in pathogenesis of diseases: Modulating the risk of various diseases through nutrigenomics – CVS, Diabetes Mellitus, Inflammatory diseases, Obesity, Malnutrition. Recent trends in omics based methods and techniques for lung disease prevention, Novel nutrigenomics approaches in food functions.

UNIT III APPLICATION OF NUTRITIONAL METABOLOMICS FOR HEALTH
Proteomics as a Comprehensive Molecular Means to Understand Dietary Health Effects. Role of Genetic variation and dietary response, Role of specific nutrients in controlling gene expression, Nutrigenomics aspects of Vitamins and Trace Elements.

UNIT IV TECHNOLOGIES IN NUTRIGENOMICS

UNIT V NUTRIGENOMICS TO INDUSTRY AND PUBLIC
Nutrigenomics to the food industry: Industry-Academia partnerships as an important challenge; Interaction with health professionals in bringing nutrigenomics to the public; Public health significance of nutrigenomics and nutrigenetics.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

CO1 understand the essential components of nutrition
CO2 get to know about the genetic components related with nutritional factors
CO3 learn the interplay and dynamics that nutrition and genetics in health and disease
TEXT BOOKS:

REFERENCES:
5. www.icmr.nic.in.
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<td>get to know about the genetic components related with nutritional factors</td>
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<td><strong>CO 3</strong></td>
<td>learn the interplay and dynamics that nutrition and genetics in health and disease</td>
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OBJECTIVES
The course aims to,

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

UNIT ISCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING  8
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  10
Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III IDEAL FLOW AND NON IDEAL FLOW  10
RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS  9
Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS  8
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:
At the end of the course the students will be able to,

CO1 write the rate equation for any type of reaction.

CO2 design reactors for homogeneous and heterogeneous reactions and optimize operating conditions.

CO3 relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

TEXT BOOKS:
REFERENCES:


Course Articulation Matrix

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,
- impart the knowledge of the various types and stages of process of sterile pharmaceutical products.
- understand the principles of formulating emulsion and suspension

UNIT I PARENTERALS
Introduction, historical perspective - parenteral routes of administration - formulation additives. Small volume parenterals - large volume parenterals.

UNIT II STERILIZATION

UNIT III INJECTIONS

UNIT IV PARENTERAL SUSPENSION AND EMULSION

UNIT V OPHTHALMIC PRODUCTS
Absorption of drugs in the eye - raw materials - ocular penetration enhancers - general safety consideration. Formulation of various ophthalmic products with their characterization.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students will be able to,

- CO1 understand the concepts of different types of sterile pharmaceutical formulations
- CO2 understand the sterilisation process for the sterile products
- CO3 understand the technology used for formulations of various sterile products

TEXT BOOKS:
REFERENCES:

Course Articulation Matrix

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
OBJECTIVES
The course aims to,

- enable students to acquire knowledge in drug regulatory affairs in India and at International level.
- understand the implications of regulatory issues concerning pharma industries

UNIT I INDIAN DRUG REGULATORY ASPECTS

UNIT II PHARMACOPOEIA AND REGULATORY BODIES, PHARMACOPOEIA AND REGULATORY BODIES
Pharmacopoeias; Indian, British, U.S. European, Japanese Regulatory bodies & requirements - Indian FDA, WHO GMP; U.S. FDA, U.K. MCA, Australian TGA, Japanese PMDA. Monographs; Standards, Specifications of different dosage forms

UNIT III cGMPs& DRUG DOSSIERS
Good manufacturing practices for active pharmaceutical ingredients (bulk drug substances), pharmaceutical excipients, pharmaceutical products, sterile pharmaceutical products, biological products, manufacture of herbal medicines and radiopharmaceutical products. documentation, good laboratory practices (GLPs), good clinical practices (GCPs) Drug dossier contents - CTD (CMC section) & data

UNIT IV PRECLINICAL/CLINICAL TRIALS AND VARIOUS PHASES
Schedule-Y, pre-clinical study requirements, clinical trial phases, types of trials, bioethics & stakeholders, Bioavailability & Bioequivalence studies, Drug development stages, FDA guidelines on IND, new drug approvals (NDA), ANDA approvals. European regulatory agency, types of filing process (Centralized, de-centralized, RMS countries), Regulation of preclinical studies, Design of clinical studies CFR/ICH/EU GCP guidelines.

UNIT V REGULATORY AND ETHICAL ISSUES IN HEALTH AND DISEASE
Animal experimentation: concerns of welfare, Justification of use of animals in research; use of alternatives; Human experimentation-Nuremberg code and Helsinki declaration; Assisted Reproductive Technologies, Pre-implantation genetic diagnosis, Surrogacy, Use of Embryos; Therapeutic and Reproductive Cloning-Ethical, Legal and Social Issues; genetic testing and Genetic Screening, Types of Testing, Clinical Utility and Validity of Tests, Testing processes; Social stigma, discrimination, misuse of data; HGP & ELSI, case study; Somatic and Germline gene therapy; Organ transplantation and Xenotransplantation; Biosafety and biodiversity: Classification of microorganisms based on safety, Biosafety levels, Risk groups, Risk Assessment and Management, Spill Protocols, Biosafety Containment guidelines; Biodiversity – Need and Methods for Protection; Convention for preservation of biodiversity and farmer’s rights; patenting of biodiversity: ethical issues

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to

CO1 acquire knowledge about the regulatory aspects of pharmaceutical industry practices.
CO2 know the process of patenting activities and IPR rights.
CO3 update the bioethical guidelines related to various health practices.

TEXT BOOKS:


REFERENCES:

## Course Articulation Matrix

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AUDIT COURSES (AC)

AD5091  CONSTITUTION OF INDIA  LT PC
3 0 0 0

OBJECTIVES:
- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I  INTRODUCTION
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II  CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES

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

UNIT IV  EMERGENCY PROVISIONS

UNIT V  LOCAL ADMINISTRATION
District’s Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction-PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

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TEXTBOOKS:
4. The Constitution of India (Bare Act), Government Publication, 1950
OBJECTIVES:
- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I   INTRODUCTION TO VALUE EDUCATION
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II   IMPORTANCE OF VALUES
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III   INFLUENCE OF VALUE EDUCATION
Personality and Behaviour development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship/Happiness Vs suffering, love for truth.

UNIT IV   REINCARNATION THROUGH VALUE EDUCATION

UNIT V   VALUE EDUCATION IN SOCIAL EMPOWERMENT
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

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REFERENCES:
OBJECTIVES:
- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I  INTRODUCTION AND METHODOLOGY:  9
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II  THEMATIC OVERVIEW  9
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III  EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV  PROFESSIONAL DEVELOPMENT  9
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.

UNIT V  RESEARCH GAPS AND FUTURE DIRECTIONS  9
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

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AD5094 STRESS MANAGEMENT BY YOGA

OBJECTIVES:
- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA
Definitions of Eight parts of yoga. (Ashtanga)

UNIT II YAM
Do’s and Don’t’s in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM
Do’s and Don’t’s in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN
Various yog poses and their benefits for mind & body

UNIT V PRANAYAM
Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do’s and Don’t’s in life through Yam
CO3 – Learn Do’s and Don’t’s in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

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1. “Rajyoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhya Mandal, Nagpur

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES:
- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9
Verses- 52,53,59 (dons) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35
Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEEITA 9
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

OUTCOMES:
CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

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REFERENCES:
1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari’s ThreeSatakam , Niti-singar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016
COURSE OBJECTIVES
The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I INTRODUCTION TO CULTURE 9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE 9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY 9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA 9
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45 PERIODS

COURSE OUTCOMES
After successful completion of the course the students will be able to

- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathinai’ and ‘Purathinai’ in Sanga Tamil Literature.
3. ‘Attruppadai’ in Sanga Tamil Literature.
4. ‘Puranaanuru’ in Sanga Tamil Literature.
5. ‘Pathitrupaththu’ in Sanga Tamil Literature.

UNIT I SANGA TAMIL LITERATURE AND INTRODUCTION

UNIT II ‘AGATHINAI’ AND ‘PURATHINAI’

UNIT III ‘ATTRUPPADAI’.

UNIT IV ‘PURANAANURU’
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & Its Effect in Puranaanuru.

UNIT V ‘PATHITRUPATHTHU’
Pathitrupaththu in ‘Ettuthogai’–Pathitrupaththu’s Parables–Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu–Message to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate ‘Agathinai’ and ‘Purathinai’ in their personal and societal life.
3. Appreciate and apply the messages in ‘Attruppadai’ in their personal and societal life.
4. Appreciate and apply the messages in ‘Puranaanuru’ in their personal and societal life.
5. Appreciate and apply the messages in ‘Pathitrupaththu’ in their personal and societal life.

REFERENCES:

COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non-verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives

✓ To familiarize students with the concept of communication using linguistic and non-linguistic resources.
✓ To help students ask critical questions regarding facts and opinions.
✓ To provide students with the material to discuss issues such as language and power structures.
✓ To help students think critically about false propaganda and fake news.

Learning Outcomes

➢ Students will be able to use linguistic and non-linguistic resources of language in an integrated manner for communication.
➢ Students will be able to analyze communication in terms of facts and opinions.
➢ Students will be able to discuss, analyze and argue about issues related to language and power.

UNIT I  LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II  STRUCTURE OF WRITING/CONVERSATION: 9

a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III  POWER STRUCTURE AND LANGUAGE USE: 9

a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV               MEDIA COMMUNICATION: 9

a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V               PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9

a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:


HU5172             VALUES AND ETHICS  L  T  P  C
                    3 0 0 3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I               DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous-Economic-Social-Aesthetic-Moral and Religious values
UNIT II CONCEPTS RELATED TO VALUES
Purusartha- Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA
Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE
The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES
The Problem of hierarchy of values and their choice. The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

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TEXTBOOKS:
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9
Human Relations and You: Self-Esteem and Self-Confidence; Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9
Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9
Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9
Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

OUTCOMES:

Students will be able to

CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

TOTAL: 45 PERIODS
TEXT BOOK:


REFERENCES:


HU5174 PSYCHOLOGICAL PROCESSES

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people’s psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

UNIT 2: SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT


UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING


UNIT 5: PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References

and intelligence (pp. 249-284). New York: Plenum Press.


HU5175 EDUCAION, TECHNOLOGY AND SOCIETY

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES


UNIT III TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning
UNIT IV EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)

(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)

(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)

(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)

(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others’ posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington
OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To foster critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one’s self and others.

UNIT I KNOWLEDGE


UNIT II ORIGIN


UNIT III WORD


UNIT IV KNOWLEDGE AS POWER/OPPRESSION


UNIT V SELF KNOWLEDGE/BRAHMAN


TOTAL : 45 PERIODS
OUTCOMES:

On completion of the course, the students will be able to:

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

7. Bacon, Francis: Power as Knowledge

HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE L T P C 3 0 0 3

UNIT I INTRODUCTION 7
Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS 9
Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH 11
Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING 7
Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR 11
Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS
HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271  GENDER, CULTURE AND DEVELOPMENT  L T P C

3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary, drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender-based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

Objectives

- To familiarize students with the concepts of sex and gender through literary and media texts.
- To help students ask critical questions regarding gender roles in society.
- To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- To help students think critically about gender based problems and solutions.

Learning Outcomes

- Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- Students will be able to analyse current social events in the light of gender perspectives.
- Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.
UNIT I: Introduction to Gender
- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

Texts:
1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations
- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

Texts:
1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)

UNIT III: Gender Development Issues
- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

Texts:
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

UNIT IV: Gender-based Violence
- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

Texts:
1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture
- Gender and Film
- Gender, Media and Advertisement

Texts:
1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements
READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:
Discussion & Classroom Participation: 20%
Project/Assignment: 30%
End Term Exam: 50%

HU5272 ETHICS AND HOLISTIC LIFE

OBJECTIVES:
- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE
The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT
Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:
Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE
Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

TOTAL: 45 PERIODS
OUTCOMES:

On completion of the course, the students will be able to:

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

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UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9
Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II LAWS 9
Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III BUSINESS ORGANISATIONS 9
Sole traders (Business has no separate identity from you, all business property belongs to you). Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors— Their Powers and Responsibilities/Liabilities.

UNIT IV LAW AND SOCIETY 9
Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence.

UNIT V CASE STUDIES 9
Important legal disputes and judicial litigations

TOTAL: 45 PERIODS
COURSE DESCRIPTION

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

OBJECTIVES:

- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I THE COMPONENTS OF FILMS

Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

UNIT II EVOLUTION OF FILM


UNIT III FILMS ACROSS THE WORLD


UNIT IV INDIAN FILMS


UNIT V INTERPRETING FILMS

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, the students will be able to:

- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.
Teaching Methods

- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Evaluation

- As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)

- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment 2: Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS L T P C

3 0 0 3

OBJECTIVES

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

CONTENTS :

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW

UNIT II MORPHOLOGY - WORDS OF LANGUAGE
UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE


UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE


UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE

Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

Teaching Methods :
Lectures, discussion.

Evaluation Internal and External :
Internal: 2 written tests + assignments, seminars, project (50+15+15+20).
External: A 3 hour written exam (50 marks)

REFERENCES:

TOTAL : 45 PERIODS

HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE

OBJECTIVES
- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.
- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

Unit 1 Introduction
Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral - Logography. Reading out literature to young children- Edmund J Farrell.

Unit 2 Reading Culture
Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel’s ‘The night of the Scorpion’. ‘Nothing’s Changed’- Tatamkhulu Afrika-Apartheid. Ruskin Bond- ‘Night train at Deoli’- How real life is different from movies.

Unit 3 Identifying Meaning
Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar’s ‘Jagat Mithya’- the world as an illusion. The Indian version as ‘meaninglesss meaning’.

Unit 4 Post Modernism
‘If on a winter's night a traveler’- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.
Unit 5. **Returning to Pictures**

Reading list
1. Bond, Ruskin: ‘Night train at Deoli’
2. Ezekiel, Nissim: ‘The Night of the Scorpion’
3. Afrika,Tatamkhulu: ‘Nothing’s Changed’
4. Barthes, Roland: *Mythologies*
5. Shankaracharya: *Viveka Chudamani*
6. Camus, Albert- *The Myth of Sisyphus*
7. Calvino, Italo: *If on a winter’s night a traveler*

Outcome
- Can identify the connections among language, literature and culture.
- Is able to relate between seemingly different aspects of life.
- Understands the fractions in modern life and can assimilate meanings.