Choice Based Credit System (CBCS)

Programme Educational Objectives (PEOs)

- To prepare students for prosperous spectrum of career avenues in academia, advanced research, industries of pharmaceutical technology, biomedicine, biotechnology, law, business and government and other pharmaceutical pursuits through dissemination of knowledge and proficiency in engineering and technology fundamentals related to pharmaceutical technology and the ability to solve problems.

- To transfuse in students the sense of confidence in professional endeavors by application of the derived knowledge and appreciation of economical impact in a societal context.

- To provide collegial and nurturing environment for the students to realize the professional, ethical obligations and their concern to protect the health and welfare of the public, and to be accountable for the social and environmental impact of their practice.

- To create an enjoyable educational environment in which students participate in multi-disciplinary, team oriented, open-ended curricular and co-curricular activities that prepare them to work either individually and as an integrated team member.

- To facilitate the students to gain the wisdom of fundamentals and advances to practice pharmaceutical technology and interdisciplinary research as career of constructive service to society and higher learning.
Program Outcomes (POs)
After completion of graduation in Pharmaceutical Technology, the students will be able to demonstrate the ability to:

a. Apply knowledge of mathematics, science and technology in the discipline.
b. Identify, formulate, research literature, and analyse complex engineering problems for its solution.
c. Design and develop system processes that meet the specified needs with appropriate consideration for public health, safety, cultural, societal, and environmental.
d. Design the experiments, its analysis and interpretation of data, synthesis of the information using research-based knowledge for complex problems.
e. Use modern engineering tools, software and equipment to meet the needs in the area of Pharmaceutical Technology.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to the professional engineering practices.
g. Apply knowledge of the impact of pharmaceutical technology solutions in a societal and global context.
h. Demonstrate ethical principles and commitment to responsibilities and norms of the Pharmaceutical technology practices.
i. Work effectively as an individual and as well as member in teams of diversified professionals.
j. Communicate effectively.
k. Understand the philosophies of project management principles in Pharmaceutical technology.

Programme specific Objectives
After successful completion of the program the graduate will be able to

1. Develop active pharmaceutical ingredients, drug intermediates and pharmaceutical products.
2. Apply data driven decisions and predictive analytical tools in smaller and larger molecule producing industries.
3. Identify technical issues related to the design, manufacturing of chemicals & pharmaceuticals and provide effective interdisciplinary solutions.
4. Adapt continuously changing technologies and play pivotal professional role in sustainable societal development.
ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
B.TECH. PHARMACEUTICAL TECHNOLOGY
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS I AND IV

**SEMESTER I**

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* NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

$ Skill Based Course

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* NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.

## SEMESTER V

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* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)
**Two weeks industrial training/internship carries one credit. Industrial training/Internship during IV Semester Summer Vacation will be evaluated in V semester.**

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*Open Elective – I shall be chosen from the emerging technologies.

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester.

* Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)

# NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

### SEMESTER VII/VIII

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**Open Elective – II shall be chosen from the emerging technologies.

***Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes

# Elective Management courses

Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

<table>
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<tr>
<th>S. NO.</th>
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*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**15 weeks of continuous Internship in an organization carries 10 credits.

TOTAL CREDITS: 166

**ELECTIVE – MANAGEMENT COURSES**

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<tr>
<th>SL. NO.</th>
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**MANDATORY COURSES I**

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**MANDATORY COURSES II**

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**PROFESSIONAL ELECTIVE COURSES : VERTICALS**

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<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
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</thead>
<tbody>
<tr>
<td><strong>Drug Design &amp; Development</strong></td>
<td><strong>Formulation and Manufacturing Technology</strong></td>
<td><strong>Quality Control and Quality Assurance</strong></td>
<td><strong>Pharmaceutical Industrial Management</strong></td>
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<tr>
<td>Medicinal Chemistry</td>
<td>Technology of Fine Chemicals and Bulk drugs</td>
<td>Biological spectroscopic techniques</td>
<td>Pharmaceutical Production Management</td>
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<tr>
<td>Bioinformatics and Cheminformatics</td>
<td>Pre formulation Technology</td>
<td>Quality Assurance in Pharmaceutical Industries</td>
<td>Pharmaceutical Supply Chain Management</td>
</tr>
<tr>
<td>Protein Structure, Function and Proteomics</td>
<td>Manufacturing Technology of Dosage Forms</td>
<td>Audits and regulatory compliance</td>
<td>Safety and Disaster Management</td>
</tr>
<tr>
<td>Computer Aided Drug Design</td>
<td>Industrial Process and Scale up Techniques</td>
<td>Validation in Pharmaceutical Industries</td>
<td>Management Information System</td>
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<tr>
<td>Regulatory Toxicology</td>
<td>Novel Drug Delivery Systems</td>
<td>Quality Management system</td>
<td>Industrial Psychology And Human Resource Management</td>
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<tr>
<td>Clinical Research and Pharmacovigilance</td>
<td>Pharmaceutical Packaging Technology</td>
<td>Product development and technology transfer</td>
<td>Project Management for Pharmaceutical Technology</td>
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</tbody>
</table>

**Registration of Professional Elective Courses from Verticals:**

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.
## PROFESSIONAL ELECTIVE COURSES: VERTICALS

### VERTICAL I: DRUG DESIGN & DEVELOPMENT

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<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
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### VERTICAL II: FORMULATION AND MANUFACTURING TECHNOLOGY

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## VERTICAL IV: PHARMACEUTICAL INDUSTRIAL MANAGEMENT

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**OPEN ELECTIVES**

Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.

**OPEN ELECTIVE I AND II**

(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

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**OPEN ELECTIVES – III**

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Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes. Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (IN ADDITIONS TO ALL THE VERTICALS OF OTHER PROGRAMMES)

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(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

**VERTICAL 1: FINTECH AND BLOCK CHAIN**

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<tr>
<td>4.</td>
<td>CMG340</td>
<td>Principles of Marketing Management For Business</td>
<td>PEC</td>
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<td>5.</td>
<td>CMG341</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>PEC</td>
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<td>6.</td>
<td>CMG342</td>
<td>Financing New Business Ventures</td>
<td>PEC</td>
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### VERTICAL 3: PUBLIC ADMINISTRATION

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<th>SL. NO.</th>
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<tr>
<td>1.</td>
<td>CMG343</td>
<td>Principles of Public Administration</td>
<td>PEC</td>
<td>3 0 0</td>
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<td>2.</td>
<td>CMG344</td>
<td>Constitution of India</td>
<td>PEC</td>
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<td>CMG345</td>
<td>Public Personnel Administration</td>
<td>PEC</td>
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<td>4.</td>
<td>CMG346</td>
<td>Administrative Theories</td>
<td>PEC</td>
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<td>5.</td>
<td>CMG347</td>
<td>Indian Administrative System</td>
<td>PEC</td>
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<td>6.</td>
<td>CMG348</td>
<td>Public Policy Administration</td>
<td>PEC</td>
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### VERTICAL 4: BUSINESS DATA ANALYTICS

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<tr>
<td>1.</td>
<td>CMG349</td>
<td>Statistics For Management</td>
<td>PEC</td>
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<td>2.</td>
<td>CMG350</td>
<td>Datamining For Business Intelligence</td>
<td>PEC</td>
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<td>3.</td>
<td>CMG351</td>
<td>Human Resource Analytics</td>
<td>PEC</td>
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<td>4.</td>
<td>CMG352</td>
<td>Marketing And Social Media Web Analytics</td>
<td>PEC</td>
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<td>5.</td>
<td>CMG353</td>
<td>Operation And Supply Chain Analytics</td>
<td>PEC</td>
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<td>6.</td>
<td>CMG354</td>
<td>Financial Analytics</td>
<td>PEC</td>
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## VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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<th>SL. NO.</th>
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<td>1.</td>
<td>CES331</td>
<td>Sustainable infrastructure Development</td>
<td>PEC</td>
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<td>2.</td>
<td>CES332</td>
<td>Sustainable Agriculture and Environmental Management</td>
<td>PEC</td>
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<td>3.</td>
<td>CES333</td>
<td>Sustainable Bio Materials</td>
<td>PEC</td>
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<td>4.</td>
<td>CES334</td>
<td>Materials for Energy Sustainability</td>
<td>PEC</td>
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<td>5.</td>
<td>CES335</td>
<td>Green Technology</td>
<td>PEC</td>
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<td>6.</td>
<td>CES336</td>
<td>Environmental Quality Monitoring and Analysis</td>
<td>PEC</td>
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<td>7.</td>
<td>CES337</td>
<td>Integrated Energy Planning for Sustainable Development</td>
<td>PEC</td>
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<td>8.</td>
<td>CES338</td>
<td>Energy Efficiency for Sustainable Development</td>
<td>PEC</td>
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</table>
This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.”

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity
This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts
Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules
This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People
Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.
(vii) Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities
About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

REFERENCES:
Guide to Induction program from AICTE

HS3151 PROFESSIONAL ENGLISH I

OBJECTIVES:
- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION
What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C’s of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

UNIT 1 INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event
UNIT III DESCRIPTION OF A PROCESS / PRODUCT
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS
Reading – Newspaper articles; Journal reports –and Non Verbal Communcation ( tables, pie charts etc,. ). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal ( chart , graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To use appropriate words in a professional context
- To gain understanding of basic grammatic structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS:
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.
COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES  9+3

UNIT II DIFFERENTIAL CALCULUS  9+3

UNIT III FUNCTIONS OF SEVERAL VARIABLES  9+3

UNIT IV INTEGRAL CALCULUS  9+3
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 - Applications : Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS  9+3

TOTAL: 60 PERIODS

COURSE 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 : Able to 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:

3. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
REFERENCES:

PH3151 ENGINEERING PHYSICS L T P C
3 0 0 3

COURSE OBJECTIVES
- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS

UNIT II ELECTROMAGNETIC WAVES
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 –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.
UNIT V APPLIED QUANTUM MECHANICS
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch’s theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

COURSE OUTCOMES
After completion of this course, the students should be able to
CO1 :Understand the importance of mechanics.
CO2 :Express their knowledge in electromagnetic waves.
CO3 :Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4 :Understand the importance of quantum physics.
CO5 :Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.

REFERENCES:
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag,

CY3151 ENGINEERING CHEMISTRY

COURSE OBJECTIVES:
• To inculcate sound understanding of water quality parameters and water treatment techniques.
• To impart knowledge on the basic principles and preparatory methods of nanomaterials.
• To introduce the basic concepts and applications of phase rule and composites.
• To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
• To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT
UNIT II  NANOCHEMISTRY  
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III  PHASE RULE AND COMPOSITES  
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV  FUELS AND COMBUSTION  

UNIT V  ENERGY SOURCES AND STORAGE DEVICES  
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles; working principles; Fuel cells: H₂-O₂ fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

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

CO1 :To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

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

CO3 :To apply the knowledge of phase rule and composites for material selection requirements.

CO4 :To recommend suitable fuels for engineering processes and applications.

CO5 :To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

REFERENCES:

GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING  

OBJECTIVES:
- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING  

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS  
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS  
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES  
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES  
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, 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 using conditionals and looping 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:
5. https://www.python.org/
TEXT-CUM-REFERENCE BOOKS
1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. History 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) (Publishedby: 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
Language Families in India - Dravidian Languages – Tamil as a Classical Language 

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

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

UNIT IV THINAI CONCEPT OF TAMILS
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
UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

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. தமிழகவரலொறு–மக்களும் பண்பொடும்–மகம. மகம. பிளமள (தவளியீடு: தமிழ்நொடுபொடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2. தெற்கிலைதமிழ்–புலசன்சோடன கொண்டதம் (திறன்மைப்பிரியல்).
3. சின்னா–தகாலதோரிக்கொரிண்டில் நூற்றாண்டு தகுந்தகரைகள் (தாரகைதிரிகைதோடேதுள்ள).
4. பாம்புதை – அற்பார்க்காதகரைகள். (தாரகைதிரிகைதோடேதுள்ள).
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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING

L  T  P  C
LABORATORY 0 0 4 2

OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/
PHYSICS LABORATORY : (Any Seven Experiments)

COURSE OBJECTIVES:
- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young’s modulus
4. Uniform bending – Determination of Young’s modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
   b) Compact disc - Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde’s string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students should be able to
- CO1: Understand the functioning of various physics laboratory equipment.
- CO2: Use graphical models to analyze laboratory data.
- CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- CO4: Access, process and analyze scientific information.
- CO5: Solve problems individually and collaboratively.

CHEMISTRY LABORATORY: (Any seven experiments)

OBJECTIVES:
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)
1. Preparation of Na₂CO₃ as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
13. Preparation of nanoparticles (TiO$_2$/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL: 30 PERIODS

OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles
- To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOK:


GE3172 ENGLISH LABORATORY

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

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

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

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.

HS3251  PROFESSIONAL ENGLISH -II  L  T  P  C
2   0  0  2

OBJECTIVES :
• To engage learners in meaningful language activities to improve their reading and writing skills
• To learn various reading strategies and apply in comprehending documents in professional context.
• To help learners understand the purpose, audience, contexts of different types of writing
• To develop analytical thinking skills for problem solving in communicative contexts
• To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I  MAKING COMPARISONS  6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT II  EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING  6
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III  PROBLEM SOLVING  6
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT IV  REPORTING OF EVENTS AND RESEARCH  6
UNIT V  THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

OUTCOMES:
At the end of the course, learners will be able

- To compare and contrast products and ideas in technical texts.
- To identify cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.
- To report events and the processes of technical and industrial nature.
- To present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

TEXT BOOKS :
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.

MA3251 STATISTICS AND NUMERICAL METHODS  L  T  P  C
3 1 0 4

OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I  TESTING OF HYPOTHESIS  9+3
Sampling distributions - Tests for single mean, proportion and 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.

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

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  9+3

UNIT IV  INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION  9+3
Lagrange’s and Newton’s divided difference interpolations – Newton’s forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3

TOTAL: 60 PERIODS

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

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

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

UNIT I PREPARATION OF MATERIALS

UNIT II ELECTRICAL PROPERTIES OF MATERIALS

UNIT III SEMICONDUCTING PROPERTIES MATERIALS

UNIT IV DIELECTRIC AND MAGNETIC MATERIALS

UNIT V NEW MATERIALS AND APPLICATIONS

COURSE OUTCOMES:
On completion of the course, the students should be able to
CO1 :Acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
CO2 :Familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
CO3 :Gain knowledge on semiconducting materials based on energy level diagrams, its types,temperature effect. Also, fabrication methods for semiconductor devices will be
understood.

CO4: Realize with theories and applications of dielectric and ferromagnetic materials

CO5: Familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

**TEXT BOOKS:**


**REFERENCES:**


**BE3252 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING**

**OBJECTIVES:**

- To introduce the basics of electric circuits and analysis
- To impart knowledge in dom wiring
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To introduce the functional elements and working of sensors and transducers.

**UNIT I ELECTRICAL CIRCUITS**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems

**UNIT II MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS**

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.

Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

**UNIT III ELECTRICAL MACHINES**


**UNIT IV ANALOG ELECTRONICS**

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon

UNIT V SENSORS AND TRANSDUCERS

Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

COURSE OUTCOMES:
After completing this course, the students will be able to
CO1: Compute the electric circuit parameters for simple problems
CO2: Explain the concepts of domestics wiring and protective devices
CO3: Explain the working principle and applications of electrical machines
CO4: Analyze the characteristics of analog electronic devices
CO5: Explain the types and operating principles of sensors and transducers

TEXT BOOKS:
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf’s Introduction to Electric Circuits, Wiley, 2018

REFERENCES:

GE3251 ENGINEERING GRAPHICS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.
UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12
Principles of isometric projection — isometric scale — Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30+P=60) 90 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Use BIS conventions and specifications for engineering drawing.
- Construct the conic curves, involutes and cycloid.
- Solve practical problems involving projection of lines.
- Draw the orthographic, isometric and perspective projections of simple solids.
- Draw the development of simple solids.

TEXT BOOKS:

REFERENCES:

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

TEXT-CUM-REFERENCE BOOKS
GE3252 TAMILS AND TECHNOLOGY L T P C

<table>
<thead>
<tr>
<th>UNIT I</th>
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<tr>
<td></td>
<td>Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Pottery.</td>
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<tr>
<th>UNIT II</th>
<th>DESIGN AND CONSTRUCTION TECHNOLOGY</th>
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<tr>
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<td>Designing and Structural construction House &amp; 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 Nayakkar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.</td>
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<td>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.</td>
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<tr>
<th>UNIT V</th>
<th>SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</th>
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TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் வரலை – மக்களும் பணி பொடியும் – காலக் பிரசுரம் (விகடன் பிரசுரம்).
2. கணினித் தமிழ் – முமனவர் இலசு.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி-மவமகநதிக்கமரயில் எங்ககொலநகரிகம் (ததொல்லியல் துமறதவளியீடு)
4. பம்பங்கி – அருங்கள் கல்விகம். (அருங்கள் கல்விக தொலைபிடி)
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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
### NCC Credit Course Level 1*

#### NX3251
**ARMY WING**
NCC Credit Course Level - I

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<td>NCC 2 Incentives</td>
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<td>NCC 3 Duties of NCC Cadet</td>
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<td>NI 3 Unity in Diversity &amp; Role of NCC in Nation Building</td>
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<td>L 2 Case Studies: Shivaji, Jhasi Ki Rani</td>
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<td>SS 7 Cyber and Mobile Security Awareness</td>
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**TOTAL: 30 PERIODS**
### NCC Credit Course Level 1*

**NX3252**  
**(NAVAL WING) NCC Credit Course Level - I**  
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#### NCC GENERAL

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#### NATIONAL INTEGRATION AND AWARENESS

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#### PERSONALITY DEVELOPMENT

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#### LEADERSHIP

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#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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TOTAL: 30 PERIODS
COURSE OBJECTIVES:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I  CIVIL ENGINEERING PRACTICES  15

PLUMBING WORK:
  a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
  b) Preparing plumbing line sketches.
  c) Laying pipe connection to the suction side of a pump
  d) Laying pipe connection to the delivery side of a pump.
  e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:
  a) Sawing.
  b) Planing and
  c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:
  a) Studying joints in door panels and wooden furniture
  b) Studying common industrial trusses using models.

PART II  ELECTRICAL ENGINEERING PRACTICES  15

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III  MECHANICAL ENGINEERING PRACTICE  15

WELDING WORK:
  a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
  b) Practicing gas welding.

BASIC MACHINING WORK:
  a) (simple)Turning.
  b) (simple)Drilling.
c) (simple) Tapping.

ASSEMBLY WORK:
  a) Assembling a centrifugal pump.
  b) Assembling a household mixer.
  c) Assembling an airconditioner.

SHEET METAL WORK:
  a) Making of a square tray

FOUNDRY WORK:
  a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:
  a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:
  a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:
  a) Study an elements of smart phone..
  b) Assembly and dismantle of LED TV.
  c) Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
  CO1 : Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
  CO2 : Wire various electrical joints in common household electrical wire work.
  CO3 : Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
  CO4 : Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

BE3272 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION

ENGINEERING LABORATORY

L  T  P  C
0  0  4  2

COURSE OBJECTIVES:
  • To train the students in conducting load tests electrical machines
  • To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers
  • To train the students to measure three phase power and displacement

LIST OF EXPERIMENTS
1. Verification of ohms and Kirchhoff’s Laws.
2. Three Phase Power Measurement
3. Load test on DC Shunt Motor.
4. Load test on Self Excited DC Generator
5. Load test on Single phase Transformer
6. Load Test on Induction Motor
7. Characteristics of PN and Zener Diodes
8. Characteristics of BJT, SCR and MOSFET
9. Design and analysis of Half wave and Full Wave rectifiers
10. Measurement of displacement of LVDT

TOTAL: 60 PERIODS

COURSE OUTCOMES:
After completing this course, the students will be able to

CO1: Use experimental methods to verify the Ohm’s law and Kirchhoff’s Law and to measure three phase power
CO2: Analyze experimentally the load characteristics of electrical machines
CO3: Analyze the characteristics of basic electronic devices
CO4: Use LVDT to measure displacement

GE3272 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 12
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 12
Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making 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

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I  PARTIAL DIFFERENTIAL EQUATIONS  9 + 3
Formation of partial differential equations – Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types - Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II  FOURIER SERIES  9 + 3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.

UNIT III  APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS  9 + 3
Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV  FOURIER TRANSFORMS  9 + 3

UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS  9 + 3

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:
- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:
REFERENCES:

PY3301 CHEMICAL PROCESS CALCULATIONS

OBJECTIVES
The course aims to,
- learn about the basic calculation techniques used in process industries
- learn the laws about the behaviour 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

SELF STUDY TOPICS (NOT FOR EXAMINATIONS)
Process flow diagram/chart for material and energy balances, Material and energy balances for Chemical reactors.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
1. Have a clear idea of various types of unit systems and students will be able to convert units from one form to another.
2. Comprehend the different gas laws, and students would be able to solve the problems on stoichiometry quantity of gaseous substances in industry.
3. Know the various measurements of humidity and clear about applying humidity charts, psychometric charts, and concepts of vaporization and vapor pressure laws.
4. Analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.
5. Attain the energy balance concepts necessary for solution of energy balance of different chemical engineering processes in industries.
6. Independently develop a stoichiometry problem solving ability in a number of useful mathematical and chemical operations.

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.)

BT3352 MICROBIOLOGY

OBJECTIVES
• To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
• To solve the problems in microbial infection and their control.

UNIT I INTRODUCTION
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.
UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 9
Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9
Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 9
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

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

COURSE OUTCOMES:
Upon completion of the course, the students would be able to understand about
CO1: Microorganisms and examination of microorganisms
CO2: Structural organization of microorganisms
CO3: Nutritional requirements of microorganisms, their growth and metabolism
CO4: Control of microorganisms
CO5: Metabolites, bioremediation, biofertilizers, biopesticides and biosensors

TEXT BOOKS

REFERENCE BOOKS

PY3302 PHARMACEUTICAL CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:
- To inculcate understanding of the properties and principles of medicinal agents that originate from organic and inorganic sources and their application in pharmaceutical industry.
- To provide knowledge on the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism.
- To provide the knowledge on fundamental principles involved in the identification, preparation of pharmaceutical aids and to apply the principle of coordination compounds in pharmaceutical substances.

UNIT I STRUCTURE AND PROPERTIES 9
Atomic orbitals, molecular orbitals theory, wave equation, bonding and antibonding orbitals, hybrid orbitals, covalent bond, polarity of bonds and molecules, dipole moment, resonance,
inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding, Isomers, optical activity, stereoisomerism, specification of configuration, chirality,

UNIT II CHEMISTRY OF ALIPHATIC, AROMATIC AND HETEROAROMATIC COMPOUNDS 9


UNIT III QUALITY CONTROL OF DRUGS AND PHARMACEUTICALS 9

Importance of quality control, significant errors, methods used for quality control, History of Pharmacopoeia, Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals and lead with suitable examples. Identification test for Magnesium hydroxide, Ferrous sulphate, Calcium gluconate, Copper sulphate. Test for purity: Swelling power of Bentonite, Neutralizing capacity of aluminum hydroxide gel, Determination of potassium iodate and iodine in potassium Iodide Preparation of inorganic pharmaceuticals: Boric acid, Potash alum and Ferrous sulphate.

UNIT IV STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS 9

Alder Reaction, Formylation reactions, Gattermann Reaction, Gattermann-Koch reaction, Vilsmeier reaction, Azide-Alkyne Cycloaddition, Catalytic hydrogenation, Meerwein-Ponndorf-Verley, Birch reduction, Clemmenson, Sandmeyer, Haloform reactions, Azo coupling, Beckmann Rearrangement, Benzidine rearrangement.

UNIT V RADIOPHARMACEUTICALS AND CO-ORDINATION COMPOUNDS 9


TOTAL: 45 PERIODS

SELF STUDY TOPICS (NOT FOR EXAMINATIONS)

Indian Pharmacopoeia, United States Pharmacopoeia, British Pharmacopoeia, European Pharmacopoeia, International Pharmacopoeia

COURSE OUTCOMES:

After completion of the course the student will be able to

- identify the relationship between structure and physical properties of pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- draw the structures and outline the synthesis of simple pharmaceutically active organic compounds having five and six membered heterocyclic compounds.
- describe the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
- distinguish between various reaction mechanism and well acquainted with the synthesis of some important class of drugs.
- apply the knowledge in the handling of radiopharmaceuticals and synthesis of new drug molecule with special reference to organic, inorganic and coordination chemistry.

TEXT BOOKS:

REFERENCES:

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BT3392 BIOCHEMISTRY L T P C
3 0 0 3

OBJECTIVE
• To enable students learn the fundamentals of Biochemical Processes and Biomolecules

UNIT I INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES: 9
Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, bio molecules structure and properties of Carbohydrates (mono, di, oligo & polysaccharides) Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate

UNIT II STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES 9
Structure and properties of Important Biomolecules.
Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.
Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure.
Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes

UNIT III METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM 9
UNIT IV INTERMEDIARY METABOLISM AND REGULATION 9
Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V PROTEIN TRANSPORT AND DEGRADATION 9
Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

TOTAL: 45 PERIODS

OUTCOMES
On completion of the course, the students would have the
- Strong foundation in the structure and reactions of Biomolecules.
- Knowledge on metabolic pathways of the major biomolecules and relevance to clinical conditions.
- Ability to correlate Biochemical processes with Biotechnology applications.

TEXT BOOKS

REFERENCES

PY3391 HUMAN ANATOMY AND PHYSIOLOGY L T P C 3 0 0 3

OBJECTIVES:
- To explain the gross morphology, structure and functions of various organs of the human body and describe the various homeostatic mechanism and their imbalance.

UNIT I HEMOPOIETIC SYSTEM 9
Composition and functions of blood, Hemopoiesis, blood components, blood groups, clotting factors and mechanism of coagulation, platelets.

UNIT II CARDIOVASCULAR SYSTEM 9
Anatomy and function of the heart; circulation: pulmonary, coronary, and systematic circulation; electrocardiogram (ECG), cardiac cycle and heart sounds, blood pressure - its maintenance and regulation.

UNIT III RESPIRATORY SYSTEM 9
Anatomy of respiratory organs and functions, mechanism/physiology of respiration and regulation of respiration, transport of respiratory gases, respiratory volumes and capacities.

UNIT IV NERVOUS SYSTEM 9
Classification of the nervous system, anatomy, physiology, and functional areas of the cerebrum, cerebellum, midbrain, thalamus, hypothalamus and basal ganglia, spinal cord: structure and reflexes.

UNIT V ENDOCRINE SYSTEM 9
Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal glands, pancreas, pineal gland, thymus.

TOTAL 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the students will be able to
- Acquire the gross histology, structure and functions of various organs of the human body
- Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
- Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.
- Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system
- Interpret graphs of anatomical and physiological data.
- Apply the methods to evaluate the potency of drugs, toxicity of drugs in animal models.

TEXTBOOKS
2. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterjee, Academic Publishers Kolkata.

REFERENCE BOOKS
3. Hole's human anatomy & physiology David Shier, Ricki Lewis, Jackie Butler Year: 2019, Edition: Fifteenth, Publisher: Mcgraw hill Education
7. Anatomy and Physiology 2e J. Gordon Betts, Tyler, Texas Kelly A. Young, Long Beach, California James A Wise, Hampton, Virginia Copyright Year: 2021

Course Articulation Matrix

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OBJECTIVES:
- To practically demonstrate various experimental techniques to identify the morphology, culture characteristics, propagation and control of microbes and industrial applications of microbes.

EXPERIMENTS
1. Demonstration of efficiency of sterilization techniques.
2. Preparation of various types of culture media: nutrient broth and agar
3. Culture techniques: isolation and preservation of cultures: broth: flask, test tubes; agar: pour plates, streak plates, slants, stabs
4. Microscopic identification of bacteria
5. Staining techniques: simple, differential- gram's staining, spore /capsule staining
6. Quantification of microbes: sampling and serial dilution; bacterial count, total count and viable count.
7. Determination of phenol coefficient to demonstrate efficiency of a disinfectant
8. Perform and report sensitivity of antibiotics (Disc diffusion and well diffusion)
9. Inoculate, Incubate and plot the growth curve of bacteria (E.coli)
10. Effect of pH, Temperature, UV radiation on Growth of bacteria (E.coli)
11. Determination of microbial inhibitory concentration (MIC).
12. Biochemical identification of unknown microbes

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to
1. Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
2. Develop the minimum skills to work on several important techniques using equipment for the study of microorganisms. Microscopically examine living microorganisms.
3. Familiar with the types of laboratory equipment and culture media needed to develop and maintain pure cultures.
4. Carry out the technique for aseptic removal and transfer of microorganisms for subculturing.
5. Determine the cultural characteristics of microorganisms as an aid in identifying and classifying organisms into taxonomic groups.
6. Practical use of the compound microscope for visualization of cellular morphology from stained slide preparations.

Equipment Needed for 1 batch
- Autoclave: 2
- Hot Air Oven: 2
- Incubators: 2
- Light Optical Microscopes: 6
- Incubator Shaker: 2
- Colorimeter: 2
- Lamina Flow Chamber: 2
- Colony counter: 2
- Laminar air flow: 2

REFERENCE BOOKS
## Course Articulation Matrix

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### PY3312 BIOCHEMISTRY AND PHYSIOLOGY LABORATORY

#### OBJECTIVES

The course aims the students to,
- Learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,).
- To learn the gross histology, structure and functions of various organs of the human body and perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body.

#### LISTOFEXPERIMENTS

**Biochemistry**
1. Qualitative tests for carbohydrates–distinguishing reducing from non-reducing sugars and keto from aldol sugars.
2. Quantitative method for amino acid estimation using binitrihydrin–distinguishing amino acid from inoim acid.
3. Quantitative analysis of carbohydrates (Benedict’s method etc.,)
4. Protein estimation by Biuret, Lowry’s method, Bradford and spectroscopic methods
5. Extraction of lipids and analysis byTLC.
8. Estimation of chlorides, glucose, ammonia and creatinine in urine.

**Physiology**
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. Determination of bleeding and clotting time
3. Determination of R.B.C. and W.B.C count of blood
4. Estimation of Haemoglobin
5. Determination of differential count of blood WBCs.
6. Enumeration of RBC
7. Determination of Erythrocyte Sedimentation Rate
8. Blood group determination
9. Observation of osmotic fragility of RBCs
10. Determination of packed cell volume and calculation of blood indices
11. Heart rate and blood pressure recording
12. ECG recording
13. Examination of respiratory system and recording of respiratory movements
Course outcomes:
On completion of the course, the students would be able to
1. Apply basic principles of chemistry to biological systems and molecular biology.
2. Correlate molecular structure and interactions present in proteins, nucleic acids, carbohydrates and lipids
3. Perform procedure to characterize the biomolecules using microscopy.
4. Understand the gross histology, structure and functions of various organs of the human body
5. Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
6. Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.

REFERENCE 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:

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:

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:

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.

PY3401 APPLIED CHEMICAL ENGINEERING THERMODYNAMICS

OBJECTIVES

- Students will learn about the behavior of fluids, laws of thermodynamics, thermodynamic property relations and their application in different chemical processes.

UNIT I CONCEPTS OF THERMODYNAMICS

UNIT II LAWS OF THERMODYNAMICS

UNIT III THERMODYNAMIC POTENTIALS
Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation, partial molar properties, ideal and non-ideal solutions, standard states definition and choice

UNIT IV ACTIVITY COEFFICIENT
Activity coefficient-composition models, Gibbs-Duhem equation, effect of pressure and temperature on activity co-efficient, activity and property change of mixing, excess properties of mixtures.

UNIT V PHASE EQUILIBRIA
Thermodynamic consistency of phase equilibria, phase equilibria in single and multicomponent systems, Duhem’s theorem, vapor-liquid equilibria and non-ideal solutions. Chemical reaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students would be able to
1. Understand the basic concepts, laws and different process related to chemical engineering thermodynamics.
2. Identify the laws related to chemical engineering thermodynamics, thermodynamic principles, flow process and its thermodynamic application
3. Understand the thermodynamic potential, its correlation and analyze and distinguish between ideal and non-ideal solution.
4. Understand and demonstrate the activity coefficient and activity property of solution.
5. Demonstrate the Chemical and phase equilibria equations
6. Understand the interrelationships between different thermodynamic properties and become familiar with the graphs to develop an intuition for the variation of these properties during various processes.

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.)

PY3402       FLUID MECHANICS

OBJECTIVES:
- To provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
- To provide the knowledge about the various transporting and flow measurement and fluid machineries.

UNIT I    FUNDAMENTAL CONCEPTS
Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II    FLUID STATICS
Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III  DIMENSIONAL ANALYSIS
The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude

UNIT IV    FLOW IN PIPES
Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and
turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V FLOW MEASUREMENT
Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps.

TOTAL : 45 PERIODS

COURSE OUTCOMES
On completion of the course, the students would be able to
1. Understand the fluid properties, apply the knowledge and equipments to determine the pressure by different techniques.
2. Ability to solve and analyze the mathematical model associated with physical fluid-flow system and its applications.
3. Describe the different flow pattern in various fluid ducts like pipes and fittings
4. Understand the fluid flow properties through solids and its application.
5. Know the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.
6. Understand the interrelationships between different fluid flow properties and become familiar with the graphs to utilize these properties during various manufacturing processes.

TEXT BOOKS:

REFERENCES:

Course articulation matrix

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64
OBJECTIVES
The course aims to,

- Enable students to understand the structure and function of the prokaryotic and eukaryotic cell with its organelles.
- Expose students to the concepts on the genetic information in the eukaryotic cell and its regulation.
- Provide knowledge on the application of recombinant DNA technology in biotechnological research.
- Illustrate the creative use of modern tools and techniques for sequencing and amplification of DNA.
- Develop students in strategizing research methodologies employing genome analysis.

UNIT I  CELL STRUCTURE AND FUNCTIONS OF THE ORGANELLES   9
Prokaryotic, Eukaryotic cells, Sub-cellular organelles, membrane systems and functions
Differences and similarities between prokaryotic and eukaryotic cells. Cytoskeletal proteins.
Extra cellular matrix, cell-cell junctions, Cell division: mitosis. Extra- and intracellular signal transduction

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. 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

COURSE OUTCOMES:
After completion of the course the student will be able to
1. Acquire knowledge on the structure and functions of prokaryotic and eukaryotic cells.
2. Illustrate an overview of nucleic acids and the central dogma of life and its significance.
3. Employ the knowledge of DNA manipulation techniques in the production of commercially important recombinant proteins.
4. Understand the concepts of PCR techniques and genome sequencing techniques in biotechnological applications.
5. Apply the knowledge of genome analysis and genomics in disease diagnostics and therapy.
6. Integrate knowledge of molecular biology principles for understanding of various disorders and genetic engineering principles for its diagnosis and therapy.
TEXT BOOKS:

REFERENCES:

Course articulation matrix

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66
OBJECTIVES:
- To impart knowledge on fundamental principles and concepts involved in pharmaceutical powders, liquid flow and dispersions
- To 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 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 interface.

UNIT III  
VISCOSITY AND RHEOLOGY 9
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 IV  
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 vehicle, rheological considerations, emulsions; types, theories, physical stability.

UNIT V  
KINETICS AND DRUG STABILITY 9
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, expiration dating.

COURSE OUTCOMES:
On completion of the course the students will able to
CO1 Explain the methods used for determining particle size, particle volume and surface area along with the derived properties of powders
CO2 Differentiate the surface and interfacial phenomenon,
CO3 Distinguish between Newtonian and non-Newtonian system and to identify methods for determining viscosity.
CO4 Describe the types and properties of colloidal dispersions, suspensions and emulsions along with its applications
CO5 Understand drug reaction kinetics, stabilization of drugs and its accelerated stability testing
CO6 Apply the knowledge of physical properties of powders, liquids, colloidal and coarse dispersions in the design of pharmaceutical dosage forms

TEXT BOOKS:
REFERENCES:

Course articulation matrix

| Course outcome | PROGRAMME OUTCOMES (PO) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|----------------|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
|                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO1            | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 1   | 1   | 1   | 1   | 1   | 1   | 1   |
| CO2            | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 3   | 1   | 1   | 1   | 1   | 1   | 1   |
| CO3            | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 2   | 1   | 1   | 1   | 1   | 1   | 1   |
| CO4            | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 3   | 2   | 2   | 1   | 1   | 1   | 1   | 1   |
| CO5            | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 3   | 2   | 2   | 1   | 1   | 1   | 1   | 1   |
| CO6            | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 1   |
| Average        | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 1   |
OBJECTIVE:

- To facilitate students to acquire knowledge about the principles and applications of pharmaceutical analysis.

UNIT I

PROCESS ANALYTICAL TECHNOLOGY

9


UNIT II

SAMPLE PREPARATION AND SPECIFIC METHODS

9

Strategies of sample preparation – liquid – liquid extraction, solid-liquid extraction – solid phase extraction techniques – radiometric analysis – Analysis of biological compounds – analysis of water.

UNIT III

PHYSICAL ANALYTICAL METHODS

9


UNIT IV

CHEMICAL ANALYTICAL METHODS

9

Appearance, absorbance, pH, related substances, residual solvents, foreign anions, sulfated ash, elemental impurities, loss on drying, moisture and water, oxidizing substances, acid value, hydroxyl value, iodine value, peroxide value, saponification value, unsaponifiable matter – Functional group analysis

UNIT V

CONTROL OF THE QUALITY OF ANALYTICAL METHODS

9


SELF STUDY TOPICS (NOT FOR EXAMS)

Different types of biological analysis of pharmaceutical substances and dosage forms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students would be able to

1. highlight the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
2. demonstrate the skills on various types of extraction techniques
3. develop skills on range of physical analytical methods
4. determine the chemical properties of pharmaceutical compound
5. control the errors in the analysis of drug sample
6. illustrate the methods used for quality control of drug samples.

TEXT BOOKS


REFERENCE BOOKS

Course Articulation Matrix

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GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C 2 0 0 2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

UNIT II ENVIRONMENTAL POLLUTION 6

UNIT III RENEWABLE SOURCES OF ENERGY 6
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6
Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case

UNIT V SUSTAINABILITY PRACTICES


TOTAL:30 PERIODS

TEXT BOOKS:
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

REFERENCE BOOKS:

PY3411 PHARMACEUTICAL CHEMISTRY LABORATORY

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

LIST OF EXPERIMENTS
1. To determine the strength of a given unknown solution of HCl by titrating it against with the help of a known solution of NaOH using phenolphthalein indicator.
2. To determine the strength of a given unknown solution of NaOH by titrating it against with the help of a known solution of HCl using methyl orange indicator.
3. To prepare and standardize 200 ml of 0.1 M silver nitrate solution.
5. Determination of partition coefficient of any medicinal compound by shake flask method.
6. Preparation and identification tests of the following official (IP) compounds: Magnesium
sulphate, Calcium Carbonate, Ferrous sulphate, Boric acid

7. Determination of impurities by limit test
8. Synthesis of compounds by hydrolysis reaction: Salicylic acid from Alkyl Benzoate.
9. Synthesis of compounds by oxidation reaction: Benzoic acid from Benzyl chloride.
10. Synthesis of compounds involving Electrophilic substitution reaction: Benzyolation: Benzanilide, Phenyl benzoate, 2-Naphthyl benzoate
   Acetylation: Aspirin
   Nitration: Picric acid, p-nitro aniline, m - dinitro benzene
   Halogenation: p-bromo acetanilide
   Haloform: Iodoform
11. Synthesis of compounds by naming reaction: 7- hydroxy -4- methyl coumarin
   (Pechmann reaction), 1- phenyl azo-2-naphthol (Diazotization and Coupling reaction)
12. Synthesis of major industrial compounds: Paracetamol from p-aminophenol,
    Benzocaine from p-nitro benzoic acid

**LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS**
- Vacuum filtration unit
- Reflux condenser
- Hot air oven
- Water bath
- Distillation unit
- Melting point apparatus
- pH meter
- Electronic Weighing balance
- Heating Mantle
- Vacuum dryer

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
The students will be able to
1. Apply safe laboratory practices in the preparation of reagents, handling and storage of chemicals.
2. Identify/confirm the unknown organic compounds by melting point determination, pKa, boiling point, Viscosity etc.
3. Carry out quality control tests for fine chemicals and bulk drugs.
4. Implement the knowledge of chemistry in designing the synthetic scheme of organic compounds.
5. Demonstrate feasible synthesis of some important class of drugs using chemical reactions.
6. Develop the reaction mechanism and orientation of chemical bonds in the synthesis of major industrial compounds.

**REFERENCES:**

**Course Articulation Matrix**
**PY3412 PHYSICAL PHARMACEUTICS LABORATORY**

**OBJECTIVES:**
- To practice the determination of fundamental properties of dosage forms of powders and dispersions.
- To study the kinetics and stability aspects of pharmaceuticals.

**LIST OF EXPERIMENTS:**
1. Determination of particle size, particle size distribution using various methods of particle size analysis.
2. Determination of surface area of powders.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
4. Determination of effect of glidant on angle of repose of powder
5. Determination of surface/interfacial tension, HLB value
6. Determination of critical micellar concentration (CMC) of surfactants.
7. Study of rheological properties of various types of systems using different viscometers.
8. Study of different types of colloids and their properties.
9. Preparation of various types of suspensions and determination of their sedimentation parameters.
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Determination of shelf life of a product based on Arrhenius principle

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENTS FOR BATCH OF 30 STUDENTS**
- Optical Microscope-5no’s
- Stage Micrometer-5no’s
- Eye piece micrometer-5no’s
- Stalagmometer-10no’s
- Ostwald’s Viscometer-10no’s
- Brookfield viscometer-1no.
- Tapped density apparatus-3no’s
- Andreason pipette-3no’s
- Sieve shaker with sieve sets of different sizes-1no.

**GLASSWARES REQUIRED**
- Pycnometer, Funnel, Beakers, Measuring cylinders, Dessicator, Mortar and pestle

**COURSE OUTCOMES:**
On completion of the course the students will able to
**CO1** Characterize and evaluate the properties of powders by suitable methods
Plan and carryout the determination of interfacial property of liquids.

Plan and carryout the determination of viscosity.

Plan and carryout the physical stability study of suspension and emulsion dosage forms.

Plan and carryout the preparation of buffer and to determine the buffer capacity and isotonicity of solutions.

Calculate the rate constant and order of reactions.

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