ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B. TECH. BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING

VISION OF THE DEPARTMENT
To become a Centre of excellence in technical education, promoting research and bringing out professionals with social commitment capable of contributing to individual and national prosperity.

MISSION OF THE DEPARTMENT
1. To impart sound basic knowledge of Biotechnology and Biochemical Engineering concepts to achieve career fulfilment.
2. To inculcate passion and motivation for lifelong learning and learning in premier National and International institutions.
3. To excel students to identify, analyze and solve problems related to the field and also skillful in emerging areas of Biotechnology and Biochemical Engineering.

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
   1. Be able to design, develop and provide solutions for products and processes in Biotechnology and Biochemical Engineering and allied fields through quality education
   2. Be able to address challenges in industrial and research areas with socio-ethical responsibilities
   3. Our graduates will excel in biotech and related industries as good process and design engineers capable of handling production related activities including quality control.
   4. Our graduates will serve as good entrepreneurs with strong ethical values and communication skills.

2. PROGRAMME OUTCOMES (POs):
The Biotechnology and Biochemical Engineering Graduates will have the ability to

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<td>Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</td>
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<td>Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.</td>
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<td>3</td>
<td>Design/development of solutions: Design solutions for complex engineering problems</td>
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and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Acquire sound basic knowledge of bioscience, biotechnology and engineering concepts to emerge as good process engineers in industries.

2. Impart expertise on various bioprocess techniques for sustainable design and development

3. As bioprocess engineer, function as member or leader for managing projects, recognize the need for technological change and communicate with the society effectively.

4. Design and develop solutions to environmental and biochemical industrial problems

4. PEOs/POs Mapping:

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5
### ANNA UNIVERSITY, CHENNAI

**NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES REGULATIONS 2021**

**CHOICE BASED CREDIT SYSTEM**

**B. TECH. BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING**

**CURRICULUM FOR SEMESTERS I TO V 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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$ Skill Based Course
### SEMESTER IV

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<td>8.</td>
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**TOTAL** | 18 | 1 | 6 | 25 | 22 |

# 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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<tr>
<th>S. NO.</th>
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<th>COURSE TITLE</th>
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**TOTAL** | 18 | 0 | 3 | 21 | 21.5 |

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

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

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**THEORY**

**PRACTICALS**

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<td>Chemical Engineering Lab-2 (Mass Transfer &amp; Chemical Reaction Engineering)</td>
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**TOTAL** 21 0 6 27 21

*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*

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**THEORY**

**PRACTICALS**

|        |             |              |          | L   | T   | P   |              |          |         |
| 7.     | BT3761      | Downstream Laboratory | PCC | 0   | 0   | 3   | 3               | 1.5      |
| 8.     | BI3711      | Industrial Training/Internship II# | EEC |              | -   | -   | -               | -        |

**TOTAL** 17 0 3 20 20.5

*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 shall be chosen from the 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
**SEMESTER VIII/VII**

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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: 163**

**ELECTIVE – MANAGEMENT COURSES**

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<td>Engineering Economics and Financial Accounting</td>
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**MANDATORY COURSES I**

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**MANDATORY COURSES II**

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<td>History of Science and Technology in India</td>
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<td>Vertical V</td>
<td>Vertical VI</td>
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</tr>
<tr>
<td>Bioprocess &amp; Biochemical Engineering</td>
<td>Human anatomy, physiology</td>
<td>Molecular medicine and diagnostics</td>
<td>Clinical data management</td>
<td>Cancer management technology</td>
<td>Agricultural biotechnology</td>
<td>Plant tissue culture</td>
</tr>
<tr>
<td>Sustainable bioprocess development</td>
<td>Pathology &amp; microbiology</td>
<td>Cancer biology</td>
<td>Big data analysis</td>
<td>Clinical trials, bioethics</td>
<td>Algae biotechnology</td>
<td>Animal Biotechnology and Cell Culture</td>
</tr>
<tr>
<td>Pilot plant, scale up practices</td>
<td>Molecular forensics</td>
<td>Pharmaceutical biotechnology</td>
<td>Genomics, proteomics</td>
<td>Regulation affairs in Biotechnology</td>
<td>Engineering properties of food materials</td>
<td>Advances in Animal Biotechnology, tissue culture</td>
</tr>
<tr>
<td>Process dynamics and control</td>
<td>Metabolic engineering</td>
<td>Drug design, discovery</td>
<td>Computational biology</td>
<td>Intellectual property rights in Biotechnology</td>
<td>Storage engineering</td>
<td>Crop improvement</td>
</tr>
<tr>
<td>Bioprocess modelling and simulations</td>
<td>Nanobiotechnology</td>
<td>Tissue engineering</td>
<td>Bioinformatics and basics of R programming</td>
<td>Entrepreneurship &amp; Management</td>
<td>Green Tech in Food processing</td>
<td>Agrochemicals</td>
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<tr>
<td>MATLAB programme</td>
<td>Stem cell therapeutics</td>
<td>Vaccine technology</td>
<td>Computer aided drug design</td>
<td>Bioethics and Biosafety</td>
<td>Biomass, Bioenergy</td>
<td>Advances in processing of Horticulture, species, plantation products</td>
</tr>
</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: BIOPROCESS & BIOCHEMICAL ENGINEERING

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<th>COURSE CODE</th>
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# Vertical VII: Plant & Animal Tissue Culture

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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.

**Verticais 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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### VERTICAL 4: BUSINESS DATA ANALYTICS

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<tr>
<th>SL. NO.</th>
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<tr>
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<td>CMG352</td>
<td>Marketing And Social Media Web Analytics</td>
<td>PEC</td>
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## VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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<tr>
<td>1.</td>
<td>CES331</td>
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<td>Materials for Energy Sustainability</td>
<td>PEC</td>
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<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>
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<td>8.</td>
<td>CES338</td>
<td>Energy Efficiency for Sustainable Development</td>
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</table>
**INDUCTION PROGRAMME**

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 dont's, 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**

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**IP3151**
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 (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.
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 Communication ( 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.

TOTAL : 45 PERIODS

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

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:
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

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  9
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  9
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.

TOTAL : 45  PERIODS

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  L T P C
3 0 0 3

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 NANO CHEMISTRY

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; working principles; Electric vehicles; 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  9
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  9
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/
பட்டம் - பண் - தமிழ்ப் பொட்டியின் தமிழ் திசையாக காண்பது -
நிலைப்படுத்துகை:
3
தமிழ் பண் திசையாக காண்பது - புரொங்கன் திசையாக - பாளத்தமிழ்
பொட்டியில் அவததாக கருத்தறிவு வழங்க்கும் வகையில் பாடல்கள், பொய்யுருங்க கதை - குறிப்பிட்டு
சிற்றகம் - நாளொன்று சிற்றகம் - தமிழ்ப் பொட்டியில் குறிப்பிட்டுச் சிற்றகம் -
இயற்கைச் சிற்றகம் சிற்றகம் - துவக்க கதைகள் - மற்றும் ஐக்கியப், ஸ்டெண்டு, ஓவியம், பகுதிகளின் - சிற்றகமில் காண்பது பாடயுள்ள வகையில்
சிற்றகத்தில் பாடல்கள்.

அத்தியியலின் கண்டை - பண் - தமிழ்ப் பொட்டியின் தொக்கை:
3
சிற்றகத்தில், கருவர், திசையாக, கருவர் கதை, புரொங்கன் கதை, கோட்டம்
சுடுமணும் தமிழகத்தில் எழுத்தறிவும், கல்வியும் சுடுமணும் கோட்டம், புரொங்க கதை, சிற்றகத்தில்
சிற்றகத்தில் பாடல்கள்.

அத்தியியலின் கண்டை - தமிழ் பொட்டியில் விளைவுப்படுத்துகை:
3
தமிழ் பொட்டியில் முதலில் - விளைவுப்படுத்துகையில் பின்னர் காண்பது
சிற்றகாரின் எழுத்தறிவும் புரொங்கன் சிற்றகாரின் - தமிழ் பொட்டியில்
விளைவுப்படுத்துகை - சார்ந்தவற்றில் தமிழ் பொட்டியில், கருவியம் -
சமூகத்துடன் இணைந்து வாரம்புகியும் - சார்ந்தவற்றில் காண்பது மதொல்பொமவக்
கூத்து - காண்பது மதொல்பொமவக் கூத்து.

அத்தியியலின் கண்டை - தமிழ் பொட்டியில் விளைவுப்படுத்துகை:
3
தமிழ் பொட்டியில் பின்னர் விளைவுப்படுத்துகை காண்பது - தமிழ் பொட்டியில்
முதலில் பரவலாக வாரம்புகியும் - கருவர் விளைவுப்படுத்துகை, சிற்றகாரின்
சிற்றகாரின் பாடல்கள - காண்பது, விளைவுப்படுத்துகை - தமிழ்
புரொங்கன் பாடல்கள்.

TEXT-CUM-REFERENCE BOOKS
1. தமிழில் பதிப்பு (முதலில் பதிப்பு வைத்து வைத்து வைத்து (எனவும்: குறித்து பாடல்கள், பொதுப்பள்ளிமுக வைத்து வைத்து).
2. கருவர் கதை - பாடல்கள் (குறித்து பாடல்கள்).
3. சிற்றகாரின் கதைகள் சார்ந்தவற்றில் சார்ந்தவற்றில் சார்ந்தவற்றில் சார்ந்தவற்றில் சார்ந்தவற்றில் சார்ந்தவற்றில்.
4. சுடுமணும் - அங்கிய தமிழ் கதை (தமிழில் நடலும்).
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. Thanuvavukkarasu) (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
GE3152 HERITAGE OF TAMILS L T P C 1 0 0 1

UNIT I LANGUAGE AND LITERATURE

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 Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE
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.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் மன்னையர் - மத்கடல் பல்லாமல் (விளையீடு: மாணவரின் பல்லாமல் பல்லாமல் கல்வியியல் கழகம்).
2. கல்வியியல் சுவாசம் - பல்லாமல் பல்லாமல்.
3. சிறை தொல்லியல் தமிழ் (விளையீடு: மாணவரின் பல்லாமல்)
4. பள்ளிவாசல் - அரசால் வாசல் பல்லாமல்.
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:
GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C 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 Patterns, pyramid pattern)

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)


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/

BS3171 PHYSICS AND CHEMISTRY LABORATORY
L T P C 0 0 4 2

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 (TiO₂/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

OUT COMES :
- 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
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
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

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**

**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**

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**

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**

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**


**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.

**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

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 derivatives 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:
OBJECTIVES:

- To make the students effectively to understand the basics of crystallography and crystal imperfections.
- To enable the students to get knowledge on various strengthening methods of materials, and also various mechanical properties and their measurement.
- To impart knowledge on the basics of phase diagrams and their applications.
- To learn about iron-carbon system, and about various ferrous and non-ferrous alloys.
- To introduce different types of biomaterials and their applications.

UNIT I CRYSTALLOGRAPHY

UNIT II MECHANICAL PROPERTIES

UNIT III PHASE DIAGRAMS
Basic concepts - Gibbs phase rule – Unary phase diagram (iron) - Binary phase diagrams: isomorphous systems (Cu-Ni) – determination of phase composition and phase amounts – tie line and lever rule - binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) – eutectoid and peritectic reactions - other invariant reactions – microstructural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions.

UNIT IV FERROUS AND NONFERROUS ALLOYS

UNIT V MATERIALS FOR BIOLOGICAL APPLICATIONS

OUTCOMES:
Upon completion of this course, the students should be able to
- understand the basics of crystallography and its importance in materials properties
- understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
- gain knowledge on binary phase diagrams, and also will be able to determine the phase composition and phase amount.
• understand about the Fe-C system and various microstructures in it, and also about various ferrous and non-ferrous alloys.
• get adequate understanding on metallic, ceramic and polymeric biomaterials and their applications.

TEXT BOOKS:

BE3252 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION

ENGINEERING

OBJECTIVES:
• To introduce the basics of electric circuits and analysis
• To impart knowledge in domestic 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

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.

TOTAL: 45 PERIODS

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. Bhattacharyya, 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:
1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. 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:
4. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi,
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.

GE3252 குருண்டை கருவியல் இயல் டெக்னிக்ஸ்

அது முதல் தலைமுறை பாத்திரத்தில் குறிப்பிட்டு சொல்வது:
3 குருண்டை கருவியல் இயல் டெக்னிக்ஸ் பாத்திரத்தில் பாத்திரம் தமிழ்நாட்டில் ஆண்டு ஒன்று கால்நடையில் உருவைக்குறிச்சி — பாத்திரம் பாத்திரவளையும் பாத்திரம் பாத்திரவளையும் சேர்க்க குருண்டை கருவியல் இயல் டெக்னிக்ஸ் நடத்துதல்.

அது முதல் வருடமான குருண்டை கருவியல் இயல் டெக்னிக்ஸ் பாத்திரத்தில்:
3 குருண்டை கருவியல் இயல் டெக்னிக்ஸ் பாத்திரம் தமிழ்நாட்டில் ஆண்டு இரண்டு கால்நடையில் உருவைக்குறிச்சி — குருண்டை கருவியல் இயல் டெக்னிக்ஸ் பாத்திரம் தமிழ்நாட்டில் ஆண்டு ஒன்று கால்நடையில் உருவைக்குறிச்சி கருவியல் செயல்.

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TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலை - மக்களும் பண் பொடும் – மக மக பிளையடை (தவளியீடு: தமிழ்நூல் பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினி தமிழ் – பொண்டசமான திற. குறிக்கும். (குரோச்சிப் பிரசுரம்).
3. சிற்றிய - செயல் திருக்காற்றுக்குள் சமணமான குரங்க குறிக்கும் (குரோச்சிப் பிரசுரம்)
4. பகைதோற் – அழகார்கள் குறிக்கும். (குரோச்சிப் பிரசுரம்)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
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9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3252 TAMILS AND TECHNOLOGY

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

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

UNIT III MANUFACTURING TECHNOLOGY
UNIT IV   AGRICULTURE AND IRRIGATION TECHNOLOGY   3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V   SCIENTIFIC TAMIL & TAMIL COMPUTING   3

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலொறு - மக்களும் பணம் பொடும் - மக.மக. பொடுக்கு (தமிழியே கல்வியியல் பணிகள் கழகம்).
2. கல்வியே கேரி - பணத்தே திறந்த. கே.சாரம். (தமிழ்நொடு பொடநூல்).
3. கேரி - கல்வியே கேரியே தொகையியே தெறு தரகிரி (தமிழ்நொடு கதை வெளியீடு).
4. வெளியீடு - அருங்காட்சியக தரகிரி (தமிழ்நொடு கதை வெளியீடு).
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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
# NCC Credit Course Level 1*

NX3251 (ARMY WING) NCC Credit Course Level - I

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## NCC GENERAL

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<td>Incentives</td>
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<td>NCC 3</td>
<td>Duties of NCC Cadet</td>
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<td>NCC 4</td>
<td>NCC Camps: Types &amp; Conduct</td>
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### 6 Periods

## NATIONAL INTEGRATION AND AWARENESS

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### 4 Periods

## PERSONALITY DEVELOPMENT

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### 7 Periods

## LEADERSHIP

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### 5 Periods

## SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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<td>SS 1</td>
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<td>SS 4</td>
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<td>New Initiatives</td>
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<td>SS 7</td>
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### 8 Periods

**TOTAL: 30 PERIODS**
## NCC Credit Course Level 1*

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

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**TOTAL : 30 PERIODS**
## NCC Credit Course Level 1*

### NX3253 (AIR FORCE WING) NCC Credit Course Level - I

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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 processes like turning, drilling, tapping in parts; Assembling 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:
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 air conditioner.

**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

**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.

TOTAL: 60 PERIODS
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

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
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
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 context.
- 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.

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

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
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
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
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

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:

BT3392  BIOCHEMISTRY  L T P C
3 0 0 3

COURSE OBJECTIVES:
- 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  
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  

UNIT IV  INTERMEDIARY METABOLISM AND REGULATION  
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  
Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

COURSE OUTCOMES:  
- To ensure students have a strong foundation in the structure and reactions of Biomolecules.
- To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- To correlate biochemical processes with Biotechnology applications.

TEXT BOOKS  

REFERENCES  
BT3351  CELL BIOLOGY

COURSE OBJECTIVES:
- To provide knowledge on the fundamentals of cell biology
- To help students understand the signalling mechanisms

UNIT I  CELL STRUCTURE AND FUNCTION OF THE ORGANELLES  9

UNIT II  CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS  9
Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications.

UNIT III  TRANSPORT ACROSS CELL MEMBRANE  9

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

UNIT V  TECHNIQUES USED TO STUDY CELLS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students
- Would have deeper understanding of cell at structural and functional level.
- Would have broad knowledge on the molecular interaction between cells.
- Would demonstrate a clear understanding of the signal transduction, secondary messengers.
- Would develop skill on working principles of microscopy and identification of cell types.

TEXT BOOKS:

REFERENCES:
COURSE 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
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
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
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
Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS

CH3352 FLUID MECHANICS FOR CHEMICAL ENGINEERS

COURSE OBJECTIVE:

- To acquire a sound knowledge on fluid properties, fluid statics, dynamic characteristics of fluid flow for through pipes and porous medium, flow measurement and fluid machineries

UNIT I
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 – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometer – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III
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 - use of dimensional analysis for scale up studies

UNIT IV
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 - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors and fans

COURSE OUTCOMES:
- Understand the fundamental properties of fluids and its characteristics under static conditions.
- Develop empirical correlation using dimensionless analysis.
- Analyze flow of fluid through pipe and over the of solid.
- Understand and select flow meter(s), characteristics of pumps used in Chemical Process Industries

TEXT BOOKS:

REFERENCES:

BT3491 CHEMICAL PROCESS CALCULATIONS IN BIOTECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVE:
- To enable the students to learn about basic concepts of chemical process and calculations
- The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics.
- This will enable the students to perform calculations pertaining to processes and operations.
UNIT I BASIC CHEMICAL CALCULATIONS 9
Dimension – Systems of units esp. engineering FPS, Engineering MKS & SI systems – Conversion from one system to the other – composition of mixtures and solutions – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density.

UNIT II IDEAL AND ACTUAL GAS EQUATIONS 9

UNIT III MATERIAL BALANCE 9
Material balance concept – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, drying, crystallization, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration

UNIT IV ENERGY BALANCE 9
General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess

UNIT V CHEMICAL REACTION 9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon success completion of this course, the students will be able to:
- Solve problems related to units and conversions and fit the given data using the methodologies
- Solve problems related to material and energy balance concepts & design reactors for biochemical processes
- Apply their knowledge in the field of biochemical engineering from the principles of Thermodynamics

TEXT BOOKS:

REFERENCES:
2. S. Pushpavanam, Introduction to Chemical Engineering, PHI Learning Pvt. Ltd.,2012
AIM
- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

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

Equipment Needed for 20 Students
- Autocalve 1
- Hot Air Oven 1
- Incubators 2
- Light Microscopes 4
- Incubator Shaker 1
- Colorimeter 2
- Laminar Flow Chamber 2

Glassware:
- Test tubes (atleast 10 per student)
- Beakers – 50 ml, 100 ml, 250 ml one each per student, 500 ml and 1000 ml atleast 5 per batch of 20 students
- Watch glasses one per student
- Petridishes as required, glass cuvettes as needed
- Burette – one per student
- Glass pipette – one each in 0.5 ml, 1 ml, 5 ml and 10 ml with suitable pipette aid.
- TLC plate as required for the experiment.

Chemicals: glucose, fructose, galactose, maltose, starch, amino acids, DNA, RNA, lipids and commercial enzymes as required. Other chemicals as per the requirement of the standard protocol and commercial kit procured from the vendor followed/ utilised by the department

TOTAL: 45 PERIODS

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

BT3362 CELL AND MICROBIOLOGY LABORATORY L T P C 0 0 3 1.5

COURSE OBJECTIVES:
- To demonstrate various techniques to learn the morphology, identification and propagation of cells and microbes.
- To learn the staining techniques and culturing of microorganism.

EXPERIMENTS
1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Microscopy – Working and care of Microscope, phase contrast and fluorescent microscopy
3. Culture Media-Types and Use: Preparation of Nutrient broth and agar
4. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
5. Identification of given plant, animal, bacterial cells and yeast/mould
6. Staining Techniques Simple, Differential- Gram’s Staining, spore /capsule staining, Giemsa, and Leishman Staining
7. Quantification of Microbes: Sampling and Serial Dilution: Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient, Antibiotic Sensitivity Assay
9. Osmosis and Tonicity and Tryphan Blue Assay
10. Growth Curve in Bacteria and Yeast
11. Staining for different stages of mitosis in AlliumCepa (Onion)
12. Effect of pH, Temperature, UV radiation on Growth Bacteria

Equipment Needed for 30 Students
- Autoclave 1
- Hot Air Oven 1
- Incubators 2
- Light Microscopes 4
- Incubator Shaker 1
- Colorimeter 2
- Lamina Flow Chamber 2
- Glassware: Petridish, Test tubes, Microscopic slides, Inoculation, loop, Gas burner

Chemicals and media
- Bacterial culture media, Yeast culture media, 70% ethanol, antibiotics, Crystal violet, Iodine, Safranin, India ink (capsule staining), Immersion oil

COURSE OUTCOMES:
Students will be able to
- Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.

TOTAL: 45 PERIODS
- Know the various aseptic techniques and sterilization methods.
- Develop the minimum skills to work on several important techniques for the study of microorganisms in the laboratory.
- Learn the various techniques of culturing of microorganisms and media preparation.
- Study the growth of microorganisms by varying the growth conditions.
- Identify the various stages of mitosis

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GE3361 PROFESSIONAL DEVELOPMENT L T P C 0 0 2 1

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

To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

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

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

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

**TOTAL: 30 PERIODS**

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

MA3391 PROBABILITY AND STATISTICS

COURSE OBJECTIVES

• This course aims at providing the required skill to apply the statistical tools in engineering problems.
• To introduce the basic concepts of probability and random variables.
• To introduce the basic concepts of two dimensional random variables.
• 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 classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES

Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ESTIMATION THEORY


UNIT IV NON-PARAMETRIC TESTS

Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests .

UNIT V STATISTICAL QUALITY CONTROL

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

• Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
• Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
• 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 and statistical quality control.
• Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS

REFERENCES:

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

UNIT I ENVIRONMENT AND BIODIVERSITY

UNIT II ENVIRONMENTAL POLLUTION

UNIT III RENEWABLE SOURCES OF ENERGY
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
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 studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES
Cycles—carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization—Socio-economical and technological change.

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

**REFERENCE BOOKS:**

**BI3401 CHEMICAL THERMODYNAMICS AND BIO THERMODYNAMICS**

**L T P C**
4 0 0 4

**COURSE OBJECTIVE:**
- To enable the students to learn about basic concepts of classical and statistical thermodynamics

**UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS**
First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell’s relations and applications.

**UNIT II SOLUTION THERMODYNAMICS**
Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

**UNIT III PHASE EQUILIBRIA**
Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.
UNIT IV CHEMICAL REACTION EQUILIBRIA
Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION
Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the student would have the ability

- To explain the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.
- To demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.
- To design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.
- To describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.

TEXT BOOKS:

REFERENCE:

BT3451 ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

COURSE OBJECTIVES:
To enable the students

- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products.

UNIT I INTRODUCTION TO SPECTROMETRY

UNIT II MOLECULAR SPECTROSCOPY

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

UNIT IV SEPARATION METHODS 9

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

TOTAL: 45 PERIODS

COURSE OUTCOME:

- On completion of the course, students will have a better understanding of spectroscopy and the separation techniques used for biological products.

TEXT BOOKS:

REFERENCES:

BT3391 BASIC INDUSTRIAL BIOTECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:
- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- The course prepares the students for the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9
Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of Upstream and
Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES
Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

UNIT III PRODUCTION OF SECONDARY METABOLITES
Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS
Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able
- To explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.
- To apply basic biotechnological principles, methods and models to solve biotechnological tasks.
- To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.
- To design and deliver useful modern biotechnology products to the Society.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
To enable the students
- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes

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

UNIT II  KINETICS OF ENZYME ACTION  

UNIT III  ENZYME IMMOBILIZATION AND BIOSENSORS  
Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

UNIT IV  PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES  
Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays

UNIT V  BIOTRANSFORMATION APPLICATIONS OF ENZYMES  

TEXT BOOKS:
1. Trevor Palmer , Enzymes IInd Horwood Publishing Ltd

REFERENCES:
1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.

**BI3411 **CHEMICAL ENGINEERING LABORATORY-1 L T P C
(FLUID MECHANICS & HEAT TRANSFER 0 0 3 1.5)

**COURSE OBJECTIVES:**
- To provide basic understanding of chemical engineering principles and operations

**EXPERIMENTS**
1. Flow measurement - Orifice meter
2. Flow measurement - Venturimeter,
3. Flow measurement - Rotameter
4. Pressure drop in flow through pipes
5. Pressure drop in flow through packed column
6. Pressure drop in flow through fluidized beds
7. Heat transfer in Composite wall
8. Heat transfer characteristics in double pipe heat exchanger
9. Heat transfer characteristics in shell and tube heat exchanger
10. Heat transfer characteristics in plate type heat exchanger
11. Heat transfer by radiation
12. Simple and steam distillation

**Equipment Needed for a batch of 30 Students**
- Orifice meter 1
- Venturimeter 1
- Rotameter 1
- Double pipe heat exchanger 1
- Shell and tube heat exchanger 1
- Plate type heat exchanger 1
- Packed bed column 1
- Fluidized bed column 1
- Composite wall 1
- Emissivity measurement apparatus 1
- Darcy's friction factor apparatus 1
- Distillation set up 1
- Glassware, Chemicals, Media as required

**COURSE OUTCOMES:**
Upon completion of this practical course the student will
- Have knowledge on the basic principles of chemical engineering
- Be able to apply the skill of material balance and energy balance in unit operations unit process of chemical engineering and biotechnology
- Be able to analyze the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives
- Understand the design and working principles of fluid moving machinery and transport phenomena

**TOTAL: 45 PERIODS**
COURSE OBJECTIVES:
To train the students
- To have a practical hands on experience on Absorption Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analysis using spectrometric and microscopic techniques

EXPERIMENTS
1. Precision and validity in an experiment using absorption spectroscopy . 60
2. Validating Lambert-Beer’s law using KMnO4
3. Finding the molar absorbitivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO4-- by nephelometry.
8. Estimation of Al3+ by Flourimetry.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

Equipment Required for a batch of 30 Students
Colorimeter 2 No.
Glassware, Chemicals, Media as required TOTAL: 45 PERIODS

COURSE OUTCOME:
- The students would visualize and interpret the theory of spectroscopic methods by hands on experiments.

REFERENCES: