1. PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The primary objective of the Bachelor of Industrial Biotechnology program is to prepare professionals with the skills required to work in the Biotechnology industry with particular emphasis on the engineering aspects of manufacturing and design. They are trained to

1. Achieve successful professional and technical career.
2. Have a strong foundation in Basic Sciences, Mathematics, Medical Sciences, Bioinformatics and process engineering.
3. Have knowledge on the theory and practices in the field of Biotechnology, especially in the areas of downstream processing, Medical biotechnology and Bioinformatics and allied areas.
5. Practice and inspire high ethical values and technical standards.

The Overall objective of the Program is to promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in industrial, governmental, or clinical settings for an ultimate benefit of society and environment.

2. PROGRAM OUTCOMES:

The Biotechnology Graduates will have the ability to

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<th>PO#</th>
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<td>1</td>
<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>2</td>
<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>Design/development of solutions: Design solutions for complex engineering problems 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.</td>
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<td>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.</td>
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<td>5</td>
<td>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.</td>
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<td>The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the</td>
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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.

PROGRAM SPECIFIC OUTCOME:
PSO I:
Impart the deeper insights in to the Fundamentals of Biotechnology topics and to familiarize them with various upcoming and challenging areas relevant to biotechnology sector.
PSO II:
Analyse and perform the experimental procedures to address the societal problems through modern tools and techniques in biotechnology.
PSO III:
Apply the interdisciplinary knowledge acquired through the program to solve problems in the biotechnology industry.
PSO IV:
Demonstrate the innovative research ideas and to provide cost-effective and sustainable solutions in Biotechnology.

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### ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES
REGULATIONS 2021
B. TECH. BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII
SEMESTER I

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$ Skill Based Course

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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.

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

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

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*Open Elective – I shall be chosen from the emerging technologies.
**Four weeks industrial training/internship carries two credits. 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.
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*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

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

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

† Elective - Management shall be chosen from the Elective Management courses

##Four weeks industrial training/internship carries two credits. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester.

### SEMESTER VIII/VII*

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

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

TOTAL CREDITS: 166
## ELECTIVE – MANAGEMENT COURSES

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## MANDATORY COURSES I*

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* Mandatory Courses are offered as Non–Credit Courses

## MANDATORY COURSES II*

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* Mandatory Courses are offered as Non–Credit Courses
PROFESSIONAL ELECTIVE COURSES : VERTICALS

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<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
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<td>Biosciences</td>
<td>Medical Biotechnology</td>
<td>Bio Chemical Engineering</td>
<td>Animal Biotechnology</td>
<td>Computational Biotechnology</td>
<td>Quality and Regulatory Affairs</td>
<td>Agro Biotechnology</td>
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<td>Bioprocess Control and Instrumentation</td>
<td>Biosensors</td>
<td>Human Genetics</td>
<td>Mass Transfer Operations</td>
<td>Fundamentals of Animal Biotechnology</td>
<td>Programming for Bioinformatics Applications</td>
<td>Clinical Trials and Health care policies in Biotechnology</td>
<td>Plant anatomy</td>
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<td>Food Processing and Technology</td>
<td>Stem Cell Technology</td>
<td>Biopharmaceutica ls and Biosimilars</td>
<td>Bioenergy and Biofuels</td>
<td>Animal Physiology and Metabolism</td>
<td>Molecular Modelling</td>
<td>Quality assurance and quality control in Biotechnology</td>
<td>Bio-fertilizer production &amp; mushroom cultivation</td>
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<tr>
<td>Bioreactor Design and Scale up process</td>
<td>Biomaterials</td>
<td>Tissue Engineering</td>
<td>Environmental Biotechnology</td>
<td>Animal Cell Culture Technology</td>
<td>Computer Aided Drug Design</td>
<td>Entrepreneurship and patent design</td>
<td>Biotechnologic al approach in crop improvement</td>
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<tr>
<td>Bioprocess Modelling and Simulation</td>
<td>Protein Engineering</td>
<td>Molecular Therapeutics and Diagnostics</td>
<td>Applied Chemical Reaction Engineering</td>
<td>Advances in Animal Biotechnology</td>
<td>Metabolomics and Metabolic Engineering</td>
<td>Intellectual property rights in Biotechnology</td>
<td>Advance techniques in agro forestry</td>
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<td>Bioreactor Consideration for Recombinant Products</td>
<td>Modern Bio analytical Techniques</td>
<td>Biomedical Engineering</td>
<td>Petroleum Biotechnology</td>
<td>Biotechniques in Animal Breeding</td>
<td>Data Mining And Machine Learning Techniques For Bioinformatics</td>
<td>Biosafety and Hazard Management</td>
<td>Plant tissue culture &amp; transformation techniques</td>
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Registration of Professional Elective Courses from Verticals:
Refer to the regulations 2021, Clause 6.3. (Amended on 27.07.2023)
### PROFESSIONAL ELECTIVE COURSES : VERTICALS

#### VERTICAL I: BIOPROCESS TECHNOLOGY

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#### VERTICAL II: BIOSCIENCES

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#### VERTICAL III: MEDICAL BIOTECHNOLOGY

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### VERTICAL V: ANIMAL BIOTECHNOLOGY

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### VERTICAL VI: COMPUTATIONAL BIOTECHNOLOGY

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**VERTICAL VII: QUALITY AND REGULATORY AFFAIRS**

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### VERTICAL VIII: AGRO BIOTECHNOLOGY

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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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<td>5</td>
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</table>
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 (Amendments) of Regulations 2021.

<table>
<thead>
<tr>
<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
<th>Vertical V</th>
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<td>Principles of Public Administration</td>
<td>Statistics For Management</td>
<td>Sustainable infrastructure Development</td>
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<td>Fundamentals of Investment</td>
<td>Team Building &amp; Leadership Management for Business</td>
<td>Constitution of India</td>
<td>Datamining For Business Intelligence</td>
<td>Sustainable Agriculture and Environmental Management</td>
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<td>Banking, Financial Services and Insurance</td>
<td>Creativity &amp; Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
<td>Sustainable Bio Materials</td>
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<tr>
<td>Introduction to Blockchain and its Applications</td>
<td>Principles of Marketing Management For Business</td>
<td>Administrative Theories</td>
<td>Marketing And Social Media Web Analytics</td>
<td>Materials for Energy Sustainability</td>
</tr>
<tr>
<td>Fintech Personal Finance and Payments</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>Indian Administrative System</td>
<td>Operation And Supply Chain Analytics</td>
<td>Green Technology</td>
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<td>Introduction to Fintech</td>
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<td>Public Policy Administration</td>
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<td>Integrated Energy Planning for Sustainable Development</td>
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<td>-</td>
<td>Energy Efficiency for Sustainable Development</td>
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</table>
VERTICALS FOR MINOR DEGREE (In Additions To All The Verticals Of Other Programmes)

(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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<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
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<th>PERIODS PER WEEK</th>
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<td>1.</td>
<td>CMG331</td>
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**VERTICAL 2: ENTREPRENEURSHIP**

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<td>1.</td>
<td>CMG337</td>
<td>Foundations of Entrepreneurship</td>
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<td>Team Building &amp; Leadership Management for Business</td>
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<td>Creativity &amp; Innovation in Entrepreneurship</td>
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<td>Financing New Business Ventures</td>
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<td>1.</td>
<td>CMG343</td>
<td>Principles of Public Administration</td>
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<td>2.</td>
<td>CMG344</td>
<td>Constitution of India</td>
<td>PEC</td>
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### VERTICAL 4: BUSINESS DATA ANALYTICS

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<td>3.</td>
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<td>Human Resource Analytics</td>
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<td>Marketing And Social Media Web Analytics</td>
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<td>5.</td>
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<td>Operation And Supply Chain Analytics</td>
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<td>6.</td>
<td>CMG354</td>
<td>Financial Analytics</td>
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</table>
This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

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

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

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

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

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

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

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

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

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

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

(vi) Lectures by Eminent People
Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

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

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

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

**REFERENCES:**
Guide to Induction program from AICTE
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?

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 grammatical structures and use them in right context.
- To read and interpret information presented in tables, charts and other graphic forms
- 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.

CO-PO & PSO MAPPING

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- 1-low, 2-medium, 3-high, '-'- no correlation
- Note: The average value of this course to be used for program articulation matrix.

MA3151  MATRICES AND CALCULUS  L T P C 3 1 0 4

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

UNIT II  DIFFERENTIAL CALCULUS

UNIT III  FUNCTIONS OF SEVERAL VARIABLES

UNIT IV  INTEGRAL CALCULUS
Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.

UNIT V  MULTIPLE INTEGRALS

TOTAL: 60 PERIODS

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

CO1 : Use the matrix algebra methods for solving practical problems.
CO2 : Apply differential calculus tools in solving various application problems.
CO3 : Able to use differential calculus ideas on several variable functions.
CO4 : Apply different methods of integration in solving practical problems.
CO5 : Apply multiple integral ideas in solving areas, volumes and other practical problems.

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

REFERENCES:
PH3151 ENGINEERING PHYSICS L T P C

COURSE OBJECTIVES

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

UNIT I MECHANICS


UNIT II ELECTROMAGNETIC WAVES

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

UNIT III OSCILLATIONS, OPTICS AND LASERS

UNIT IV  BASIC QUANTUM MECHANICS
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes - Normalization, probabilities and the correspondence principle.

UNIT V  APPLIED QUANTUM MECHANICS
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch’s theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

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

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

REFERENCES:

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1-Low,2-Medium,3-High,”-“no correlation
Note: the average value of this course to be used for program articulation matrix.
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  9


UNIT II  NANO CHEMISTRY  9

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  9

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  9


UNIT V  ENERGY SOURCES AND STORAGE DEVICES  9

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

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the students will be able:
CO1: To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3: To apply the knowledge of phase rule and composites for material selection requirements.
CO4: To recommend suitable fuels for engineering processes and applications.
CO5: To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

REFERENCES:

CO-PO & PSO MAPPING

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- 1-low, 2-medium, 3-high, '-'- no correlation

GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

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  9

UNIT II  DATA TYPES, EXPRESSIONS, STATEMENTS  9
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  9
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/

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1 - low, 2 - medium, 3 - high, '-' - no correlation

GE3152  குறியீட்டு பாடை

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

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. கற்பகு மார்பு முடிசும் பர்திகாறு - திருவுண்ணம் மாலைக்குழு (திருவுண்ணம் மாலைக்குழு மற்றும் பர்திகாறு குழு). (திருவுண்ணம் மாலைக்குழு).
2. கல்வையிடல் மாணவர் - தொழில்நுட்ப தொழில்நுட்ப. (மிக்க பிள்ளை).
3. சிலம் - சென்றை தொழில்நுட்பக்குழு சார்ந்தவாறு வரும் தொழில்நுட்ப (மிக்க பிள்ளை தொழில்நுட்ப).
4. மாணவர் - அவர்களை வரும் தொழில்நுட்ப. (மிக்க பிள்ளை தொழில்நுட்ப).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
OBJECTIVES:

- 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.

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/

COs- PO's & PSO's MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation

BS3171

PHYSICS AND CHEMISTRY LABORATORY

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.

CO's-PO's & PSO's MAPPING

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- 1-Low, 2-Medium, 3-High,"-"-no correlation
- Note: the average value of this course to be used for program articulation matrix.

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

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

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

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

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

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen to and comprehend general as well as complex academic texts information
- To listen to and understand different points of view in a discussion
- To speak fluently and accurately in formal and informal communicative contexts
- To describe products and processes and explain their uses and purposes clearly and accurately
- To express their opinions effectively in both formal and informal discussions

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.

CO-PO & PSO MAPPING

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AVG.

- 1-low, 2-medium, 3-high, '-'- no correlation
- Note: The average value of this course to be used for program articulation matrix.
OBJECTIVES:
- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

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

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH  6

UNIT V  THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY  6
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

OUTCOMES:
At the end of the course, learners will be able
- To compare and contrast products and ideas in technical texts.
- To identify and report cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
- To present their ideas and opinions in a planned and logical manner
- To draft effective resumes in the 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.

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• 1-low, 2-medium, 3-high, ‘-’-no correlation

Note: The average value of this course to be used for program articulation matrix

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:
PH3252  MATERIALS SCIENCE FOR BIOTECHNOLOGISTS  L T P C  
3 0 0 3

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 – tieline 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


TOTAL: 45 PERIODS

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:

REFERENCES:

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

REFERENCES:
GE3251                                  ENGINEERING GRAPHICS
                                          L  T  P  C
                                      2 0 4 4

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  6+12
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)

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 BOOK:

REFERENCES:

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

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Low (1) ; Medium (2) ; High (3)
UNIT V  BIOORGANIC REACTIONS
Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Merrifield state peptide synthesis – Sanger method for peptide and DNA sequencing
TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: bonding and stereochemistry
CO2: mechanisms of substitution and addition reactions
CO3: Thermodynamics, kinetics and mechanism
CO4: Catalysis
CO5: Bioorganic reactions and mechanisms

TEXT BOOKS:

REFERENCES:

GE3252  கரிசோயியதுணைமுறைமுறைமுறைமுறை L T P C
10 01
UNIT IV  
TEXT-TABLE-REFERENCE BOOKS
1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
4. 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)
5. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3252  
TAMILS AND TECHNOLOGY  
L T P C  
1 0 0 1  
UNIT I  
WEAVING AND CERAMIC TECHNOLOGY  
3  
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II  
DESIGN AND CONSTRUCTION TECHNOLOGY  
3  
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  3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-
Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass
beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types
described in Silappathikaram.

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
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development
of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries –
Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. கல்விக் கோரியட்டு – மாதுரம் பாண்டியர் – தொல்க. பிரித்தான் (தமிழில்: கல்விக் கோரியட்டு பாண்டியர் மாதுரம் தொல்க. பிரித்தான் பிரித்தான்).
2. கல்விக் கோரியட்டு – பாண்டியர் தொல்க. (தமிழில்: பாண்டியர் தொல்க.).
3. சில்வில் – தென்னூர் தொல்காலம் கொள்ளக்கொள்ள தொல் தாக்கியின் (தமிழில்: சில்வில் தென்னூர்
தொல்காலம் கொள்ளக்கொள்ள தொல் தாக்கியின்).
4. பற்றிகுறிகள் – தொல்காலக் கொள்ளக்கொள்ள. (தமிழில்:பற்றிகுறிகள் தொல்காலக் கொள்ளக்கொள்ள).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
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Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)
(Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text
Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference
Book.
**NCC Credit Course Level 1**

**NX3251 (ARMY WING) NCC Credit Course Level - I**

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### NCC Credit Course Level 1*

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

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#### NCC GENERAL  
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- **NCC 1** Aims, Objectives & Organization of NCC  
- **NCC 2** Incentives  
- **NCC 3** Duties of NCC Cadet  
- **NCC 4** NCC Camps: Types & Conduct

#### NATIONAL INTEGRATION AND AWARENESS  
4

- **NI 1** National Integration: Importance & Necessity  
- **NI 2** Factors Affecting National Integration  
- **NI 3** Unity in Diversity & Role of NCC in Nation Building  
- **NI 4** Threats to National Security

#### PERSONALITY DEVELOPMENT  
7

- **PD 1** Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving  
- **PD 2** Communication Skills  
- **PD 3** Group Discussion: Stress & Emotions

#### LEADERSHIP  
5

- **L 1** Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code  
- **L 2** Case Studies: Shivaji, Jhasi Ki Rani

#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT  
8

- **SS 1** Basics, Rural Development Programmes, NGOs, Contribution of Youth  
- **SS 4** Protection of Children and Women Safety  
- **SS 5** Road / Rail Travel Safety  
- **SS 6** New Initiatives  
- **SS 7** Cyber and Mobile Security Awareness

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

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

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#### NCC GENERAL
- **NCC 1** Aims, Objectives & Organization of NCC  
- **NCC 2** Incentives  
- **NCC 3** Duties of NCC Cadet  
- **NCC 4** NCC Camps: Types & Conduct

#### NATIONAL INTEGRATION AND AWARENESS
- **NI 1** National Integration: Importance & Necessity  
- **NI 2** Factors Affecting National Integration  
- **NI 3** Unity in Diversity & Role of NCC in Nation Building  
- **NI 4** Threats to National Security

#### PERSONALITY DEVELOPMENT
- **PD 1** Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving  
- **PD 2** Communication Skills  
- **PD 3** Group Discussion: Stress & Emotions

#### LEADERSHIP
- **L 1** Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code  
- **L 2** Case Studies: Shivaji, Jhasi Ki Rani

#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT
- **SS 1** Basics, Rural Development Programmes, NGOs, Contribution of Youth  
- **SS 4** Protection of Children and Women Safety  
- **SS 5** Road / Rail Travel Safety  
- **SS 6** New Initiatives  
- **SS 7** Cyber and Mobile Security Awareness

**TOTAL : 30 PERIODS**

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*Note: The credit courses are designed to cultivate various aspects of personal and national development through structured learning and practical engagements.*
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:
- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

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

Wood Work Study:
- Studying joints in door panels and wooden furniture
- 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:
- Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- 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 the elements of a smartphone.
   b) Assembly and dismantling of LED TV.
   c) Assembly and dismantling 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 equipment; 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.

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Low (1); Medium (2); High (3)

TOTAL: 60 PERIODS
COURSE OBJECTIVES

- Make the students understand the mechanism of synthesis of different chemical moieties
- Familiarise the students with the isolation of biomolecules from natural sources

**LIST OF EXPERIMENTS**

1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from tartaric acid
5. Preparation of alpha D-glucopyranose pentaacetate
6. Preparation of 1,2,5,6 dicyclohexylnoine alpha d glucofuranose
7. Isolation of lycopene from tomato paste
8. Preparation of L-proline
9. Preparation of L-cysteine from hair
10. Preparation of S-ethylhydroxyl butonate from methylacetoacetate using yeast

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Comprehend the mechanism of reactions
CO2: Be able to synthesize various Bioorganic compounds
CO3: Be able to work independently for the experimentation.

REFERENCES:

GE3272 COMMUNICATION LABORATORY

OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT I

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life-discussing past events-Writing: writing emails (formal & semi-formal).
UNIT II
Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures-talking about travel problems-making arrangements-describing arrangements-discussing plans and decisions-discussing purposes and reasons-understanding common technology terms-Writing: - writing different types of emails.

UNIT III
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
At the end of the course, learners will be able
- Speak effectively in group discussions held in a formal/semi formal contexts.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision
- Give appropriate instructions and recommendations for safe execution of tasks

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

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- 1-low, 2-medium, 3-high, '-'- no correlation
- Note: The average value of this course to be used for program articulation matrix.
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


UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS


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:

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BASELINE

BT3392 BIOCHEMISTRY L T P C 3 0 0 3

COURSE OBJECTIVES
The student should be able to
- Enable students learn the fundamentals of Biochemical processes and Biomolecules.
- Understand the chemical basis which allows biological molecules to give rise to the process.

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

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

UNIT III METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM 9

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course the student will be able to
- Ensure students have a strong foundation in the structure and reactions of biomolecules.
- Introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- Correlate biochemical processes with biotechnology application.
- Understand in detail about structures, types and classifications of amino acid.
- Illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways.
- Relate the structure of DNA with its function in replication and gene expression.

TEXT BOOKS

REFERENCES
BT3351  CELL BIOLOGY  

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<td>• To help students understand the signalling mechanisms</td>
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TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students
- To have deeper understanding of cell at structural and functional level
- To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells
- To become familiar on the use of cellular components to generate and utilize energy in cells
- To possess broad knowledge on the molecular interaction between cells.
- To demonstrate a clear understanding between secondary messengers and signal transduction mechanism
- To develop skill on working principles of microscopy and identification of cell types.

TEXT BOOKS:

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COURSE OBJECTIVES
- To introduce students the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To impart knowledge to the students 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

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

TEXT BOOKS

REFERENCE BOOKS
### CO / PO Mapping

(3/2/1 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak

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COURSE OBJECTIVE:
• To enable the students to learn about basic concepts of classical and statistical Thermodynamics
• Apply the knowledge on Phase equilibrium and chemical reaction equilibrium.

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

COURSE OUTCOMES:
Upon completion of this course the student will be able to
• To explain the theoretical concepts of thermodynamics and how it applies to energy Conversion.
• To demonstrate the capability to analyse the energy conversion performance in a variety of modern applications in biological systems.
• To design and carry out bioprocess engineering experiments, and analyse 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.
• To understand the microbial growth and product formation and its kinetics.
• To explore the thermodynamic concepts in bio chemical engineering.

TEXT BOOKS:

REFERENCE:
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

UNIT II PRODUCTION OF PRIMARY METABOLITES 9
Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

UNIT III PRODUCTION OF SECONDARY METABOLITES 9
Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 9
Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 9

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 bio products 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.
- Recognize the concepts of industrial biotechnology.
- Apply biotechnological concept and principles in bioprocesses.

TEXT BOOKS:

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COURSE OBJECTIVES
The student should make to

- Learn fundamental approaches for experimentally investigating biochemical problems.
- Able to extract living cell samples from plants and animals for genetic research

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).

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course the student will be able to

- Analyze current biochemical and molecular techniques to plan and carry out experiments.
- Perform good biochemical laboratory practices.
- Adapt methods for biochemical analysis.
- Carry out experiments in biomolecular separations.
- Learn and understand the principles behind the qualitative and quantitative estimation of biomolecules.
- Understand the applicability of biochemical methods to realistic solution.

TEXTBOOKS
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

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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
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

TOTAL: 45 PERIODS

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

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GE3361 PROFESSIONAL DEVELOPMENT

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

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

10 Hours
MS EXCEL:

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

MS POWERPOINT:

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

TOTAL: 30 PERIODS

OUTCOMES:
On successful completion the students will be able to

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

BT3401  MOLECULAR BIOLOGY  L T P C

COURSE OBJECTIVES:
The course aims to enable the students to

- By doing this course students will acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
- This course will emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in different Prokaryotes and Eukaryotes.
UNIT I CHEMISTRY OF NUCLEIC ACIDS

UNIT II DNA REPLICATION & REPAIR

UNIT III TRANSCRIPTION

UNIT IV TRANSLATION

UNIT V CELL DIVISION & CELL CYCLE

COURSE OUTCOMES:
Upon completion of the course, students will be able to
- Understand the composition, structure and characteristics of nucleic acids.
- Understand the chemical and molecular processes that occur in and between cells.
- Discuss clearly about gene organization and mechanisms of control the gene expression.
- Gain insights into the most significant molecular and cell-based methods to expand his/her understanding of biology.
- Comprehend the basic mechanisms of cell division and its status under proliferative and degenerative disorders.
- Articulate applications of molecular biology in the modern world.

TEXTBOOKS:
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GE3451 ENVIROMENTAL SCIENCES AND SUSTAINABILITY L T P C 2 0 0 2

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 6
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

TOTAL: 30 PERIODS

OUTCOMES:
- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization

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

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BT3402 FLUID FLOW AND HEAT TRANSFER OPERATIONS

COURSE OBJECTIVES:
- To introduce the students the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.

UNIT I FLUID PROPERTIES & FLUID MECHANICS

UNIT II FLOW OF FLUID THROUGH PACKINGS

UNIT III CONDUCTION HEAT TRANSFER
UNIT IV CONVECTION HEAT TRANSFER
Forced and natural convection – Dimensional analysis, Dimensional numbers, Convection heat transfer coefficient, Correlations for flow over plate, through tubes, over spheres and cylinders, Agitated systems, Packed columns, condensation phenomena, Film and drop wise condensation over tubes. Billing phenomena, heat transfer coefficient.

UNIT V RADIATION HEAT TRANSFER AND HEAT TRANSFER EQUIPMENTS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Understand the basic knowledge of Dimensional analysis & agitation process of Current Biotech Industries.
- Acquire knowledge on the steady, unsteady and combined resistances of conduction and convection
- Familiar with radiation, boiling and condensation process of heat transfer
- Analyse the design of various industrial heat exchangers, the concept of NTU for higher education in the field of Biotechnology.
- Learn fundamentals of three heat transfer modes, and have hands-on experience on heat transfer equipment’s.
- Understand the basics of major heat and mass transfer operations

TEXT BOOKS:

REFERENCE:
2. R.K.Rajput A text Book of Heat & Mass Transfer SI Units , S.Chand publisher,2018

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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

UNIT IV SEPARATION METHODS

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY

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

COURSE OBJECTIVES:
- 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.
- The course 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

COURSE OUTCOMES:
Upon success completion of this course, the students will be able to:
1. To recite the basics of enzyme and principles of catalysis
2. To understand the enzyme kinetics and various enzyme kinetic models
3. To gain the knowledge to develop the enzyme immobilization and biosensors
4. To analyze and learn enzyme reactions for the production and purification process
5. To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes
6. To apply the skills for the development of processes and products

TEXT BOOKS:

REFERENCES:
2. S. Pushpavanam, Introduction to Chemical Engineering, PHI Learning Pvt. Ltd.,2012
BT3452 INDUSTRIAL ENZYMEOLOGY

L T P C 3 0 0 3

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

UNIT I INTRODUCTION TO ENZYMES 9
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 9

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS 9
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 9
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 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of the course, the students would have the knowledge on

- On enzyme and enzyme reactions will be the key step in to proceed towards various concepts in biotechnology.
- Theoretical and practical aspects of kinetics will provide the importance and utility of enzyme kinetics towards research.
- Process of immobilization has been increased steadily in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.
- Ideas on Processing, Production and Purification of enzymes at an industrial scale will be helpful to work technologically.

TEXT BOOKS:

REFERENCES:
2. James M. Lee, Biochemical Engineering, PHI, USA

NCC Credit Course Level 2*  
NX3451  
(ARMY WING) NCC Credit Course Level - II  

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TOTAL: 45 PERIODS
NCC Credit Course Level 2*

NX3453 (AIR FORCE WING) NCC Credit Course Level - II

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TOTAL: 45 PERIODS

BT3411 CHEMICAL ENGINEERING LABORATORY FOR BIOTECHNOLOGISTS

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<td>COURSE OBJECTIVES:</td>
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<td>• To provide basic understanding of chemical engineering principles and operations</td>
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<td>• Course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters</td>
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EXPERIMENTS

1. Flow measurement - Orifice meter
2. Flow measurement - Venturi meter,
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. Characteristics of centrifuge pump
8. Filtration through plate and frame filter press
9. Filtration in leaf filter
10. Heat transfer characteristics in heat exchanger
11. Simple and steam distillation

COURSE OUTCOMES:

- Acquire knowledge on the basic concepts of chemical engineering.
- Develop the skill of material balance and energy balance in unit operations and unit process.
- Analyse the chemical engineering principles and their applications in chemical, mechanical and biological perspectives.
- Realize the design and working principles of fluid moving machinery and transport phenomena in biological systems.
- Select and apply appropriate techniques used for biological products.
- Recognize the need for instrumentation studies in technical environment.

TOTAL: 45 PERIODS

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BT3461 ANALYTICAL INSTRUMENTATION LABORATORY

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.
2. Validating Lambert-Beer's law using KMnO4
3. Finding the molar absorbity 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.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- The students would visualize and interpret the theory of spectroscopic methods by practice.

REFERENCES:
OBJECTIVES:
To enable the students to
- Get connected with industry/ laboratory/research institute
- Get practical knowledge on production process in the industry and develop skills to solve related problems
- Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.
No. of Weeks: 04

OUTCOMES:
On completion of the course, the student will know about
CO1: Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute
CO2: Analysis of industrial / research problems and their solutions
CO3: Documenting of material specifications, machine and process parameters, testing parameters and results
CO4: Preparing of Technical report and presentation

BT3551 BIOPROCESS PRINCIPLES
COURSE OBJECTIVES:
- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To endow the students with the basics of microbial kinetics, metabolic stoichiometry and energetics.

UNIT I OVERVIEW OF FERMENTATION PROCESSES 9
Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor (CSTR) and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 9
Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

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

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


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course the student will be able to
- Identify suitable process instrumentation for monitoring and control of fermentor.
- Formulate the fermentation medium to facilitate improved product production.
- Select and apply the sterilization techniques in bioprocessing.
- Interpret the metabolic stoichiometry in microbial processes.
- Analyze the kinetics of microorganisms during fermentation processes.
- Develop strategies to solve the issues in bioprocessing.

TEXT BOOKS:

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BT3552 IMMUNOLOGY

OBJECTIVES:
- To discuss the structure, functions and integration of immune system.
- To explain the immune response and protective mechanism against various pathogens.
UNIT I  INTRODUCTION TO IMMUNE SYSTEM
Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex

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

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, students will be able to
• Understand the structure, functions and integration of immune system.
• Understand the antigen-antibody interactions that offers defence mechanism.
• Gain knowledge in importance of learning immunoregulation in immunity development
• Understand the importance of various techniques of therapeutically significant monoclonal and engineered antibodies production
• Aware of the concepts and mechanism behind tumour development, allergy and hypersensitivity reactions.
• Gain knowledge in Immunotherapeutic development for Clinical Applications

TEXT BOOKS:

REFERENCES:
### CO / PO Mapping

(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak

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### BT3501  GENETIC ENGINEERING

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**OBJECTIVES:**

- To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts.

**UNIT I  BASIC OF RECOMBINANT DNA TECHNOLOGY**

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

**UNIT II  DNA LIBRARIES**

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

**UNIT III  SEQUENCING AND AMPLIFICATION OF DNA**

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

**UNIT IV  ORGANIZATION AND STRUCTURE OF GENOMES**

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies, Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

**UNIT V  CURRENT STATUS OF GENOME SEQUENCING PROJECTS**

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- To clone commercially important genes
- To produce the commercially important recombinant proteins
- To be aware of gene and genome sequencing techniques
- To design modern tools and techniques for manipulation and analysis of genomic sequences
- To develop skills in microarrays, analysis of gene expression and proteomics
- To strategize research methodologies employing genetic engineering techniques

**TEXT BOOKS:**

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**BT3511 MOLECULAR BIOLOG AND GENETIC ENGINEERING LABORATORY**

**COURSE OBJECTIVES:**
- Provide hands-on experience in performing basic molecular biology and Genetic Engineering techniques.
- Introduce the theory behind in each technique and to describe common applications of each methodology in biological research. This will facilitate the students to take up specialized project in Molecular biology and will be a pre-requisite for research work.

**LIST OF EXPERIMENTS**
1. Isolation of total DNA
2. Isolation of Plasmid DNA
3. Agarose gel electrophoresis
4. Restriction enzyme digestion of DNA
5. DNA ligation
6. Competent cell preparation & Transformation
7. Blue-White screening
8. Induction and Analysis of Gene expression
9. PCR
10. SDS-PAGE
11. Western blot
TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon completion of the course, students will be able to
- Understand basic techniques of DNA isolation and manipulation.
- Gain experience in selecting genetically transformed organisms for downstream analysis.
- Aware basic techniques involved in analysis of gene expression at nucleic acids and proteins level
- Establish the ability to carry out laboratory experiments and interpret the results.
- Apply practical knowledge to solve biotechnological problems.
- Aware of the hazardous chemicals and safety precautions in case of emergency.

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BT3561 IMMUNOLOGY LABORATORY

COURSE OBJECTIVES:
- To give practical training in the functioning of immune system.
- To give laboratory training in different immunological and immunotechnological techniques.

EXPERIMENTS
1. Animal Handling – Immunization – Bleeding techniques by Virtual methods
2. Identification of immune cells in a blood smear and Identification of blood group
3. Isolation of serum and plasma
4. Testing for typhoid antigens by Widal test
5. Immunodiffusion – SRID and Ouchterlony Double Diffusion
6. Immunoelctrophoresis – Classical, Counter Current and Rocket immunoelectrophoresis
7. Enzyme Linked ImmunoSorbent Assay (ELISA) - Types
8. Isolation of peripheral blood mononuclear cells
9. Isolation of monocytes from blood
10. Lymphocyte migration assay
11. Plaque forming cell assay
12. Identification of T cells by T-cell rosetting using sheep RBC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- The students would be aware of immune system cells and tissues.
- The students would have knowledge on immunological /clinical tests.
- The students would be able to isolate lymphocytes and monocytes.
- The students would be able to identify various immune system cells.
- The students would become familiar with the techniques involved in antigen-antibody reaction.
- The students will be able to identify the cellular and molecular basis of immune responsiveness.

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BT3601 BIOINFORMATICS

OBJECTIVES:
- To launch the Bioinformatics core concepts to students.
- To provide knowledge on Biological databases, sequence analysis, evolutionary analysis and applications of Bioinformatics.

UNIT I BIOLOGICAL DATABASES
Introduction to Bioinformatics and Computational Biology, Biological sequences, Classification of biological databases - Sequence Databases, Structure Databases, Genome specific databases, Special Databases and applications- Microarray, Metabolic pathway, motif, and domain databases, Data file formats.

UNIT II SEQUENCE ANALYSIS
Sequence Alignment: Homology vs Similarity, Similarity vs Identity. Types of Sequence alignment - Pairwise and Multiple sequence alignment, Global alignment, Local alignment, Dotplot, Alignment algorithms- Needleman wunsch and Smith and waterman algorithm, Substitution matrices- PAM,
BLOSUM. Multiple Sequence Alignment- Application of multiple alignments, Viewing and editing of MSA and Scoring function. Database Similarity Searching- Basic Local Alignment Search Tool (BLAST), FASTA, PHI BLAST, PSI BLAST, BLAST algorithm.

UNIT III MOLECULAR PHYLOGENY 9

UNIT IV MACROMOLECULAR STRUCTURE ANALYSIS 9

UNIT V APPLICATIONS 9
Introduction to Systems Biology and Synthetic Biology, Microarray data analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of Bioinformatics in genomics and proteomics- Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

TOTAL: 45 Periods

COURSE OUTCOMES
Upon completion of this course, Student will be able to
- Use and describe bioinformatics data and information resources.
- Apply computational based solutions for biological perspectives
- Analyze the evolutionary relationship between the organisms
- Understand the macromolecules structure prediction methods
- Relate how bioinformatics methods can be used in sequence to structure and function analysis.
- Learn the applications of bioinformatics approach for drug discovery, genomics and proteomics.

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

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COURSE OBJECTIVES:
The student should be made to,
- To provide the students with the basics of bioreactor engineering.
- To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT I  CONFIGURATION OF BIOREACTORS  9
Ideal reactors and its characteristics Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation Packed bed reactor, airlift reactor, introduction to fluidized bed reactor bubble column reactors

UNIT II  BIOREACTOR SCALE – UP  9
Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III  BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS  9
Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors

UNIT IV  MODELLING AND SIMULATION OF BIOPROCESSES  9
Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V  RECOMBINANT CELL CULTIVATION  9
Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichia pastoris/ Saccharomyces cerevisae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

OUTCOMES:
Upon completion of this course the student will be able to
- Describe various bioreactor configurations and operation modes.
- Apply the knowledge of bioreactor scale up on the basis of rule of thumbs.
- Define kinetic parameters and apply the bioreactor considerations for immobilized enzymes systems.
- Utilize modelling approaches and simulation concepts for bioprocess estimations.
- Apply bioreactor considerations for the development of recombinant products.
- Explore the engineering concepts of bioreactors.

TEXT BOOKS:
REFERENCES
3. James M. Lee, Biochemical Engineering, PHI, USA, 1992

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NCC Credit Course Level 3*
NX3651
(ARMY WING) NCC Credit Course - III

PERSONALITY DEVELOPMENT
PD 3 Group Discussion: Team Work 2
PD 4 Career Counselling, SSB Procedure & Interview Skills 3
PD 5 Public Speaking 4

BORDER & COASTAL AREAS
BCA 2 Security Setup and Border/Coastal management in the area 2
BCA 3 Security Challenges & Role of cadets in Border management 2

ARMED FORCES
AF 2 Modes of Entry to Army, CAPF, Police 3

COMMUNICATION
C 1 Introduction to Communication & Latest Trends 3

INFANTRY
INF 1 Organisation of Infantry Battalion & its weapons 3

MILITARY HISTORY
MH 1 Biographies of Renowned Generals 4
MH 2 War Heroes - PVC Awardees 4
MH 3 Study of Battles - Indo Pak War 1965, 1971 & Kargil 9
MH 4 War Movies 6

TOTAL: 45 PERIODS
### PERSONALITY DEVELOPMENT
- **PD 3** Group Discussion: Team Work
- **PD 4** Career Counselling, SSB Procedure & Interview Skills
- **PD 5** Public Speaking

### BORDER & COASTAL AREAS
- **BCA 2** Security Setup and Border/Coastal management in the area
- **BCA 3** Security Challenges & Role of cadets in Border management

### NAVAL ORIENTATION
- **NO 3** Modes of Entry - IN, ICG, Merchant Navy
- **AF 2** Naval Expeditions & Campaigns

### NAVAL COMMUNICATION
- **NC 1** Introduction to Naval Communications
- **NC 2** Semaphore

### NAVIGATION
- **N 1** Navigation of Ship - Basic Requirements
- **N 2** Chart Work

### SEAMANSHIP
- **MH 1** Introduction to Anchor Work
- **MH 2** Rigging Capsule
- **MH 3** Boatwork - Parts of Boat
- **MH 4** Boat Pulling Instructions
- **MH 5** Whaler Sailing Instructions

### FIRE FIGHTING FLOODING & DAMAGE CONTROL
- **FFDC 1** Fire Fighting
- **FFDC 2** Damage Control

### SHIP MODELLING
- **SM** Ship Modelling Capsule

**TOTAL : 45 PERIODS**

### PERSONALITY DEVELOPMENT
- **PD 3** Group Discussion: Team Work
- **PD 4** Career Counselling, SSB Procedure & Interview Skills
- **PD 5** Public Speaking

### BORDER & COASTAL AREAS
- **BCA 2** Security Setup and Border/Coastal management in the area
- **BCA 3** Security Challenges & Role of cadets in Border management

### AIRMANSHIP
- **A 1** Airmanship

### BASIC FLIGHT INSTRUMENTS
- **FI 1** Basic Flight Instruments

### AERO MODELLING
- **AM 1** Aero Modelling Capsule
OBJECTIVES

- To provide a practical exposure to the bioinformatics databases, tools and software.
- To select and use functions in Perl for processing sequence data.

LIST OF EXPERIMENTS

1. Introduction to UNIX basic commands.
2. Perl programming and applications to Bioinformatics.
   - Basic scripting.
   - Regular expression101
   - File i/o& control statement.
   - Subroutines
   - String specific functions.
3. Biological databases and their uses
   - Sequence databases
   - Structure databases
4. Sequence Analysis
   - BLAST, FASTA
   - Multiple sequence alignment
   - ExPASy Tools
   - DOTPLOT
5. Phylogenetic tree prediction
6. Protein secondary structure prediction
7. Protein tertiary structure prediction- Homology modeling using automated tool and Any open source software.
8. Lead molecule search using databases.
9. Protein-Ligand docking
10. Protein-Protein docking
11. ADMET modeling

COURSE OUTCOMES:
Upon completion of this course,
Student will be able to
- Understand basic commands UNIX OS.
- Apply Perl programming to develop bioinformatics tools.
- Retrieve and analyze sequence and structure data.
- Access the databases and tools used for computer aided drug designing.
- Compare and analyse biological sequences.
- Know the relationship of biomolecules from different species.

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BT3661 BIOPROCESS LABORATORY

COURSE OBJECTIVES
- To provide a practical exposure to the bioinformatics databases, tools and software.
- To select and use functions in Perl for processing sequence data.

EXPERIMENTS
1. Enzyme kinetics – Determination of Michaelis-Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment
6. Enzyme immobilization – Cross-linking
7. Enzymatic conversion in Packed bed Column
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9. Optimization by Plackett Burman Design
10. Optimization by Response Surface Methodology
11. Estimation of KLa – Dynamic by different methods
12. Estimation of Overall Heat Transfer Coefficient and mixing time in reactor

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

- Explain about Enzyme kinetics and characterization and how to use them for practical applications.
- Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques.
- Determine an experimental objective, understand the theory behind the experiment, and operate the relevant equipment safely.
- Demonstrate good lab citizenry and the ability to work in team

REFERENCES:

BT3711 INDUSTRIAL TRAINING / INTERNSHIP II## L T P C 0 0 0 2
OBJECTIVES:
To enable the students to

- Get connected with industry/ laboratory/research institute
- Get practical knowledge on production process in the industry and develop skills to solve related problems
- Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.
No. of Weeks: 04

OUTCOMES:
On completion of the course, the student will know about

CO1: Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute
CO2: Analysis of industrial / research problems and their solutions
CO3: Documenting of material specifications, machine and process parameters, testing parameters and results
CO4: Preparing of Technical report and presentation

BT3751 DOWNSTREAM PROCESSING L T P C 3 0 0 3
OBJECTIVES:
To enable the students to

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Have depth knowledge and hands on experience with on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion
UNIT I INTRODUCTION

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

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:
Upon success completion of this course, the students will be able to:
- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques

TEXT BOOKS:

REFERENCES:

GE3791 HUMAN VALUES AND ETHICS

COURSE DESCRIPTION
This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

COURSE OBJECTIVES:
- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
➢ To inculcate respect for all people irrespective of their religion or other affiliations.
➢ To instill the scientific temper in the students’ minds and develop their critical thinking.
➢ To promote sense of responsibility and understanding of the duties of citizen.

UNIT I  DEMOCRATIC VALUES
Reading Text: Excerpts from John Stuart Mills’ On Liberty

UNIT II  SECULAR VALUES
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.
Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani

UNIT III  SCIENTIFIC VALUES
Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R

UNIT IV  SOCIAL ETHICS
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.
Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari

UNIT V  SCIENTIFIC ETHICS
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

TOTAL: 30 PERIODS

REFERENCES:
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

COURSE OUTCOMES
Students will be able to
CO1 : Identify the importance of democratic, secular and scientific values in harmonious functioning of social life
CO2 : Practice democratic and scientific values in both their personal and professional life.
CO3 : Find rational solutions to social problems.
CO4 : Behave in an ethical manner in society
CO5 : Practice critical thinking and the pursuit of truth.
OBJECTIVES:
- To provide hands on training in Downstream processing through simple experimentations in the laboratory. This will be a pre-requisite for project work.
- The objectives of this course is to practice the students
- To understand the nature of the end product, its concentration, stability and degree of purification required
- To design processes for the recovery and subsequent purification of target biological products.

EXPERIMENTS
1. Solid liquid separation – centrifugation
2. Solid liquid separation - microfiltration
3. Cell disruption techniques – ultrasonication or French pressure cell or Dynomill
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biologicals
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography
9. Product polishing – spray drying or freeze drying
10. Size exclusion chromatography

TOTAL: 45 PERIODS

OUTCOMES:
Upon success completion of this course, the students would have
1. Acquired knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.
2. Learned cell disruption techniques to release intracellular products
3. Learned various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products
4. Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses.

REFERENCES:

OBJECTIVES:
To train the students in
- Identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.
- Conducting experiments, analyze and discuss the test results, and make conclusions.
- Preparing project reports and presentation

The students shall individually / or as group work on a specific topic approved by the
Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

**OUTCOMES:**
At the end of the project, the student will be able to
CO1: Formulate and analyze problem / create a new product/ process.
CO2: Design and conduct experiments to find solution
CO3: Analyze the results and provide solution for the identified problem, prepare project report and make presentation.

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**COURSE OBJECTIVES:**
Sketch the Evolution of Management.
Extract the functions and principles of management.
Learn the application of the principles in an organization.
Study the various HR related activities.
Analyze the position of self and company goals towards business.

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**
Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-
managerial roles and skills – Evolution of Management –Scientific, human relations, system and 
contingency approaches– Types of Business organization- Sole proprietorship, partnership, 
company-public and private sector enterprises- Organization culture and Environment – Current 
trends and issues in Management.

**UNIT II PLANNING**

**UNIT III ORGANISING**

**UNIT IV DIRECTING**

**UNIT V CONTROLLING**
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

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GE3752 TOTAL QUALITY MANAGEMENT

COURSE OBJECTIVES:
- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

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

UNIT II TQM PRINCIPLES
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning-
Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service
Quality, Kano Model and Customer retention – Employee involvement – Motivation,
Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal–
Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier
partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9
The seven traditional tools of quality - New management tools - Six-sigma Process Capability-
Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark,
Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the
findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design
FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM –
Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards
- AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-
Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO
14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and
FMEA.
CO4: Ability to understand Taguchi’s Quality Loss Function, Performance Measures and apply
QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

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TEXT BOOK:
1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field, MaryB.Sacre, HemantUrdhwareshe
   and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised

REFERENCES:
   Heinemann Ltd, 2016.
   2006 .
GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING L T P C 3 0 0 3

COURSE OBJECTIVES:
- Understanding the concept of Engineering Economics.
- Implement various micro economics concept in real life.
- Gaining knowledge in the field of macro economics to enable the students to have better understanding of various components of macro economics.
- Understanding the different procedures of pricing.
- Learn the various cost related concepts in micro economics.

UNIT I DEMAND & SUPPLY ANALYSIS 9
Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis.
Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9
Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function.

UNIT III PRICING 9
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT) 9
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Students able to
CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions
CO2: Evaluate the economic theories, cost concepts and pricing policies
CO3: Understand the market structures and integration concepts
CO4: Understand the measures of national income, the functions of banks and concepts of globalization
CO5: Apply the concepts of financial management for project appraisal

TEXT BOOKS:

REFERENCES:
GE3754 HUMAN RESOURCE MANAGEMENT

OBJECTIVE:
- To provide knowledge about management issues related to staffing.
- To provide knowledge about management issues related to training.
- To provide knowledge about management issues related to performance.
- To provide knowledge about management issues related to compensation.
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT

UNIT II HUMAN RESOURCE PLANNING

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT
Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION

UNIT V PERFORMANCE EVALUATION AND CONTROL

COURSE OUTCOMES:
CO1: Students would have gained knowledge on the various aspects of HRM.
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM.

TEXT BOOKS:

REFERENCES:
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GE3755 KNOWLEDGE MANAGEMENT

COURSE OBJECTIVES:
The student should be made to:
Learn the Evolution of Knowledge management.
Be familiar with tools.
Be exposed to Applications.
Be familiar with some case studies.

UNIT I INTRODUCTION
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING

UNIT III KNOWLEDGE MANAGEMENT THE TOOLS
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Understand the process of acquire knowledge from experts
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

TOTAL: 45 PERIODS
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TEXT BOOK:

REFERENCE:

GE3792 INDUSTRIAL MANAGEMENT

COURSE OBJECTIVES
- To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- To study the planning; organizing and staffing functions of management in professional organization.
- To study the leading; controlling and decision making functions of management in professional organization.
- To learn the organizational theory in professional organization.
- To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II FUNCTIONS OF MANAGEMENT - I
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT - II
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow’s hierarchy of needs theory; Herzberg’s motivation-hygien theory; McClelland’s three needs motivation theory; Vroom’s valence-expectancy theory – Change Management: Concept of Change; Lewin’s Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students would be able to
CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
CO2 Discuss the planning; organizing and staffing functions of management in professional organization.
CO3 Apply the leading; controlling and decision making functions of management in professional organization.
CO4 Discuss the organizational theory in professional organization.
CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXTBOOKS:

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UNIT I BIOCHEMICAL PROCESS VARIABLES AND THEIR MEASUREMENTS
Temperature, flow measurement and control, Pressure measurement and control, shaft power, rate of stirring, detection and prevention of foam, measurement of cells, measurement and control of dissolved oxygen, inlet and outlet gas analysis, pH measurement and control

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

UNIT III CLOSED LOOP SYSTEMS
Closed loop control systems, development of block diagram for feed-back control systems servo and regulatory problems, transfer function for controllers and final control element

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

UNIT V ADVANCED PROCESS CONTROL AND BIOSENSORS
Introduction to advanced control systems, cascade control, feed forward control On-line analysis of process parameters; Introduction to biosensors; Transduction principles used in biosensors; Characteristics of biosensors; Biosensors based on amperometric, potentiometric, thermistor FET, fiber optics and bioluminescence; Microbial biosensors; Fundamentals of digital process control; Use of computer in control and optimization of microbiological processes. Artificial neural networking and use in prediction of bioprocess and control

TEXT BOOKS:
3. Sensors in Bioprocess Control (Biotechnology and Bioprocessing Series) by John Twork , 2020

REFERENCES:

COURSE OBJECTIVES
The student should be made to,
- Recognize the overall industrial fermentation process and the process flow sheet.
- Understand the knowledge on algal biotechnology.
- Interpret the knowledge on production of commercially important primary metabolites & secondary metabolites.
- Understand the biological effluent treatment process
- Apply the knowledge for the production of modern biological products.

UNIT I INTRODUCTION TO FERMENTATION
History and development of fermentation industry; General requirements of fermentation processes; types of fermentation – homo fermentation, hetero fermentation: category of
fermentation based on end product formed – lactic acid fermentation, alcohol fermentation, acetic acid fermentation, butyric acid fermentation.

**UNIT II ALGAL BIOTECHNOLOGY**

Isolation, preservation and improvement of industrially important microorganisms. Microorganisms and raw materials used for microbial Oil production, Current technologies of biofuel production – Cyanobacterial and algal fuels; Fine chemicals and neutraceuticals from algae; UV absorbing pigments Industrial products from macro algae - seaweed biotechnology; Bioweapons and Bioshields.

**UNIT III FUTURE ASPECTS OF FERMENTATION TECHNOLOGY**


**UNIT IV BIOLOGICAL EFFLUENT TREATMENT**

Microbes involved in aerobic and anaerobic processes in nature; Water treatment- BOD, COD, dissolved gases, removal of heavy metals, total organic carbon removal; secondary waste water treatments; use of membrane bioreactor; aquaculture effluent treatment; Aerobic sludge and land fill leachate process; aerobic digestion.

**UNIT V FERMENTATION PROCESS ECONOMICS**

Process economics: General fermentation process economics; materials usage and cost; capital investment estimate; production cost estimate. Case studies –Traditional product and recombinant product; Bioprocess validation: Introduction, why validation, when does validation occur, validation structure, resources for validation, validation of systems and processes including SIP and CIP.

**COURSE OUTCOMES**

Upon completion of this course the student will be able to

1. Recall the basics of industrial fermentation and other processes.
2. Extend their knowledge on algal Biotechnology.
3. Extend their knowledge on commercial production of primary and secondary metabolites.
4. Extend their knowledge on the biological effluent treatment process.
5. Support for the commercial production of modern biological products.
6. Extend their knowledge on importance of fermentation process economics

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| PSOs |
COURSE OBJECTIVES:

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- To know different techniques used for the preservation of foods.

Pre-requisite(s): Knowledge of Microbiology required

UNIT I FOOD ENERGY AND LAWS

- Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics. National food legislation, other food legislations/authorities and their role- essential commodities act, ISI mark of BIS and agmark, food and agricultural organization (FAO), world health organization (WHO), codex joint FAO/WHO expert committee on food additives (JECFA), world trade organization (WTO), international organization for standardization (ISO) Food safety and quality management systems.

UNIT II FOOD ADDITIVES

- Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants-natural and artificial; food flavours; enzymes as food processing aids.

UNIT III MICROORGANISMS ASSOCIATED WITH FOOD

- Bacteria, yeasts and molds - sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV FOOD BORNE DISEASES

- Classification – food infections-bacterial and other types; food intoxications and poisonings-bacterial and non bacterial; food spoilage- factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V FOOD PRESERVATION

- Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning, frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Understand the basic concepts of food constituents present in Food and microorganisms involved in food processing
- Apply the principles and methods involved in the processing of different foods.
- Able to understand various food processing additives
- Understand different principles and food preservation techniques.
- Apply the knowledge of unit operations in modern food processing in industries
• Familiar with the food borne diseases and factors involved in food spoilage

TEXT BOOKS

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BT3004 BIOREACTOR DESIGN AND SCALE UP PROCESS

UNIT I BASIC BIOREACTOR CONCEPTS
Bioreactor Operation – Batch operation, semi-continuous and fed-batch operation, Continuous Operation – Chemostat, turbidostat – Microbiological reactors, enzyme reactors – Tank-type, Column-type biological reactors – Case studies – Continuous Fermentation with Biomass Recycle, Tanks-in-series, Tubular plug flow bioreactors.

UNIT II AERATION AND AGITATION IN BIOPROCESS SYSTEMS
Mass transfer in agitated tanks; Power requirement for mixing; Agitation rate studies – Mixing time and residence time distribution; Bioreactor Geometry – Reactor, impeller, sparger and baffle design; shear damage, bubble damage, methods of minimizing cell damage. Case Studies for Aeration and Agitation;

UNIT III SELECTION AND DESIGN OF BIOPROCESS EQUIPMENT
Materials of construction for bioprocess plants – Design considerations for maintaining sterility of process streams processing equipments, selection, specification – Design of heat and mass transfer equipment used in bioprocess industries.

UNIT IV BIOREACTOR SCALE-UP AND SCALE-DOWN
Scale-up Techniques: – Scale up by geometric similitude, constant power consumption per volume, constant mixing time, constant impeller tip speed, constant volumetric mass transfer coefficient; Scale–down Related Aspects; Case Studies in Bioreactor Scaleup and Scale-down Aspects

UNIT V CASE STUDIES
Requirements, design and operation of bioreactor for microbial, plant cell and animal cell.

**TEXT BOOKS**

**REFERENCES**

CBT331 BIOPROCESS MODELLING AND SIMULATION L T P C
3 0 0 3

**COURSE OBJECTIVES**
The student should be made to,
- To understand the mathematical models in Biochemical Engineering systems.
- To learn about different aspects of modelling in Bioprocess system.
- To learn various techniques to solve and simulate various bioprocess models.

**UNIT I** BASIC MODELLING PRINCIPLES
Introduction, definition of Modelling and simulation, different types of models, application of mathematical modelling. Fundamental laws: continuity equation, energy equation, equation of motion, transport equation, equation of state, Phase and chemical equilibrium, chemical kinetics with examples.

**UNIT II** MATHEMATICAL MODELS FOR BIOREACTOR SYSTEMS
Batch reactor, CSTR isothermal with cooling/heating jacket or coil, Fed Batch reactor.

**UNIT III** MODELLING APPROACHES FOR BIOLOGICAL SYSTEMS
Growth kinetic Models – structured and unstructured systems; Compartment models; Cybernetic models; Genetically structured models, Single cell models, Morphologically structured models. Thermal death kinetics models, Stochastic Model for thermal sterilization of medium.

**UNIT IV** MODELLING APPROACHES FOR BIOLOGICAL PROCESSES
Modelling for activated sludge process, Model for anaerobic digestion, Model for lactic acid fermentation, antibiotic production, Ethanol fermentation.

**UNIT V** SIMULATION OF BIOPROCESSES
Software packages for simulation of bioprocesses – MATLAB-SIMULINK, Creating bioprocess models in MATLAB and Simulink environment. Linear and non-linear estimation of the kinetic parameters for types and models.

**COURSE OUTCOMES**
Upon completion of this course the student will be able to
- To understand the basic modelling principles in Biochemical Engineering systems.
- Apply the knowledge of modeling concepts for bioreactor design.
- To formulate model for biological System.
- To utilize modelling approaches for various bioprocess estimation.
- To build kinetic simulation models of the cell growth and product formation.
To connect different models together to build a bioprocess model.

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BT3005 BIOREACTOR CONSIDERATIONS FOR RECOMBINANT PRODUCTS  L T P C  3 0 0 3

OBJECTIVE:
- To expose students to application of recombinant DNA technology in biotechnological research.
- To train students in strategizing research methodologies employing genetic engineering techniques.

UNIT I GENETICALLY ENGINEERED ORGANISMS
Different host vector systems, Guidelines for choosing Host Vector systems, Process constraints – Genetic instability, considerations in plasmid design, Regulatory constraints, principles and implementation of containment, good industrial large-scale practice (GILSP).

UNIT II CONSIDERATIONS FOR ANIMAL CELL CULTURES
Structure and biochemistry of animal cells - Methods Used for the cultivation of animal cells - Bioreactor considerations for animal cell culture - Products of animal cell cultures, economics of animal cell tissue cultures.

UNIT III CONSIDERATIONS FOR PLANT CELL CULTURES
Overview of plant cell cultures - Plant cells in culture compared to microbes - Bioreactor considerations for plant cell culture - Bioreactors for suspension cultures - Reactors using cell immobilization - Bioreactors for organized tissues, economics of plant cell tissue cultures.

UNIT IV DOWNSTREAM PROCESSING CONSIDERATIONS
Release of protein from Biological Host, genetic approaches to facilitate protein purification, Solid-Liquid separation, extraction of Recombinant protein, Avoidance of proteolysis from extracts, membranes for protein isolation and purification, Chromatographic techniques, Removal of detergent from protein fractions, precipitation of proteins, protein crystallization for large scale bio separation.
UNITV SAFETY CONSIDERATIONS ASSOCIATED WITH AGRICULTURAL AND ENVIRONMENTAL APPLICATIONS

Risk assessment methods, safety considerations, Application of rDNA organism in the environment, Survival, multiplication and/or dissemination in the environment, Interactions with species or biological systems, effects on the environment, evaluating environmental risks of rDNA organisms released from industrial applications.

TOTAL 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course the student will be able to
- To acquire skills on techniques of isolation of gene of interest and construction of recombinant DNA.
- To apply techniques for production of pharmaceuticals, growth hormones, vaccines, gene therapy in expression system.
- To apply rDNA technology in evolving plants for resistance to pest and disease, tolerance to herbicides and abiotic factors.
- To identify problems associated with production of recombinant proteins and protein purification and devising strategies to overcome problem.
- To acquire knowledge on environmental applications of genetic engineering through bioremediation.
- To identify the methods for selection of recombinants and to express recombinant protein in E. coli and eukaryotes.

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UNIT I  FUNDAMENTALS OF BIOSENSOR
Biosensors as functional analogs of chemoreceptors, structure and function of transducers, qualitative and quantitative sensors, sensor parameters, transduction methods-optical, calorimetric, electrochemical and piezoelectric sensors Supports and support modifications-synthetic polymers, carbon material supports, metal supports, bifunctional crosslinkers.

UNIT II  METABOLIC SENSORS
Methods of enzyme immobilization-adsorption, gel entrapment, covalent coupling, crosslinking immobilization effects in biosensors, characterisation of immobilized enzymes in biosensors, effectiveness factor, enzyme loading test, Metabolic sensors-glucose, ascorbic acid, lactate sensors, determination of alcohols, sensors for phenols and amines, coupled enzyme reactors, sequence electrodes for nucleic acid, enzyme sensor for inhibitors.

UNIT III  AFFINITY SENSORS AND REAGENTLESS SENSORS
Affinity sensors based on small ligands, immunosensors, immunoassay-RIA, ELISA and TELISA, piezoelectric immunosensors, optical immunosensors, electrochemical immunoassay, Biocompatibility of sensors, biomimetic sensors, bioconjugated silica nanoparticles for bioanalysis.

UNIT IV  NOVEL BIOSENSORS
Surface dielectric enhancement- gold nanoparticles enhanced surface plasmon resonance, magnetic biosensors and biochips, quantum dot based biosensors, DNA and protein conformational changes, optical and magnetic sensors, micro and nanocantilevers, electrochemical QCM, MEMS, PCR microchamber array chip system, Detection of target DNA on a single chip.

UNIT V  APPLICATIONS OF BIOSENSORS
Biosensors and diabetes management, Microfabricated biosensors and point-of-care diagnostics systems, Noninvasive biosensors in clinical analysis; Surface plasmon resonance and evanescent wave biosensors, Biosensor in cancer and HIV early diagnosis.

TOTAL 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, students will be able to
- Describe how bio specific interaction is used for various applications.
- Compare different techniques with emphasis on selectivity and sensitivity.
- Demonstrate knowledge of the general principles of sampling and manipulation of data generated by biosensors.
- Apply the knowledge to identify the various types of analytical methods.
- Design a system component or process to meet desired needs within realistic constraints.
- Recognize different types of transducers, and their application in biosensor design.

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BT3007  BIO-NANOTECHNOLOGY  L T P C  3 0 0 3

UNIT I  NANOSCALE PROCESSES AND NANOMATERIALS  9

UNIT II  STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY  9

UNIT III  PROTEIN-BASED NANOTECHNOLOGY  9

UNIT IV  DNA-BASED NANOTECHNOLOGY  9

UNIT V  APPLICATIONS OF NANOTECHNOLOGY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able
- To recognize the nanoscale processes and nanomaterials
• To relate the structural and functional principles
• To develop the protein based nanomaterials
• To construct the DNA based nanomaterials
• To apply the theoretical knowledge for the development of nanomedicine and nanosensors
• To develop the nanomaterials based process and products

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BT3008 STEM CELL TECHNOLOGY

UNIT I INTRODUCTION TO STEM CELLS
Stem cell Classification, Sources and Properties –Types of stem cells: methods of isolation, study of stem cells and their viability IPSC, embryonic stem cells, cancer stem cells. – Preservations of Stem cell. Embryonic stem cell: Isolation, Culturing, Differentiation, Properties – Adult stem cell: Isolation, Culturing, Differentiation, Trans-differentiation, Plasticity, and Properties

UNIT II HUMAN EMBRYONIC AND ADULT STEM CELL
Stem cells and their developmental potential. In vitro fertilization-culturing of embryos - blastocyst-inner cell mass-isolation and growing ES cells in lab; Identification and characterization of human ES cells. Somatic stem cells-test for identification of adult stem cells- adult stem cell differentiation-trans differentiation-plasticity-different types of adult stem cells-liver stem cells-skeletal muscle stem cells-bone marrow derived stem cells.

UNIT III DIFFERENTIATION OF STEM CELLS INTO CELL TYPES
Factors influencing cell specialization – internal factors – asymmetric segregation, cell signaling mechanisms – diffusion, direct contact and gap junctions; environmental factors – temperature, drugs and injuries; mechanism of stem cell differentiation – errors in cell differentiation – anaplasia, dysplasia and metaplasia.
UNIT IV   STEMS CELLS IN TISSUE ENGINEERING

Haematopoietic Stem Cells-Growth factors and the regulation of haematopoietic stem cells, clinical applications of haematopoietic stem cells; HLA matching, patient selection, peripheral blood and bone marrow transplantation; Mesenchymal stem cells and their role in bone tissue engineering-bone repair; Stem cell based gene therapy and benefits to human. Techniques in stem cell technology - fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging

UNIT V   APPLICATION AND ETHICAL ISSUES

Therapeutic applications-Parkinsons disease, Cancer stem cell – Neural stem cell for central nervous system repair – Spinal cord injury – use of ESC to treat heart disease – Burns and skin ulcers – Orthopaedic applications of stem cell - Insulin-producing Cells Derived from Stem cells: A Potential Treatment for Diabetes; Stem cell policy and ethics, stem cell research: Hype, hope and controversy.

Course outcomes:
- To differentiate different types of stem cells and to characterize them
- To gain knowledge on animal and plant stem cells
- To develop techniques to program stem cells into specific cell types
- To determine the factors affecting stem cell differentiation
- To understand the role of stem cells in tissue engineering and regenerative medicine
- To become familiarized with stem cell technology and its applications for the betterment of society

TOTAL: 45 PERIODS

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OBJECTIVES

- To Study the phenomena various metals used in implant applications
- To Acquire knowledge importance of ceramics and polymer used biomedical diagnostics
- To Obtain the concept of different types biomaterials applied in-vitro and in-vivo biomedical implants
- To Gain the knowledge about biomaterials used in various biomedical implant application

UNIT I INTRODUCTION

Definition of biomaterials, requirements and classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties.

UNIT II METALLIC IMPLANT MATERIALS


UNIT III POLYMERIC IMPLANT MATERIALS


UNIT IV CERAMIC IMPLANT MATERIALS

Definition of bio ceramics. Common types of bioceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Polymers Filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

UNIT V TESTING OF MATERIALS

Biocompatibility and Toxicological screening of biomaterials: Definition of biocompatibility blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situimplantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

TOTAL 45 PERIODS

COURSE OUTCOMES

- Understand the basic principle and properties of biomaterials:
- Analyze various types of metals used in implant applications.
- Explain the process of importance of ceramics and polymer used biomedical diagnostics

TEXT BOOKS:


REFERENCES:
3. Larry L. Hench and Julian R. Jones, Biomaterials, artificial organs and tissue engineering, CRC Press 2010

BT3010 PROTEIN ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To identify the importance of protein biomolecules.
- To realize the structure-function relationships in proteins

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 9
Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE 9

UNIT III TERTIARY STRUCTURE 9
Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 9
DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications. Computer exercise on the above aspects

UNIT V PROTEOMICS 9
Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above aspects

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course the student will be able to
- Analyze the various interactions in protein makeup.
• Be familiar with different levels of protein structure.
• Know the role of functional proteins in various field of study.
• Practice the latest application of protein science in their research.
• Understand the major factors for protein folding.
• Analyze and compare protein sequence data.

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BT3011 MODERN BIO ANALYTICAL TECHNIQUES

OBJECTIVES:
• To study the various analytical techniques used in Biotechnology.

UNIT I SPECTROSCOPY STUDY OF CHEMICAL COMPOUNDS AND BIO-MOLECULES
UNIT II DIFFRACTION TECHNIQUE

Introduction to lattice and lattice systems, Bragg's plane, miller indices, point groups and space groups. Principle of diffraction and X-ray diffraction: X-rays production, X-ray spectra, Bragg’s law and intensity of X-rays, Mosley’s law, powdered XRD, percentage crystallinity, single crystal XRD, macromolecular XRD (protein crystallization, data collection and structure solution).

UNIT III CHROMATOGRAPHY

Classification of chromatographic techniques and their principles, Theory of chromatography, band broadening, rate and plate theory factors responsible for separation. Column chromatography, TLC, Paper chromatography. Liquid Chromatography and HPLC: Instrumentation, pumps, solvent delivery system, isocratic and gradient programming modes, sample introduction system, columns, detectors, reversed phase and normal phase chromatography. Gas Chromatography: Instrumentation, carrier gas supply, injectors, columns, packed and capillary columns, column oven and temperature programming, different detectors. Introduction to hyphenated techniques in chromatography, GC-MS and LC-MS.

UNIT IV MICROSCOPY


UNIT V ELECTROPHORETIC TECHNIQUES

Principle, equipment and process, Agarose gel electrophoresis, horizontal and vertical gel electrophoresis, electrophoresis techniques, Isoelectric focusing, capillary electrophoresis and application of electrophoresis in analysing macromolecules.

OUTCOMES:
- The students will be capable of handling different instruments in the laboratory.
- They would be able to compare different separation techniques and use them effectively in research work.

TEXTBOOKS:

REFERENCE:

VERTICAL III (Medical Biotechnology)  
BT3012 HUMAN GENETICS L T P C 3 0 0 3

OBJECTIVES:
- To discuss the patterns of inheritance and its relevance in disease and therapy
- To describe various genetic laws, learn the chromosome structure function and understand methodologies for cytogenetic applications.

UNIT I INTRODUCTION 9
History of genetics – Mendel’s principles and experiments, segregation, multiple alleles – Independent Assortments, Genotypic interactions, epistasis and Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis

UNIT II COMPLEX TRAITS 9
Approaches to analysis of complex traits- ‘Nature vs nurture’, role of family and shared environment, monozygotic and dizygotic twins and adoption studies – Polygenic inheritance of continuous (quantitative) traits and discontinuous (dichotomous) traits – Genetic susceptibility in complex traits - Estimation of genetic components of multifactorial traits: emperic risk, heritability, coefficient of relationship, application of Baye’s theorem.

UNIT III HUMAN CYTOGENETICS 9

UNIT IV APPLIED GENETICS 9

UNIT V CLINICAL GENETICS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of the course, students will be able to
- Understand the concept of Mendelian and non-Mendelian genetics.
- Know the concepts of complex traits inheritance and mechanism of sex determination.
- Discuss clearly about the chromosomal pathologies.
- Describe the principles behind DNA fingerprinting methodologies using molecular markers RFLP, RAPD, STRP, and SNP’s.
- Applying the genetic technologies knowledge in industries related to pharmaceuticals, biotechnology, and diagnostic clinics.
• To bring awareness to human society on various genetic disorders, its inheritance patterns and to develop the methods, and techniques of fighting against the diseases.

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CBT372 CANCER BIOLOGY

COURSE OBJECTIVES:
The goal of this course is to enable the students to
• Understand the basics of cancer and cancerous cells
• Discuss the significance of carcinogenesis in the development of cancer
• Interpret the role of oncogenes and their growth factors
• Make understanding on process of cancer metastasis and their dysregulation factors
• Gain knowledge on the advancement in cancer treatment
• Design the novel drugs to treat cancer or to reduce the effect of carcinogenesis

UNIT I FUNDAMENTALS OF CANCER BIOLOGY
Introduction, historical perspective, classification carcinogenesis, cancer initiation, promotion & progression, pathways of spread- Epidemiology Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer, Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.
UNIT II  PRINCIPLES OF CARCINOGENESIS

UNIT III  MOLECULAR BIOLOGY OF CANCER

UNIT IV  CANCER METASTASIS
Clinical significances of invasion, Molecular genetic of metastasis development, stromal microenvironment and carcinogenesis, dysregulation of cancer, associated genes Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V  ADVANCES IN CANCER THERAPY
Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy. Recent technology to detect cancer diseases and advanced technology to cure cancer diseases. Targeted drug delivery methods to cure cancer.

TOTAL: 45 PERIODS

COURSE OUTCOMES (CO):
- Explain the development and proliferation of cancer with specific causes
- Describe the influence of carcinogenesis in the cancer development
- Identify the pathways and therapeutic targets of cancer
- Outline the steps involved in metastasis and tumour cell invasion
- Develop novel drugs and technologies for the treatment of cancer
- Summarize the microenvironment of cancer cells and their attack on immune cells

TEXT BOOKS:

REFERENCES:
5. https://archive.org/details/biologyofcancera00burc
BT3013  
**BIOPHARMACEUTICALS AND BIOSIMILARS**  
**L T P C**  
3 0 0 3

**COURSE OBJECTIVES**

- To provide strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- To impart the knowledge of the various dosage forms and its implications in pharmaceutical technology.

**UNIT I  INTRODUCTION**


**UNIT II  DOSAGE FORMS**


**UNIT III  ADVANCED DRUG DELIVERY SYSTEMS**


**UNIT IV  BIOSIMILARS**


**UNIT V  CASE STUDIES ON BIOPHARMACEUTICALS**


**TOTAL 45 PERIODS**

**Course Outcomes**

Upon completion of the course, students will be able to

- Comprehend the factors influencing the bioavailability and bioequivalence of drugs.
• Grasp the current regulatory acts and safety norms of the modern pharmaceutical industries.
• Recognize the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.
• Acquired knowledge on novel drug delivery systems and their applications in therapeutic fields.
• Understand the design and analysis of biosimilar drugs.
• Demonstrate knowledge and understanding of current topical and newly emerging aspects of biopharmaceuticals.

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| CO 4 | PO 37 | PO 38 | PO 39 | PO 40 | PO 41 | PO 42 | PO 43 | PO 44 | PO 45 | PO 46 | PO 47 | PO 48 |
| CO 5 | PO 49 | PO 50 | PO 51 | PO 52 | PO 53 | PO 54 | PO 55 | PO 56 | PO 57 | PO 58 | PO 59 | PO 60 |
| CO 6 | PO 61 | PO 62 | PO 63 | PO 64 | PO 65 | PO 66 | PO 67 | PO 68 | PO 69 | PO 70 | PO 71 | PO 72 |

CBT333 TISSUE ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
• To enable the students
• To learn the fundamentals of tissue engineering and tissue repairing
• To acquire knowledge on clinical applications of tissue engineering
• To understand the basic concept behind tissue engineering focusing on the stem cells
• To study the biomaterials and its applications

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

UNIT II TISSUE ARCHITECTURE 9
Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS 9
Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS 9
Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, hematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS 9

OUTCOMES:
Upon completion of this course, the students would get
- Ability to understand the components of the tissue architecture
- Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
- Awareness about the properties and broad applications of biomaterials
- Overall exposure to the role of tissue engineering and stem cell therapy

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
UNIT I  INTRODUCTION TO MOLECULAR DIAGNOSTICS  9
History of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of
diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing
to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and
other parasites; general approach to clinical specimens, Sample collection- method of collection,
transport and processing of samples,

UNIT II  TRADITIONAL DISEASE DIAGNOSIS METHODS AND TOOLS  9
Diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and
Mycobacterium., Diagnosis of major fungal infections: Dermatophytoses, Candidiosis and
Aspergillosis. · Diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses,
Hepatitis Viruses and · Retroviruses. · Diagnosis of Protozoan diseases: Amoebiosis, Malaria,
Trypanosomosis, Leishmaniasis.

UNIT III  DIAGNOSIS AND TREATMENT OF COMMON DISEASES  9
Atherosclerosis, ischemic heart disease and cerebrovascular disease; coagulation system and
hypertension; metabolic syndrome and diabetes mellitus; asthma, allergy and inflammatory
diseases of the lung; gastrointestinal system, including inflammatory bowel diseases.

UNIT IV  TARGETED THERAPY  9
Objective and types of targeted therapy, working mode of targeted therapy against cancer – by
immunotherapy, by cell signaling interruption, by angiogenesis inhibitors, monoclonal antibody
therapy, by apoptosis, hormone therapy for prostate cancer and hormone therapy for breast
cancer; side effects of cancer treatment and drawbacks of targeted therapy. Targeted drug
delivery – active and passive targeting, drug delivery vehicles

UNIT V  TECHNIQUES IN MOLECULAR AND CLINICAL DIAGNOSTICS  9
PCR-based methods for mutation detection, alternative methods for mutation detection and DNA
sequencing for disease association, microarray approaches for gene expression analysis,
methods for analysis of DNA methylation; clinical diagnostic technologies: flow cytometry, medical
cytogenetics, fluorescence in situ hybridization, immunohistochemistry and laser capture
microdissection (FFPE).

TOTAL 45 PERIODS

TEXT BOOKS:
Burtis, Elsevier Health Sciences 2007

REFERENCES:
1. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications by Lela
Buckingham, F. A. Davis Company 2019
C. Prendergast, Wiley & Sons, Inc. 20043.
3. Molecular and Cellular Therapeutics by David Whitehouse, Ralph Rapley, Wiley & Sons, Ltd.
2012.
BT3015 BIOMEDICAL ENGINEERING L T P C 3 0 0 3

UNIT I HUMAN BODY SUBSYSTEM AND TRANSDUCERS 9
Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT 9

UNIT III ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY 9

UNIT IV IMAGING MODALITIES AND BIO-TELEMETRY 9

UNIT V LIFE ASSISTING AND THERAPEUTIC DEVICES 9

TOTAL 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, students will be able to
- Identify, analyze and solve the real-life problems by applying principles of biomedical engineering.
- Design, develop and specify the mathematical model to understand the inter relation among various physiological systems.
- Demonstrate various applications of engineering and physiological subsystems in designing and developing human body systems.
- Apply the knowledge to identify the various types of analytical and diagnostic equipments used in biomedical engineering
- Design a system component or process to meet desired needs within realistic constraints.
- Develop healthcare information system for automation and remote access.

TEXT BOOKS:

REFERENCES:
VERTICAL - IV - BIO CHEMICAL ENGINEERING

BT3016 MASS TRANSFER OPERATIONS L T P C

OBJECTIVES:
- To define the principles of adsorption, absorption, leaching and drying extraction, distillation crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of products.

UNIT I DIFFUSION AND MASS TRANSFER 9
Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

UNIT II GAS LIQUID OPERATIONS 9
Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT III VAPOUR LIQUID OPERATIONS 9
V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & ONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT IV EXTRACTION OPERATIONS 9
L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

UNIT V SOLID FLUID OPERATIONS 9
Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
- To recognize and apply analogies among momentum, heat and mass transfer in various types of mass transfer operations.
• To investigate gas-liquid, vapour-liquid, solid-liquid and liquid-liquid equilibrium in mass transfer operations
• To employ the engineering correlations of diffusion and mass transfer coefficients to model a separation process
• To demonstrate a multi-stage equilibrium separation process.
• To apply the knowledge on downstream processing
• To attain the desired products by mass transfer operations

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BT3017 TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEM L T P C 3 0 0 3

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION 9
Vectors/Tensors, Newton’s law of viscosity, Newtonian & Non-Newtonian fluids, rheological models, Temperature, pressure and composition dependence of viscosity, Kinetic theory of viscosity, Fourier’s law of heat conduction, Temperature, pressure and composition dependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick’s law of diffusion, Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.

UNIT II MOMENTUM TRANSPORT 9
Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces, of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus, Adjacent flow of two Immiscible fluids. Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) their applications in fluid flow problems.

UNIT III HEAT TRANSPORT 9
Shell energy balances, boundary conditions, temperature profiles, average temperature, energy fluxes at surfaces for different types of heat sources such as electrical, nuclear viscous and chemical, Equations of change (non-isothermal), equation of motion for forced and free convection, equation of energy (non-isothermal).
UNIT IV  MASS TRANSPORT
Shell mass balances, boundary conditions, concentration profiles, average concentration, mass flux at surfaces for Diffusion through stagnant gas film, Diffusion with homogeneous and heterogeneous chemical reaction, Diffusion in to a falling liquid film, Diffusion and chemical reaction in porous catalyst the effectiveness factor, equation of continuity for binary mixtures, equation of change to set up diffusion problems for simultaneous heat and mass transfer.

UNIT V  TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW
Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Introduction to macroscopic balances for isothermal flow systems, non isothermal systems and multi component systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course the student will be able to
- Employ shell balance equations to obtain desired profiles for velocity, temperature and concentration.
- Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.
- Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.
- Utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest.
- Recognize and apply analogies among momentum, heat and mass transfer.
- Appreciate relevance of transport principles in diverse applications of chemical, biological, and materials science and engineering.

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BT3018 BIOENERGY AND BIOFUEL

UNIT I INTRODUCTION

UNIT II ETHANOL
Ethanol as transportation fuel and additive; bioethanol production from carbohydrates; engineering strains for ethanol production from variety of carbon sources to improved productivity.

UNIT III BIODIESEL
Chemistry and Production Processes; Vegetable oils and chemically processed biofuels; Biodiesel composition and production processes; Biodiesel economics; Energetics of biodiesel production and effects on greenhouse gas emissions Expanding biodiesel production.

UNIT IV OTHER BIOFUELS
Biodiesel from microalgae and microbes; biohydrogen production; biorefinery concepts - Biobutanol,Biopropanol, bioglycerol – Principles, materials and feedstocks- Process technologies and techniques - Advantages and Limitations.

UNIT V APPLICATIONS OF BIOFUELS

TOTAL 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, students will be able to
- Determine the important properties of biomass.
- Produce solutions to real world problems related to bioenergy.
- Analyse bioenergy systems and their potential in future energy supply.
- Use of biomass as an inexpensive feedstock as sustainable and renewable energy.
- Replace fossil-based products with biodiesel.
- Source other alternate energy such as biohydrogen and biorefinery.

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**BT3019**  
**ENVIRONMENTAL BIOTECHNOLOGY**  

**UNIT I  BIODEGRADATION**  
Aerobic degradation of aliphatic and aromatic compounds – Co-metabolic degradation of organopollutants – Anaerobic degradation of aromatic compounds, halogenated organics and sulfonates – Biodegradation of herbicides and pesticides –Biodesulphurization of coal and oil – Bioleaching, bioprecipitation, bioaccumulation and biosorption of heavy metals.

**UNIT II  MICROBIAL METABOLISM IN WASTEWATER TREATMENT**  

**UNIT III  BIOLOGICAL TREATMENT OF WASTEWATER**  

**UNIT IV  BIOTECHNOLOGY FOR AIR POLLUTION AND SOLID WASTE MANAGEMENT**  
Air pollution control and treatment strategies – Biotechnology for treating air pollutants – Biofilters and Bioscrubbers – Biotechnology for the management of agricultural, plastic, dairy, paper and pulp, textile, leather, hospital and pharmaceutical industrial wastes.

**UNIT V  BIOPRODUCTS FROM RENEWABLE SOURCES**  
Overview of renewable sources – Production of biocompost and vermicompost – Production of biofertilizers and biopesticides – Production of biomethane, bioethanol, biohydrogen, biodiesel – Production of bioplastics and biopolymers – Bioelectricity generation and value added products from renewable sources.

**COURSE OUTCOMES:**  
At the end of course, students will be able  
- To know the importance of biodegradation  
- To recognise the microbial processes for the treatment of wastewater
To develop the various biological processes for wastewater treatment
To integrate the biotechnology concepts for the control of air pollution
To apply the knowledge for the development of bioproducts from renewable sources
To develop the biotechnological process for a clean and green environment

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BT3020 APPLIED CHEMICAL REACTION ENGINEERING L T P C 3 0 0 3

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

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 9
Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II IDEAL REACTORS 9
Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III NON IDEAL REACTORS 9
RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9
Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.
UNIT V  FIXED BED AND FLUID BED REACTORS
G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course the student will be able to
- To design and conduct an experimental investigation in order to determine rate equations.
- To demonstrate an ability to solve material and energy balances in order to analyze the performance of a reactor.
- To demonstrate an experimental data using standard statistical methods to establish quantitative results.
- To design a reactor for biobased products to achieve production and yield specifications.
- To recognize and apply analogies among momentum, heat and mass transfer in various types of chemical reactions.
- To Appreciate relevance of principles in diverse applications of chemical, biological, engineering.

TEXT BOOKS:

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BT3021  PETROLEUM TECHNOLOGY  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To impart the knowledge about biotransformation in petroleum industries.
- To provide a core foundation for the analysis and design of Bio refineries.

UNIT I  INTRODUCTION TO PETROLEUM BIOTECHNOLOGY

UNIT II MICROBIAL ENHANCED AND BIO UPGRADING OIL RECOVERY 9

UNIT III BIO CATALYTIC DESULFURISATION AND DENITROGENATION 9

UNIT IV BIOREMEDIATION 9
Kinetics of petroleum biotransformation in soil: Indigenous and augmented microbial population, pollutant type and concentration, soil characteristics studies- soil type, Degree of weathering, nutrient concentration, moisture content, temperature, soil interactions with macro and microorganisms, aeration, acidity-alkalinity, heavy metals, surfactants. Oil spill remediation methods, factors influencing rates of oil spill remediation, bioremediation technology for marine oil spill. Case studies and challenges.

UNIT V THE FUTURE OF PETROLEUM BIOTECHNOLOGY Periods 9
Biorefining, technology potential, biorefinery products and by products, petroleum nano biotechnology-modern applications for sustainable future. Challenges and prospects in biotechnology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student would be able
- To demonstrate an ability to apply various process parameters.
- To conduct an experimental investigation in order to determine biotransformation process.
- To apply bioprocess and biochemical principles in petroleum refineries.
- To maintain a suitable environment to obtain quantitative qualitative outputs.
- To design an equipment for bio-based products to achieve production and yield Specifications in petroleum industries.
- To apply various methods to recovery, refining and remediation in the uses of petroleum and petroleum products.

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(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak

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Biotechnology – Vertical V (Animal Biotechnology)

BT3022  FUNDAMENTALS OF ANIMAL BIOTECHNOLOGY  L T P C
3 0 0 3

COURSE OBJECTIVE:
- To provide the fundamentals of animal cell culture, details of the diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

UNIT I  ORIGIN AND EVOLUTION OF LIFE  9

UNIT II  ANIMAL DIVERSITY  9
Basis of classification, levels of organization (Symmetry, diploblastic and triploblastic organization), Coelom, segmentation, Notochord. The nature of natural selection, Examples of natural selection, levels of selection, selection oforganisms and groups, species selection.

UNIT III  STRUCTURAL ORGANIZATION AND CELL CULTURE TECHNIQUES  9
Animals Tissues: Epithelial Tissue, connective Tissue, Muscle Tissue, Neural Tissue. Culturing of cells, primary and secondary cell lines, Cell culture-Scaling up of animal cell culture- monolayer culture, suspension culture;

UNIT IV  MICROMANIPULATION OF EMBRYOS  9
What is micromanipulation technology; equipments used in micromanipulation; enrichment of xandy bearing sperms from semen samples of animals; artificial insemination and germ cellmanipulations; in vitro fertilization and embryo transfer; micromanipulation technology andbreeding of farm animals.

UNIT V  TRANSGENIC ANIMALS  9
Concepts of transgenic animal technology; strategies for the production of transgenic animals andtheir importance in biotechnology; stem cell cultures in the production of transgenic animals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this subject the student will be able to
- Understand the evolution of life and animal diversity
- Understand the animal cell culture
- Know the concepts of micromanipulation technology and transgenic animal technology

REFERENCES:

BT3023  ANIMAL HEALTH AND NUTRITION  L T P C
3 0 0 3

COURSE OBJECTIVE:
To provide the basic nutritional requirements for laboratory animals
To gain knowledge about the animal health management and its behavior
UNIT I  BASIC NUTRITIONAL REQUIREMENTS AND FEEDING  9
Nutritional requirements for rat, Mice, guinea pigs, rabbit. Types of diets: Natural, semi synthetic and synthetic. Feeding of water, nutritions to kids, young adults, mature adults. Significance of carbohydrates, lipids, proteins, major minerals, trace minerals, fat soluble vitamins, water soluble vitamins.

UNIT II  ANIMAL HEALTH AND DISEASE MANAGEMENT  9
Bacterial and viral diseases in animals like rat, Mice, guinea pigs, rabbit, monkeys and horse. Type of diseases, Symptoms, causative agent, colonization and disease transmission. Control of parasites.

UNIT III  ANIMALDISEASE DIAGNOSIS  9
Monoclonal antibodies and their use in diagnosis: Antigen-antibody based diagnostic assays including radioimmunoassay and enzyme immunoassays; Immunoblotting; Nucleic acid based diagnostic methods including nucleic acid probe hybridization; Restriction endonuclease analysis; PCR, Real time PCR; Nucleic acid sequencing; Probiotics.

UNIT IV  ANIMALVACCINES AND THERAPEUTICS  9
Introduction to the concept of vaccines; Conventional methods of vaccine production; Recombinant approaches to vaccine production; Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; gene therapy for animal diseases.

UNIT V  ANIMAL BEHAVIOR IN EXPERIMENTAL RESEARCH  9
Types of behavior, Behavioral observation of Mice, guinea pigs, rabbit. neuroscience research, chicken welfare, Spatial behavior, rat social behavior, zebrafish studies. Live stock and wild life summary data sheet.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this subject the student will be able to
- Understand the basic nutritional requirements
- Know the various diseases and its diagnostic methods.
- Know the concepts of therapeutic methods
- Understand the behavior of animal on experiments

REFERENCES:

BT3024  ANIMAL PHYSIOLOGY AND METABOLISM  L T P C
3 0 0 3

COURSE OBJECTIVE:
- To gain knowledge about the animal physiology
- To understand the concept of various system
- To know the nutrient transport and metabolism

UNIT I  INTRODUCTION TO ANIMAL PHYSIOLOGY  9
The various physiological organ systems and their importance to the integrative function of the animal body. The concept of homeostasis, including set point, negative and positive feedback loops, and compensatory responses. Body fluid and its dynamics. Transport of through biological membranes.

UNIT II BLOOD AND CIRCULATORY SYSTEM

UNIT III RESPIRATORY SYSTEM AND DIGESTIVE SYSTEM
Respiration: Structure and functions of the respiratory system, Structure and functions of smooth muscle, including excitation--contraction coupling in smooth muscle. Digestion: Structure, function and physiology of digestive system. Control of motility and secretion of alimentary canal and reflexes in the control of digestive functions. Control of rumen motility. Digestion in ruminant and monogastric animals.

UNIT IV NUTRIENT TRANSPORT AND ENERGY METABOLISM
Food, energy, ATP, carbohydrates, lipids, proteins, major minerals, trace minerals, fat soluble vitamins, water soluble vitamins, metabolic disorders, comparative nutrition, nutrigenomics, endocrinology, ruminology.

UNIT V MICROMANIPULATION OF EMBRYOS AND REPRODUCTION
What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

TOTAL: 45 PERIODS

COURSE OUTCOME:
Upon completion of this subject the student will be able to:
- Understand the basics of animal physiology
- Know the various animal systems
- Understand the nutrient transport and metabolism
- Learn the micromanipulation technique

REFERENCE BOOKS:
5. Animal Physiology, Richard W. Gordon A and Margaret A. Sinauer Associates, USA

BT3025 ANIMAL CELL CULTURE TECHNOLOGY

COURSE OBJECTIVE:
- To know the basic requirements of animal cell culture laboratory
- To understand the cell culture media, types and reactors
To understand the applications of cell culture

UNIT I BASIC REQUIREMENTS OF LAB FACILITY

UNIT II MEDIA PREPARATION AND TYPES
Media components - Serum, tissue extracts, growth factors, hormones, carrier proteins, lipids, vitamins, additive, detergents. Types: natural media, synthetic media, chemically defined and serum free media – advantages, disadvantages, BSS, CMRL, Eagle's, RPMI, animal cell cultures, their maintenance and preservation.

UNIT III BIOREACTORS AND GROWTH OF CELLS
Bioreactor process control, stirred animal cell culture, Air-lift fermentor, hemostat/Turbidostat; Culturing: various types of cultures suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; growth of cells.

UNIT IV GENETIC ENGINEERING OF ANIMAL CELL
Gene therapy-prospects and problems, Recent advancements in Gene therapy; Knock out mice and mice model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications. Recent advancements in diagnostic tool development and its diagnostic procedure.

UNIT V PRODUCTS FROM ANIMAL CELL

COURSE OUTCOME:
Upon completion of this subject the student will be able to
- Understand the basic requirements of lab facility
- Know the various types of media
- Understand the bioreactor and growth of cells
- Learn the role of genetic engineering in animal cell culture
- Understand the valuable products from animal cell

REFERENCES:
5. Freshney R.I. Animal Cell Culture- a practical approach, 6th ed., 2010

BT3026 ADVANCES IN ANIMAL BIOTECHNOLOGY

COURSE OBJECTIVE:
• To educate the students about the scope, regulatory issues and commercially available products produced using of animal biotechnology.
• To provide depth knowledge about the available viral vectors that can be used to create recombinant DNA for gene therapy purposes so that they can undertake research/project work related to biopharming.
• To teach the importance of cell culture study for invitro study purposes and for scaling up the products at commercial level.
• To educate the principle behind invitro fertilization and biopharming in order to createttransgenic animal of commercial importance.

UNIT I  BASICS OF ANIMAL BIOTECHNOLOGY

Scope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, bloodproducts, vaccines, hormones and other therapeutic proteins.

UNIT II  MOLECULAR BIOLOGY


UNIT III  CELL CULTURE TECHNOLOGY IN ANIMAL SCIENCE

Culturing of cells, primary and secondary cell lines, Cell culture- Scaling up of animal cell culture-monolayer culture, suspension culture; Various bio-reactors used for animal cell culture-Roller bottle culture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, hemostat/Turbidostat; High technology vaccines; Hybridoma technology; Cell lines and their applications

UNIT IV  GENETIC ENGINEERING APPLICATIONS IN ANIMAL SCIENCE

Gene therapy-prospects and problems, Recent advancements in Gene therapy; Knock out mice and mouse model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications. Recent advancements in diagnostic tool development and its diagnostic procedure

UNIT V  ADVANCEMENTS AND APPLICATIONS IN ANIMAL BIOTECHNOLOGY

Rumen manipulation- probiotics embryo transfer technology, invitro fertilization, transgenesis- methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Biopharming – Transgenic animals (case study : Mice, Cows, Pigs, Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer.

TOTAL : 45 PERIODS

COURSE OUTCOME:
After completion of the course the students will be able to:
• Understand the scope, regulatory issues and commercially available products produced using of animal biotechnology.
• Gain knowledge about the available viral vectors that can be used to create recombinant DNA for gene therapy purposes so that they can undertake research/project work related to biopharming.
• Understand the importance of cell culture study for invitro study purposes and for scaling up the products at commercial level.
• Gain knowledge in creating recombinant products for gene therapy purpose and the importance of molecular probe which is an important tool for medical and forensic studies.
• Understand the principle behind invitro fertilization and biopharming in order to create transgenic animal of commercial importance.
REFERENCES:

BT3027 BIO-TECHNIQUES IN ANIMAL BREEDING

COURSE OBJECTIVE:
- To educate the students about the basic tools requirement for cell culture and micromanipulation
- To provide depth knowledge about micromanipulation and application.
- To teach the importance of stem cell mediated production and guidelines.

UNIT I BASIC TOOLS REQUIREMENTS FOR CELL CULTURE AND MICROMANIPULATION
Biosafety levels, safety equipments, personal protective equipments, safe laboratory practices. cell culture equipments: basic equipments - centrifuge, Inverted microscope, confocal microscope, flow cytometer, Hemocytometer, cell culture vessels, bioreactors. Cell culture laboratory: Aseptic work area, Cell culture hood, Incubator, cryostorage, cell counter, aseptic technique, Maintenance of nutrients, prevention of cross contamination. Micromanipulation tools: micromanipulator, pipette puller, pipette grinder, holding pipette,

UNIT II MICROMANIPULATION AND ITS APPLICATION
Enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT III STEM CELLS AND TRANSGENIC ANIMALS
Stem cells – sources, types, uses, ES cells, pluripotent stem cells, adult stem cell, epithelial stem cell, bone marrow and hematopoietic, neural stem cell, transgenic techniques, Stem cell mediated transgenic animals.

UNIT IV TRANSGENIC ANIMALS IN RESEARCH
Ethics of transgenic technology, Dolly (transgenic sheep), Transgenic mice, rat, sheep, goat, rabbit, pig, fish, cow- case studies.

UNIT V ETHICAL GUIDELINES ON ANIMAL BREEDING
Justification on research, care and housing of laboratory animals, acquisition of laboratory animals, experimental procedure, CPCSEA guidelines. Animal integrity and ethical limits to breeding. Animal welfare issues. Record Maintenance as per guidelines.

TOTAL: 45 PERIODS

COURSE OUTCOME:
Upon completion of the course the student will able to
- Understand the concept of basic tools requirement for cell culture and micromanipulation
- Gain knowledge on micromanipulation and its application
- Know the concept of stem cells and ES cell of transgenic animals.
- Understand the research importance in transgenic animals.
- Gain knowledge on ethical CPCSEA guidelines

REFERENCES:

Vertical - VI (Computational Biotechnology)

BT3028 PROGRAMMING FOR BIOINFORMATICS APPLICATIONS

OBJECTIVES:
- To improve the programming skills and database development of the student.
- To introduce the fundamentals of Perl programming language to the student.
- To familiarize with Perl modules and to write scripts for manipulating/processing genomic and proteomic data.

UNIT I INTRODUCTION
Introduction to Operating systems, Linux commands, File transfer protocols FTP and telnet, Data life cycle, Database management system models. Structured Query Language (SQL) - Data Definition Language (DDL), Data Manipulation Language (DML) and Query by example. PL/SQL - Stored procedure, Database triggers; Relational Data Base Management system.

UNIT II PERL PROGRAMMING
Perl overview, variables and data types, control Structure, loops- while loop, for loop, until loop, File handles - opening and closing files, reading and writing file handles, Library Functions: String specific functions, User defined functions.

UNIT III OPERATORS

UNIT IV REGULAR EXPRESSIONS
Simple characters, * special character, . character, | character, Grouping with ()s, anchor characters, pattern matching, regular expression shortcuts, defining subroutines, returning values, using arguments, inheritance in Perl, polymorphism in Perl.

UNIT V APPLICATIONS OF PERL IN BIOINFORMATICS
Concatenating DNA Fragments, Transcription: DNA to RNA, Reading Protein Files, Finding Motifs, Simulating DNA, Generating Random DNA, Analysing DNA, Translating DNA to Proteins, Reading DNA from Files in FASTA format, Separating Sequence and Annotation, Parsing Annotation, Parsing PDB files, Parsing BLAST output, Bio-perl.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, Students will be able to
- Understand the basics of Linux operating system and the SQL for database creation and management.
- Use the Perl data types to construct programs in Perl.
- Apply the various operators, Regular expressions, conditional statements and loops in Perl programs.
- Understand the applications of Perl Programming in handling genomics and Proteomics data.

**TEXT BOOKS:**

**REFERENCE BOOK:**

**BT3029 FUNDAMENTALS OF ALGORITHMS FOR BIOINFORMATICS**

**OBJECTIVES:**
- To study various Algorithm design techniques and applying it in bioinformatics.
- To understand the algorithms such as Dynamic programming, HMM and ANN in Biological applications.

**UNIT I INTRODUCTION TO ALGORITHMS**
Algorithms-Complexity of algorithms and running time, Polynomial, NP complete problems, Recursion, Linear, Exhaustive search, Branch and Bound, divide and conquer algorithms, Travelling sales man problem, sorting.

**UNIT II DYNAMIC PROGRAMMING AND SEQUENCE BASED ALGORITHMS**
Dynamic programming Principles and its uses. Local and Global alignment principles, Finding longest common subsequences, Heuristics second generation alignment tools for database searching: (Blast, FASTA, ClustalW), Statistical and Similarity based methods for gene prediction, Models of evolution.

**UNIT III EXACT MATCH AND HIDDEN MARKOV MODELS**
Knuth-Morris-Pratt and Boyer-Moore algorithm for exact match and graph and maximum likelihood algorithm, Hidden Markov Model: Forward and Backward Algorithms, Most probable state path: Viterbi algorithm, Parameter Estimation for HMMs: Baum-Welch Algorithm, EM Algorithm, Applications of profile HMMs for multiple alignment of proteins and for finding genes in the DNA.

**UNIT IV ARTIFICIAL NEURAL NETWORKS**
Introduction to Artificial Neural Networks (ANN): A Simple Neuron, Firing rule, Network layers, Architectures of Artificial Neural Network: Feed-Forward networks, Feed-Back networks, Perceptrons, Pattern recognition problems, Back Propagation Algorithm, Applications of Neural Networks.

**UNIT V DNA AND RNA RELATED ALGORITHMS**

**TOTAL: 45 PERIODS**
OUTCOMES:
Upon completion of this course, Students will be able to
- Understand the basics of algorithms used in Bioinformatics.
- Apply dynamic programming in sequence analysis.
- Analyze the macromolecules using HMM, ANN and other related algorithms.

TEXT BOOKS

REFERENCE BOOKS

BT3030 MOLECULAR MODELING L T P C 2 1 0 3

OBJECTIVES:
The course aims to
- Understand the molecular behaviour of proteins, nucleic acids and small molecules in the biological system.
- Explain the principles involved in molecular modelling

UNIT I INTRODUCTION TO CLASSICAL MECHANICS 9
Newtons laws of motion – time intervals- algorithms

UNIT II INTRODUCTION TO STATISTICAL MECHANICS 9

UNIT III QUANTUM MECHANICS 9

UNIT IV GROMOS , GROMACS, AMBER & DOCK 9
Various forcefields for proteins and nucleic acids – Molecular mechanics – Molecular dynamics– Molecular dynamics simulations in water and organic solvents.

UNIT V GAUSSIAN 9

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course the students will be able to
CO1 Understand the behaviour of Small and macro molecules in biological system.
CO2 Simulate the biomolecules using molecular modelling softwares.
CO3 Assess and utilize various softwares and tools which utilizes quantum and molecular mechanics principles.

TEXTBOOKS:

REFERENCES:
2. Quantum Mechanics; D. McQuarrie, Narosa, 1999.
3. GROMOS Handbook www.gromacs.org

CPY331 COMPUTER AIDED DRUG DESIGN

OBJECTIVES:
The objective of this course is to
- Find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
- To know the informatics approaches to the prediction of chemical properties of new drugs
- To present the appropriate tools for such a modelling, ranging from electronic Structure Methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics.

UNIT I ELECTRONIC STRUCTURE METHODS 8
Quantum chemical methods semi-empirical and ab initio methods. Conformational analysis, energy minimization, predicting the mechanism of organic reactions using electronic structure methods.

UNIT II MOLECULAR MODELING 9

UNIT III STRUCTURE ACTIVITY RELATIONSHIPS IN DRUG DESIGN 9

UNIT IV QSAR: ELECTRONIC EFFECTS 9
Hammett equation, lipophilicity effects. Hansch equation, steric effects. Taft equation. Experimental and theoretical approaches for the determination of physicochemical parameters, parameter interdependence: Regression analysis, Descriptor calculation. The importance of biological data in the correct form; 2D QSAR; 3D-QSAR examples of CoMFA and CoMSIA.
UNIT V  MOLECULAR DOCKING

Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex-S,Autodock and Dock softwares, with successful examples. Dynamics of drugs, biomolecules, drug receptor complexes, Monte Carlo simulations and Molecular dynamics in performing conformational search and docking.

TOTAL:  45 PERIODS

COURSE OUTCOMES:
The students will be able to
1. Gain knowledge about fundamental concepts, challenges, and rich opportunities in developing and applying algorithms for structural bioinformatics and healthcare.
2. Interpret and practice the fundamental concepts of Molecular Modeling and Computer aided Drug Design.
3. Develop practical skills in computational approaches to analyse, predict, and engineer biomolecules and biomolecular systems.
4. Find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
5. Present the appropriate tools for such a modelling, ranging from electronic Structure methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics
6. Apply the fundamental tools in techniques like docking, modelling, electronic structure methods which leads to new drug target design.

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OBJECTIVES
- To provide the fundamental knowledge on upcoming field of Metabolomics and metabolic engineering in post genomic era.
- To introduce the redesign of metabolism to enable cells to produce new products.

UNIT I INTRODUCTION TO METABOLOMICS 9

UNIT II BIOINFORMATICS IN METABOLOMICS 9
Online databases and pipelines for metabolomics – GC-MS based metabolomics – Computational methods to compute and integrate metabolic data-software for metabolomics- metabolomics and medical sciences.

UNIT III INTRODUCTION TO METABOLIC ENGINEERING 9
Metabolic engineering: introduction, mass balance, black box, metabolic flux analysis, stoichiometry, Principles of metabolic engineering, Importance of metabolic engineering-comprehensive models for cellular reactions-material balances & data consistency- metabolic pathway synthesis.

UNIT IV METABOLIC FLUX ANALYSIS 9
Flux balance analysis, flux balance methods, group based flux balance, metabolic control analysis: overview, control coefficients, methods of measuring control. Flux analysis of networks- top down approach, bottom up approach.

UNIT V METABOLIC NETWORKS AND APPLICATIONS 9
Kinetic model of metabolic networks-Systems metabolic engineering of E.coli. Applications of Metabolomics to biology: examples and case studies, Metabolome informatics, data integration and mining.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, Students will be able to
- Understand the concept of Metabolome and Metabolomics.
- Apply the Bioinformatics tools in metabolomics.
- Understand the fundamentals of Metabolic engineering.
- Analyze the metabolic pathways using flux control.

TEXT BOOKS

REFERENCES
OBJECTIVES:
- To learn various data mining techniques used to analyses huge biological data to find the hidden patterns.
- To familiarize students with a new rapidly evolving filed of machine learning and mining.

UNIT I  OVERVIEW OF MACHINE LEARNING TECHNIQUES  9

UNIT II  MACHINE LEARNING TECHNIQUES  9
Classification: Decision tree, Bayesian, Rule based classification, ANN, SVM, HMM; Case based reasoning and Applications in Bioinformatics. Clustering: Partition Methods, Hierarchical methods, Density based methods, Grid based clustering, Model based clustering, clustering of high dimensional data, constraints based clustering, Analysis of MD trajectories, Protein Array data Analysis.

UNIT III  INTRODUCTION TO DATA MINING  9
Introduction to Data mining, Data mining Functionalities, Classification of Data mining Systems, Data Mining Task Primitives, Integration of Data mining systems, Major issues of Data mining.

UNIT IV  DATA PREPROCESSING AND VISUALIZATION  9
Overview of data preprocessing, Data cleaning, Data integration, Data reduction, Data transformation and discretization, Visualization- Visualizing a single attributes, Visualizing pair of attributes, Visualizing several attributes, Visualizing results of machine learning.

UNIT V  APPLICATIONS OF DATA MINING  9
Application of Data Mining in Biodata analysis: DNA/protein sequence Analysis, Genome analysis, Protein Structure Analysis, Pathway analysis, microarray data analysis, annotation, gene ontology, gene mapping. Biological data mining tools: Entrez, Blast, sequence retrieval system (SRS).

OUTCOMES:
Upon completion of this course, Students will be able to
- Know the basic notions and terminology used in Machine learning and Data mining.
- Understand fundamental principles of modern data analysis.
- Understand the applications of Machine learning and Data mining in biological data processing and visualization.

TEXT BOOK

REFERENCE BOOK
1. Data Mining: Concepts and Techniques by Jiawei Han and MichelineKamber, 2000
3. Data mining in bioinformatics by Wang et al, Springer-Verlag, 2005
OBJECTIVES:
- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials

UNIT I REQUIREMENTS IN CLINICAL RESEARCH
Good clinical practice (ICH GCP E6), Clinical trial materials (Documentation, Investigational drugs, logistical materials)

UNIT II TYPES AND DESIGNS IN CLINICAL RESEARCH AND SAFETY MONITORING IN CLINICAL TRIALS
Types of research designs based on Controlling Method (Experimental, Quasi experimental, and Observational methods) Randomization techniques (Simple randomization, restricted randomization, blocking method and stratification), Time Sequences (Prospective and Retrospective), Sampling methods (Cohort study, case Control study and cross sectional study), Health outcome measures (Clinical & Physiological, Humanistic and economic)

UNIT III CLINICAL TRIAL STUDY AND GOVERNING REGULATIONS
Roles and responsibilities of: Investigator, Study Coordinator, Sponsor, Monitor, Contract Research Organization, Site management Organizations Guidelines to the preparation of following documents: Protocols, Investigator’s Brochure, Informed Consent Form, Case report forms, Contracts and agreements, Trial Master File preparation and maintenance, Investigator Site File, Pharmacy File, Dairy Cards

UNIT IV OVERVIEW TO UNDERSTANDING THE HEALTHCARE SYSTEM

UNIT V HEALTH CARE POLICIES
Health care policy- overview- Private health care sectors, Health policy and planning

OUTCOMES:
The student will be able to
- Explain key concepts in the design of clinical trials.
- Describe study designs used, identify key issues in data management for clinical trials.
- Describe the roles of regulatory affairs in clinical trials.

TEXTBOOK:
1. Guidance for Industry on Submission of Clinical Trial Application for Evaluating Safety and Efficacy by CDSCO (Central Drug Standard Control Organisation)
UNIT I  INTRODUCTION
Process validation and quality assurance: a) Installation Qualification (IQ), Operational Qualification (OQ) and Performance Qualification (PQ) for laboratory instruments. b) Methods of validation and calibration of equipments c) Documentation: importance and significance d) Current Good Manufacturing Practices (cGMP) and Current Good Laboratory Practices (cGLP).

UNIT II  VALIDATION OF PHARMACEUTICAL PRODUCTION
Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities, Analytical method validation

UNIT III  VALIDATION OF FOOD NEUTRACEUTICALS AND COSMETICS
Microbiological quality control for Nutraceuticals.

UNIT IV  VALIDATION OF MEDICAL DEVICES
Validation and Verification of Medical device Physical and Mechanical Testing of medical device, Chemical Testing of Medical Device materials, Biological Testing of Medical Devices.

UNIT V  BIOTECHNOLOGY PROCESS AND EQUIPMENT VALIDATION
Process validation, General considerations for process equipments, Regulatory requirements for process validation, Documentation, Analytical methods.

TOTAL 45 PERIODS

TEXTBOOKS:
1. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash
6. Fermentation Microbiology and Biotechnology by M. El-Mansi and C.Bryce

BT3035  QUALITY ASSURANCE AND QUALITY CONTROL IN BIOTECHNOLOGY

OBJECTIVES
1. The student shall be able to understand the scope of quality certifications.
2. Appreciate the importance of documentation.
3. The cGMP aspects in a pharmaceutical industry.
4. To understand the responsibilities of QA & QC departments in biotechnology industries
UNIT I  INTRODUCTION  9
Quality Assurance , Quality Control , Role of Quality Assurance, QA testing, Role of Quality Control, Test for quality control, Quality assurance – Quality control – Practice of cGMP- Overview of ICH Guidelines - QSEM, with special emphasis on Q-series guidelines. Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non clinical testing, control on animal house, , scope of quality certifications - responsibilities of QA & QC departments, Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), Developing specification (ICH Q6 and Q3)

UNIT II  QUALITY ASSURANCE AND QUALITY CONTROL IN CLINICAL TRIALS  9
Audit criteria, Audit process, Responsibilities of stakeholders in audit process, Audit follow-up and documentation, Audit resolution and Preparing for FDA inspections, Fraud and misconduct management - Clinical Trial Data Management- Standard Operating Procedures, Data management plan, CRF & Data base design considerations, Study set-up, Data entry, CRF tracking and corrections, Central lab, IVRS, source data. Data cleaning, managing laboratory and ADR data, Data transfer and database lock, Quality Control and Quality Assurance in CDM, Data mining and warehousing

UNIT III  QUALITY ASSURANCE AND QUALITY CONTROL IN PHARMACEUTICAL INDUSTRIES  9

UNIT IV  QUALITY SYSTEM REGULATIONS AND QUALITY CONTROL OF MEDICAL DEVICES  9
Quality System Requirements 21 CFR Part 820, Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI), Quality System requirements and clinical evaluation and investigation. IMDRF study groups and guidance documents, ISO 13485, Quality Risk Management of Medical Devices: ISO 1497-

UNIT V  QUALITY IN FOOD, NUTRACEUTICALS, BIOLOGICAL AND COSMETIC PRODUCTS  9

OUTCOMES:
- This course deals with the various aspects of quality control and quality assurance aspects of various biotechnological industries.
- It covers the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

TEXTBOOK:
2. Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin and Gary Walsh
REFERENCE:

BT3036 ENTREPRENEURSHIP AND PATENT DESIGN L T P C 3 0 0 3

OUTCOME:
- Student will be able to develop entrepreneurial skills and writing of business plan market strategies
- They will gain knowledge on patent filing and design

UNIT I ENTREPRENEUR
Entrepreneurial motivation – dynamics of motivation. Entrepreneurial competency – Concepts. Developing Entrepreneurial competencies - requirements and understanding the process of entrepreneurship development, self-awareness, interpersonal skills, creativity, assertiveness, achievement, factors affecting entrepreneur role.

UNIT II BUSINESS PLAN, MARKETING PLAN
Develop a Business Plan

UNIT III MARKETING PLAN
Choose Your Location and Set Up for Business, Market Your Business, Hire and Manage a Staff

UNIT IV OPERATIONS MANAGEMENT
Finance, Protect and Insure Your Business, Record Keeping and Accounting, Financial Management.

UNIT V PATENTS

TOTAL: 45 PERIODS

TEXT BOOKS:
CBT332  INTELLECTUAL PROPERTY RIGHTS IN BIOTECHNOLOGY  L T P C  3 0 0 3

**UNIT I  INTRODUCTION**  9
Introduction to IPRs, Basic concepts and need for Intellectual Property - IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

**UNIT II  REGISTRATION OF IPRs**  10
Meaning and practical aspects of registration of CopyRights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III  AGREEMENTS AND LEGISLATIONS**  10

**UNIT IV  DIGITAL PRODUCTS AND LAW**  9

**UNIT V  ENFORCEMENT OF IPRs**  7
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

**TOTAL:45 PERIODS**

**OUTCOME:**
Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXT BOOKS:**

**REFERENCES:**

BT3037  BIOSAFETY AND HAZARD MANAGEMENT  L P T C  3 0 0 3

**OBJECTIVE:**
- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification

**UNIT I  INTRODUCTION**  9
Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

**UNIT II  QUALITY CHECKS**  9
Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety.
UNIT III  RISK ANALYSIS  9
Overall risk analysis—emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV  SAFETY AUDITS  9
Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras- Vizag Bopal analysis.

UNIT V  HAZARDOUS OPERATIONS  9
Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL: 45 PERIODS  

TEXT BOOKS:  

REFERENCES:  

VERTICAL VIII (Agro Biotechnology)  
BT3038  PLANT ANATOMY  L T P C  3 0 0 3  

COURSE OUTCOME:  
• To make the student to become familiar and to understand the plant cell, tissues, and internal structures of stem, root and leave.

UNIT I  PLANT CELL STRUCTURE  9
Plant cell structure and tissues Plant cell structure –nature of plant cell wall. Tissue and tissue systems -meristematic tissue, permanent tissue and secretary cells

UNIT II  MORPHOLOGICAL CHARACTERS OF PLANT CELL  9
Morphogenesis and Differentiation Morphogenesis in plants -Differentiation of stem, root and leaf - Vascular bundles and Vascular cambium.

UNIT III  CELLULAR ORGANIZATION OF MERISTEMS  9
Organization of meristems Meristems – types of meristems: apical, intercalary and lateral; primary meristem and secondary meristem. Apical meristems – theories on organization of meristems – apical cell theory, Tunica-Corpus theory and histogen theory.
UNIT IV ANATOMY OF STEM AND ROOT
Structure of Dicot stem–primary and secondary structure; Structure of Monocot stem; Nodal anatomy. Structure of Dicot root–primary and secondary structure; Structure of monocot root

UNIT V ANATOMY OF LEAF AND ANOMALOUS
Secondary growth Leaf anatomy–dorsiventral and isobilateral; Stomatal types Anomalous secondary growth –Bignonia, Aristolochia, Boerhaavia (dicot stem) Dracaena (monocot stem).

TEXT BOOKS

REFERENCE:

BT3039 THERAPEUTIC APPLICATION OF PHYTOCHEMICALS L T P C 3 0 0 3

COURSE OUTCOME:
The main objective is to provide an overview of the plant derived natural products for their occurrence, sources, basic chemistry and therapeutic applications.

UNIT I INTRODUCTION PLANT NATURAL PRODUCTS
- History- general significance- classification- list of floral sources- general detection, extraction and characterization procedures

UNIT II GLYCOSIDES AND FLAVONOIDS GLYCOSIDES
Classification, therapeutic value, chemical properties & tests for identification. Flavonoids: Sources, classification, biogenesis, extraction, isolation, identification and therapeutic applications.

UNIT III ANTHOCYANINS AND COUMARINS ANTHOCYANINS
Sources, classification, extraction, isolation, identification and therapeutic applications. Coumarins: Sources, classification, biosynthesis - furanocoumarins and pyranocoumarins: pharmacological properties and photo-toxicity.

UNIT IV LIGNANS, TERPENES, VOLATILE OILS, SAPONINS LIGNANS AND NEO LIGNANS:
Classification, natural sources and pharmacological applications. Terpenes: Classification, biosynthesis, origin of 5-carbons isoprene unit, head to tail coupling and tail-totail coupling of isoprene units - Volatile Oils: Classifications, sources, medicinal and non-medicinal uses - Saponins : Sources, classification, physical and biological properties

UNIT V CAROTENOID S AND ALKALOIDS CAROTENOIDS:
Sources, biogenesis, classification and therapeutic values. Alkaloids: Classification, distribution in nature, localization, nomenclature, physico-chemical properties, extraction, detection, isolation, purification, biosynthetic origin and pharmacological activities.

TEXT BOOKS
BT3040  BIO-FERTILIZER PRODUCTION AND MUSHROOM CULTIVATION  

COURSE OUTCOME:
1. To train the students to gain hands on experience in mushroom cultivation, using different types of mushrooms.
2. To equip the students with skills in bio-composting and biofertilizer production.
3. To instill in students the ability and skills required to become self-employed / entrepreneur.
4. To gain knowledge on the marketing potential of the produced mushroom and composts.

UNIT I  MUSHROOM BIOLOGY MORPHOLOGY  
Classification: edible and poisonous mushrooms. Life cycle of Basidiomycetes fungi Breeding and Genetic improvement of mushroom strains. Medicinal and Nutritional value of mushrooms.

UNIT II  MUSHROOM CULTIVATION TECHNIQUES  

UNIT III  ECONOMICS OF MUSHROOM CULTIVATION  
Economics of the production of oyster mushroom, milky mushroom and paddy straw mushroom cultivation: Infrastructure facilities, expenditure on fixed assets, plant and machinery, cost of the project, recurring expenditure, interest and depreciation of the expenditure, cost of production and profit. Entrepreneurship in mushroom cultivation.

UNIT IV  COMPOSTING TECHNIQUE INTRODUCTION  

UNIT V  BIO-FERTILIZERS AND THEIR PRODUCTION  
Introduction - Types: Microbes as biofertilizer, Green manure, importance of macronutrients; Biofertilizers vs Chemical fertilizers; Nitrogen fixers – types and examples; Phosphate solubilizers – role of bacteria and Mycorrhizae - Mass cultivation and Application of the following biofertilizers: i)Rhizobium ii)Azospirillum iv) Cyanobacteria v) Mycorrhizae Quality control; Challenges and opportunities; Biofertilizer Entrepreneurship.

TOTAL 45 PERIODS
TEXT BOOKS

REFERENCES:

BT3041 BIOTECHNOLOGICAL APPROACH IN CROP IMPROVEMENT L T P C 3 0 0 3

COURSE OUTCOME:
- The crops produced need to increase with ever increasing population. Conventional methods for crop improvement are not able to deliver fully. Therefore, high use of throughput technologies is need of the hour.
- This course is intended to give some idea to students how crop plants can be improved quantitatively and qualitatively using biotechnological approaches. Students are able to understand plant genome organization. To acquaint students with recent techniques for crop improvement Application of molecular markers for crop improvement.

UNIT I PLANT GENOME ORGANIZATION
Features of plant chromosomes: centromere, telomere, euchromatin, heterochromatin and nucleolus organizing region (NOR); karyotype (asymmetric and symmetric). C-value paradox, range of interspecific and intraspecific variation, origin of quantitative DNA variation. Estimation of various components of higher-plant genome: highly repetitive sequences, middle repetitive sequences, and unique DNA sequences. Rice and maize genome sequencing projects; cereal genome databases.

UNIT II BIOTECHNOLOGICAL APPROACH FOR CROP IMPROVEMENT

UNIT III MOLECULAR MARKERS AND CROP IMPROVEMENT
Types of molecular markers used in analyzing genetic diversity for crop improvement; molecular mapping and tagging of agronomically important traits. Molecular cytogenetic markers: FISH and GISH, their application in crop improvement. Transposable elements: mechanism of action and their role in crop improvement. Quantitative trait loci (QTL) mapping: introduction, types of mapping populations; role in crop improvement.
UNIT IV APPLICATION OF MOLECULAR MARKERS 9
Construction of molecular maps (using F2, DH, RILs); gene tagging using bulked segregant analysis (BSA) and near isogenic lines (NILs); QTL analysis; map-based cloning of genes; elementary idea of marker-assisted selection (MAS) in plant breeding.

UNIT V PRODUCTION OF TRANSGENIC PLANTS IN VARIOUS FIELD CROPS 9
cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases. Biotechnology applications in male sterility/hybrid breeding, molecularfarming. MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights. Bioinformatics & Bioinformatics tools. Nanotechnology and its applications in crop improvement programmes.

TEXT BOOKS:

BT3042 ADVANCE TECHNIQUES IN AGRO FORESTRY L T P C 3 0 0 3

COURSE OUTCOME:
To introduce the students to the essential basics of phytogeography and forestry of India.

UNIT I SILVICULTURE 9
General silvicultural principles; ecological and physiological factors influencing vegetation; natural and artificial regeneration of forests; nursery techniques; seed technology collection, storage, pre-treatment and germination; establishment and tendings. Silvicultural systems-clear felling, uniform, shafter-wood, selection, coppice and conversion systems. Social forestry-objectives, scope, necessity; agro-forestry; extension forestry: recreation forestry; people’s participation.

UNIT II FOREST MENSURATION, MANAGEMENT AND UTILIZATION 9
Methods of measuring-diameter, girth, height and volume of trees; form factor; volume estimation of stand: sampling methods; yield calculation; current annual increment; mean annual increment; sample plots; yield and stand tables; scope and objectives of forest inventory; aerial survey and remote-sensing techniques. Forest management-objectives and principles; techniques; sustained yield relation; normal forest; growing stock; regulation of yield-methods of application; working plans-preparation and control. Forest utilisation: Logging and extraction techniques and principles; transport, storage and sale. Minor and major forest product : definition and scope. Collection, processing and disposal of minor and major forest products.
UNIT III       ADVANCES IN TREE IMPROVEMENT

UNIT IV       ADVANCES IN WOOD AND NON-WOOD FOREST PRODUCTS
Mechanics of wood and wood composites; Application of orthotropic and non-linear constitutive relations, Laminate theory and failure criterion in the prediction of mechanical properties of solid woods; Wood-polymer, Hybrid composite processing. Methods of extraction, chemistry, processing, import and export potential of gums, resins, tannins, dyes, essential oils, fixed oils, cutch and katha, drugs, spices, poisons, insecticides, pesticides, wild edible fruits etc.

UNIT V       CLIMATE CHANGE AND FORESTRY
Climate change and implications for sustainable forest management. Impact of climate change on Indian forest - Adaptation of forest trees to climate change – Potential for adaptation – Evolutionary mechanisms – The challenge of climate change for forest management – Different concepts of adaptation to climate change – Case studies on the management of certain tree species in India

TEXT BOOKS

REFERENCE

BT3043       PLANT TISSUE CULTURE AND TRANSFORMATION TECHNIQUES
COURSE OUTCOME:
1. Understand the basic principles of plant tissue culture
2. Understand the methods in biotechnology
3. Get an insight into Recombinant DNA technology and Methods of gene transfer.
4. Appreciate the applications of Biotechnology
UNIT I  PLANT TISSUE CULTURE :  9
History of plant tissue culture research - basic principles of plant tissue callus culture, meristem culture, organ culture, Totipotency of cells, differentiation and dedifferentiation. Methodology - sterilization (physical and chemical methods), culture media, Murashige and Skoog’s (MS medium), phytohormones, medium for micro-propagation/clonal propagation of ornamental and horticulturally important plants. Callus subculture maintenance, growth measurements, morphogenesis

UNIT II  PLANT TISSUE CULTURE  9
Endosperm culture – Embryo culture - culture requirements – applications, embryo rescue technique. Production of secondary metabolites. Cryopreservation; Germ plasm conservation

UNIT III  ORGAN CULTURE  9

UNIT IV  TISSUE CULTURE IN FOREST TREES  9
In vitro propagation via enhanced release of auxiliary buds. Somatic organogenesis and somatic embryo genesis, leaf diseases, embryoid and synthetic seed production. Haploid culture and production of homodiploids, Protoplast isolation, culture and regeneration.

UNIT V  TRANSFORMATION TECHNIQUES :  9
Genetic transformation techniques in plants: Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated nuclear transformation. Ti and Ri plasmids, binary & cointegrated vector systems; genetic markers; reporter genes; genetic transformation techniques for overcoming biotic and abiotic stress. Green house and green home technology. Arid and semiarid technology

TOTAL 45 PERIODS

TEXT BOOK:

REFERENCE:
MANDATORY COURSES I

MX3081  INTRODUCTION TO WOMEN AND GENDER STUDIES  L T P C  3 0 0 0

COURSE OUTLINE

UNIT I  CONCEPTS
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II  FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III  WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL
Rise of Feminism in Europe and America.
Women's Movement in India.

UNIT IV  GENDER AND LANGUAGE
Linguistic Forms and Gender.
Gender and narratives.

UNIT V  GENDER AND REPRESENTATION
Advertising and popular visual media.
Gender and Representation in Alternative Media.
Gender and social media.

TOTAL : 45 PERIODS

MX3082  ELEMENTS OF LITERATURE  L T P C  3 0 0 0

OBJECTIVE:
- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

1. COURSE CONTENTS

   Introduction to Elements of Literature

1. Relevance of literature
   a) Enhances Reading, thinking, discussing and writing skills.
   b) Develops finer sensibility for better human relationship.
   c) Increases understanding of the problem of humanity without bias.
   d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction
   a) Fiction, fact and literary truth.
   b) Fictional modes and patterns.
   c) Plot character and perspective.
3. **Elements of poetry**
   a) Emotions and imaginations.
   b) Figurative language.
   c) (Simile, metaphor, conceit, symbol, pun and irony).
   d) Personification and animation.
   e) Rhetoric and trend.

4. **Elements of drama**
   a) Drama as representational art.
   b) Content mode and elements.
   c) Theatrical performance.
   d) Drama as narration, mediation and persuasion.
   e) Features of tragedy, comedy and satire.

3. **READINGS:**

   3.1 Textbook:
   3.2 *Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

4. **OTHER SESSION:**
   4.1*Tutorials:
   4.2*Laboratory:
   4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature

5. **ASSESSMENT:**
   5.1HA:
   5.2Quizzes-HA:
   5.3Periodical Examination: one
   5.4Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
   5.5Final Exam:

   **TOTAL : 45 PERIODS**

**OUTCOME OF THE COURSE:**
- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.
In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

**Theme - A: The Component of Films**
- A-1: The material and equipment
- A-2: The story, screenplay and script
- A-3: The actors, crew members, and the director
- A-4: The process of film making… structure of a film

**Theme - B: Evolution of Film Language**
- B-1: Film language, form, movement etc.
- B-2: Early cinema… **silent film** (Particularly French)
- B-3: The emergence of feature films: Birth of a Nation
- B-4: Talkies

**Theme - C: Film Theories and Criticism/Appreciation**
- C-1: Realist theory; Auteurists
- C-2: Psychoanalytic, Ideological, Feminists
- C-3: How to read films?
- C-4: Film Criticism / Appreciation

**Theme – D: Development of Films**
- D-1: Representative Soviet films
- D-2: Representative Japanese films
- D-3: Representative Italian films
- D-4: Representative Hollywood film and the studio system

**Theme - E: Indian Films**
- E-1: The early era
- E-2: The important films made by the directors
- E-3: The regional films
- E-4: The documentaries in India

**READING:**
A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

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**COURSE OBJECTIVE**
- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

**UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS**
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals
UNIT II  DISASTER RISK REDUCTION (DRR)  9
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRls/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III  DISASTER MANAGEMENT  9
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV  TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT  9

UNIT V  DISASTER MANAGEMENT: CASE STUDIES  9
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:
1  Taimpo (2016), Disaster Management and Preparedness, CRC Publications

REFERENCES

COURSE OUTCOME:
CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
CO3: To develop disaster response skills by adopting relevant tools and technology
CO4: Enhance awareness of institutional processes for Disaster response in the country and
CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity
CO’s – PO’s & PSO’s MAPPING

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MANDATORY COURSES II

MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA

COURSE OBJECTIVES:
- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE

Health: Definition - Importance of maintaining health - More importance on prevention than treatment
Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.


Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet
Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes
Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 3+4
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life - Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.


Sleep - Sleep and its importance for mental wellness - Sleep and digestion.
Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS
TEXT BOOKS:
1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health
   https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
   https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
   https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
10. CAM : https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:
After completing the course, the students will be able to:
- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health
UNIT-I CONCEPTS AND PERSPECTIVES

Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation versus evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT-II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA
Introduction to the works of D.D. Kosambi, Dharmapal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT-III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA
Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times
Science and technology from 1st century AD to C-1200.

UNIT-IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA
Legacy of technology in Medieval India, Interactions with Arabs
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

UNIT-V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA
Science and the Empire
Indian response to Western Science
Growth of techno-scientific institutions

UNIT-VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA
Science, Technology and Development discourse
Shaping of the Science and Technology Policy
Developments in the field of Science and Technology
Science and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

Pre-Requisite: None. (Desirable: Universal Human Values 1, Universal Human Values 2)

OBJECTIVES:
• This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.
COURSE TOPICS:
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each)
(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures)
(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. (2 lectures)

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.
(Refs: Marx, Lenin, Mao, M N Roy) (5 lectures)

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature. (6 lectures)
(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)
(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

Reference Books: Authors mentioned along with topics above. Detailed reading list will be provided.

GRADING:

Mid sems 30
End sem 20
Home Assign 10
Term paper 40

TOTAL : 45 PERIODS

OUTCOME:
- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.
OBJECTIVE:
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

TOPICS:
Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy.
Why a federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)
New social movements.
The changing nature of Indian Political System, the future scenario.
What can we do?

OUTCOME OF THE COURSE:
It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

SUGGESTED READING:


TOTAL : 45 PERIODS

MX3089 INDUSTRIAL SAFETY L T P C 3 0 0 0

OBJECTIVES
- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

UNIT III SAFETY ACTIVITIES

UNIT IV WORKPLACE HEALTH AND SAFETY
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

Course outcomes on completion of this course the student will be able:
- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.
TEXTBOOKS
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES
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OBJECTIVES:
The main objectives of this course are to:
1. Understand the importance, principles, and search methods of AI
2. Provide knowledge on predicate logic and Prolog.
3. Introduce machine learning fundamentals
4. Study of supervised learning algorithms.
5. Study about unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III LEARNING 6
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 6

UNIT V UNSUPERVISED LEARNING 6
Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm

PRACTICAL EXERCISES: 30 PERIODS
Programs for Problem solving with Search
1. Implement breadth first search
2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space
4. Implement and compare Greedy and A* algorithms.

Supervised learning
5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier.
Unsupervised learning

9. Implementing neural network using self-organizing maps
10. Implementing k-Means algorithm to cluster a set of data.
11. Implementing hierarchical clustering algorithm.

Note:
- Installation of gnu-prolog, Study of Prolog (gnu-prolog).
- The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface.
- Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

OUTCOMES:
CO1: Understand the foundations of AI and the structure of Intelligent Agents
CO2: Use appropriate search algorithms for any AI problem
CO3: Study of learning methods
CO4: Solving problem using Supervised learning
CO5: Solving problem using Unsupervised learning

TOTAL PERIODS: 60

TEXT BOOK
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

REFERENCES
UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT

UNIT IV OPEN PLATFORMS AND PROGRAMMING

UNIT V IOT APPLICATIONS
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system

OUTCOMES:
CO 1: Explain the concept of IoT.
CO 2: Understand the communication models and various protocols for IOT.
CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TOTAL : 60 PERIODS

TEXTBOOKS

REFERENCES
1. Perry Lea, “Internet of things for architects”, Packt, 2018
COURSE OBJECTIVES:
- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT I  INTRODUCTION
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II  DATA MANIPULATION

UNIT III  MACHINE LEARNING
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis

UNIT IV  DATA VISUALIZATION

UNIT V  HANDLING LARGE DATA
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

PRACTICAL EXERCISES:
1. Download, install and explore the features of Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
   a) Frequency distributions
   b) Mean, Mode, Standard Deviation
   c) Variability
   d) Normal curves
   e) Correlation and scatter plots
   f) Correlation coefficient
   g) Regression
6. Use the standard benchmark data set for performing the following:
   a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
   b) Bivariate Analysis: Linear and logistic regression modelling.
7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

COURSE OUTCOMES:
At the end of this course, the students will be able to:
   CO1: Gain knowledge on data science process.
   CO2: Perform data manipulation functions using Numpy and Pandas.
   CO3: Understand different types of machine learning approaches.
   CO4: Perform data visualization using tools.
   CO5: Handle large volumes of data in practical scenarios.

TOTAL PERIODS: 60

TEXT BOOKS

REFERENCES

UNIT I INTRODUCTION

UNIT II VR MODELING
UNIT III VR PROGRAMMING
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS

UNIT V AUGMENTED REALITY
Introduction to Augmented Reality – Computer vision for AR – Interaction – Modelling and Annotation – Navigation – Wearable devices

PRACTICAL EXERCISES: 30 PERIODS
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
10. Develop simple MR enabled gaming applications.

TOTAL PERIODS: 60

OUTCOMES:
On completion of the course, the students will be able to:
CO1: Understand the basic concepts of AR and VR
CO2: Understand the tools and technologies related to AR/VR
CO3: Know the working principle of AR/VR related Sensor devices
CO4: Design of various models using modeling techniques
CO5: Develop AR/VR applications in different domains

TEXTBOOKS:
1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
CO’s – PO’s & PSO’s MAPPING

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OPEN ELECTIVE III

OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS

COURSE DESCRIPTION:

Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.

OBJECTIVES:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students’ confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I


UNIT II


UNIT III


UNIT IV

Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an

UNIT V

TOTAL: 45 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
• expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required
• identify errors with precision and write with clarity and coherence
• understand the importance of task fulfilment and the usage of task-appropriate vocabulary
• communicate effectively in group discussions, presentations and interviews
• write topic based essays with precision and accuracy

CO-PO & PSO MAPPING

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• 1-low, 2-medium, 3-high, '-'- no correlation

Note: The average value of this course to be used for program articulation matrix.

Teaching Methods:
Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:
Internal Tests – 50%
End Semester Exam - 50%

TEXTBOOKS:

REFERENCE BOOKS:
OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES

OBJECTIVE:
- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I  INTRODUCTION
Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with respect to its management practices -construction project phases - The problems with current construction management techniques.

UNIT II  LEAN MANAGEMENT
Introduction to lean management - Toyota’s management principle - Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.

UNIT III  CORE CONCEPTS IN LEAN

UNIT IV  LEAN TOOLS AND TECHNIQUES

UNIT V  LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY
Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

TOTAL : 45 PERIODS

OUTCOME:
On completion of this course, the student is expected to be able to
CO1 Explain the contemporary management techniques and the issues in present scenario.
CO2 Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.
CO3 Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.

CO4 Apply lean techniques to achieve sustainability in construction projects.

CO5 Apply lean construction techniques in design and modeling.

REFERENCES:

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES
- to understand the importance of sustainable development
- to acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- to comprehend the role of NGOs in attaining sustainable development

UNIT I ENVIRONMENTAL CONCERNS
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

UNIT II ROLE OF NGOS
Role of NGO’s in national development, NGO’s and participatory management, Challenges and limitations of NGO’s, Community Development programmes, Role of NGO’s in Community Development programmes, Participation of NGO’s in environment management, Corporate Social responsibility, NGO’s and corporate social responsibility

UNIT III SUSTAINABLE DEVELOPMENT
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV NGO’S FOR SUSTAINABILITY
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies
UNIT V LEGAL FRAMEWORKS
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO’s in implementing environmental laws, Challenges in the implementation of environmental legislation

OUTCOMES
Upon completion of this course, the student will:
CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development
CO2 have a knowledge on the role of NGOs towards sustainable development
CO 3 present strategies for NGOs in attaining sustainable development
CO 4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment
CO 5 understand the environmental legislations

REFERENCE BOOKS

OMG353 DEMOCRACY AND GOOD GOVERNANCE L T P C
3 0 0 3

UNIT-I Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance (9)

UNIT-II Regulatory Institutions – SEBI, TRAI, Competition Commission of India, (9)

UNIT-III Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc. (9)

UNIT- IV Contemporary Political Economy of Development in India: Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E-governance (9)

UNIT-V Dynamics of Civil Society: New Social Movements, Role of NGO's, Understanding the political significance of Media and Popular Culture. (9)

TOTAL 45 : PERIODS
REFERENCES:

195
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India, 2013.

**CME365 RENEWABLE ENERGY TECHNOLOGIES**

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**COURSE OBJECTIVES**

1. To know the Indian and global energy scenario
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies.

**UNIT I ENERGY SCENARIO**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

**UNIT II SOLAR ENERGY**


**UNIT III WIND ENERGY**


**UNIT IV BIO-ENERGY**


**UNIT V OCEAN AND GEOTHERMAL ENERGY**


**TOTAL: 45 PERIODS**

**OUTCOMES:** At the end of the course the students would be able to

- Discuss the Indian and global energy scenario.
- Describe the various solar energy technologies and its applications.
- Explain the various wind energy technologies.
- Explore the various bio-energy technologies.
- Discuss the ocean and geothermal technologies.
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Low (1) ; Medium (2) ; High (3)

OME354  
APPLIED DESIGN THINKING

OBJECTIVES:
The course aims to
- Introduce tools & techniques of design thinking for innovative product development
- Illustrate customer-centric product innovation using on simple use cases
- Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

UNIT I  
DESIGN THINKING PRINCIPLES
Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

UNIT II  
ENDUSER-CENTRIC INNOVATION
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit
UNIT III      APPLIED DESIGN THINKING TOOLS
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT IV CONCEPT GENERATION
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

UNIT V SYSTEM THINKING
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

COURSE OUTCOMES
At the end of the course, learners will be able to:
● Define & test various hypotheses to mitigate the inherent risks in product innovations.
● Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.
● Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching
● Apply system thinking in a real-world scenario

TEXT BOOKS
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
6. https://blog.forgeforward.in/star-up-failure-is-like-true-lie-7812cde9b85

MF3003 REVERSE ENGINEERING

COURSE OBJECTIVES:
● The main learning objective of this course is to prepare students for:
● Applying the fundamental concepts and principles of reverse engineering in product design and development.
● Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
● Applying the concept and principles of material identification and process verification in
reverse engineering of product design and development.

- Analysing the various legal aspect and applications of reverse engineering in product design and development.
- Understand about 3D scanning hardware & software operations and procedure to generate 3D model

UNIT I INTRODUCTION & GEOMETRIC FORM 9 Hours

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9 Hours

UNIT III DATA PROCESSING 9 Hours

UNIT IV 3D SCANNING AND MODELLING 9 Hours

UNIT V INDUSTRIAL APPLICATIONS 9 Hours

TOTAL : 45 PERIODS

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

- Apply the fundamental concepts and principles of reverse engineering in product design and development.
- Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and
COURSE OBJECTIVES:

- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

UNIT – I ECONOMIC SUSTAINABILITY

UNIT – II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY
Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT – III SUSTAINABILITY PRACTICES
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model.

UNIT – IV MANUFACTURING STRATEGY FOR SUSTAINABILITY
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – V TRENDS IN SUSTAINABLE OPERATIONS

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:

COURSE OBJECTIVES:
- The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and subsystem design and hybrid vehicle control.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
UNIT II ENERGY SOURCES

UNIT III MOTORS AND DRIVES
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS
Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT V HYBRID AND ELECTRIC VEHICLES
Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

COURSE OUTCOMES:
At the end of this course, the student will be able to
1. Understand the operation and architecture of electric and hybrid vehicles
2. Identify various energy source options like battery and fuel cell
3. Select suitable electric motor for applications in hybrid and electric vehicles.
4. Explain the role of power electronics in hybrid and electric vehicles
5. Analyze the energy and design requirement for hybrid and electric vehicles.

TOTAL: 45 PERIODS

TEXT BOOKS:

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OBJECTIVES:
- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young’s modulus, Poisson’s ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.

UNIT I
STANDARD ATMOSPHERE
6
History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II
AERODYNAMICS
10
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

UNIT III
PERFORMANCE AND PROPULSION
9
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV
AIRCRAFT STABILITY AND STRUCTURAL THEORY
10

UNIT V
SPACE APPLICATIONS
10
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newtons law of gravitation.

TOTAL: 45 PERIODS

OUTCOMES:
- Illustrate the history of aviation & developments over the years
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

REFERENCE:
COURSE OBJECTIVES:
To introduce fundamental concepts of industrial management
To understand the approaches to the study of Management
To learn about Decision Making, Organizing and leadership
To analyze the Managerial Role and functions
To know about the Supply Chain Management

UNIT I  INTRODUCTION  9

UNIT II  FUNCTIONS OF MANAGEMENT  9

UNIT III  ORGANIZATIONAL BEHAVIOUR  9

UNIT IV  GROUPDYNAMICS  9

UNIT V  MODERN CONCEPTS  9
Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage

COURSE OUTCOMES:
CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4: Analyze the learning curves

TOTAL: 45 PERIODS
CO5 : Understand the placement and performance appraisal

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COURSE OBJECTIVES
- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing the special control procedures for service and process oriented industries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION

UNIT II CONTROL CHARTS
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES
Warning and modified control limits, control chart for individual measurements, multi-vari chart, Xchart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL
Process stability, process capability analysis using a Histogram or probability plots and control chart.Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables,MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to:
CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.

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OSF351 FIRE SAFETY ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES
1. To enable the students to acquire knowledge of Fire and Safety Studies
2. To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
3. To learn about fire area, fire stopped areas and different types of fire-resistant doors
4. To learn about the method of fire protection of structural members and their repair due to fire damage.
5. To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I INHERENT SAFETY CONCEPTS 9
Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.

UNIT II PLANT LOCATIONS 9
Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.

UNIT III WORKING CONDITIONS 9
Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES 9
Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel
structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS

TOTAL PERIODS: 45

COURSE OUTCOMES
On completion of the course the student will be able to
CO1: Understand the effect of fire on materials used for construction
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

REFERENCES:

CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the basic importance of NDT in quality assurance.
• Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
• Equipping themselves to locate a flaw in various materials, products.
• Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
• Acquiring the knowledge on the selection of the suitable NDT technique for a given application

UNIT I INTRODUCTION TO NDT & VISUAL TESTING 9
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.
Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY 9
Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV ULTRASONIC TESTING & AET 9
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration.

UNIT V RADIOGRAPHY TESTING 9
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Realize the importance of NDT in various engineering fields.
2. Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
3. Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
4. Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
5. Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

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OMR351 MECHATRONICS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Selecting sensors to develop mechatronics systems.
2. Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
3. Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Applying PLC as a controller in mechatronics system.
5. Designing and develop the apt mechatronics system for an application.

UNIT – I INTRODUCTION AND SENSORS
UNIT – II  8085 MICROPROCESSOR  9

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE  9

UNIT – IV PROGRAMMABLE LOGIC CONTROLLER  9
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO 4: Apply PLC as a controller in mechatronics system.
CO 5: Design and develop the apt mechatronics system for an application.

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CO/PO & PSO Average: 3 2 1

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES
ORA351 FOUNDATION OF ROBOTICS

L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To study the kinematics, drive systems and programming of robots.
2. To study the basics of robot laws and transmission systems.
3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4. To familiarize students with the various Programming and Machine Vision application in robots.
5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT – I  FUNDAMENTALS OF ROBOT

UNIT – II  ROBOT KINEMATICS
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT – III  ROBOT DRIVE SYSTEMS AND END EFFECTORS

UNIT – IV  SENSORS IN ROBOTICS
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT – V  PROGRAMMING AND APPLICATIONS OF ROBOT
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS
COURSE OUTCOMES
At the end of the course, students will be able to:
CO1: Interpret the features of robots and technology involved in the control.
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

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UNIT II  AIRCRAFT CONFIGURATIONS AND ITS CONTROLS  10
Different types of flight vehicles, classifications-Components of an airplane and their functions- Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III  BASICS OF AERODYNAMICS  9

UNIT IV  BASICS OF AIRCRAFT STRUCTURES  9

UNIT V  BASICS OF PROPULSION  9
Basic ideas about piston, turboprop and jet engines — use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL : 45 PERIODS

OUTCOMES:
- Illustrate the history of aircraft & developments over the years
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS

REFERENCE

OGI351  REMOTE SENSING CONCEPTS  L T P C
3 0 0 3

OBJECTIVES:
- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

UNIT I  REMOTE SENSING AND ELECTROMAGNETIC RADIATION  9
Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien’s Displacement Law, Stefan’s
UNIT II  EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL  9

UNIT III  ORBITS AND PLATFORMS  9
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential – Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

UNIT IV  SENSING TECHNIQUES  9

UNIT V  DATA PRODUCTS AND INTERPRETATION  9
Photographic and digital products – Types, levels and open source satellite data products — selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO 1  Understand the concepts and laws related to remote sensing
CO 2  Understand the interaction of electromagnetic radiation with atmosphere and earth material
CO 3  Acquire knowledge about satellite orbits and different types of satellites
CO 4  Understand the different types of remote sensors
CO 5  Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

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**OAI351   URBAN AGRICULTURE**

**OBJECTIVES:**
- To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways.
- To delineate the role of agricultural engineers in relation to various crop production practices.

**UNIT I   INTRODUCTION**
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

**UNIT II   VERTICAL FARMING**

**UNIT III   SOIL LESS CULTIVATION**
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, **backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping**

**UNIT IV   MODERN CONCEPTS**
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops
UNIT V  WASTE MANAGEMENT
Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes- solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

COURSE OUTCOMES
1. Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops
2. Explain different methods of crop production on roof tops
3. Explain nutrient and pest management for crop production on roof tops
4. Illustrate crop water requirement and irrigation water management on roof tops
5. Explain the concept of waste management on roof tops

TEXT BOOKS:

REFERENCES:

CO-PO MAPPING

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PSO2  To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.  | 2  | 1  | 2  | 1  | 1  | 1  |

PSO3  To inculcate entrepreneurial skills through strong Industry-Institution linkage.  | 1  | 2  | 1  | 2  | 1  | 2  |

OEN351  DRINKING WATER SUPPLY AND TREATMENT  L T P C  3 0 0 3

OBJECTIVE:
- To equip the students with the principles and design of water treatment units and distribution system.

UNIT I  SOURCES OF WATER  9

UNIT II  CONVEYANCE FROM THE SOURCE  9

UNIT III  WATER TREATMENT  9
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation — sand filters - Disinfection - –Construction, Operation and Maintenance aspects.

UNIT IV  ADVANCED WATER TREATMENT  9

UNIT V  WATER DISTRIBUTION AND SUPPLY  9

TOTAL: 45 PERIODS

OUTCOMES
CO1: an understanding of water quality criteria and standards, and their relation to public health
CO2: the ability to design the water conveyance system
CO3: the knowledge in various unit operations and processes in water treatment
CO4: an ability to understand the various systems for advanced water treatment
CO5: an insight into the structure of drinking water distribution system
TEXTBOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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Note: The average value of this course to be used for program articulation matrix.

OEE352 ELECTRIC VEHICLE TECHNOLOGY

COURSE OBJECTIVES
• To provide knowledge about electric machines and special machine
• To understand the basics of power converters
• To know the concepts of controlling DC and AC drive systems
• To understand the architecture and power train components.
• To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)

UNIT I ROTATING POWER CONVERTERS

UNIT II STATIC POWER CONVERTERS
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.
UNIT III CONTROL OF DC AND AC MOTOR DRIVES

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS


UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power split mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Able to understand the principles of conventional and special electrical machines.
CO2: Acquired the concepts of power devices and power converters
CO3: Able to understand the control for DC and AC drive systems.
CO4: Learned the electric vehicle architecture and power train components.
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.

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REFERENCES:
OEI353 INTRODUCTION TO PLC PROGRAMMING

COURSE OBJECTIVES:
1. Understand basic PLC terminologies digital principles, PLC architecture and operation.
2. Familiarize different programming language of PLC.
3. Develop PLC logic for simple applications using ladder logic.
4. Understand the hardware and software behind PLC and SCADA.
5. Exposures about communication architecture of PLC/SCADA.

UNIT I INTRODUCTION TO PLC
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

UNIT II PLC INSTRUCTIONS
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples.

UNIT III PLC PROGRAMMING
Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

UNIT IV COMMUNICATION OF PLC AND SCADA
Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT V CASE STUDIES
Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.

COURSE OUTCOMES:
CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)
CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming. (L2)
CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block. (L3)
CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)
CO5 Ability to Understand the Concepts of Communication used for PLC/SCADA. (L1)

TEXT BOOKS:
REFERENCES:
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108105063

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OCH351 NANO TECHNOLOGY L T P C 3 0 0 3

UNIT I INTRODUCTION 8
General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials – Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS 8
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES 10
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermostet based and elastomer based- influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES 10
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.
UNIT V  APPLICATIONS OF NANO MATERIALS

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots-Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS

OUTCOMES:
CO1 - understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.
CO2 – able to acquire knowledge about the different types of nano material synthesis
CO3 – describes about the shape, size, structure of composite nano materials and their interference
CO4 – understand the different characterization techniques for nanomaterials
CO5 - develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

REFERENCES

COURSE ARTICULATION MATRIX

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OBJECTIVE:
- The course emphasis on the molecular safe assembly and materials for polymer electronics.

UNIT I   INTRODUCTION

UNIT II   MOLECULAR SELF ASSEMBLY

UNIT III   BIO-INSPIRED MATERIALS

UNIT IV   SMART OR INTELLIGENT MATERIALS
9 Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composities.

UNIT V   MATERIALS FOR POLYMER ELECTRONICS
9 Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS
OUTCOME:
- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOK:

REFERENCE:

OPY352 IPR FOR PHARMA INDUSTRY L T P C 3 0 0 3

COURSE OBJECTIVES:
- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I INTRODUCTION- INTELLIGENT PROPERTY RIGHTS
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II PATENTS
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III PLANT VARIETY-TRADITIONAL KNOWLEDGE- GEOGRAPHICAL INDICATIONS
Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR
UNIT V  INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY  9


TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005

COURSE OUTCOME
The student will be able to
C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
C6 Understand the interrelationships between different Intellectual Property Rights on International Society

CO – PO MAPPING

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OTT351 BASICS OF TEXTILE FINISHING  L T P C
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OBJECTIVE:
- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.
UNIT I  RESIN FINISHING  9

UNIT II  FLAME PROOF & WATERPROOF  9
Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

UNIT III  SOIL RELEASE AND ANTISTATIC FINISHES  9

UNIT IV  MECHANICAL FINISHES  9

UNIT V  STIFFENING AND SOFTENING  9
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET. Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO: 2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.
CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
CO: 4 Concept of Mechanical finishing.
CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62
OTT352  INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY  L T P C  3 0 0 3

OBJECTIVES:

- To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry

UNIT I  INTRODUCTION
Scope of industrial engineering in apparel Industry, role of industrial engineers.

Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process. Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

UNIT II  WORK STUDY
Definition, Purpose, Basic procedure and techniques of work-study.

Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment

Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.

UNIT III  METHOD STUDY
Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart

MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

UNIT IV  WORK MEASUREMENT
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V  WORK STUDY APPLICATION
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

OUTCOMES:
Upon the completion of the course the student shall be able to understand

CO1: Fundamental concepts of industrial Engineering and productivity
CO2: Method study
CO3: Motion analysis
CO4: Work measurement and SAM
CO5: Ergonomics and its application to garment industry

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES

COURSE ARTICULATION MATRIX:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

UNIT I  NATURAL FIBRES
Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres..

UNIT II  REGENERATED AND SYNTHETIC FIBRES
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.

UNIT III  BASICS OF SPINNING
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations

UNIT IV  BASICS OF WEAVING
Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms.

UNIT V  BASICS OF KNITTING AND NONWOVEN

TOTAL : 45 PERIODS

OUTCOMES:
On completion of this course, the students shall have the basic knowledge on
CO1: Classification of fibres and production of natural fibres
CO2: Regenerated and synthetic fibres
CO3: Yarn spinning
CO4: Weaving
CO5: Knitting and nonwoven

TEXTBOOKS
REFERENCES:

COURSE ARTICULATION MATRIX:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
The course is aimed to
Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL
Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of
Petroleum - Atmospheric and Vacuum Distillation.

UNIT II CRACKING
Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and
Air Blowing of Bitumen

UNIT III REFORMING AND HYDROTREATING
Catalytic Reforming of Petroleum Feed Stocks. Lube oil processing- Solvent Treatment
Processes, Dewaxing, Clay Treatment and Hydrofining. Treatment Techniques: Removal of
Sulphur Compounds in all Petroleum Fractions to improve performance.

UNIT IV INTRODUCTION TO PETROCHEMICALS
Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene,
Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of
Aromatics.

UNIT V PRODUCTION OF PETROCHEMICALS
Production of Petrochemicals like Dimethyl Terephthalate(DMT), Ethylene Glycol, Synthetic
glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate
Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde,
Acetaldehyde, Pentaerythritol and production of Carbon Black.

OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the classification, composition and testing methods of crude petroleum and its
products. Learn the mechanism of refining process.
CO2: Understand the insights of primary treatment processes to produce the precursors.
CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce
more petroleum products.
CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities
from petroleum products.
CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.
CO6: Learn the importance of optimization of process parameters for the high yield of petroleum
products.

TEXT BOOKS
   Sons,1986.

REFERENCES
OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I INTRODUCTION

UNIT II ELECTRICAL SYSTEMS

UNIT III THERMAL SYSTEMS

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3: Skills on combustion thermodynamics and kinetics.
CO4: Apply calculation and design tube still heaters.
CO5: Studied different heat treatment furnace.
CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:
REFERENCES:

OPT351  BASICS OF PLASTICS PROCESSING   L T P C
3 0 0 3

COURSE OBJECTIVES
• Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
• To gain practical knowledge on the polymer selection and its processing
• Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
• To understand suitable additives for plastics compounding
• To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I  INTRODUCTION TO PLASTICS PROCESSING  9

UNIT II  EXTRUSION  9

UNIT III  INJECTION MOLDING  9
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting
UNIT IV  COMPRESSION AND TRANSFER MOLDING

Compression moulding – Basic principles of compression and transfer moulding—Meaning of terms—Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties—Curing time—Mould temperature and Pressure requirements. Preforms and preheating—Techniques of preheating. Machines used—Types of compression mould—positive, semi-positive and flash. Common moulding faults and their correction—Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity—Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding.

UNIT V  BLOW MOLDING, THERMOFORMING AND CASTING


TOTAL HOURS: 45

COURSE OUTCOMES
- Ability to find out the correlation between various processing techniques with product properties.
- Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.
- Acquire knowledge on additives for plastic compounding and methods employed for the same.
- Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.
- Select an appropriate processing technique for the production of a plastic product.

REFERENCES
COURSE OBJECTIVES:
- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I  CLASSIFICATION OF SIGNALS AND SYSTEMS

UNIT II  ANALYSIS OF CONTINUOUS TIME SIGNALS
Fourier series for periodic signals - Fourier Transform – properties - Laplace Transforms and Properties

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS

UNIT IV  ANALYSIS OF DISCRETE TIME SIGNALS
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V  LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: determine if a given system is linear/causal/stable
CO2: determine the frequency components present in a deterministic signal
CO3: characterize continuous LTI systems in the time domain and frequency domain
CO4: characterize discrete LTI systems in the time domain and frequency domain
CO5: compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits.
- To analyze the frequency response of small signal amplifiers.
- To design and analyze single stage and multistage amplifier circuits.
- To study about feedback amplifiers and oscillators principles.
- To understand the analysis and design of multi vibrators.

UNIT I  SEMICONDUCTOR DEVICES  9
PN junction diode, Zener diode, BJT, MOSFET, UJT – structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator

UNIT II  AMPLIFIERS  9
Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers– Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III  MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER  9
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV  FEEDBACK AMPLIFIERS AND OSCILLATORS  9

UNIT V  POWER AMPLIFIERS AND DC/DC CONVERTERS  9
Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits.

TOTAL: 45 PERIODS
TEXT BOOKS:

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CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT L T P C 3 0 0 3

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

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9
UNIT III  DESIGN AND TESTING  

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

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  

TOTAL: 45 PERIODS

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

TEXT BOOKS:
1. Book specially prepared by NASSCOM as per the MoU.

REFERENCES:
OBJECTIVES:
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

UNIT I CARDIAC ASSIST DEVICES
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump. Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

UNIT II HEMODIALYSERS
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2: Describe the underlying principles of hemodialyzer machine.
CO3: Indicate the methodologies to assess the hearing loss.
CO4: Evaluate the types of assistive devices for mobilization.
CO5: Explain about TENS and biofeedback system.
TEXT BOOKS

REFERENCES
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

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OMA352 OPERATIONS RESEARCH

OBJECTIVES:
This course will help the students to
- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.

UNIT I LINEAR PROGRAMMING

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS

UNIT III INTEGER PROGRAMMING
UNIT IV  DYNAMIC PROGRAMMING PROBLEMS  

UNIT V  NON - LINEAR PROGRAMMING PROBLEMS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students will be able to
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
- solve the integer programming problems using various methods.
- conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
- determine the optimum solution for non-linear programming problems.

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OBJECTIVES:
- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I GROUPS AND RINGS
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange’s theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II FINITE FIELDS AND POLYNOMIALS
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS
Division algorithm - Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV DIOPHANTINE EQUATIONS AND CONGRUENCES
Linear Diophantine equations – Congruence’s – Linear Congruence’s - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.

UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS
Wilson’s theorem – Fermat’s Little theorem – Euler’s theorem – Euler’s Phi functions – Tau and Sigma functions.

TOTAL: 45 PERIODS

OUTCOMES:
- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the statements proven by the text

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I  MATRICES AND SYSTEM OF LINEAR EQUATIONS  9

UNIT II  VECTOR SPACES  9
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III  LINEAR TRANSFORMATION  9
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.

UNIT IV  INNER PRODUCT SPACES  9
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V  EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION  9

COURSE OUTCOMES:
After the completion of the course the student will be able to
1. Test the consistency and solve system of linear equations.
2. Find the basis and dimension of vector space.
3. Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4. Find orthonormal basis of inner product space and find least square approximation.
5. Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

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OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING L T P C

COURSE OBJECTIVES:
The Course will enable Learners to,
- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNIT I

UNIT II

UNIT III
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV
UNIT V


TOTAL:45 PERIODS

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

- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intension of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.

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- Note: The average value of this course to be used for program articulation matrix.

REFERENCES


OCE354     BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT

OBJECTIVES

- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I     OVERVIEW OF IWRM


UNIT II     WATER USE SECTORS: IMPACTS AND SOLUTION

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.
UNIT III  WATER ECONOMICS  9
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV  RECENT TRENDS IN WATER MANAGEMENT  9
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V  IMPLEMENTATION OF IWRM  9
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

OUTCOMES
• On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.
CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.
CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO4 Illustrate the recent trends in water management.
CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

REFERENCES
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).
UNIT II  INTERPOLATION  
9
Central difference: Stirling and Bessel's interpolation formulae; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline; Least square approximation for continuous data (upto 3rd degree).

UNIT III  NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS  
9

UNIT IV  FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS  
9
Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes - Leibmann's iterative methods - Dirichlet's and Neumann conditions - Laplace equation in polar coordinates: Finite difference schemes.

UNIT V  FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS  
9
Parabolic equations: Explicit and implicit finite difference methods - Weighted average approximation - Dirichlet's and Neumann conditions - First order hyperbolic equations - Method of characteristics - Different explicit and implicit methods; Wave equation: Explicit scheme - Stability of above schemes.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;
CO2: understand the interpolation theory;
CO3: understand the concepts of numerical methods for ordinary differential equations;
CO4: demonstrate the understandings of common numerical methods for elliptic equations;
CO5: understand the concepts of numerical methods for time dependent partial differential equations

TEXT BOOKS :

REFERENCES:
### OBJECTIVES:
- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

### UNIT I  RANDOM VARIABLES

### UNIT II  RANDOM PROCESSES

### UNIT III  SPECIAL RANDOM PROCESSES

### UNIT IV  CORRELATION AND SPECTRAL DENSITIES

### UNIT V  LINEAR SYSTEMS WITH RANDOM INPUTS
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

**TOTAL: 45 PERIODS**

### OUTCOMES
Upon successful completion of the course, students should be able to:
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.

Analyze the response of random inputs to linear time invariant systems.

**TEXT BOOKS**

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OMA357 QUEUEING AND RELIABILITY MODELLING

**OBJECTIVES:**
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

**UNIT I RANDOM PROCESSES**
9

**UNIT II MARKOVIAN QUEUEING MODELS**
9
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms.
UNIT III ADVANCED QUEUEING MODELS

M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E_k/1 as special cases – Series queues – Open Jackson networks.

UNIT IV SYSTEM RELIABILITY


UNIT V MAINTAINABILITY AND AVAILABILITY

Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

TOTAL: 45 PERIODS

OUTCOMES

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

- Enable the students to apply the concept of random processes in engineering disciplines.
- Students acquire skills in analyzing various queueing models.
- Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.
- Students can analyze reliability of the systems for various probability distributions.
- Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

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OBJECTIVES:

- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organization of production function, recent trends in production/operations management - production as an organizational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS

Production Systems- principles - Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS


UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT


OUTCOMES:

Upon completion of this course the learners will be able:

CO 1 To understand the basics and functions of Production and Operation Management for business owners.

CO 2 To learn about the Production & Operation Systems.

CO 3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.

CO 4 To known about the Production & Operations Management Processes in organisations.

CO 5 To comprehend the techniques of controlling, Production and Operations in industries.
REFERENCES

OMG355 MULTIVARIATE DATA ANALYSIS

OBJECTIVE:
- To know various multivariate data analysis techniques for business research.

UNIT I INTRODUCTION
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS
Conceptualization of research model with variables, collection of data – Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS
Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. Approaches to factor analysis – interpretation of results.

UNIT IV LATENT VARIABLE TECHNIQUES
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V ADVANCED MULTIVARIATE TECHNIQUES
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL: 45 PERIODS

OUTCOMES:
- Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.
- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
- Make better business decisions by using advanced techniques in data analytics.
REFERENCES:

OME352 ADDITIVE MANUFACTURING

COURSE OBJECTIVES:
- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
- To be acquainted with vat polymerization and material extrusion processes
- To be familiar with powder bed fusion and binder jetting processes.
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies.

UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY
Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

COURSE OUTCOMES:
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.
CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

REFERENCES:

CME343 NEW PRODUCT DEVELOPMENT L T P C
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COURSE OBJECTIVES
1. To introduce the fundamental concepts of the new product development
2. To develop material specifications, analysis and process.
3. To Learn the Feasibility Studies & reporting of new product development.
4. To study the New product qualification and Market Survey on similar products of new product development.
   To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model.

UNIT – I FUNDAMENTALS OF NPD 9

UNIT – II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing
process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis, ), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT – III  ESSENTIALS OF NPD

UNIT – IV  CRITERIONS OF NPD
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT – V  REPORTING & FORWARD-THINKING OF NPD
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

OUTCOMES: At the end of the course the students would be able to
1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:
1. Product Development – Sten Jonsson
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
5. Product Design & Value Engineering – Dr. M.A. Bulsara & Dr. H.R. Thakkar

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OBJECTIVES:
The course aims to
- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I  
UI/UX  
9

UNIT II  
APP DEVELOPMENT  
9
SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup - Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III  
INDUSTRIAL DESIGN  
9
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV  
MECHANICAL RAPID PROTOTYPING  
9
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V  
ELECTRONIC RAPID PROTOTYPING  
9
Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, learners will be able to:
- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction / product feature
- Develop 3D models for prototyping various product ideas
- Built prototypes using Tools and Techniques in a quick iterative methodology

TEXT BOOKS

REFERENCES

MF3010 MICRO AND PRECISION ENGINEERING

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS:
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.

UNIT IV PRECISION MACHINING PROCESSES
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS
Metrology for micro systems - Surface integrity and its characterization.

257
COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

TEXT BOOKS:

REFERENCES:

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS

COURSE OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT – I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT – II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

UNIT – III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing
UNIT – IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9

UNIT – V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

REFERENCES:

AU3002  BATTERIES AND MANAGEMENT SYSTEM  L T P C  3 0 0 3

COURSE OBJECTIVES:
- The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management.

UNIT I  ADVANCED BATTERIES  9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.

UNIT II  BATTERY PACK  9
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.
UNIT III BATTERY MODELLING
Battery Modelling Methods- Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frameworks

UNIT IV BATTERY STATE ESTIMATION

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

AU3008 SENSORS AND ACTUATORS
L T P C 3 0 0 3

COURSE OBJECTIVES:
- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS
UNIT II VARIABLE RESISTANCE AND INDUCTANCE SENSORS
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers: EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment’s for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of these sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

TEXT BOOKS:

REFERENCES:

OAS353 SPACE VEHICLES

OBJECTIVES:
- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
• To deploy the skills effectively in the understanding of space vehicle configuration design.
• To explain Engine system and support of space vehicle
• To interpret nose cone configuration of space vehicle

UNIT I FUNDAMENTAL ASPECTS
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION

UNIT IV THRUST VECTOR CONTROL
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

UNIT V NOSE CONE CONFIGURATION
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
• Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
• Apply knowledge in selecting the appropriate rocket propulsion systems.
• Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
• Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
• Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352 MANAGEMENT SCIENCE

COURSE OBJECTIVES:
Of this course are
• To introduce fundamental concepts of management and organization to students.
• To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
• To make students familiarize with the concepts of human resources management.
• To acquaint students with the concepts of project management and cost analysis.
• To make students familiarize with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION
Concepts of Management and organization- nature, importance and Functions of Management,

UNIT II OPERATIONS AND MARKETING MANAGEMENT 9
Principles and Types of Plant Layout-Methods of Production (Job, batch and Mass Production), Work Study - Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering (BPR) - Statistical Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on Product Life Cycle.

UNIT III HUMAN RESOURCES MANAGEMENT 9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels.

UNIT IV PROJECT MANAGEMENT 9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carryout production operations through Work-study.
CO2: Survey the markets, customers and competition better and price the given products appropriately.
CO3: Ensure quality for a given product or service.
CO4: Plan, schedule and control projects through PERT and CPM.
CO5: Evaluate strategy for a business or service organisation.
TEXTBOOKS:

REFERENCES:

OIM353 PRODUCTION PLANNING AND CONTROL

COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design- Marketing aspect - Functional aspects- Operational aspect- Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing- Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING
UNIT V  INVENTORY CONTROL AND RECENT TRENDS IN PPC

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course,
CO1:The students can able to prepare production planning and control act work study,
CO2:The students can able to prepare product planning,
CO3:The students can able to prepare production scheduling,
CO4:The students can able to prepare Inventory Control.
CO5:They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

REFERENCES
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corp.1984

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COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I  INTRODUCTION TO OPERATIONS MANAGEMENT
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit, framework; Supply Chain Management

UNIT II  FORECASTING, CAPACITY AND FACILITY DESIGN

UNIT III  DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS

UNIT IV  MATERIALS MANAGEMENT

UNIT V  SCHEDULING AND PROJECT MANAGEMENT
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.

CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

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TEXT BOOKS

REFERENCES

OSF352 INDUSTRIAL HYGIENE L T P C
3 0 0 3

COURSE OBJECTIVES:
- Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
- Compare and contrast the roles of environmental and biological monitoring in work health and safety
- Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates
- Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures
- Provide high-level advice on managing and controlling noise and noise-related hazards

UNIT I INTRODUCTION AND SCOPE
9
UNIT II  MONITORING FOR SAFETY, HEALTH & ENVIRONMENT  9
Occupational Health and Environment Safety Management System, ILO and EPA Standards
Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods,
Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal
hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III  OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION  9
Element of training cycle, Assessment of needs. Techniques of training, design and development
of training programs. Training methods and strategies types of training. Evaluation and review of
training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training,
Stress and Safety, Exposure Limit.

UNIT IV  OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT  9
Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process
Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards,
Performance measurements to determine effectiveness of PSM. Importance of Industrial safety,
role of safety department.

UNIT V  INDUSTRIAL HAZARDS  9
i. Radiation: Types and effects of radiation on human body, Measurement and detection of
radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive
waste, Control of radiation. ii. Noise and Vibration: Sources, and its control, Effects of noise on the
auditory system and health, Measurement of noise, Different air pollutants in industries, Effect of
different gases and particulate matter, acid fumes, smoke, fog on human health. Vibration: effects.

COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing
systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment
design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with
respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

TOTAL PERIODS: 45

TEXT BOOKS:
1. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems,
   Khanna publishers, New Delhi (2006)

REFERENCES:
   Jourdan publication
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,
   India
   Ltd., London
5. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems,
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OSF353 CHEMICAL PROCESS SAFETY L T P C 3 0 0 3

COURSE OBJECTIVES

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES

- Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS

- Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways. Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS

- Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.
UNIT IV  SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS

Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards - standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures - condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V  SAFETY AND ANALYSIS

Safety vs reliability - quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.

CO2 Develop thorough knowledge about safety in the operation of chemical plants.

CO3 Apply the principles of safety in the storage and handling of gases.

CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.

CO5 Develop thorough knowledge about

TEXT BOOK


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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of various materials used in electrical, electronics and magnetic applications
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application
4. Knowing the fundamental concepts in Semiconducting materials
5. Getting equipped with the materials used in optical and optoelectronic applications.

UNIT - I  DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials.

UNIT – II  MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT – III  SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT – IV  MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetallic fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V  OPTICAL AND OPTOELECTRONIC MATERIALS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Select suitable materials for electrical engineering applications.
5. Identify right material for optical and optoelectronic applications

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OML353 NANOMATERIALS AND APPLICATIONS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.
UNIT IV  STRUCTURAL CHARACTERISTICS
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis.

UNIT V  APPLICATIONS
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

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TOTAL: 45 PERIODS
COURSE OBJECTIVES:
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT – I \text{SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES}\hspace{2em} 9

UNIT – II \text{DISPLACEMENT, PROXIMITY AND RANGING SENSORS}\hspace{2em} 9

UNIT – III \text{FORCE, MAGNETIC AND HEADING SENSORS}\hspace{2em} 9

UNIT – IV \text{OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS}\hspace{2em} 9

UNIT – V \text{SIGNAL CONDITIONING}\hspace{2em} 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.
Mapping of COs with POs and PSOs

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TEXT BOOKS

REFERENCES

ORA352 CONCEPTS IN MOBILE ROBOTS

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

UNIT – II KINEMATICS
UNIT – III  
PERCEPTION  

UNIT – IV  
LOCALIZATION  

UNIT – V  
PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS  

TOTAL: 45 PERIODS

COURSE OUTCOMES: 
Upon completion of this course, the students will be able to:  
CO1: Evaluate the appropriate mobile robots for the desired application.  
CO2: Create the kinematics for given wheeled and legged robot.  
CO3: Analyse the sensors for the intelligence of mobile robotics.  
CO4: Create the localization strategies and mapping technique for mobile robot.  
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

REFERENCES:

MV3501  
MARINE PROPULSION  
L T P C  
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COURSE OBJECTIVES: 
1. To impart knowledge on basics of propulsion system and ship dynamic movements  
2. To educate them on basic layout and propulsion equipment’s  
3. To impart basic knowledge on performance of the ship  
4. To impart basic knowledge on Ship propeller and its types  
5. To impart knowledge on ship rudder and its types
UNIT I  BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS

law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II  SHIPS MOVEMENTS AND SHIP STABILIZATION

Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III  SHIPS SPEED AND ITS PERFORMANCE

Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV  BASICS OF PROPELLER


UNIT V  BASICS OF RUDDER

Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:

1. GP. Ghose, “Basic Ship propulsion”,2015

REFERENCES BOOKS:

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OMV351 MARINE MERCHANT VESSELS LT P C 3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS 9

UNIT II TYPES OF SHIP 10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS 9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER 8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY 9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ) , MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352 ELEMENTS OF MARINE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM 9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories
UNIT V  SHIP PROPELLERS AND STEERING MECHANISM  
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

OUTCOMES:  
At the end of the course, students should able to,  
1. Distinguish the role of various marine machinery systems  
2. Relate the components of marine propulsion machinery system  
3. Explain the importance of marine auxiliary machinery system  
4. Acquire knowledge of marine boiler system  
5. Understand the importance of ship propellors and steering system

TEXT BOOKS:  

REFERENCES:  
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006  
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

CRA332  DRONE TECHNOLOGIES  

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COURSE OBJECTIVES:  
1. To understand the basics of drone concepts  
2. To learn and understand the fundaments of design, fabrication and programming of drone  
3. To impart the knowledge of an flying and operation of drone  
4. To know about the various applications of drone  
5. To understand the safety risks and guidelines of fly safely

UNIT – I  INTRODUCTION TO DRONE TECHNOLOGY  
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT – II  DRONE DESIGN, FABRICATION AND PROGRAMMING  
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT – III  DRONE FLYING AND OPERATION  
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications
UNIT – IV DRONE COMMERCIAL APPLICATIONS
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT – V FUTURE DRONES AND SAFETY
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization-Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Createthe programs for various drones

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Average

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS


REFERENCES

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I  FUNDAMENTALS OF GIS  9

UNIT II  SPATIAL DATA MODELS  9

UNIT III  DATA INPUT AND TOPOLOGY  9

UNIT IV  DATA QUALITY AND STANDARDS  9
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V  DATA MANAGEMENT AND OUTPUT  9
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXTBOOKS:

REFERENCES:
CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

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<td>Design/Development of Solutions</td>
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<td>Conduct Investigations of Complex Problems</td>
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<td>PSO 1</td>
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<td>PSO 3</td>
<td>Conceptualization and evaluation of Design solutions</td>
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OAI352     AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT       L T P C

3 0 0 3

OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I   ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT

Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II   AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE

Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).
UNIT III  ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE  9
Entrepreneurship - Essence of managerial knowledge - Management functions - Planning-organizing-Directing-Motivation-ordering-leading-supervision - communication and control -
Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-
leverage ratios, coverage ratios-turnover ratios-Profitability ratios. Agro-based industries-Project-
Project cycle-Project appraisal and evaluation techniques-undiscounted measures-Payback period-proceeds per rupee of outlay, Discounted measures-Net Present Value (NPV)-Benefit-Cost Ratio (BCR)-Internal Rate of Return (IRR) -Net benefit investment ratio (N/K ratio)-sensitivity analysis.

UNIT IV  ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE  9
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNIT V  ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT  9
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

COURSE OUTCOMES
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS

REFERENCES
CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
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<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<td>PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
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<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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OEE353 INTRODUCTION TO CONTROL SYSTEMS L T P C 3 0 0 3

OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems.
- To analyze the stability of linear systems in frequency domain and time domain.
- To develop linear models mainly state variable model and transfer function model.

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS 9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE 9
UNIT III FREQUENCY RESPONSE ANALYSIS
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS

UNIT V STATE VARIABLE ANALYSIS
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL : 45 PERIODS

OUTCOMES:
Ability to
CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

REFERENCES
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.

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<th>PO1</th>
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OCH353 ENERGY TECHNOLOGY

UNIT I INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources
UNIT II  CONVENTIONAL ENERGY  8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III  NON-CONVENTIONAL ENERGY  10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV  BIOMASS ENERGY  10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION  9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.  

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2: Students will excel as professionals in the various fields of energy engineering
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
CO4: Explain the technological basis for harnessing renewable energy sources.
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

REFERENCES
## COURSE ARTICULATION MATRIX

<table>
<thead>
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<th>Course Outcomes</th>
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<th>Program Outcomes</th>
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<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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<td>CO2</td>
<td>Students will excel as professionals in the various fields of energy engineering</td>
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<td>CO3</td>
<td>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>CO4</td>
<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<td>CO5</td>
<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:

- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fischer-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES

OUTCOME:

- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena.

TEXT BOOK:

REFERENCE:
OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 0 3

COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To Introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques.
4. To educate on the components used in distributed control systems.
5. To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION

UNIT II AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/etc)
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards.
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software).

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block (L3).
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

<table>
<thead>
<tr>
<th>CO’s- PO’s &amp; PSO’s MAPPING</th>
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OTT354 BASICS OF DYEING AND PRINTING

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT
UNIT III  DYEING  9

UNIT IV  PRINTING  9
Definition of printing – Difference between printing and dying - Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V  MACHINERIES  9

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry

TEXT BOOKS:

REFERENCES:
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series

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

FT3201  FIBRE SCIENCE  L T P C
3 0 0 3

COURSE OBJECTIVES
- To enable the students to learn about the types of fibre and its properties

UNIT I  INTRODUCTION TO TEXTILE FIBRES  9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and
cultivation of Natural Fibers: Cotton, Silk, Wool - Physical and chemical structure of the above fibres.

UNIT II REGENERATED FIBRES
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel , Tencel

UNIT III SYNTHETIC FIBRES
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V FUNCTIONAL SPECIALITY FIBRES
Properties and end uses: Fibres for medical application – Biodegradable fibres based on PLA, Super absorbent fibres elastomeric fibres, ultra-fine fibres, electros spun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the student would be able to
- Understand the process sequence of various fibres
- Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care 294abelling of apparels

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of the course, the students will be able to Understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and careabelling

TEXT BOOKS:
2 Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

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OPE353 INDUSTRIAL SAFETY L T P C 3 0 0 3

OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.
UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

UNIT IV HAZARDS AND RISK MANAGEMENT 9

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES L T P C

OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I FLUID MECHANICS CONCEPTS 9
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.
UNIT II  
FLOW MEASUREMENTS & MECHANICAL OPERATIONS  
9

UNIT III  
CONDUCTIVE & CONVECTIVE HEAT TRANSFER  
9
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV  
BASICS OF MASS TRANSFER  
9

UNIT V  
MASS TRANSFER OPERATIONS  
9
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

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

- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996
COURSE OBJECTIVES

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I  INTRODUCTION TO PLASTIC MATERIALS
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II  ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III  THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV  MISCELLANEOUS PLASTICS FOR END APPLICATIONS
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbachole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V  PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

COURSE OUTCOMES

- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based onpolyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

TOTAL HOURS: 45
REFERENCES

COURSE OBJECTIVES
- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I  INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS  9

UNIT II  MECHANICAL PROPERTIES  9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III  THERMAL RHEOLOGICAL PROPERTIES  9
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV  ELECTRICAL AND OPTICAL PROPERTIES  9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.
UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE


TOTAL : 45 PERIODS

COURSE OUTCOMES:
- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES:

OEC353 VLSI DESIGN L T P C 3 0 0 3

OBJECTIVES:
- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks.

UNIT I MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics, small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.
UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS

Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TOTAL: 45 PERIODS

TEXTBOOKS

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CBM370 WEARABLE DEVICES L T P C 3 0 0 3

OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS
UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9
Wearability issues - physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements - Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

UNIT IV SMART TEXTILE 9

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9
Medical Diagnostics, Medical Monitoring - Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL PERIODS: 45

TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

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CBM356  MEDICAL INFORMATICS  L T P C 3 0 0 3

PREAMBLE:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I  INTRODUCTION TO MEDICAL INFORMATICS  9
Introduction - Structure of Medical Informatics - Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II  COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING  9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging - nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III  COMPUTERISED PATIENT RECORD  9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology - Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING  9
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS  9
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:
CMG331 FINANCIAL MANAGEMENT

LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

UNIT I
INTRODUCTION TO FINANCIAL MANAGEMENT
- Definition and Scope of Finance Functions
- Objectives of Financial Management
- Profit Maximization and Wealth Maximization
- Time Value of money
- Risk and return concepts.

UNIT II
SOURCES OF FINANCE
- Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III
INVESTMENT DECISIONS
- Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV
FINANCING AND DIVIDEND DECISION
- Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy

UNIT V
WORKING CAPITAL DECISION

TEXT BOOKS

TOTAL : 45 PERIODS
REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332  FUNDAMENTALS OF INVESTMENT  LT P C
3 0 0 3

OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT I  THE INVESTMENT ENVIRONMENT  9
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II  FIXED INCOME SECURITIES  9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III  APPROACHES TO EQUITY ANALYSIS  9
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV  PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES  9
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V  INVESTOR PROTECTION  9
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I  INTRODUCTION TO INDIAN BANKING SYSTEM  9
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer – Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II  MANAGING BANK FUNDS/ PRODUCTS  9

UNIT III  DEVELOPMENT IN BANKING TECHNOLOGY  9

UNIT IV  FINANCIAL SERVICES  9

UNIT V  INSURANCE  9

REFERENCES :

TOTAL : 45 PERIODS
UNIT II  INTRODUCTION TO CRYPTOCURRENCY

UNIT III  ETHEREUM
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV  WEB3 AND HYPERLEDGE

UNIT V  EMERGING TRENDS

REFERENCES:
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335  FINTECH PERSONAL FINANCE AND PAYMENTS

UNIT I  CURRENCY EXCHANGE AND PAYMENT

UNIT II  DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III  INSURETECH
InsurTech Introduction , Business model disruption AI/ML in InsurTech ● IoT and InsurTech ● Risk Modeling ●Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV  PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

TOTAL: 45 PERIODS
UNIT V REGULATORY ISSUES


REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336 INTRODUCTION TO FINTECH

OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY


UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL : 45 PERIODS

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

VERTICAL 2: ENTREPRENEURSHIP

CMG337 FOUNDATIONS OF ENTREPRENEURSHIP

COURSE OBJECTIVES
- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
- To empower the learners to run a Technology driven business efficiently and effectively

UNIT I INTRODUCTION TO ENTREPRENEURSHIP
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends
UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship -- Success Stories of Technopreneurs - Case Studies

UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunites in Industries relating to Technopreneurship
CO 4 Learn about applications of tehnprenreurship and successful technoprenours
CO 5 Acquaint with the recent and emerging trends in entrepreneruship

TEXT BOOKS:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES
• To develop and strengthen the Leadership qualities and motivation of learners.
• To impart the Leadership skills and traits essential to become successful entrepreneurs.
• To apply the principles and theories of Team Building in managing Technology oriented businesses.
• To empower the learners to build robust teams for running and leading a business efficiently and effectively

TOTAL45 : PERIODS
UNIT I  INTRODUCTION TO MANAGING TEAMS  9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development -  
Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams -  
Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS  9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and  
team development - Experiential Learning - Coaching and Mentoring in team building - Building  
High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team  
Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP  9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation -  
Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership -  
Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS  9
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational  
Leadership Model - Contingency Model and Path Goal Theory – Transactional and  
Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS  9
Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership -  
Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management -  
Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

OUTCOMES:  
Upon completion of this course, the student should be able to:  
CO 1 Learn the basics of managing teams for business.  
CO 2 Understand developing effective teams for business management.  
CO 3 Understand the fundamentals of leadership for running a business.  
CO 4 Learn about the importance of leadership for business development.  
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.”

REFERENCES:  
COURSE OBJECTIVES

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT I CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities-Quality of Creativity- Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION

UNIT IV INNOVATION AND ENTREPRENEURSHIP

UNIT V INNOVATIVE BUSINESS MODELS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

SUGGESTED READINGS:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.
COURSE OBJECTIVES:
- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

UNIT II MARKETING ENVIRONMENT 9

UNIT III PRODUCT AND PRICING MANAGEMENT 9

UNIT IV PROMOTION AND DISTRIBUTUION MANAGEMENT 9

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

TOTAL 45 : PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to :
CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.
REFERENCES:

CMG341 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS L T P C 3 0 0 3

OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM

UNIT II HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V CONTROLLING HUMAN RESOURCES

TOTAL 45 : PERIODS

OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.
REFERENCES

CMG342 FINANCING NEW BUSINESS VENTURES

COURSE OBJECTIVES
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE

UNIT II INTRODUCTION TO VENTURE FINANCING

UNIT III SOURCES OF DEBT FINANCING

UNIT IV SOURCES OF EQUITY FINANCING
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
CO 1  Learn the basics of starting a new business venture.
CO 2  Understand the basics of venture financing.
CO 3  Understand the sources of debt financing.
CO 4  Understand the sources of equity financing.
CO 5  Acquaint with the methods of fund raising for new business ventures.
REFERENCES :
1) Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION L T P C
3 0 0 3

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS
REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344  CONSTITUTION OF INDIA  L T P C 3 0 0 3

UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345  PUBLIC PERSONNEL ADMINISTRATION  L T P C 3 0 0 3

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems
UNIT-II
1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India's Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS

CMG346 ADMINISTRATIVE THEORIES L T P C
3 0 0 3

UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT II
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker

TOTAL: 45 PERIODS
REFERENCES:
1. Crozior M: The Bureaucratic phenomenon (Chand)
3. Prestrhus. R: The Organizational Society (MAC)
5. Keith Davis: Organization Theory (MAC)

CMG347 INDIAN ADMINISTRATIVE SYSTEM

UNIT I
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV
Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

TOTAL: 45 PERIODS

REFERENCES:
1. S.R. Maheswari: Indian Administration
2. Khera. S.S: Administration in India
3. Ramesh K. Arora: Indian Public Administration
4. T.N. Chaturvedi: State administration in India
5. Basu, D.D: Introduction to the Constitution of India

CMG348 PUBLIC POLICY ADMINISTRATION

UNIT-I

UNIT-II
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT-III
UNIT-IV
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

REFERENCES:
4. Pradeep Saxena : Public Policy Administration and Development

VERTICAL 4: BUSINESS DATA ANALYTICS

CMG349 STATISTICS FOR MANAGEMENT L T P C 3 0 0 3

OBJECTIVE:
➢ To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION 9
Basic definitions and rules for probability, Baye’s theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION 9
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS 9
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS 9

UNIT V CORRELATION AND REGRESSION 9

TOTAL:45 PERIODS
OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems.
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments.
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

CMG350 DATAMINING FOR BUSINESS INTELLIGENCE

OBJECTIVES:
- To know how to derive meaning form huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms.
REFERENCES:
1. Jaiwei Han and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011

CMG351 HUMAN RESOURCE ANALYTICS L T P C 3 0 0 3

OBJECTIVE:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I - INTRODUCTION TO HR ANALYTICS 9
People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business – HR metrics and KPIs.

UNIT II - HR ANALYTICS I: RECRUITMENT 9
Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio - Quality of hire.

UNIT III - HR ANALYTICS - TRAINING AND DEVELOPMENT 9
Training & Development Metrics: Percentage of employees trained - Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV - HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - Employee tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT 9
Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS
OUTCOME:
- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS

OBJECTIVE:
- To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media - Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

TOTAL: 45 PERIODS
REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

CMG353 OPERATIONS AND SUPPLY CHAIN ANALYTICS

OBJECTIVE:
- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I INTRODUCTION
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains - Basics, transforming supply chains.

UNIT II WAREHOUSING DECISIONS
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III INVENTORY MANAGEMENT
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS

UNIT V MCDM MODELS
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
- To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:
OBJECTIVE:
- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I  CORPORATE FINANCE ANALYSIS  9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II  FINANCIAL MARKET ANALYSIS  9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III  PORTFOLIO ANALYSIS  9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV  TECHNICAL ANALYSIS  9

UNIT V  CREDIT RISK ANALYSIS  9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOME
- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

OBJECTIVE:
- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
UNIT I  SUSTAINABLE DEVELOPMENT GOALS

UNIT II  SUSTAINABLE INFRASTRUCTURE PLANNING

UNIT III  SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management; precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT IV  SUSTAINABLE CONSTRUCTION MATERIALS

UNIT V  SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer 2005

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CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
### OBJECTIVES

- To impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

### UNIT I  INTRODUCTION TO BIOMATERIALS  

### UNIT II  BIO POLYMERS  
Molecular structure of polymers -Molecular weight - Types of polymerization techniques--Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polyactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan-reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

### UNIT III  BIO CERAMICS AND BIOCOMPOSITES  
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)--glass ceramics - Orthopedic implants-Tissue engineering scaffolds

### UNIT IV  METALS AS BIOMATERIALS  
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals
UNIT V NANOBIOIMATERIALS


TOTAL : 45 PERIODS

OUTCOMES

• Students will gain familiarity with Biomaterials and they will understand their importance.
• Students will get an overview of different biopolymers and their properties
• Students gain knowledge on some of the important Bioceramics and Biocomposite materials
• Students gain knowledge on metals as biomaterials
• Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES

6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY

OBJECTIVES

• To familiarize the students about the challenges and demands of energy sustainability
• To provide fundamental knowledge about electrochemical devices and the materials used.
• To introduce the students to various types of fuel cell
• To enable students to appreciate novel materials and their usage in photovoltaic application
• To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT I SUSTAINABLE ENERGY SOURCES

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy
UNIT II ELECTROCHEMICAL DEVICES

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III FUEL CELLS


UNIT IV PHOTOVOLTAICS


UNIT V SUPERCAPACITORS

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non-Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

OUTCOMES:
- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES:
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

<table>
<thead>
<tr>
<th>COURSE OBJECTIVE:</th>
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</thead>
<tbody>
<tr>
<td>To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.</td>
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<tr>
<td>To provide green engineering solutions to energy demand, reduced energy footprint.</td>
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<thead>
<tr>
<th>UNIT I</th>
<th>PRINCIPLES OF GREEN CHEMISTRY</th>
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</thead>
<tbody>
<tr>
<td>9</td>
<td>Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.</td>
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<thead>
<tr>
<th>UNIT II</th>
<th>POLLUTION TYPES</th>
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<tbody>
<tr>
<td>9</td>
<td>Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.</td>
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<thead>
<tr>
<th>UNIT III</th>
<th>GREEN REAGENTS AND GREEN SYNTHESIS</th>
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<tbody>
<tr>
<td>9</td>
<td>Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions</td>
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<tr>
<th>UNIT IV</th>
<th>DESIGNING GREEN PROCESSES</th>
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<tbody>
<tr>
<td>9</td>
<td>Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention</td>
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<tr>
<th>UNIT V</th>
<th>GREEN NANOTECHNOLOGY</th>
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<tbody>
<tr>
<td>9</td>
<td>Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology</td>
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</tbody>
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| TOTAL: 45 PERIODS |

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<thead>
<tr>
<th>COURSE OUTCOMES</th>
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<tbody>
<tr>
<td>CO1: To understand the principles of green engineering and technology</td>
</tr>
<tr>
<td>CO2: To learn about pollution using hazardous chemicals and solvents</td>
</tr>
<tr>
<td>CO3: To modify processes and products to make them green and safe.</td>
</tr>
<tr>
<td>CO4: To design processes and products using green technology</td>
</tr>
<tr>
<td>CO5 – To understand advanced technology in green synthesis</td>
</tr>
</tbody>
</table>
TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS L T P C 3 0 0 3

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS 9

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS 9

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT 9

UNIT V AUTOMATED DATA ACQUISITION AND PROCESSING 9
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS
COURSE OUTCOMES
After completion of this course, the students will know

| CO1 | Basic concepts of environmental standards and monitoring. |
| CO2 | the ambient air quality and water quality standards; |
| CO3 | the various instrumental methods and their principles for environmental monitoring |
| CO4 | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5 | the various ways of raising environmental awareness among the people. |
| CO6 | Know the standard research methods that are used worldwide for monitoring the environment. |

TEXTBOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc.

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

Course Articulation Matrix

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>PO 1</td>
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<tr>
<td>CO2</td>
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<td>CO3</td>
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<td>CO4</td>
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<td>CO5</td>
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<tr>
<td>CO6</td>
<td>3</td>
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<tr>
<td>Over all</td>
<td>3</td>
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CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development
UNIT I  ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II  ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III  SUSTAINABLE DEVELOPMENT

UNIT IV  RENEWABLE ENERGY TECHNOLOGY

UNIT V  ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy
COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

REFERENCES: