1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)
   a) To produce employable graduates with the knowledge and competency in Chemical and Electrochemical Engineering
   b) To impart problem solving, analytical skills in the contemporary processes.
   c) To design and develop eco-friendly sustainable technologies with the aid of computational skills
   d) To facilitate the ability to learn, innovate and communicate technical developments for the benefit of humanity
   e) To enable the students to work as teams on multidisciplinary projects with effective communication skills, individual, supportive and leadership qualities
   f) To disseminate the knowledge related to intellectual property ownership rights, ethics, professionalism, entrepreneurship, and their societal impact.

2. PROGRAMME OUTCOMES (POS)
   On successful completion of B. Tech. Chemical and Electrochemical Engineering programme, the graduates of this programme would have following skills

<table>
<thead>
<tr>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tbody>
<tr>
<td>PO1 Engineering knowledge</td>
<td>Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>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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<tr>
<td>PO3 Design / development of solutions</td>
<td>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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<tr>
<td>PO4 Conduct investigations of complex problems</td>
<td>Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.</td>
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<td>PO5</td>
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<td>PO6</td>
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<td>PO11</td>
<td>Project management and finance</td>
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<td>PO12</td>
<td>Life-long learning</td>
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3. **PROGRAM SPECIFIC OUTCOMES (PSOs):**
   By the completion of chemical and electrochemical Engineering Programme the student will have following Program-specific outcomes.

   1. Graduates will have a strong foundation in engineering, science and current Chemical Engineering practices and will have experience in solving structured and unstructured problems using conventional and innovative solutions.
   2. Graduates will be able to effectively describe the Chemical Engineering problem, analyze the data, develop potential solutions, evaluate these solutions, and present the results using their oral, written and electronic media skills.
   3. Graduates will have an understanding of ethical and professional responsibilities of an engineer and the impact of engineering solutions on society and the global environment.
4. PEOs / POs Mapping

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1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

4. PEOs / POs & PSO Mapping

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1-Low, 2-Medium, 3-High, "-"-no correlation
ANNA UNIVERSITY, CHENNAI  
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES  
REGULATIONS 2021  
CHOICE BASED CREDIT SYSTEM  
B.TECH. CHEMICAL AND ELECTROCHEMICAL ENGINEERING  
CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS  
SEMESTER I

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**TOTAL**  16  1  10  27  22

$ Skill Based Course

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**TOTAL**  17  1  16  30  26

$ 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

### Semester VI

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

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

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

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

#### THEORY

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**Total**: 17 0 4 21 21

*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 credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

### SEMESTER VIII/ VII

#### PRACTICALS

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**Total**: 0 0 20 20 10

*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 are offered as Non-Credit Courses*

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*Mandatory Courses are offered as Non-Credit Courses*

**PROFESSIONAL ELECTIVE COURSES**

**VERTICALS**

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<th>Vertical I Advanced Electrochemical Processes</th>
<th>Vertical II Diversified Courses</th>
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<td>Electrochemical Process Technology</td>
<td>Air Pollution and Control Engineering</td>
</tr>
<tr>
<td>Corrosion Science and Engineering</td>
<td>Energy Conservation and Management</td>
</tr>
<tr>
<td>Electrochemical Energy Conversion and Storage</td>
<td>Design of Experiments</td>
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<tr>
<td>Advanced Electrochemical Energy Storage Systems</td>
<td>Selection of Materials</td>
</tr>
<tr>
<td>Industrial Metal Finishing</td>
<td>Testing of Materials</td>
</tr>
<tr>
<td>Cathodic Protection and Electrophoretic Coatings</td>
<td>Industrial Safety in chemical industries</td>
</tr>
<tr>
<td>Electrometallurgy and Thermics</td>
<td>Renewable Energy Sources</td>
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<tr>
<td>Electrochemical Materials Science</td>
<td>Control Systems Engineering</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)
### VERTICAL I - ADVANCED ELECTROCHEMICAL PROCESSES

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OPEN ELECTIVES

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

OPEN ELECTIVE I AND II
(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

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OPEN ELECTIVES – III

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166
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.

**Verticals FOR MINOR DEGREE** (in additions to all the verticals of other programmes)

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<td>-</td>
<td>Energy Efficiency for Sustainable Development</td>
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(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)
### VERTICAL 1: FINTECH AND BLOCK CHAIN

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<tr>
<th>SL. NO.</th>
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<tr>
<td>1.</td>
<td>CMG331</td>
<td>Financial Management</td>
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<td>Fundamentals of Investment</td>
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<td>3.</td>
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<td>Banking, Financial Services and Insurance</td>
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<td>4.</td>
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<td>Introduction to Blockchain and its Applications</td>
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### VERTICAL 2: ENTREPRENEURSHIP

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<td>Foundations of Entrepreneurship</td>
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<td>Team Building &amp; Leadership Management for Business</td>
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<td>3.</td>
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<td>Creativity &amp; Innovation in Entrepreneurship</td>
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<td>4.</td>
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<td>Principles of Marketing Management For Business</td>
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<td>Human Resource Management for Entrepreneurs</td>
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<td>Administrative Theories</td>
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<td>Indian Administrative System</td>
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<td>6.</td>
<td>CMG348</td>
<td>Public Policy Administration</td>
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### VERTICAL 4: BUSINESS DATA ANALYTICS

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### VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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<td>CES333</td>
<td>Sustainable Bio Materials</td>
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<td>4.</td>
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<td>Materials for Energy Sustainability</td>
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<td>Green Technology</td>
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<td>6.</td>
<td>CES336</td>
<td>Environmental Quality Monitoring and Analysis</td>
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<td>7.</td>
<td>CES337</td>
<td>Integrated Energy Planning for Sustainable Development</td>
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<td>8.</td>
<td>CES338</td>
<td>Energy Efficiency for Sustainable Development</td>
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IP3151  INDUCTION PROGRAMME
This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

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

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

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

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

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

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

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

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

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

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

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

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

(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

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<td>PROFESSIONAL ENGLISH I</td>
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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 9
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 II DESCRIPTION OF A PROCESS / PRODUCT 9
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 9
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 9
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

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<td>COURSE OBJECTIVES:</td>
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<tr>
<td>• To develop the use of matrix algebra techniques that is needed by engineers for practical applications.</td>
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<td>• To familiarize the students with differential calculus.</td>
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<td>• To familiarize the student with functions of several variables. This is needed in many branches of engineering.</td>
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<td>• To make the students understand various techniques of integration.</td>
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<tr>
<td>• To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.</td>
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UNIT I MATRICES 9+3

UNIT II DIFFERENTIAL CALCULUS 9+3

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

UNIT IV INTEGRAL CALCULUS 9+3
Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 9+3

TOTAL: 60 PERIODS
COURSE OUTCOMES:
At the end of the course the students will be able to
- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- 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:

CO-PO & PSO MAPPING

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1-low, 2-medium, 3-high, "-": no correlation

PH3151 ENGINEERING PHYSICS L T P C
3 0 0 3

COURSE OBJECTIVES
- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.
UNIT I   MECHANICS  9

UNIT II   ELECTROMAGNETIC WAVES  9
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  9

UNIT IV   BASIC QUANTUM MECHANICS  9
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V   APPLIED QUANTUM MECHANICS  9
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch’s theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

COURSE OUTCOMES
After completion of this course, the students should be able to
• Understand the importance of mechanics.
• Express their knowledge in electromagnetic waves.
• Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
• Understand the importance of quantum physics.
• 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:

### 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.

### CY3151 ENGINEERING CHEMISTRY

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

#### UNIT I WATER AND ITS TREATMENT


#### UNIT II NANOCHEMISTRY

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

#### UNIT III PHASE RULE AND COMPOSITES

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

#### UNIT IV FUELS AND COMBUSTION

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum
and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO2 emission and carbon footprint.

UNIT V ENERGY SOURCES AND STORAGE DEVICES
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles; working principles; Fuel cells: H2-02 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:

- To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To apply the knowledge of phase rule and composites for material selection requirements.
- To recommend suitable fuels for engineering processes and applications.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

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

UNIT I: COMPUTATIONAL THINKING AND PROBLEM SOLVING

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

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

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

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

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

TOTAL : 15 PERIODS

UNIT I LANGUAGE AND LITERATURE
in Tamil Land - Bakthi Literature Azhvars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

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

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. டவுன்புறம் மாநிலம் – மத்திய முரண்புத்து கல்விக் கட்டுரை (திருக்காவின்: டவுன்புறம் மாநிலம் முரண்புத்து கல்விக் கட்டுரை).
2. காற்றைச் செல்வு – செல்வு குவுரு காற்றை (மலையில் பொல்லால்).
3. பொருத்தம் – கோவில் துவக்குகளுக்கு முன் ஆனால் செல்வு துவக்குகள் (திருக்காவின் குறல் பொருத்தம்).
4. போஸ்குரை – போஸ்குரைக்கு துவக்குகள். (திருக்காவின் குறல் பொருத்தம்)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNB & 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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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)

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

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

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation)
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

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

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/
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BS3171  
PHYSICS AND CHEMISTRY LABORATORY  
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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

OUTCOMES:
Upon completion of the course, the students should be able to
- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.
### CHEMISTRY LABORATORY: (Any seven experiments)

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

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

1. Preparation of Na$_2$CO$_3$ as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler’s method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
13. Preparation of nanoparticles (TiO$_2$/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

**TOTAL: 30 PERIODS**

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

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

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

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

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

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.

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

HS3252  
PROFESSIONAL ENGLISH -II  
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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

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

TOTAL : 30 PERIODS

OUTCOMES:
At the end of the course, learners will be able
- To compare and contrast products and ideas in technical texts.
- To identify 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. CO-PO & PSO MAPPING
2. 1-low, 2-medium, 3-high, "-" no correlation
3. Note: The average value of this course to be used for program articulation matrix.
MA3251  STATISTICS AND NUMERICAL METHODS  L  T  P  C
3 1 0 4

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

UNIT I  TESTING OF HYPOTHESIS  9+3
Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II  DESIGN OF EXPERIMENTS  9+3
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2² factorial design.

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  9+3

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

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3

TOTAL: 60 PERIODS

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

TEXT BOOKS:

REFERENCES:

CO-PO & PSO MAPPING

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

PH3258  PHYSICS OF MATERIALS  

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

UNIT I  PREPARATION OF MATERIALS  9

UNIT II  ELECTRICAL PROPERTIES OF MATERIALS  9
UNIT III SEMICONDUCTING PROPERTIES MATERIALS

UNIT IV DIELECTRIC AND MAGNETIC MATERIALS

UNIT V NEW MATERIALS AND APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students should be able to
- acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
- familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
- gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
- realize with theories and applications of dielectric and ferromagnetic materials
- familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

TEXT BOOKS:

REFERENCES:
BE3252  BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING

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

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 domestic 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

REFERENCES:

CO’s, PO’s & PSO’s MAPPING

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

GE3251 ENGINEERING GRAPHICS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

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

REFERENCES:

**Publication of Bureau of Indian Standards:**

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

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**CO-PO & PSO MAPPING**

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

**CH3251 INTRODUCTION TO CHEMICAL ENGINEERING**

**COURSE OBJECTIVES:**
- To acquaint the students with the fundamentals of Chemical Engineering and to build their perspective in a wholesome manner

**UNIT I INTRODUCTION**
Chemical Engineering in day to life with examples, Origin and growth of chemical Engineers in chemical process industries, unit operations and unit processes concepts, scaling up or down, units and dimensions, application of mathematics in chemical Engg, recent developments in chemical process industries

**UNIT II INTRODUCTION TO MATERIAL AND ENERGY BALANCES**
Basic concepts of material and energy balances, energy and mass transport, and kinetics of chemical reactions. Introduction to heat and mass transfer. Process flow sheeting and symbols.

**UNIT III FLUID FLOW**

**UNIT IV CHEMICAL ENGINEERING COMPUTER SOFTWARE TOOLS AND APPLICATIONS**
Introduction to Process Engineering Design Software (HYSYS and PRO II), Computations Using Microsoft Excel, Computer-Aided Design & Drafting, Piping and Equipment Design Software
UNIT V CAREER DIVERSITIES IN CHEMICAL ENGINEERING

Career Development Leading to Specialization, Chemical Engineering Job Titles/Options, Chemical and Process Engineers, Commissioning Engineer, Process Control/Automation Engineer, Process Safety Engineer, Research & Development Engineer Pharmaceutical Engineer/Pharmaceutical Process Engineer, Pipeline Engineer Chemical Manufacturing Engineer, Environment Engineer

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, student should be able to:
CO1. Correlate day to day like with the principles of chemical Engineering.
CO2. Assess the mass and energy involved in any chemical plant.
CO3. Have an insight into areas where Chemical Engineering plays major role.
CO4. Carry out modelling and simulation using software tools.
CO5. Identify their right future.
CO6: Gain confidence and outline about the programme as a whole.

TEXT BOOKS:

REFERENCES:
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1, 2, and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) - A joint publication of TNTB & ESC and RMRL (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

TOTAL : 15 PERIODS
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)

GE3252 TAMILS AND TECHNOLOGY

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

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

UNIT III MANUFACTURING TECHNOLOGY

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. சுத்துற்காந்தசுந்தரம் - செத்தாண்டதம்பாலியின் - கு.து. பின்னைலாசா (சுத்துற்காந்தசுந்தரம் பாண்டம் பதிவுக்கும் நோல் பதிப்பு)
2. சுத்துற்காந்தசுந்தரம் - செத்தாண்டதம்பாலியின் (சுத்துற்காந்தசுந்தரம் பதிவு)
3. திருவிதாங்கம் - திருவிதாங்கம் கும்பு கொண்ட தமிழ் (திருவிதாங்கம் கும்பு கொண்ட தமிழ்)
4. மதுரை - மதுரைக் கோட்டைப் பாண்டம் (மதுரைக் கோட்டைப் பாண்டம்)
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).
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8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:
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)


### NCC Credit Course Level 1*

NX3251 (ARMY WING) NCC Credit Course Level - I

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**TOTAL : 30 PERIODS**
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NX3252  (NAVAL WING) NCC Credit Course Level - I

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TOTAL: 30 PERIODS

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

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50
The main learning objective of this course is to provide hands on training to the students in:

1. 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.
2. Wiring various electrical joints in common household electrical wire work.
3. 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.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.
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 PRACTICES  

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

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

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

SHEET METAL WORK:  
a) Making of a square tray

FOUNDRY WORK:  
a) Demonstrating basic foundry operations.

PART IV  
ELECTRONIC ENGINEERING PRACTICES  

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

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

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

TOTAL : 60 PERIODS

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

- 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.
- Wire various electrical joints in common household electrical wire work.
- Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
- Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
BE3272 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION  
ENGINEERING LABORATORY  
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COURSE OBJECTIVES:
- To train the students in conducting load tests electrical machines
- To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers
- To train the students to measure three phase power and displacement

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

TOTAL: 60 PERIODS

OUTCOMES:
After completing this course, the students will be able to
CO1: Use experimental methods to verify the Ohm's law and Kirchhoff's Law and to measure three phase power
CO2: Analyze experimentally the load characteristics of electrical machines
CO3: Analyze the characteristics of basic electronic devices
CO4: Use LVDT to measure displacement

CO's, PO's & PSO's MAPPING

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1-low, 2-medium, 3-high, "-" no correlation
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- 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.

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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TOTAL: 60 PERIODS
MA3356  DIFFERENTIAL EQUATIONS

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OBJECTIVES

- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.
- To understand the finite methods for time dependent partial differential equations.

UNIT I  ORDINARY DIFFERENTIAL EQUATIONS

Higher order linear differential equations with constant coefficients – Particular integrals: Operator methods, Method of variation of parameters, Methods of undetermined coefficients – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II  PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations - Lagrange’s linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT III  NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS


UNIT IV  FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS

Laplace and Poisson’s equations in a rectangular region: Five point finite difference schemes, Leibmann’s iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes.

UNIT V  FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – First order hyperbolic equations – method of characteristics, different explicit and implicit methods; Wave equation: Explicit scheme- Stability of above schemes.

TOTAL: 60 PERIODS

OUTCOMES

Upon successful completion of the course, students will be able to:
- Apply various methods of solving differential equation which arise in many application problems.
• Understand how to solve the given standard partial differential equations.
• 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.
• Familiar with various methods to solve time dependent partial differential equations.

**TEXT BOOKS**

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OBJECTIVE:
- To impart knowledge on laws of chemistry and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

UNIT I
9
Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II
9
Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT III
9
Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT IV
9
Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy, Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction - Unsteady state energy balances

UNIT V
9
Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students would
- Understand the concepts of dimensional consistency and effective application of units and dimensions.
- Analyze a problem statement and balance the material flowing through single and various operations
- Understand the gas behavior and its properties.
- Understand general energy balance, simplify and apply to open and closed systems
- Write material and energy balance for unsteady state how material and energy balances are formulated for equation- and modular based flow sheeting codes

TEXT BOOKS:

REFERENCE:
### Course Articulation Matrix

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<tr>
<th>Course Outcomes</th>
<th>Statements</th>
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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 learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger.

UNIT I  CONDUCTION

UNIT II  CONVECTION

UNIT III  CONDENSATION & BOILING

UNIT IV  HEAT EXCHANGE EQUIPMENTS

UNIT V  RADIATION & EVAPORATION

OUTCOME:
- Understand heat transfer by conduction in solids for steady state
- Understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows
- Understand heat transfer from condensing vapors and mechanisms of boiling
- Understand he design of heat exchange equipments
- Understand evaporation radiative heat transfer including blackbody radiation

TOTAL: 45 PERIODS

TEXT BOOKS:

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Course articulation matrix:

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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To impart the students, the knowledge on fluid properties, fluid static and dynamic characteristics flow metering and transport, particle mechanics, techniques of solid – fluid separation

UNIT I PROPERTIES OF FLUID

UNIT II FLOW THROUGH PIPES & BOUNDARY LAYER CONCEPTS
Reynolds number regimes, Flow through pipes – pressure drop under laminar and turbulent flow conditions; boundary layer concepts; Friction factor, Moody Chart, Flow meters ; different types of flowmeters; Valves, pumps, compressors – characteristics and sizing; Agitation and Mixing;

UNIT III SIZE ANALYSIS
General characteristics of solids, techniques of size analysis; Laws of size reduction, equipments for size reduction

UNIT IV FLOW THROUGH FLUIDIZED BEDS
Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds. Filtration – batch and continuous, filtration equipments - selection, operation

UNIT V CLASSIFIERS
Screening, gravity separation - sedimentation, thickening, elutriation, classifiers - Centrifugal separation - continuous centrifuges, cyclones and hydro cyclones, electrostatic and magnetic separators

OUTCOMES:
- Understand the fundamental properties of fluids and its characteristics , Bernoulli principle, Navier - Stokes equation
- Understand flow through pipes & boundary layer concepts
- Understand characteristics of solids and size analysis
- Understand flow through fluidized beds and filtration equipments
- Understand various separation and purification techniques employed in solid particles

TEXT BOOKS:

REFERENCES:
## COURSE ARTICULATION MATRIX

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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
- To import knowledge on basic principles of electrochemistry and its applications.

UNIT I  ION-SOLVENT & ION-ION INTERACTIONS  9
ion-solvent interaction, Experimental $\Delta H$ and $\Delta$ion-solvent interaction – Expression for verification of Born Model, Ion-dipole model of ion-solvent interaction and expression for heat of solvation, Ion-Ion Interaction – True and Potential electrolytes, Debye-Huckel (ion-cloud) theory of ion-ion interactions, Activity coefficients and ion-ion interaction

UNIT II  ION TRANSPORT IN SOLUTION  9
Diffusion & Diffusion coefficient, Einstein-Smoluchowski equation, Conduction, Molar & Equivalent conductivity, Kohlrausch’s Law, Ionic mobility, Stokes-Einstein relation, Nernst-Einstein equation, Transport numbers – determination by Hittorf’s & Moving Boundary methods – Walden’s rule - Debye Huckel-Onsager equation, Non-aqueous solutions

UNIT III  POLARISATION AND OVER POTENTIAL  9
Electrolytic polarization, Dissolution and Decomposition potential, Overvoltage – hydrogen and oxygen overvoltage, applications, Polarography – principles, diffusion layer, limiting current density, polarographic circuit, dropping mercury electrode, merits & demerits, supporting electrolyte, current maxima, polarograms, half wave potential, diffusion current, applications

UNIT IV  COLLOIDAL ELECTROCHEMISTRY  9
Electrochemical properties of colloids – Charge on colloidal particles, Electrical Double Layer, Cogulation of colloidal sols, Electrokinetic phenomena - Electro-Osmosis – Determination of zeta potential, Electrophoresis – sedimentation potential (Dorn effect), Determination of colloidal particle size, Surfactant, Emulsion, Emulsifiers, gels - Applications

UNIT V  ELECTROACTIVE LAYERS AND MODIFIED ELECTRODES  9
Chemically modified electrodes, Types and methods of modification – chemisorption, covalent bond formation, polymer film coatings, inorganic materials, Langmuir-Blodgett (LB) methods, properties of the modified electrodes, electrochemistry at monolayer and multilayer modified electrodes, characterisation of modified electrodes

TOTAL: 45 PERIODS

OUTCOMES:
- Understand ion-solvent interaction
- Understand ion transport in solution
- Understand he concept of polarisation and over potential
- Understand colloidal electrochemistry
- Understand electrochemistry at monolayer and multilayer modified electrodes and characterisation of modified electrodes

TEXT BOOKS:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
- To impart knowledge on the principle and importance of various analytical instruments used for the characterization of various materials

UNIT I  INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS  9
Electromagnetic radiation: various ranges, dual properties, various energy levels, interaction of photons with matter, absorbance & transmittance and their relationship, permitted energy levels for the electrons of an atom and simple molecules, various electronic transitions in organic and inorganic compounds effected by UV, and visible radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and visible radiations, choice of solvents, cut off wavelengths for solvents

UNIT II  QUALITATIVE ANALYSIS BY UV AND VISIBLE SPECTROCOPY  9
Lamda max and epsilon max rules, Woodward -Fieser rules for the calculation of absorption maxima (Lamda max) for dienes and carbonyl compounds, Effects of auxochromes and effects of conjugation on the absorption maxima, Different shifts of absorption peaks(Bathochromic, hypochromic, hypochromic), Instrumentation for UV and Visible spectrophotometers (source, optical parts and detectors), Applications of UV and Visible spectroscopy.

UNIT III  QUANTITATIVE ANALYSIS BY UV AND VISIBLE SPECTROCOPY  9
Beer-Lambert's law, limitations, deviations (real, chemical, instrumental), estimation of inorganic ions such as Fe, Ni and estimation of nitrite using Beer -Lambert's law, multicomponent analysis (no overlap, single way overlap and two way overlap), photometric titration(experimental set -up and various types of tittations and their corresponding curves).

UNIT IV  IR SPECTROSCOPY  9
Theory of IR spectroscopy, various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (near, mid, finger print and far) and their usefulness, Instrumentation (only the sources and detectors used in different regions), sample preparation techniques, qualitative analysis of alkanes, alkenes and carbonyl compounds.

UNIT V  CHROMATOGRAPHIC METHODS  9
Classification of chromatographic methods, column, thin layer, paper, gas, High Performance Liquid Chromatographical methods (principle, mode of separation and technique).

OUTCOMES:
At the end of this course, the students would
- Understand the fundamentals, concepts and mechanisms involved in spectral analysis.
- Understand the purpose and theories in qualitative analysis
- Understand the purpose and theories in quantitative analysis
- Understand the purpose and theories in IR spectral analysis
- Understand the purpose and theories of chromatographic methods.

TEXT BOOKS :

REFERENCES:
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<tr>
<td>CO5</td>
<td>Understand the purpose and theories of chromatographic methods</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
- To develop skill to use software to create 2D and 3D models.

**List of Exercises using software capable of Drafting and Modeling**
1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg.V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

OUTCOMES:
Upon completion of the laboratory course, the students would have the
- Understand capabilities of software for drafting and modeling
- Able to use the softwares for drafting and modeling
- Able to create 2D and 3D models of Engineering Components
- Able to draw of a plan of residential building and isometric projection of simple objects
- Able to create 3D models of simple objects and obtaining 2D multi-view drawings from 3-D model

**CO-PO & PSO MAPPING**

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1 Understand capabilities of software for drafting and modeling</td>
<td>1  1  3 -  2 - - -  1  1  1  2  3  3  2</td>
</tr>
<tr>
<td>CO2 Able to use the softwares for drafting and modeling</td>
<td>1  1  3 -  2 - - -  1  1  1  2  3  3  2</td>
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<tr>
<td>CO3 Able to create 2D and 3D models of Engineering Components</td>
<td>1  1  2 -  3 - - -  1  1  1  2  3  3  2</td>
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<tr>
<td>CO4 Able to draw of a plan of residential building and isometric projection of simple objects</td>
<td>1  1  3 -  1 - - -  1 -  1  2  3  3 -</td>
</tr>
<tr>
<td>CO5 Able to create 3D models of simple objects and obtaining 2D multi-view drawings from 3-D model</td>
<td>1  1  3 -  2 - - -  1 -  1  2  3  3  2</td>
</tr>
<tr>
<td>OVERALL CO</td>
<td>1  1  3 -  2 - - -  1  1  1  2  3  3  2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
To enable the students to
- Develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.
- Learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

LIST OF EXPERIMENTS
1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Characteristics of batch sedimentation
4. Reduction ratio in Jaw Crusher / Pulverizer / Hammer mill
5. Reduction ratio in Ball mill
6. Reduction ratio of Roll Crusher
7. Size separation using Sub-Sieving
8. Viscosity measurement of non Newtonian fluids
9. Flow through annular pipe
10. Flow through helical coil and spiral coil
11. Pressure drop studies in packed column
12. Hydrodynamics of fluidized bed

Minimum 10 experiments shall be offered

OUTCOME:
Upon completion of the course, the students would have the
- Determine the size analysis in solid-solid separation systems
- Capability to select different solid-fluid separation equipments
- Evaluate the size reduction and various crushing parameters
- Ability to use variable area flow meters and variable head flow meters
- Understand hydrodynamics of packed column fluidized bed columns and its application

Course articulation matrix

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes Statements</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
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<th>PSO2</th>
<th>PSO3</th>
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<td>Determine the size analysis in solid-solid separation systems</td>
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<td>CO2</td>
<td>Capability to select different solid-fluid separation equipments</td>
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<td>Evaluate the size reduction and various crushing parameters</td>
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<tr>
<td>CO5</td>
<td>Understand hydrodynamics of packed column fluidized bed columns and its application</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

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

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

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

TOTAL: 30 PERIODS

OUTCOMES:
On successful completion the students will be able to
- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
MA3451  TRANSFORM TECHNIQUES  L T P C
3 1 0 4

OBJECTIVES:
- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- 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 transform techniques used in wide variety of situations.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- 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  VECTOR CALCULUS  9+3
Gradient and directional derivative – Divergence and curl – Irrotational and solenoidal vector fields – Line integral over a plane curve – Surface integral – Area of a curved surface – Volume integral – Green’s, Gauss divergence and Stoke’s theorems – Verification and applications in evaluating line, surface and volume integrals.

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

UNIT III  FOURIER TRANSFORMS  9+3

UNIT IV  LAPLACE TRANSFORMS  9+3

UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS  9+3

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- 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.
- Understand the mathematical principles on Laplace transforms and would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.
TEXT BOOKS

REFERENCES

CO-PO & PSO MAPPING

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1-low, 2-medium, 3-high, '-'- no correlation
UNIT I  MOLECULAR DIFFUSION  9
Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.

UNIT II  CONVECTIVE TRANSFER AND INTERPHASE MASS TRANSFER  9
Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients.

UNIT III  ABSORPTION  9
Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; determination of height of packing using HTU and NTU calculations.

UNIT IV  DISTILLATION  9
Vapour liquid equilibria - Raoult’s law, Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method, Total reflux, minimum reflux ratio, optimum reflux ratio.

UNIT V  LEACHING & EXTRACTION  9
Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for single stage extraction, multi-stage cross current extraction, multi-stage counter current operation. Solid-liquid equilibria- equilibrium diagram for leaching, single stage leaching, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the fundamentals, types and mechanism of mass transfer operations
CO2: Understand the theories of mass transfer and the concept of inter-phase mass transfer
CO3: Understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process
CO4: Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower
CO5: Apply the ternary equilibrium diagram concepts for separation of liquid-liquid extraction process, Describe core principles of leaching, estimate the number of ideal stages in leaching operation

TEXT BOOKS:

REFERENCES:
## Course articulation matrix

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statements</th>
<th>PO 1</th>
<th>PO 2</th>
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<th>PS O2</th>
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<td>Understand the fundamentals, types and mechanism of mass transfer operations</td>
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<td>Understand the theories of mass transfer and the concept of inter-phase mass transfer</td>
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<tr>
<td>CO3</td>
<td>Understand concept and determine theoretical stages, number of transfer units and height requirements for a gas absorption process</td>
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<tr>
<td>CO4</td>
<td>Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower</td>
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<tr>
<td>CO5</td>
<td>Apply the ternary equilibrium diagram concepts for separation of liquid-liquid extraction process, Describe core principles of leaching, estimate the number of ideal stages in leaching operation</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES:
- To enable the students to gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

UNIT I
Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.

UNIT II
Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, Equal sized CSTRs in series and parallel, Equal sized PFRs in series and parallel, size comparison of reactors.

UNIT III
Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

UNIT IV
Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

UNIT V
The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Understand the kinetics of homogenous reaction
- Understand the reactor arrangement in series and parallel configuration
- Develop performance equation and determine the conversion for different reactors
- Understand the non-isotherm operation of the reactor
- Understand the residence time distribution function and analyze the non-ideality in the reactor.

TEXT BOOKS:

REFERENCE:
## COURSE ARTICULATION MATRIX

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statements</th>
<th>PO 1</th>
<th>PO 2</th>
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<td>Understand the kinetics of homogenous reaction</td>
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<tr>
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<td>Understand the residence time distribution function and analyze the non-ideality in the reactor.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES:

- To enable the students to learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I  
**PVT RELATIONS AND FIRST LAW OF THERMODYNAMICS**  

UNIT II  
**SECOND LAW AND THERMODYNAMIC CORRELATIONS**  

UNIT III  
**SOLUTION THERMODYNAMICS**  
Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures. Activity coefficient-composition models.

UNIT IV  
**PHASE EQUILIBRIA**  
Phase equilibrium in ideal solution, excess Gibbs free energy models, Henry’s law, fugacity, Vapor-Liquid Equilibrium at low, moderate and high pressures; bubble and dew point calculation, thermodynamic consistency test of VLE data, Phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium.

UNIT V  
**REACTION EQUILIBRIA**  
Chemical Reaction Equilibrium of single and multiple reactions, Standard Gibbs free change, equilibrium constant-effect of temperature; homogeneous gas and liquid phase reactions.

COURSE OUTCOMES:

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

- Understand PVT relations and first law of thermodynamics
- Apply second law and analyse the feasibility of system/devices
- Understand the systematic development of new class of properties to describe real mixtures
- Develop the idea of chemical potential to derive the idea of phase equilibria
- Understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion.

TEXT BOOKS:


REFERENCES:

## COURSE ARTICULATION MATRIX

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<th>Course Outcomes</th>
<th>Statements</th>
<th>PO 1</th>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES:

- To impart necessary basic knowledge in order to understand, analyze and solve problems related to electrochemical processes.

UNIT I   ELECTRICAL DOUBLE LAYER

Thermodynamics of ideally polarizable and non-polarizable interfaces- Lipman equation- determination of interfacial tension, charge density, surface excess and double layer capacitance by electro capillary & bridge methods- Helmholtz, Gouy-Chapman and Stern models of the double layer with discussion of potential and charge distribution inside the double layer-contact adsorption and its determination.

UNIT II   ELECTRODE KINETICS

Concepts of equilibrium potential, Nernst equation, overpotential and its different types, equilibrium exchange current density- derivation of Butler-Volmer equation – high field and low field approximations – charge transfer resistance and polarizability of the interface – concepts of rate determining step, Stoichiometric number, reaction order – Determination of kinetics parameters \([ i_0, k_s, \beta(\alpha)]\) by Tafel and linear polarization methods.

UNIT III   ELECTROCATALYSIS


UNIT IV   ELECTROCHEMICAL TECHNIQUES I

Ion selective electrodes – Principles of potentiometry and amperometry- determination of dissolved oxygen. Linear sweep voltammetry and cyclic voltammetry derivation of Randles- Sevciks equation – effect of sweep rate-analysis of cyclic voltammograms.

UNIT V   ELECTROCHEMICAL TECHNIQUES II

Potential step method (chronoamperometry) under diffusion control derivation of Cottrell equation for a planar and spherical electrode- significance of spherical diffusion – derivation of Ilkovic equation.- Chronopotentiometry and analysis of chronopotentiograms-derivation of sands equation for constant current input under linear diffusion- concepts of Faradaic impedance –derivation of kinetic parameters from impedance measurements – Nyquist and bode plots for simple redox reactions-principles of scanning probe techniques-STM-AFM and SECM – working principles of electrochemistry.

COURSE OUTCOMES:

Upon completion of the course,

- Understand the concept of electrical double layer
- Understand the concept of electrode kinetics
- Understand the concept of electrocatalysis
- Understand the principles of potentiometry and amperometry
- Understand the principles of various electrochemical techniques.

TEXT BOOKS:

REFERENCES:
## CO-PO & PSO MAPPING

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
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  6

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

UNIT IV  SUSTAINABILITY AND MANAGEMENT  6
Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millenium 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  6

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.

REFERENCE BOOKS:

CO-PO & PSO MAPPING

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

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

PERSONALITY DEVELOPMENT
PD 3 Group Discussion: Change your mindset, Time Management, Social Skills 6
PD 5 Public Speaking 3

LEADERSHIP
L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965 7

DISASTER MANAGEMENT
DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation 3
DM 2 Initiative Training, Organising Skills, Do’s & Don’ts, Natural Disasters, Man Made Disasters 9
### DM 3
Fire Service & Fire Fighting

### ENVIRONMENTAL AWARENESS & CONSERVATION
- **EA 1** Environmental Awareness and Conservation

### GENERAL AWARENESS
- **GA 1** General Knowledge

### ARMED FORCES
- **AF 1** Armed Forces, Army, CAPF, Police

### ADVENTURE
- **AD 1** Introduction to Adventure Activities

### BORDER & COASTAL AREAS
- **BCA 1** History, Geography & Topography of Border/Coastal areas

**TOTAL: 45 PERIODS**

### NCC Credit Course Level 2*

**NX3452**

(NAVAL WING) **NCC Credit Course Level - II**

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<td>• Enable the students to develop a sound working knowledge on different types of heat transfer equipments and mass transfer equipments.</td>
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<td>12. Double pipe heat exchanger</td>
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<td>TOTAL: 60 PERIODS</td>
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COURSE OUTCOMES:
At the end of the course, the student would be able to

- Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipments
- Estimate the heat transfer rate and heat transfer co-efficient
- To perform heat transfer operation and to compare observed with predicted performance
- Determine the diffusivity practically and compare the results with the empirical correlations
- Evaluate the performance/calculate the parameters in different distillation processes

REFERENCE:

1. Laboratory Manual prepared by Faculty
<table>
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<tr>
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<tr>
<td><strong>Statements</strong></td>
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<tr>
<td>CO1</td>
<td>Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipments</td>
</tr>
<tr>
<td>CO2</td>
<td>Estimate the heat transfer rate and heat transfer co-efficient</td>
</tr>
<tr>
<td>CO3</td>
<td>To perform heat transfer operation and to compare observed with predicted performance</td>
</tr>
<tr>
<td>CO4</td>
<td>Determine the diffusivity practically and compare the results with the empirical correlations</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluate the performance/calculate the parameters in different distillation processes</td>
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<tr>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
EL3412  ELECTROCHEMISTRY LABORATORY

COURSE OBJECTIVES:
- To enable the students to develop a sound working knowledge on different types of electrochemical techniques and electrochemical parameter calculations.

LIST OF EXPERIMENTS
1. Fabrication of Reference electrode (Ag/AgCl) and its validation
2. Fabrication of modified electrodes and calculation of surface excess
3. Potentiometric titration of redox couple (Fe/Ce ions)
4. Estimation of equilibrium potential of quinhydrone electrode (pH dependence)
5. Determination of formal potential and diffusion coefficient for a reversible process using ferricyanide and ferrocyanide
6. Distinguish between inner and outer sphere processes using Pt and glassy carbon electrode
7. Effect of dissolved oxygen in electrochemical reduction of nitrophenol
8. Amperometric method for sensing hydrogen peroxide
9. Determination of dihydroxy phenols using cyclic voltammetry
10. Investigation of electrochromism using electropolymerisation on a ITO substrate
11. Double-layer capacitance measurement using cyclic voltammetry
12. Electrode surface area measurement using a redox probe.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students would be able to
- Acquire knowledge on different types of electrochemical techniques and electrochemical parameter calculations
- Fabrication of various types of electrodes and its validation
- Estimation of equilibrium potential and formal potential of electrodes
- Investigation of electrochromism and capacitance measurement
- Calculate electrochemical parameters from various electrochemical techniques

COURSE ARTICULATION MATRIX

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<thead>
<tr>
<th>Course Outcomes</th>
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<td>CO1 Acquire knowledge on different types of electrochemical techniques and electrochemical parameter calculations</td>
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<td>CO3 Estimation of equilibrium potential and formal potential of electrodes</td>
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<td>CO4 Investigation of electrochromism and capacitance measurement</td>
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<td>CO5 Calculate electrochemical parameters from various electrochemical techniques</td>
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</table>

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

EL3501 ELECTROCHEMICAL REACTION ENGINEERING

OBJECTIVE:
- To familiarize in the aspects of current-voltage relationships & estimation of mass transfer co-efficient, PFR & CSTR systems model

UNIT I CURRENT-VOLTAGE RELATIONSHIPS & ESTIMATION OF MASS TRANSFER CO-EFFICIENT
A general view of electrolytic processes; current-voltage relationships in electrolytic reactors; the limiting current plateau; mass & energy balance, and efficiency in electrochemical reactors. The estimation of mass transport coefficients at commonly occurring electrodes. The estimation of mass transport coefficients under enhanced convection conditions.

UNIT II PLUG FLOW& CSTER SYSTEMS MODEL
A general view of plug flow model of electrochemical reactors employing parallel plate reactor; Plug flow model under constant mass flux conditions; PFM analysis with electrolyte recycling PFM and real electrochemical reactors. General view of simple CSTER systems; CSTER in cascades; CSTER analysis of batch electrochemical reactors, CSTER analysis of semi-continuous electrochemical reactors; CSTER analysis of electrolyte recycling; Batch reactor combined with electrolyte recycling.

UNIT III THERMAL BEHAVIOR OF REACTORS
General aspects of thermal behavior in electrochemical reactor. Thermal behavior under CSTER conditions. The estimation of heat losses; the thermal behavior under PFR conditions; Thermal behavior of batch electrochemical reactors.

UNIT IV CONVECTIVE DIFFUSION EQUATION & CURRENT DISTRIBUTION
Convective diffusion equation and migration effects – derivation of convective diffusion equation theory – scope and limitation – migration effects – Electroneutrality conditions – supporting electrolyte effect – fundamental of Nernst layer model – Estimation of true limiting current
UNIT V DISPERSION MODELS & OPTIMIZATION OF ELECTROCHEMICAL REACTOR


TOTAL :45 PERIODS

OUTCOME:

- Understand current-voltage relationships & estimation of mass transfer co-efficient the kinetics of homogenous reaction
- Acquire knowledge on plug flow& cster systems m
- Understand the general aspects of thermal behavior in electrochemical reactor
- Understand Convective diffusion equation and migration
- Understand dispersion models & optimization of electrochemical reactor

TEXT BOOK:


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<tr>
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<td>Understand dispersion models &amp; optimization of electrochemical reactor</td>
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</table>

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

OBJECTIVE:
- Students develop a sound working knowledge on different types of reactors. It's also
  students to experimentally determine the kinetic constant and conversion of a given
  electrochemical reactor in a batch reactor, tubular reactor and mixed flow reactor and
  compare with the theoretically predicted conversions.

LIST OF EXPERIMENTS
1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug flow reactor
3. Kinetic studies in a CSTR
4. Kinetic studies in a PFR followed by a CSTR
5. RTD studies in a PFR
6. RTD studies in a CSTR
7. Study of temperature dependence of rate constant using CSTR.

OUTCOMES:
- Acquire knowledge on kinetics of reactors
- Understand rate equation for different types of reactors
- Assess the performance of Plug flow Mixed flow and Packed bed by studying the residence
time distribution.
  o Determine the kinetic constant and conversion of a given electrochemical reaction in a reactor
  o Compare experimentally determined results with the theoretically predicted conversion

ELECTROCHEMICAL REACTION ENGINEERING

OBJECTIVE:
- To make the students to experimentally determine the kinetic constant and conversion of a
  given electrochemical reaction in a batch reactor, tubular reactor and mixed flow reactor
  and compare with the theoretically predicted conversions.

LIST OF EXPERIMENTS
1. Electrochemical batch reactor-constant current operation / constant potential operation.
2. Factorial design for investigating the current efficiency of copper deposition.
3. Monopolar and bipolar cells.
4. Electrochemical batch reactor – Constant current operations for Copper/Titanium/Stainless steel
   electrode.
5. Continuous flow stirred tank electrochemical reactor (CSTER)
6. Axial flow electrochemical reactor (PFER) – Single outlet
7. Packed bed reactor – Flow through configuration (Copper bed)

TOTAL: 60 PERIODS

REFERENCE:
1. Laboratory Manual prepared by Faculty
<table>
<thead>
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<td>PO 1  PO 2  PO 3  PO 4  PO 5  PO 6  PO 7  PO 8  PO 9  PO 10  PO 11  PO 12  PS O1  PS O2  PS O3</td>
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<tr>
<td>CO1</td>
<td>Acquire knowledge on kinetics of reactors</td>
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<tr>
<td>CO2</td>
<td>Understand rate equation for different types of reactors</td>
<td>3 3 - - - 1 1 1 3 2 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Assess the performance of Plug flow Mixed flow and Packed bed by studying the residence time distribution.</td>
<td>3 3 3 - - 1 1 1 3 2 2</td>
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<tr>
<td>CO4</td>
<td>Determine the kinetic constant and conversion of a given electrochemical reaction in a reactor</td>
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<tr>
<td>CO5</td>
<td>Compare experimentally determined results with the theoretically predicted conversion</td>
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<td>OVERALL CO</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- Determine possible control objectives, input variables (manipulated variables and disturbances), model the dynamic behavior of a process, design PID controllers, frequency response and analyze stability of closed loop and open loop systems.

UNIT I

UNIT II
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, FOPDT Model, Skogestad’s rule for FOPDT and SOPDT, Lead- Lag systems

UNIT III
Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, control valves, transient response of closed-loop control systems and their stability, Root locus diagram.

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

UNIT V
Introduction to advanced control systems, cascade control, feed forward control, Controllers for Inverse response Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the need to develop mathematical description of a chemical process as a Prerequisite to process design and to control the process.
CO2: Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.
CO3: Represent a physical system using FOPDT model and estimate parameters in FOPDT model.
CO4: Convert a process and instrumentation diagram to a control block diagram
CO5: Understand Frequency response of control systems and tune the PID controllers and Appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.

TEXT BOOKS:
New York: Oxford University Press.


REFERENCES:

## COURSE ARTICULATION MATRIX

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<th>PS O2</th>
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<td>Understand the need to develop mathematical description of a chemical process as a prerequisite to process design and to control the process.</td>
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<td>CO2</td>
<td>Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.</td>
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<tr>
<td>CO3</td>
<td>Represent a physical system using FOPDT model and estimate parameters in FOPDT model.</td>
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<td>Convert a process and instrumentation diagram to a control block diagram.</td>
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<tr>
<td>CO5</td>
<td>Understand Frequency response of control systems and tune the PID controllers and appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feedforward, Dead time compensation.</td>
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</table>

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### 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

### ARMED FORCES
- **AF 2**: Modes of Entry to Army, CAPF, Police

### COMMUNICATION
- **C 1**: Introduction to Communication & Latest Trends

### INFANTRY
- **INF 1**: Organisation of Infantry Battalion & its weapons

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

### 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
NCC Credit Course Level III
NX3653 (AIR FORCE WING) NCC Credit Course Level - III

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<td>TOTAL: 45 PERIODS</td>
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EL3611 PROCESS DYNAMICS AND CONTROL

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OBJECTIVE:
- To train the students to determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

LIST OF EXPERIMENTS
1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a level system
10. Tuning of a pressure system
11. Tuning of a thermal system
12. Flow co-efficient of control valves
13. Characteristics of different types of control valves
14. Closed loop study on a pressure system
15. Tuning of pressure system
16. Closed loop response of cascade control system
*Minimum 10 experiments shall be offered.

TOTAL: 60 PERIODS

OUTCOME:
- Able to determine the response of a first order and second order system for various input
- Able to determine the response of an interacting and non-interacting system for various input
- Understand the difference between an open loop and closed loop system
- Understand the concept of three classical controller P, PI, PID controller
- Understand the concept of stability and tuning of a system
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<th>Course Outcomes</th>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To train the students to understand the techniques to measure the corrosion rate, to provide hands-on experience in metal finishing and to train the students on the concepts of electrometallurgy

LIST OF EXPERIMENTS

CORROSION
1. Determination of efficiency of the given inhibitor by gravimetric method
2. Efficiency of cathodic protection by impressed current method
3. Determination of anode efficiency in sacrificial anode system
4. Standard Test Methods for specific gravity of pigments (3 pigments)
5. Determination of corrosion rate by galvanostatic polarization method [Tafel and linear Polarization methods]

METAL FINISHING
(Any Five experiments)
1. Anodizing of Aluminium
2. Electroforming of Metal Foil
3. Hull Cell Studies in Electroplating Bath
4. Throwing Power Studies in Electroplating Bath
5. Nickel Plating & Analysis of nickel plating solution
6. Electrophoretic deposition
7. Electroless Plating

OUTCOME:
- Understand the techniques to measure the corrosion rate
- Acquire knowledge on efficiency of inhibitor
- Acquire knowledge on cathodic protection
- Acquire knowledge on metal finishing
- Acquire knowledge on concepts of electrometallurgy

REFERENCE:
1. Laboratory Manual prepared by Faculty.

COURSE ARTICULATION MATRIX

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<th>Course Outcomes</th>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
EL3712  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

EL3701  SCIENCE AND TECHNOLOGY OF LEAD ACID BATTERIES  L T P C  3 0 0 3

OBJECTIVE:
- To enable the students to gain the knowledge of principle, applications of lead acid batteries

UNIT I
Invention and development of lead acid batteries, working principle of lead acid batteries, secondary reactions, active material in positive electrode, active material in negative electrode, grid alloys. Manufacturing process of lead acid batteries, formation technology, batteries with tubular plates.

UNIT II
Charging techniques: Constant voltage-charging, constant current charging, taper charging, and boost charging. Valve regulated lead acid batteries: Design, temperature influence, influence of overcharging voltage, heat effects, and thermal run away.

UNIT III
Capacity, capacity as current scale, discharge parameters, temperature influence on capacity, charge parameters, cycling, depth of discharge, internal resistance, service life expectancy. Lead acid batteries for SLI, solar, telecom, and inverter applications. Failure modes analysis.

UNIT IV
Advanced battery concepts: Tubular gel batteries, lead-carbon batteries, bi-polar design, start-stop batteries, e-Rickshaw battery, battery monitoring and management.

UNIT V
Introduction to battery standards, Indian and International standards for the performance evaluation of flooded and valve regulated lead acid systems used in stationary, solar and automotive applications. Recycling of lead acid batteries.

TOTAL: 45 PERIODS
OUTCOMES:
- Understand current-voltage relationships & estimation of mass transfer co-efficient
  the kinetics of homogenous reaction
- Acquire knowledge on plug flow& CSTER systems m
- Understand the general aspects of thermal behavior in electrochemical reactor
- Understand convective diffusion equation and migration
- Understand dispersion models & optimization of electrochemical reactor

TEXT BOOKS
2. D.A.J. Rand, P.T.Mosley, J. Garche, C.D.Parker, Valve-Regulated lead acid batteries,
   Elsevier, Amsterdam, 2011

REFERENCES
1. D. Berndt, Maintenance-free batteries: Lead-acid, Nickel/cadmium, Nickel/metal Hydride : a
   Handbook of Battery Technology, Research Studies Press, 1997
## 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
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

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.

REFERENCES:

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.

EL3711 COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING
LABORATORY
(Any Ten experiments)

OBJECTIVE:
- To give the students an understanding the fundamentals concepts in mathematics, problems solving and computer programming.

Suggested Exercises
1. Equations of state using Newton’s method
2. Regression for parameter estimation using a set of data points
3. Equilibrium flash distillation (Multicomponent Ideal)
4. Batch Reactor
5. CSTR in Series Stage wise contacting equipment
6. Solving a simple flow sheet by simultaneous approach
7. Simulation of batch Distillation (binary ideal).
8. Gravity Flow Tank
9. Heat Exchanger
10. Plug Flow Reactor
11. Absorber

Specific examples in ASPEN/HYSYS/MATLAB/EXCEL
1. Solving equation of state, regression of parameters using EXCEL/MATLAB
2. Calculation of Reynolds number, friction factor and pressure drop using EXCEL/MATLAB
3. Calculation of heat transfer coefficient in a Heat Exchanger using EXCEL/MATLAB
4. Calculation of minimum Reflux ratio for binary/tertiary system in a fractionator using EXCEL/MATLAB
5. Calculation of HTU and NTU in a Absorber using EXCEL/MATLAB
6. Calculation of Antoine’s coefficient using EXCEL/MATLAB
7. Estimation of settling velocity of solids in liquids using Stoke’s law using EXCEL/MATLAB
8. Calculation of minimum number of stages in a distillation column using EXCEL/MATLAB
9. Solving mass and energy balance problems using EXCEL/MATLAB
10. Calculation of Power in Reciprocating compressor using EXCEL/MATLAB
11. Steady state simulation of Heat Exchanger using PROCESS SIMULATION SOFTWARE TOOL
12. Steady state simulation of a CSTR using PROCESS SIMULATION SOFTWARE TOOL
13. Steady state simulation of Flash vessel using PROCESS SIMULATION SOFTWARE TOOL
14. Steady state simulation of Distillation Column using PROCESS SIMULATION SOFTWARE TOOL
15. Steady state simulation of an Absorption column using PROCESS SIMULATION SOFTWARE TOOL
17. Dynamic simulation of a CSTR using PROCESS SIMULATION SOFTWARE TOOL
18. Dynamic simulation of Flash vessel using PROCESS SIMULATION SOFTWARE TOOL
19. Dynamic simulation of Distillation Column using PROCESS SIMULATION SOFTWARE TOOL
20. Dynamic simulation of an Absorption column using PROCESS SIMULATION SOFTWARE TOOL

TOTAL: 60 PERIODS

OUTCOME:
- Understand the fundamentals of modeling and their applications to transport/energy equations, chemical and phase equilibria kinetics
- Associate the model with constitutive relations such as phenomenological laws, rate equations, equations of state, property estimation
methods

- Create the mathematical models for different unit operations equipments such as stirred tank heaters, Heat exchangers, Evaporators, Reactors, distillation Columns
- Analyze the principles of steady state/unsteady state lumped systems and steady state/unsteady state distributed systems
- Apply relevant solution methods for the mathematical models with relevant initial and/or boundary conditions

Minimum 10 experiments to be offered

TEXT BOOKS:

## COURSE ARTICULATION MATRIX

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<td>Understand the fundamentals of modeling and their applications to transport/energy equations, chemical and phase equilibria kinetics</td>
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<td>Associate the model with constitutive relations such as phenomenological laws, rate equations, equations of state, property estimation methods</td>
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<td>Create the mathematical models for different unit operations equipments such as stirred tank heaters, Heat exchangers, Evaporators, Reactors, distillation columns</td>
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<td>Analyze the principles of steady state/unsteady state lumped systems and steady state/unsteady state distributed systems</td>
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<td>Apply relevant solution methods for the mathematical models with relevant initial and/or boundary conditions</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
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.

TOTAL: 300 PERIODS

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.

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

UNIT II PLANNING

UNIT III ORGANISING
Recruitment, selection, Training and Development, Performance Management, Career planning and management.

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.

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:

REFERENCES:

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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  9
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  9

UNIT III  TQM TOOLS & TECHNIQUES I  9

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

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.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:
REFERENCES:

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
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

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

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)
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)
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:
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

MAPPING OF COS AND POS:

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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

TOTAL: 45 PERIODS
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:

CO’s- PO’s & PSO’s MAPPING

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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 acquiring 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.

CO’s- PO’s & PSO’s MAPPING

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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-hygiene 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.

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### PROFESSIONAL ELECTIVES

**EL3001 ELECTROCHEMICAL PROCESS TECHNOLOGY**

**OBJECTIVE:**
- To provide an adequate mastery in the principles involved in the electrochemical process and its applications.

**UNIT I ELECTRODES AND SEPARATORS**
Electrodes and separators for the electrolytic production of chemicals – preparation, characteristics and applications of graphite, magnetite, lead dioxide coated anodes, noble metal coated anodes, noble metal oxide coated anodes, spinal anodes, Perovskite platinum and nickel anodes, steel cathodes, coated cathodes, diaphragms and ion exchange membranes.

**UNIT II ELECTROLYTIC PRODUCTION OF IN-ORGANIC CHEMICALS**
Electrolytic production of sodium hypochlorite, sodium and potassium chlorates, bromates and iodates. Sodium, potassium and ammonium perchlorates, perchloric acid. Potassium, and ammonium persulphates, hydrogen peroxide, potassium permanganate, cuprous oxide and manganese dioxide – Basic principles, reaction mechanisms, effect of operating variables, cell design and operating characteristics of industrial cells.

**UNIT III ELECTRO ORGANIC CHEMISTRY AND ELECTRODIALYSIS**
Production of hydrogen by water electrolysis. Electrodialysis and its application to desalination of water electrolysis and waste recovery. Basic principles of Electro organic chemistry, constant current electrolysis, controlled potential electrolysis, material yield, current efficiency, selectivity and energy consumption for electro organic synthesis. Paired synthesis with example.

**UNIT IV ELECTROCHEMICAL REDUCTION AND OXIDATION OF FUNCTIONAL GROUPS**
UNITV ELECTRO POLYMERIZATION AND ELECTRO ORGANIC PROCESSES


TOTAL: 45 PERIODS

OUTCOME:
- Acquire knowledge on electrodes and separators for the electrolytic production of chemicals
- Acquire knowledge on electrolytic production of in-organic chemicals
- Understand electro organic chemistry, electrodialysis and its applications
- Acquire knowledge on electrochemical reduction and oxidation of functional groups
- Understand electro polymerization and electro organic processes

TEXT BOOKS:

REFERENCES:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
EL3002  CORROSION SCIENCE AND ENGINEERING  L T P C  3 0 0 3

OBJECTIVE:
- To provide fundamental understanding on aspects of electrochemistry and materials science relevant to corrosion phenomena and Identify practices for the prevention and remediation of corrosion.

UNIT I  BASIC ASPECTS OF CORROSION  9

UNIT II  FORMS OF CORROSION  9
Definition, factors and control methods of various forms of corrosion: uniform, galvanic, pitting, intergranular, crevice, dezincification, stress corrosion, corrosion fatigue, hydrogen embrittlement.

UNIT III  ATMOSPHERIC CORROSION AND PROTECTIVE COATINGS  9

UNIT IV  IMMERSION CORROSION AND ELECTROCHEMICAL PROTECTION  9

UNIT V  CORROSION MONITORING  9
Laboratory corrosion tests, accelerated chemical tests for studying different forms of corrosion. Electrochemical methods of corrosion rate measurements by Gravimetric, Tafel polarization, linear polarization, cyclic polarization, impedance spectroscopy, harmonics and NDT techniques-ultrasonics, radiography eddy current.

TOTAL: 45 PERIODS

OUTCOME:
- Understand basic aspects of corrosion
- Understand factors and control methods of various forms of corrosion
- Understand the concepts of atmospheric corrosion and protective coatings
- Acquire knowledge on Corrosion in immersed condition and Electrochemical methods of protection
- Acquire knowledge on chemical tests for studying different forms of corrosion

TEXT BOOKS:

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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 gain the knowledge of principle and applications of batteries and fuel cells.

UNIT I  FUNDAMENTALS
EMF, reversible and irreversible cells, free energy, effect of cell temperature, thermodynamic calculation of the capacity of a battery, calculations of energy density of cells.

UNIT II  FACTORS AFFECTING BATTERY PERFORMANCE
Factors affecting battery capacity, voltage level, current drain of discharge, types of discharge: continuous, intermittent, constant current, constant load, constant power, service life, voltage regulation, charging methods, battery age & storage condition.

UNIT III  STORAGE BATTERIES
Principle, design, construction, performance characteristics, advantage and disadvantages. Primary batteries - Zn-MnO₂, carbon-zinc, carbon-zinc chlorides, and zinc-silver oxide. Secondary batteries – lead-acid, nickel-cadmium, nickel-metal hydride, silver oxide-zinc system, lithium-ion, lithium-polymer. Batteries for electric vehicle applications, Micro batteries.

UNIT IV  TESTING & EVALUATION

UNIT V  FUEL CELLS & SUPERCAPACITOR

OUTCOME:
- Understand fundamentals of electrochemical cell
- Understand Factors affecting battery performance
- Acquire knowledge on the principle, design, construction, performance characteristics and applications of storage batteries
- Acquire knowledge on testing & evaluation of electrochemical cell
- Acquire knowledge on fuel cells & supercapacitor

TEXT BOOKS:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
UNIT I  LITHIUM-ION ENERGY STORAGE SYSTEMS
Working principle: lithium-ion battery, Lithium-ion battery cathodes (LFP, NMC, NCA). Lithium-ion battery anodes (Intercalation- graphite, LTO; conversion- Fe$_3$O$_4$, SnO$_2$; alloying- Sn, Sb). Lithium-ion battery electrolytes (1 M LiPF$_6$/ 1M LiBF$_4$ in organic carbonate solvents, ionic liquid electrolytes, polymer electrolytes, solid electrolytes).
Performance parameters: (C-rate, galvanostatic cycling stability (capacity retention), energy density, power density. Design aspects (electrode preparation, thickness of the electrode, electrode material crystal structure and the influence on electrochemical performance, cell stacking). Safety aspects: BMS, thermal runaway, gas evolution.
Recycling and refurbishing: of lithium metal and other expensive transition metals.

UNIT II  FUTURISTIC ENERGY STORAGE SYSTEMS
Working Principle: sodium-ion battery, Multivalent-ion batteries (Calcium-ion, Mg-ion, Al-ion), lithium-sulfur battery, metal-air battery. -Cell Components (cathode, anode, electrolyte and examples): sodium-ion battery, Multivalent-ion batteries (Calcium-ion, Mg-ion, Al-ion), lithium-sulfur battery, metal-air battery. Advantages and Limitations in comparison with Lithium-ion batteries- Technology development (state-of-the-art)

UNIT III  REDOX FLOW BATTERY
Properties of redox flow batteries. Merits and demerits in commercial application, design and development of flow battery, international status of flow batteries; coupling the flow batteries with solar power systems. Flow management for various electrode design merits and demerits. Solar power integrated flow batteries and requirements.

UNIT IV  SOLID STATE AND 3D PRINTABLE BATTERIES
Micro battery systems and macro battery design using 3D printing, material usage in 3D printing and properties of material in 3D printable batteries. properties of material selection and design. Design and commercial requirement related to different type of application. Industrial requirement for bulk production of solid state batteries.

UNIT V  SUPERCAPACITORS

COURSE OUTCOMES:
- Understand the principle of lithium-ion energy storage systems
- Acquire knowledge on futuristic energy storage systems
- Understand Properties of redox flow batteries
- Acquire knowledge on solid state and 3d printable batteries
- Acquire knowledge on various supercapacitors

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
### CO-PO & PSO MAPPING

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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 differentiate between the electroplating and anodizing process and
- To compare the various engineering aspects and electroplating process.

UNIT I  ELECTROPLATING OF METALS  9
Fundamental principles – Faraday’s laws, mechanism of deposition, surface preparation for electroplating, electroplating of copper, nickel, chromium, zinc, tin and precious metals (gold and silver)

UNIT II  EVALUATION & TESTING  9

UNIT III  ELECTROPLATING OF ALLOYS AND OTHER PLATING METHODS  9
Principles of alloy deposition, barrel finishing and plating, electroforming of copper and nickel, electroless deposition of copper and nickel, brush plating, continuous plating, PCB plating.

UNIT IV  ENGINEERING ASPECTS  9
Equipment selection, rectifier, pre-treatment equipment - mechanical - chemical, automation, flooring, materials for tanks and linings, ventilation, bus bar, filtration and purification, agitation, heating and cooling arrangement for electrolytes.

UNIT V  ANODIZING  9
Anodizing of aluminium, principles, pre-treatment, jigging. Sulphuric acid process, operating conditions for decorative and protective anodizing, effect of impurities, analysis for free acid and aluminium content, chromic acid process, operating conditions, effect of impurities, coloring of anodized aluminium with organic dyes. Sealing in hot water and dichromate solution. Testing of anodic film thickness by Eddy current method and stripping method, coating weight – coating ratio.

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the fundamental principles of electroplating of metals
- Understand evaluation & testing of electroplating process
- Understand electroplating of alloys and other plating methods
- Acquire knowledge on engineering aspects of electroplating techniques
- Acquire knowledge on anodizing concepts

TEXT BOOKS:

REFERENCES:
## COURSE ARTICULATION MATRIX

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To familiarize the students with the basics of cathodic protection and electrophoretic coatings.

UNIT I  BASICS OF CATHODIC PROTECTION  9

UNIT II  SACRIFICIAL ANODE SYSTEM & IMPRESSED CURRENT SYSTEM  9
Cathodic protection system, components of galvanic systems, galvanic anodes, fields of application and backfills for sacrificial anodes. Advantages and disadvantages of sacrificial anode system. Impressed current system, impressed current anodes, fields of application and backfills for impressed current anodes.

UNIT III  DESIGNING OF CP SYSTEM  9
Design parameters in cathodic protection, soil resistivity measurement, pipe to soil potential data, pH determination, redox potential measurement, coating resistance, stray current measurement and cathodic protection interferences designing of sacrificial anode system - designing of impressed current system - designing of cathodic protection to ship hull

UNIT IV  BASIC CONCEPTS OF ELECTROPHORETIC COATINGS  9

UNIT V  APPLIED ASPECTS OF ELECTROPHORETIC COATINGS  9

OUTCOME:
- Understand the basics of cathodic protection
- Understand sacrificial anode system & impressed current system
- Understand designing of cp system
- Electroplating of alloys and other plating methods
- Acquire knowledge on basic concepts of electrophoretic coatings
- Apply aspects of electrophoretic coatings

TEXT BOOKS:

REFERENCE:
# 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:
- This course aims to provide the basics of hydrometallurgy and electrometallurgy techniques that are used in the processing of minerals

UNIT I  INTRODUCTION
- Metallurgical industries in India with special reference to electrometallurgical industries. Preparation of cell feed for copper, zinc, aluminium, magnesium, and electrolytic cells. Principles of solvent extraction/ion exchange for the recovery of metallic values. Pollution and control measures adopted/recommended in electrometallurgical Industries like Al, Cr.

UNIT II  ELECTROCHEMICAL PRINCIPLES
- Cell voltage and its components- types of anodes and cathodes-necessity of diaphragms. Physicochemical properties of molten & aqueous electrolytes like conductivity, decomposition potential, density etc. Current and energy efficiency- features of aqueous and molten salt electrolysis distinction between electro winning and refining. Anode effect.

UNIT III  AQUEOUS SYSTEM

UNIT IV  MOLTEN SALT ELECTROLYSIS

UNIT V  THERMICS
- Modes of electrical heating. Design criteria of arc furnaces. Description of furnaces used and the process for production of calcium carbide. Calcium silicide, Calcium cyanamide, fused alumina, ferroalloys, phosphorous, graphite, and Silicon carbide.

OUTCOME:
- Understand the basics electrometallurgy techniques
- Understand electrochemical principles
- Understand concepts of electro winning and electro refining
- Acquire knowledge on molten salt electrolysis
- Acquire knowledge on different modes of electrical heating.

TEXT BOOKS:

REFERENCES:
## COURSE ARTICULATION MATRIX

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

### EL3008 ELECTROCHEMICAL MATERIALS SCIENCE

**OBJECTIVE:**

- This course will give an introduction to basic electrochemistry, principles of electrochemical devices, electroactive materials used in such devices, and case studies of batteries and sensors.

#### UNIT I THIN FILMS: PHYSICAL METHODS OF PREPARATION


#### UNIT II THIN FILMS: CHEMICAL METHODS OF PREPARATION


#### UNIT III PROPERTIES OF THIN FILMS

Thickness measurements-multiple beam interference-quartz crystal-ellipsometric-stylus techniques-optical-reflection-absorbance-transmittance-band gap measurement- electrical (hot probe and four probe techniques) and dielectric behavior of thin films-mechanical properties-testing methods-adhesion-surface and tribological coatings-electrochemical characterization-potentiodynamic polarization-electrochemical impedance spectroscopy

#### UNIT IV ADVANCED FUNCTIONAL MATERIALS

UNIT V  BIOMATERIALS


TOTAL: 45 PERIODS

OUTCOME:
- Understand the physical methods of preparation of thin films
- Understand the chemical methods of preparation of thin films
- Acquire knowledge on properties of thin films
- Acquire knowledge on thin film metallic glasses—preparation—properties and applications
- General characteristics of Biomaterials

TEXT BOOKS:

REFERENCES:

COURSE ARTICULATION MATRIX

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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

UNIT I INTRODUCTION
Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards.

UNIT II METEOROLOGY

UNIT III CONTROL OF PARTICULATE CONTAMINANTS

UNIT IV CONTROL OF GASEOUS CONTAMINANTS

UNIT V INDOOR AIR QUALITY MANAGEMENT
Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

OUTCOMES:
The students completing the course will have
- Understand the structure and composition of atmosphere
- Understand the effects of meteorology on air pollution
- Understand the factors affecting selection of particulate control equipment
- Understand the factors affecting selection of gaseous control equipment
- Acquire knowledge on sources, types and control of indoor air pollutants

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:
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  9

UNIT II  ELECTRICAL SYSTEMS  9

UNIT III  THERMAL SYSTEMS  9

UNIT IV  ENERGY CONSERVATION IN MAJOR UTILITIES  9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V  ECONOMICS  9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
- CO1: Understand and analyze the energy data of industries
- CO2: Carryout energy accounting and balancing
- CO3: Understand the principles in thermal systems
- CO4: Conduct energy audit and suggest methodologies for energy savings
- CO5: Utilize the available resources in optimal ways

TEXT BOOKS:

REFERENCES:
COURSE ARTICULATION MATRIX

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<td>Conduct energy audit and suggest methodologies for energy savings</td>
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EL3010  
DESIGN OF EXPERIMENTS  
L T P C  
3 0 0 3

OBJECTIVE:
• To impart knowledge on various types of experimental designs conduct of experiments and data analysis techniques.

UNIT I  
FUNDAMENTALS OF EXPERIMENTAL DESIGNS  
9
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT II  
SINGLE FACTOR EXPERIMENTS  
9
Completely Randomized Design- effect of coding the observations- model adequacy checking- estimation of model parameters, residuals analysis- treatment comparison methods-Duncan’s multiple range test, Newman-Keuel’s test, Fisher’s LSD test, Tukey’s test testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT III  
FACTORIAL DESIGNS  
9
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2 K Design with two and three factors- Yate’s Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT IV  
SPECIAL EXPERIMENTAL DESIGN  
9
Blocking and Confounding in 2K Designs- blocking in replicated design- 2 K Factorial Design in two blocks- Complete and partial confounding- Confounding 2K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2K Design.
UNIT V  
TAGUCHI METHODS
9
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments-Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design.

OUTCOME:
- Understand the fundamentals of experimental designs
- Understand the concept of single factor experiments
- Understand the concept of factorial designs
- Acquire knowledge on various data analysis techniques
- Acquire knowledge on Taguchi methods

TOTAL: 45 PERIODS

OUTCOME:
- Understand the fundamentals of experimental designs
- Understand the concept of single factor experiments
- Understand the concept of factorial designs
- Acquire knowledge on various data analysis techniques
- Acquire knowledge on Taguchi methods

TEXT BOOK:

REFERENCES:

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

EL3011  
INDUSTRIAL SAFETY IN CHEMICAL INDUSTRIES
L T P C
3 0 0 3

OBJECTIVES:
- To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I  
INTRODUCTION
9
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.
UNIT II  CHEMICAL HAZARDS  9
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation – Industrial Hygiene – Industrial Toxicology.

UNIT III  ENVIRONMENTAL CONTROL  9
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT IV  HAZARD ANALYSIS  9
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment

UNIT V  SAFETY REGULATIONS  9

TOTAL: 45 PERIODS

OUTCOMES:
- Understand modern safety concepts to prevent chemical, environmental mechanical, fire hazards
- Identify and apply proper safety techniques for chemical hazard
- Understand industrial health hazards and environmental control
- Acquire knowledge on hazard analysis techniques
- Acquire knowledge on safety Management practices

TEXT BOOK:

REFERENCES:

COURSE ARTICULATION MATRIX

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The subject exposes students to the basics parameter for selection of materials and different classes of materials, manufacturing processes and their properties, applications of materials.

UNIT I  ENGINEERING MATERIALS

UNIT II  MATERIAL PROPERTIES

UNIT III  MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS

UNIT IV  MATERIALS SELECTION CHARTS AND TESTING

UNIT V  APPLICATIONS AND USES

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the basics parameters for different classes of materials and selection of materials
- Ability to identify the material properties
- Understand manufacturing processing and economic analysis
- Acquire knowledge on materials selection charts and testing
- Acquire knowledge on applications of materials

TEXT BOOKS:
## COURSE ARTICULATION MATRIX

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**EL3013 TESTING OF MATERIALS**

**OBJECTIVE:**
- To understand the various destructive and non-destructive testing methods of materials and its industrial applications.

**UNIT I INTRODUCTION TO MATERIALS TESTING**
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

**UNIT II MECHANICAL TESTING**
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

**UNIT III NON DESTRUCTIVE TESTING**

**UNIT IV MATERIAL CHARACTERIZATION TESTING**
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

---

140
UNIT V OTHER TESTING


TOTAL: 45 PERIODS

OUTCOMES:
- Understand the Classification of material testing, Purpose of testing
- Understand the various destructive testing methods
- Understand the various non-destructive testing methods
- Acquire knowledge on material characterization testing
- Identify suitable testing technique to inspect industrial component

TEXT BOOKS:

REFERENCES:

COURSE ARTICULATION MATRIX

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<tr>
<td>CO1</td>
<td>Understand the Classification of material testing, Purpose of testing</td>
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<tr>
<td>CO2</td>
<td>Understand the various destructive testing methods</td>
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<tr>
<td>CO3</td>
<td>Understand the various non-destructive testing methods</td>
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<tr>
<td>CO4</td>
<td>Acquire knowledge on material characterization testing</td>
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<tr>
<td>CO5</td>
<td>Identify suitable testing technique to inspect industrial component</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT I PRINCIPLES OF SOLAR RADIATION 9
Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION 9
Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS 9
Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV WIND ENERGY 9

UNIT V GEOTHERMAL ENERGY 9
Resources, types of wells, methods of harnessing the energy, potential in India. OCEANENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, and principles of DEC.

TOTAL: 45 PERIODS

OUTCOMES:

- Gain exposure on solar radiation and its environmental impact to power
- Ability to classify the solar energy collectors and methodologies of storing solar energy
- Gain Knowledge in applying solar energy in a useful way
- Acquire knowledge on the wind energy and biomass and its economic aspects.
- Acquire knowledge on geothermal energy and other energy sources

TEXT BOOKS:

REFERENCES:
## COURSE ARTICULATION MATRIX

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<td>Gain exposure on solar radiation and its environmental impact to power</td>
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<td>Ability to classify the solar energy collectors and methodologies of storing solar energy</td>
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<td>Gain Knowledge in applying solar energy in a useful way</td>
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<td>CO4</td>
<td>Acquire knowledge on the wind energy and biomass and its economic aspects.</td>
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<td>CO5</td>
<td>Acquire knowledge on geothermal energy and other energy sources</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT I
SYSTEMS COMPONENTS AND THEIR REPRESENTATION

- Control System: Terminology and Basic Structure
- Feed forward and Feedback control theory
- Electrical and Mechanical Transfer Function Models
- Block diagram Models
- Signal flow graphs models
- DC and AC servo Systems
- Synchros
- Multivariable control system

UNIT II
TIME RESPONSE ANALYSIS

- Transient response
- Steady state response
- Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole
- Steady error constant and system type number
- PID control
- Analytical design for PD, PI, PID control systems

UNIT III
FREQUENCY RESPONSE AND SYSTEM ANALYSIS

- Closed loop frequency response
- Performance specification in frequency domain
- Frequency response of standard second order system
- Bode Plot
- Polar Plot
- Nyquist plots
- Design of compensators using Bode plots
- Cascade lead compensation
- Cascade lag compensation
- Cascade lag-lead compensation

UNIT IV
CONCEPTS OF STABILITY ANALYSIS

- Concept of stability
- Bounded - Input Bounded
- Output stability
- Routh stability criterion
- Relative stability
- Root locus concept
- Guidelines for sketching root locus
- Nyquist stability criterion

UNIT V
CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS

- State variable representation
- Conversion of state variable models to transfer functions
- Conversion of transfer functions to state variable models
- Solution of state equations
- Concepts of Controllability and Observability
- Stability of linear systems
- Equivalence between transfer function and state variable representations
- State variable analysis of digital control system
- Digital control design using state feedback

OUTCOMES:

- Identify the various control system components and their representations.
- Analyze the various time domain parameters
- Analyze the various frequency response plots and its system
- Apply the concepts of various system stability criterions
- Design various transfer functions of digital control system using state variable models

TEXT BOOK:

REFERENCES
## COURSE ARTICULATION MATRIX

<table>
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<tr>
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<td>CO1</td>
<td>Identify the various control system components and their representations.</td>
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<td>Analyze the various frequency response plots and its system</td>
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<td>Apply the concepts of various system stability criterions</td>
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<td>CO5</td>
<td>Design various transfer functions of digital control system using state variable models</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
MANDATORY COURSES I

MX3081 INTRODUCTION TO WOMEN AND GENDER STUDIES

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

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:
   5.1 HA:
   5.2 Quizzes-HA:
   5.3 Periodical Examination: one
   5.4 Project/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.
   5.5 Final 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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**MX3084 DISASTER RISK REDUCTION AND MANAGEMENT**

**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 (PRIs/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 3 0 0 0

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 2+4

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:
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
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.legend.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

MX3086 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA

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 verses 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, Dharmpal, 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  L T P C
3 0 0 0

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:

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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.

MX3088   STATE, NATION BUILDING AND POLITICS IN INDIA

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: 
 viii. 

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 LimitValue (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

TOTAL: 45 PERIODS

COURSE OUTCOMES
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
## COURSE ARTICULATION MATRIX

<table>
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<tr>
<th>Course Outcomes</th>
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**Industrial safety**

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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

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES
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
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

UNIT V UNSUPERVISED LEARNING
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 : 60 PERIODS

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

REFERENCES

OCS352 IOT CONCEPTS AND APPLICATIONS L T P C 2 0 2 3

OBJECTIVES:
- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.


UNIT II COMPONENTS IN INTERNET OF THINGS Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules) 5

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 PERIODS: 60

TEXTBOOKS

REFERENCES
1. Perry Lea, “Internet of things for architects”, Packt, 2018

OCS353  DATA SCIENCE FUNDAMENTALS  L T P C
2023

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.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

LAB 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 : 60 PERIODS

TEXT BOOKS

REFERENCES

CCS333 AUGMENTED REALITY/VIRTUAL REALITY

OBJECTIVES:
- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

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

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UNIT V AUGMENTED REALITY

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

30 PERIODS

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 :60 PERIODS

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

<table>
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<tr>
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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

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:

### REFERENCEBOOKS:

### Websites
- http://www.examenglish.com/
- http://www.ets.org/
- http://www.bankxams.com/
- http://civilservicesmentor.com/
- http://www.educationobserver.com
- http://www.cambridgeenglish.org/in/

### OMG352 NGOS AND SUSTAINABLE DEVELOPMENT

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**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  9
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  9
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  9
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  9
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  9
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

TOTAL 45 : PERIODS

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
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.

OUTCOME:

On completion of this course, the student is expected to be able to

CO1 Explains 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:


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

UNIT II
Regulatory Institutions – SEBI, TRAI, Competition Commission of India,

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

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

UNIT V
Dynamics of Civil Society: New Social Movements, Role of NGO’s, Understanding the political significance of Media and Popular Culture.

TOTAL 45 : PERIODS

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

CME365  RENEWABLE ENERGY TECHNOLOGIES  L  T  P  C
3  0  0  3

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

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.

TEXBOOKS:

REFERENCES:

CO-PO & PSO MAPPING

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

1-low, 2-medium, 3-high, '-'- no correlation
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.
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 of 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 aspects and applications of reverse engineering in product design and development.
  - Understanding 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:

OPR351 SUSTAINABLE MANUFACTURING L T P C
3 0 0 3

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 9

UNIT – II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY 9
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 formulation 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.

Mapping of COs with POs and PSOs

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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 9


UNIT II ENERGY SOURCES 9


UNIT III MOTORS AND DRIVES 9

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 9

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 9

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.

TOTAL: 45 PERIODS

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.

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OAS352  SPACE ENGINEERING  L  T  P  C

6 3 0 0 3

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
History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II  AERODYNAMICS
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
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV  AIRCRAFT STABILITY AND STRUCTURAL THEORY

UNIT V  SPACE APPLICATIONS
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:

OIM351 INDUSTRIAL MANAGEMENT

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

UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUPDYNAMICS

UNIT V MODERN CONCEPTS
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

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

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OIE354 QUALITY ENGINEERING L T P C
TOTAL: 45 PERIODS

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 CONTROLCHARTS
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, $X$-chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

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

UNIT V ACCEPTANCESAMPLING
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

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

UNIT I INHERENT SAFETY CONCEPTS
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
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
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
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: 45 PERIODS

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

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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

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE

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

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN

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.

TEXT BOOKS
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”
REFERENCES

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1 – Slight, 2 – Moderate, 3 – Substantial

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  9

UNIT – II  ROBOT KINEMATICS  9
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

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo
Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of
All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic
Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection
and design considerations of a gripper.

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-Effectors commands, and simple
programs - Role of robots in inspection, assembly, material handling, underwater, space and
medical fields.

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.

TEXT BOOKS:


REFERENCES:

1. Fu K.S. Gonalez R.C. and ice C.S.G.”Robotics Control, Sensing, Vision and Intelligence”,
   reprint, 2010.

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TOTAL: 45 PERIODS
OBJECTIVES:
- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I  HISTORY OF FLIGHT
Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II  AIRCRAFT CONFIGURATIONS AND ITS CONTROLS
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

UNIT IV  BASICS OF AIRCRAFT STRUCTURES

UNIT V  BASICS OF PROPULSION
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.

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
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

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:

184
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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approach in agriculture with proper knowledge and skill

| 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 |

**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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OEI353 INTRODUCTION TO PLC PROGRAMMING L T P C
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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 9
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 9
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 9
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

TOTAL:45 PERIODS

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:
1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

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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OFD352 TRADITIONAL INDIAN FOODS L T P C 3 0 0 3

OBJECTIVE:
• To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

UNIT I HISTORICAL AND CULTURAL PERSPECTIVES 9
Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

UNIT III TRADITIONAL FOOD PATTERNS 9
Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods.

UNIT IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS 9
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V HEALTH ASPECTS OF TRADITIONAL FOODS 9
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 To understand the historical and traditional perspective of foods and food habits
CO2 To understand the wide diversity and common features of traditional Indian foods and meal
TEXT BOOKS:

OFD353 INTRODUCTION TO FOOD PROCESSING

OBJECTIVE:
• The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III LARGE-SCALE FOOD PROCESSING
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV FOOD WASTES IN VARIOUS PROCESSES
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V FOOD HYGIENE
Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course the students are expected to
CO1 Be aware of the different methods applied to processing foods.
CO2 Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.
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- INTELLECTUAL PROPERTY RIGHTS  9
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II  PATENTS  9
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  9
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  9

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

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OTT351 BASICS OF TEXTILE FINISHING

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

UNIT II FLAME PROOF & WATERPROOF
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
UNIT IV MECHANICAL FINISHES

UNIT V STIFFENING AND SOFTENING
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: 1 Basics of Resin Finishing Process
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.

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
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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

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:


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Overall CO
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

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

UNIT II CRACKING
Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen

UNIT III REFORMING AND HYDROTREATING

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.

TOTAL: 45 PERIODS

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

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

TOTAL: 45 PERIODS

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:
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  9
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  9

TOTAL : 45 HOURS
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:


OEC351  SIGNALS AND SYSTEMS  L T P C 3 0 0 3

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  9

UNIT II  ANALYSIS OF CONTINUOUS TIME SIGNALS  9
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III  LINEAR TIME IN Variant CONTINUOUS TIME SYSTEMS  9
UNIT IV  ANALYSIS OF DISCRETE TIME SIGNALS  9
Baseband signal Sampling—Fourier Transform of discrete time signals (DTFT)—Properties of DTFT - Z Transform & Properties

UNIT V  LINEAR TIME IN Variant-DISCRETE TIME SYSTEMS  9

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 :

OEC352  FUNDAMENTALS of ELECTRONIC DEVICES AND CIRCUITS  L T P C  3 0 0 3

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
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
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV  FEEDBACK AMPLIFIERS AND OSCILLATORS

UNIT V  POWER AMPLIFIERS AND DC/DC CONVERTERS
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.

TOTAL: 45 PERIODS

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

TEXT BOOKS :

REFERENCES :
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 in to 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

UNIT II REQUIREMENTS AND SYSTEM DESIGN

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:

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CBM333 ASSISTIVE TECHNOLOGY

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  L  T  P  C
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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

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.

TEXT BOOKS:

REFERENCES :
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.

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

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OMA354 LINEAR ALGEBRA
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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

UNIT II VECTOR SPACES
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III LINEAR TRANSFORMATION
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
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION

TOTAL : 45 PERIODS

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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OBT352 BASICS OF MICROBIAL TECHNOLOGY <br>L T P C <br>3 0 0 3

COURSE OBJECTIVE:
- Enable the Non-biological student’s to understand about the basics of life science and their pro and cons for living organisms.

UNIT I BASICS OF MICROBES AND ITS TYPES 9
Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

UNIT II MICROBIAL TECHNIQUES 9
Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.

UNIT III PATHOGENIC MICROBES 9
Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengue, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT IV BENEFICIAL MICROBES 9
Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

UNIT V PRODUCTS FROM MICROBES 9

TOTAL: 45 PERIODS
COURSE OUTCOME:
At the end of the course the students will be able to
1. Microbes and their types
2. Cultivation of microbes
3. Pathogens and control measures for safety
4. Microbes in different industry for economy.

TEXT BOOKS

OBT353 BASICS OF BIOMOLECULES

OBJECTIVES:
- The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.

UNIT I CARBOHYDRATES
Introduction to carbohydrate, classification, properties of monosaccharide, structural aspects of monosaccharides. Introduction to disaccharide (lactose, maltose, sucrose) and polysaccharide (Heparin, starch, and glycogen) biological function of carbohydrate.

UNIT II LIPID AND FATTY ACIDS
Introduction to lipid, occurrence, properties, classification of lipid. Importance of phospholipids, sphingolipid and glycerolipid. Biological function of lipid. Fatty acid, Introduction, Nomenclature and classification of fatty acid Essential and non essential fatty acids.

UNIT III AMINO ACIDS AND PROTEIN.

UNIT IV NUCLEIC ACIDS
Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA &amp; RNA Structure of Nitrogen bases in DNA and RNA along with the nomenclature- DNA double helix (Watson and crick) model, types of DNA, RNA.

UNIT V VITAMINS AND HORMONES

TOTAL: 45 PERIODS

OUTCOMES:
- Students will learn about various kinds of biomolecules and their physiological role.
- Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.
TEXT BOOKS:
   W.H.Freeman and Company 2017

REFERENCES:

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY L T P C
3 0 0 3

OBJECTIVES:
- To provide knowledge on the fundamentals of cell biology.
- To understand the signalling mechanisms.
- Understand basic principles of molecular biology at intracellular level to regulate growth,
  division and development.

UNIT-I INTRODUCTION TO CELL 9
Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution,
Organisation, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria,
mycoplasma and prions.

UNIT II CELL ORGANELLES 9
Molecular organisation, biogenesis and function Mitochondria, endoplasmic reticulam, golgi
apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome,
Nucleus and nucleolus. Endo membrane system, concept of compartmentalisation.

UNIT III BIO-MEMBRANE TRANSPORT 9
Physiochemical properties of cell membranes. Molecular constitute of membranes, asymmetrical
organisation of lipids and proteins. Solute transport across membrane’s-fick’s law, simple diffusion,
passive-facilitated diffusion, active transport- primary and secondary, group translocation, transport
ATPases, membrane transport in bacteria and animals. Transportmechanism- mobile carriers and
pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration.

UNIT IV CELL CYCLE 9
Cell cycle- Cell division by mitosis and meosis, Comparision of meosis and mitosis, regulation of
cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell
junction, cell cycle checkpoints.

UNIT V CENTRAL DOGMA 9
Overview of Central dogma DNA replication: Meselson & Stahl experiment, bi–directional
DNA replication, Okazaki fragments. Structure and function of mRNA, tRNA and rRNA. RNA
synthesis: Initiation, elongation and termination of RNA synthesis Introduction to Genetic code-
Steps in translation: Initiation, Elongation and termination of protein synthesis.

TOTAL: 45 PERIODS

213
OUTCOMES:
- Understanding of cell at structural and functional level.
- Understand the central dogma of life and its significance.
- Comprehend the basic mechanisms of cell division.

TEXTBOOKS:

REFERENCES:

OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING L T P C 3 0 0 3

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 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.


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
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV RECENT TREANDS IN WATER MANAGEMENT
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.
UNIT V IMPLEMENTATION OF IWRM

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).


OMA355 ADVANCED NUMERICAL METHODS

OBJECTIVE:

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM


UNIT II INTERPOLATION

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

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

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

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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.

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 of 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.

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OMA357 QUEUEING AND RELIABILITY MODELLING L T P C 3 0 0 3

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 9
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/Ek/1 as special cases – Series queues – Open Jackson networks.

UNIT IV SYSTEM RELIABILITY 9

UNIT V MAINTAINABILITY AND AVAILABILITY 9
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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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

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, organisation of production function, recent trends in production /operations management - production as an organisational 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
7. "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

L T P C
3 0 0 3

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  9

UNIT IV  MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION  9

UNIT V  SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY  9
Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

TOTAL: 45 PERIODS

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
3  0  0  3

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  9

UNIT – IV  CRITERIONS OF NPD  9
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  9
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.)

TOTAL :45 PERIODS

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
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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OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES

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

UNIT II APP DEVELOPMENT
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
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
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
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          LT P C
            3 0 0 3

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  9
Metrology for micro systems - Surface integrity and its characterization.

TOTAL : 45 PERIODS

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  L  T  P  C
3  0  0  3

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  9
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  9
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  9
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.

TOTAL: 45 PERIODS

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:

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  9

UNIT II  VARIABLE RESISTANCE AND INDUCTANCE SENSORS  9
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 the sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

TEXT BOOKS:

REFERENCES:

OAS353  SPACE VEHICLES  L T P C  3 0 0 3

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 9
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 9

UNIT IV THRUST VECTOR CONTROL 9
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 9
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

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
1. To introduce fundamental concepts of management and organization to students.
2. To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
3. To make students familiar with the concepts of human resources management.
4. To acquaint students with the concepts of project management and cost analysis.
5. To make students familiar with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION 9

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) - StatisticalQualityControl:controlchartsforVariablesandAttributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ,ABC Analysis, Purchase Procedure, Stores

**UNIT III  HUMAN RESOURCES MANAGEMENT**

- 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, Wages 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**

- 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**


**TOTAL: 45 PERIODS**

**OURSOUTCOMES:**

Upon completion of the course, Students will be able to:

- **CO1:** Plan an organizational structure for a given context in the organization to carry out 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 organization.

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**TEXTBOOKS:**


**REFERENCES:**

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.

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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OIE353 OPERATIONS MANAGEMENT  
L T P C  
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COURSE OBJECTIVES:
- 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  
Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues.

UNIT IV MATERIALS MANAGEMENT 9

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9
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.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOKS:

REFERENCES
OSF352

INDUSTRIAL HYGIENE

L T P C
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COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety.
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
5. Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I  INTRODUCTION AND SCOPE

UNIT II  MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
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

UNIT IV  OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT-V  INDUSTRIAL HAZARDS

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: 45 PERIODS
TEXT BOOKS:

REFERENCES:
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,

CO’s- PO’s & PSO’s MAPPING

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OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS L T P C 3 0 0 3

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, pyroelectric materials.

UNIT – II MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriiction, 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
9
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals 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
9

TOTAL: 45 PERIODS

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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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  SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES
9

UNIT – II  DISPLACEMENT, PROXIMITY AND RANGING SENSORS
9

UNIT – III  FORCE, MAGNETIC AND HEADING SENSORS
9

UNIT – IV  OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS
9

UNIT – V  SIGNAL CONDITIONING
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.
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**TEXT BOOKS**


**REFERENCES**


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**ORA352 CONCEPTS IN MOBILE ROBOTS**

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**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 9

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:
UNIT II  SHIPS MOVEMENTS AND SHIP STABILIZATION 9
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 9
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 9

UNIT V  BASICS OF RUDDER 9
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:

MAPPING OF COS AND POS:

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241
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 Gascarriers - 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

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
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 9
Importance of Propeller 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

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 propellers 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       L T P C
            3 0 0 3

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals 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       9
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       9
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       9
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       9
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       9
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

TOTAL: 45 PERIODS

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: Create the programs for various drones
CO-PO MAPPING:

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES

OGI352 GEOGRAPHIC INFORMATION SYSTEM

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS

UNIT II SPATIAL DATA MODELS

UNIT III DATA INPUT AND TOPOLOGY
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.

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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TOTAL:45 PERIODS
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 9
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 9
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

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

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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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OEN352 BIODIVERSITY CONSERVATION L T P C 3 0 0 3

OBJECTIVE:
The identification of different aspects of biological diversity and conservation techniques.

UNIT I INTRODUCTION
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.
UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

UNIT III MICROBIAL DIVERSITY
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV MEGA DIVERSITY
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V CONSERVATIONS OF BIODIVERSITY
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OUTCOMES
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

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.
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

- 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


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.
OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS

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

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<thead>
<tr>
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AVg. 3

OFD354 FUNDAMENTALS OF FOOD ENGINEERING L T P C 3 0 0 3

OBJECTIVES
The course aims to
• acquaint and equip the students with different techniques of measurement of engineering properties.
• make the students understand the nature of food constituents in the design of processing equipment

UNIT I 9
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.
UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment: plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 understand the importance of food polymers
CO2 understand the effect of various methods of processing on the structure and texture of food materials
CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXTBOOKS:
OBJECTIVES:

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973
OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I  INTRODUCTION AND SIGNIFICANCE  6
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II  PHYTOCHEMICALS AS NUTRACEUTICALS  11
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III  ASSESSMENT OF ANTIOXIDANT ACTIVITY  11
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV  ROLE IN HEALTH AND DISEASE  11
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V  SAFETY ISSUES  6
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
COURSE OUTCOME - NUTRACEUTICALS

CO 1 acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.

CO 2 acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

CO 3 attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.

CO 4 distinguish the various in vitro and in vivo assessment of Antioxidant activity of compounds from plant sources.

CO 5 gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.

CO 6 Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

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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

UNIT IV PRINTING
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


TOTAL: 45 PERIODS

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:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
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  9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel

UNIT III  SYNTHETIC FIBRES  9
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  9
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  9
Properties and end uses : Fibres for medical application – Biodegradable fibres based on PLA ,Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

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  PATTERNS 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 259abelling of apparels

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 care labelling

TOTAL: 45 PERIODS

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

REFERENCES:
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  9
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

OPT352 PLASTIC MATERIALS FOR ENGINEERS L T P C 3 0 0 3

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 9
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 9
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 9
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 9
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers-their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9
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

TOTAL: 45 PERIODS

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 on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers
REFERENCES:

OPT353 PROPERTIES AND TESTING OF PLASTICS

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

UNIT II MECHANICAL PROPERTIES
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
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
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

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.

TOTAL: 45 PERIODS
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.

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 9

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

TEXT BOOKS

REFERENCES

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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
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
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
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
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 inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS
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.

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:

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**OBT355 BIOTECHNOLOGY FOR WASTE MANAGEMENT**

**UNIT I BIOLOGICAL TREATMENT PROCESS**

**UNIT II WASTE BIOMASS AND ITS VALUE ADDITION**
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

**UNIT III BIOCONVERSION OF WASTES TO ENERGY**
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

**UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES**
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

**UNIT V BIOCOMPOSTING OF ORGANIC WASTES**
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**
After completion of this course, the students should be able
1. To learn the various methods biological treatment
2. To know the details of waste biomass and its value addition
3. To develop the bioconversion processes to convert wastes to energy
4. To synthesize the chemicals and enzyme from wastes
5. To produce the biocompost from wastes
6. To apply the theoretical knowledge for the development of value added products

**TEXT BOOKS**
REFERENCE BOOKS

OBT356 LIFESTYLE DISEASES

UNIT I INTRODUCTION
Lifestyle diseases – Definition; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES
Coronary atherosclerosis – Coronary artery disease; Causes - Fat and lipids, Alcohol abuse -- Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TEXT BOOKS:

REFERENCES:

OBT357 BIOTECHNOLOGY IN HEALTH CARE

COURSE OBJECTIVES
The aim of this course is to
- Create higher standard of knowledge on healthcare system and services
- Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I PUBLIC HEALTH
UNIT II  CLINICAL DISEASES
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V  BASICS OF IMAGING MODALITIES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn 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
Long term sources of Finance - Equity Shares – Debentures – Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III INVESTMENT DECISIONS

UNIT IV FINANCING AND DIVIDEND DECISION

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES.
2. Prasanna Chandra, Financial Management, 
OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities.
3. Explain 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
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
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
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
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V  INVESTOR PROTECTION
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

CMG333  BANKING, FINANCIAL SERVICES AND INSURANCE
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
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:

CMG334  INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS  9
INTRODUCTION TO BLOCKCHAIN
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

INTRODUCTION TO CRYPTOCURRENCY

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

WEB3 AND HYPERLEDGE
UNIT V  EMERGING TRENDS

TOTAL : 45 PERIODS

REFERENCE
2. Peter Borovykh, Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335  FINTECH PERSONAL FINANCE AND PAYMENTS

UNIT I  CURRENCY EXCHANGE AND PAYMENT
Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning, Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI), Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations, Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

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

UNIT V  REGULATORY ISSUES

REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016
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.

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

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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

TOTAL: 45 PERIODS

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 opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entreprenuship

TEXT BOOKS:

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

UNIT I INTRODUCTION TO MANAGING TEAMS
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Deciosn Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS
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
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

UNIT V LEADERSHIP EFFECTIVENESS

TOTAL 45 : PERIODS
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:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

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

TOTAL 45 : PERIODS
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.

CMG340  PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS  L T P C
3 0 0 3

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

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

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  9

UNIT V  CONTROLLING HUMAN RESOURCES  9

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  L T P C  
3 0 0 3

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 quity financing.
- To empower the learners towards fund rasiing for new ventures effectively.

UNIT I  ESSENTIALS OF NEW BUSINESS VENTURE  9

UNIT II  INTRODUCTION TO VENTURE FINANCING  9

UNIT III  SOURCES OF DEBT FINANCING  9
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:

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

TOTAL : 45 PERIODS
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.
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
UNIT-I  3 0 0 3
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II  (9)
1. Generalist Vs Specialist
2. Civil Servants’ Relationship with Political Executive
3. Integrity in Administration.

UNIT-III  (9)
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV  (9)
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V  (9)
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

CMG346  ADMINISTRATIVE THEORIES  L T P C
UNIT I  3 0 0 3
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT II  (9)
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory

UNIT III  (9)
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

REFERENCES:
1. Crozior M : The Bureaucratic phenomenon (Chand)
3. Presthus. R : The Organizational Society (MAC)
5. Keith Davis : Organization Theory (MAC)

TOTAL: 45 PERIODS
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.

TOTAL: 45 PERIODS

REFERENCES:
4. Pradeep Saxena : Public Policy Administration and Development

VERTICAL 4: BUSINESS DATA ANALYTICS

CMG349  
STATISTICS FOR MANAGEMENT

OBJECTIVE:
➢ To learn the applications of statistics in business decision making.

UNIT I  
INTRODUCTION  
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  
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III  
TESTING OF HYPOTHESIS - PARAMETIRC TESTS  
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  

UNIT V  
CORRELATION AND REGRESSION  

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 Ham 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.
CMG351  HUMAN RESOURCE ANALYTICS

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
People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business – HR metrics and KPIs.

UNIT II   HR ANALYTICS I: RECRUITMENT
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
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
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V    HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT
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.

TOTAL: 45 PERIODS

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

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  OPERATION AND SUPPLY CHAIN ANALYTICS  L T P C  3 0 0 3

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  9
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II  WAREHOUSING DECISIONS  9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III  INVENTORY MANAGEMENT  9
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  9

UNIT V  MCDM MODELS  9
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:

CMG354  FINANCIAL ANALYTICS  L T P C  3 0 0 3

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

CES331  SUSTAINABLE INFRASTRUCTURE DEVELOPMENT  L T P C
3  0  0  3

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  9

UNIT II  SUSTAINABLE INFRASTRUCTURE PLANNING  9
UNIT III       SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES


UNIT IV       SUSTAINABLE CONSTRUCTION MATERIALS


UNIT V       SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


TOTAL: 45 PERIODS

OUTCOME:
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", Springer2005

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

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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

OUTCOME
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

CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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CES333 SUSTAINABLE BIOMATERIALS

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
Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials-

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 Composites(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 NANOBIOMATERIALS

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
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-O_2 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, LiCoO_2, LiFePO_4, LiMn_2O_4) – 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.

TOTAL : 45 PERIODS
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

CES335 GREEN TECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVE:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9
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.

UNIT II POLLUTION TYPES 9
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9
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

UNIT IV DESIGNING GREEN PROCESSES 9
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
UNIT V  GREEN NANOTECHNOLOGY  9
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

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5 – To understand advanced technology in green synthesis

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

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

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<td>the ambient air quality and water quality standards;</td>
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<td>the various instrumental methods and their principles for environmental monitoring</td>
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<td>CO3</td>
<td>the significance of environmental standards in monitoring quality and sustainability of the environment.</td>
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<td>the various ways of raising environmental awareness among the people.</td>
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<td>CO5</td>
<td>Know the standard research methods that are used worldwide for monitoring the environment.</td>
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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

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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

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT

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

TOTAL: 45 PERIODS

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: