PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To prepare students for successful careers in Environmental Engineering field that meets the needs of National and International organisations.

II. To develop the confidence and ability among students to synthesize data and technical concepts and thereby apply it in real world problems.

III. To develop students to use modern techniques, skill and mathematical engineering tools for solving problems in Environmental Engineering.

IV. To provide students with a sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyse environmental problems and to prepare them for graduate studies.

V. To promote students to work collaboratively on multi-disciplinary projects and make them engage in life-long learning process throughout their professional life.

PROGRAM OUTCOMES (POs)

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<th>PO#</th>
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<td>1</td>
<td><strong>Engineering knowledge</strong>: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</td>
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<td><strong>Problem analysis</strong>: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of Mathematics, natural sciences, and engineering sciences.</td>
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<td><strong>Design/development of solutions</strong>: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.</td>
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<td><strong>Conduct investigations of complex problems</strong>: 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><strong>Modern tool usage</strong>: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.</td>
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<td><strong>The engineer and society</strong>: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.</td>
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<td><strong>Environment and sustainability</strong>: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.</td>
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<td><strong>Ethics</strong>: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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<td><strong>Individual and team work</strong>: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</td>
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10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

**PROGRAM SPECIFIC OUTCOMES (PSOs)**
Graduates of the programme B.E Environmental Engineering will be able to

**PSO1** Knowledge of Environmental Engineering discipline
Demonstrate in-depth knowledge Environmental Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge.

**PSO2** Critical analysis of Environmental Engineering problems and innovation
Critically analyze complex Environmental Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.

**PSO3** Conceptualization and evaluation of engineering solutions to Environmental Engineering Issues Conceptualize and solve Environmental Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio-cultural factors

**PEO / PO Mapping:**

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

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* Skill Based Course

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

### SEMESTER VI

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*Open Elective – I shall be chosen from the emerging technologies
*Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)
*NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
## SEMESTER VII/VIII*

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*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

## SEMESTER VIII/VII*

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*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII

**TOTAL CREDITS: 163**

## MANDATORY COURSES I*

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*Mandatory Courses are offered as Non-Credit Courses
### MANDATORY COURSES II*

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

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<th>VERTICAL III</th>
<th>VERTICAL IV</th>
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<td>Water and Wastewater Engineering</td>
<td>Air Pollution Engineering</td>
<td>Solid Waste Management</td>
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<td>Groundwater and Well Engineering</td>
<td>Indoor Air Quality Management</td>
<td>Biochemical and Thermochemical Conversion of Biomass</td>
<td>Surface and Groundwater Quality Modelling</td>
<td>Coastal Zone Management</td>
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<td>Functional design of Rainwater Harvesting Systems</td>
<td>Noise Pollution Control in Industries</td>
<td>Biomedical Waste Management</td>
<td>Remote Sensing and GIS Applications in Environmental Management</td>
<td>Irrigation Water Quality and Wastewater Management</td>
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<tr>
<td>Operation and Maintenance of Water and Wastewater Treatment Plants</td>
<td>Climate Change and Adaptation</td>
<td>Landfill Engineering and Remediation Technology</td>
<td>Occupational Health, Safety and Risk Assessment</td>
<td>Solar and Wind Energy System</td>
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<tr>
<td>Sludge and Septage Management</td>
<td>Low Carbon Economy</td>
<td>Plastic and E waste Management</td>
<td>Planning, Design and Management of Large Housing Complexes</td>
<td>Epidemiology and Control of Communicable Diseases</td>
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<tr>
<td>Marine Pollution and Control</td>
<td>Climatology and Meteorology</td>
<td>Industrial Hazardous waste Management</td>
<td>Energy Management in Industries</td>
<td>Cleaner Production</td>
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<td>Natural Wastewater Treatment Systems</td>
<td>Air Quality Modelling and mapping</td>
<td>Resource recovery from waste</td>
<td>Public Health Engineering Services in Buildings</td>
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<td>Green buildings</td>
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### Registration of Professional Elective Courses from Verticals:

Refer to the Regulations 2021, Clause 6.3. (Amended on 27.07.2023)
**PROFESSIONAL ELECTIVE COURSES: VERTICALS**

### VERTICAL I: WATER AND WASTEWATER ENGINEERING

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### VERTICAL II: AIR POLLUTION ENGINEERING

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### VERTICAL IV: ENVIRONMENTAL MANAGEMENT

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### VERTICAL V: DIVERSIFIED COURSES

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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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**SUMMARY**

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Credits per Semester</th>
<th>Credits Total</th>
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<tbody>
<tr>
<td>8. Mandatory Course (Non credit)</td>
<td>□ □ □ □ □ □ □ □</td>
<td>□ □ □ □ □ □ □</td>
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</table>

**NAME OF THE PROGRAMME**
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) or 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 addition to all the verticals of other programmes)**

<table>
<thead>
<tr>
<th>VERTICAL I</th>
<th>VERTICAL II</th>
<th>VERTICAL III</th>
<th>VERTICAL IV</th>
<th>VERTICAL V</th>
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<tbody>
<tr>
<td>Fintech and Block Chain</td>
<td>Entrepreneurship</td>
<td>Public Administration</td>
<td>Business Data Analytics</td>
<td>Environment and Sustainability</td>
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<tr>
<td>Financial Management</td>
<td>Foundations of Entrepreneurship</td>
<td>Principles of Public Administration</td>
<td>Statistics for Management</td>
<td>Sustainable infrastructure Development</td>
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<tr>
<td>Fundamentals of Investment</td>
<td>Team Building and Leadership Management for Business</td>
<td>Constitution of India</td>
<td>Datamining for Business Intelligence</td>
<td>Sustainable Agriculture and Environmental Management</td>
</tr>
<tr>
<td>Banking, Financial Services and Insurance</td>
<td>Creativity and Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
<td>Sustainable Bio Materials</td>
</tr>
<tr>
<td>Introduction to Blockchain and its Applications</td>
<td>Principles of Marketing Management for Business</td>
<td>Administrative Theories</td>
<td>Marketing and Social Media Web Analytics</td>
<td>Materials for Energy Sustainability</td>
</tr>
<tr>
<td>Fintech Personal Finance and Payments</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>Indian Administrative System</td>
<td>Operation and Supply Chain Analytics</td>
<td>Green Technology</td>
</tr>
<tr>
<td>Introduction to Fintech</td>
<td>Financing New Business Ventures</td>
<td>Public Policy Administration</td>
<td>Financial Analytics</td>
<td>Environmental Quality Monitoring and Analysis</td>
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<td>Integrated Energy Planning for Sustainable Development</td>
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<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>
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<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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**VERTICAL 2: ENTREPRENEURSHIP**

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### VERTICAL 4: BUSINESS DATA ANALYTICS

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### VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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<td>Sustainable Agriculture and Environmental Management</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>
<td>PEC</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 under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

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

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

References:
Guide to Induction program from AICTE

**HS3152 PROFESSIONAL ENGLISH I**

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES:</th>
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<tbody>
<tr>
<td>• To improve the communicative competence of learners</td>
</tr>
<tr>
<td>• To learn to use basic grammatic structures in suitable contexts</td>
</tr>
<tr>
<td>• To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text</td>
</tr>
<tr>
<td>• To help learners use language effectively in professional contexts</td>
</tr>
<tr>
<td>• To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.</td>
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</tbody>
</table>
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: Why/Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II  NARRATION AND SUMMATION  
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing - Paragraph writing Short Report on an event (field trip etc.) Grammar – Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes & suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III  DESCRIPTION OF A PROCESS / PRODUCT  
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product/Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

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

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

TOTAL : 45 PERIODS

LEARNING OUTCOMES :
At the end of the course, learners will be able
CO1: To use appropriate words in a professional context
CO2: To gain understanding of basic grammatical structures and use them in right context.
CO3: To read and infer the denotative and connotative meanings of technical texts
CO4: To read and interpret information presented in tables, charts and other graphic forms
CO5: To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS :
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.
REFERENCES:

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’s-PO’s & PSO’s MAPPING

<table>
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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

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

UNIT I MATRICES
UNIT II DIFFERENTIAL CALCULUS 9+3

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

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

UNIT V MULTIPLE INTEGRALS 9+3

TOTAL : 60 PERIODS

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

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

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

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**PH3151 ENGINEERING PHYSICS**

**L T P C**
3 0 0 3

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

**UNIT I MECHANICS**


**UNIT II ELECTROMAGNETIC WAVES**

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

**UNIT III OSCILLATIONS, OPTICS AND LASERS**


**UNIT IV BASIC QUANTUM MECHANICS**

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

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

TOTAL: 45 PERIODS

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

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

REFERENCES:

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


UNIT V ENERGY SOURCES AND STORAGE DEVICES

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2 To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

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

CO4 To recommend suitable fuels for engineering processes and applications.

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

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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

GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING

L T P C 3 0 0 3

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

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

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

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

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

TOTAL : 45 PERIODS

COURSE 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/

**COs- PO’s & PSO’s MAPPING**

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

**GE3152**  

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**அக்து பொருளியல் ததயானத்தின்**


**அக்து இ பொருள்**


**அக்து மாற்று முறையில் முழுமையில்**

TEXT-CUM-REFERENCE BOOKS
1. Tamil Language – Tamil Literature – Dr. K.K. Pillay (Published by: Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
2. Classical Tamil – Classical Tamil Literature (Dr. T. V. Sriramuni).
4. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
5. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies).
6. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
7. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies).
8. 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)
9. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
10. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

UNIT I LANGUAGE AND LITERATURE

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE
UNIT III  FOLK AND MARTIAL ARTS  3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலொறு – மக்களும் பண பொடும் – மக.மக.பிள்மள (தவளியீடு:தமிழ்நொடுபொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முமனவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – த மவமக நதிக்கமரயில் எங்ககொல நகரிகம் (ததொல்லியல் தவளியீடு).
4. பொருமந – ஆற் ரங்கமர நொகரிகம். (ததொல்லியல் தவளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

COURSE 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

COURSE 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:
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.

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1 Understand the functioning of various physics laboratory equipment.
CO2 Use graphical models to analyze laboratory data.
CO3 Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4 Access, process and analyze scientific information.
CO5 Solve problems individually and collaboratively.

**CO’s-PO’s & PSO’s MAPPING**

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

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

**COURSE 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, pHmetry, 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

1. Preparation of Na₂CO₃ as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler’s method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strengths of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
13. Preparation of nanoparticles (TiO₂/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

**TOTAL: 30 PERIODS**

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

CO’s-PO’s & PSO’s MAPPING

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GE3172 ENGLISH LABORATORY

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

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

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

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

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

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

CO1 To listen to and comprehend general as well as complex academic information
CO2 To listen to and understand different points of view in a discussion
CO3 To speak fluently and accurately in formal and informal communicative contexts
CO4 To describe products and processes and explain their uses and purposes clearly and accurately
CO5 To express their opinions effectively in both formal and informal discussions

ASSESSMENT PATERN

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

CO'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.

HS3252 PROFESSIONAL ENGLISH II

COURSE OBJECTIVES:

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

UNIT I MAKING COMPARISONS

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases
UNIT II EXPRESSIONS CAUSAL RELATIONS IN SPEAKING AND WRITING 6
Reading - Reading longer technical texts - Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

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

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

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

TOTAL : 30 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able
CO1 To compare and contrast products and ideas in technical texts.
CO2 To identify and report cause and effects in events, industrial processes through technical texts
CO3 To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
CO4 To present their ideas and opinions in a planned and logical manner
CO5 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.

REFERENCES:

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'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.

MA3251 STATISTICS AND NUMERICAL METHODS

L T P C
3 1 0 4

COURSE 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

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

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - $2^2$ factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS


UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

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

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

CO1  Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2  Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO3  Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4  Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5  Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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COURSE 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.

COURSE OUTCOMES:
After completion of the course, the students should be able to
CO1 acquire knowledge about heat transfer through different materials, thermal performance of building and thermal insulation.
CO2 gain knowledge on the ventilation and air conditioning of buildings
CO3 understand the concepts of sound absorption, noise insulation and lighting designs
CO4 now about the processing and applications of composites, metallic glasses, shape memory alloys and ceramics
CO5 get an awareness on natural disasters such as earthquake, cyclone, fire and safety measures

TOTAL: 45 PERIODS
TEXT BOOKS:
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf’s Introduction to Electric Circuits, Wiley, 2018

REFERENCES:

CO’s, PO’s & PSO’s MAPPING

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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)

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

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1 Use BIS conventions and specifications for engineering drawing.
CO2 Construct the conic curves, involutes and cycloid.
CO3 Solve practical problems involving projection of lines.
CO4 Draw the orthographic, isometric and perspective projections of simple solids.
CO5 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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BE3255 BASIC CIVIL AND MECHANICAL ENGINEERING

COURSE OBJECTIVES:
- To provide the students an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.
- To help students acquire knowledge in the basics of surveying and the materials used for construction.
- To provide an insight to the essentials of components of a building and the infrastructure facilities.
- To explain the component of power plant units and detailed explanation to IC engines their working principles.
- To explain the Refrigeration & Air-conditioning system.

UNIT I PART A: OVERVIEW OF CIVIL ENGINEERING
Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

UNIT I PART B: OVERVIEW OF MECHANICAL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS

UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE


UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS
Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM

COURSE OUTCOMES:
CO1: Understanding profession of Civil and Mechanical engineering.
CO2: Summarise the planning of building, infrastructure and working of Machineries.
CO3: Apply the knowledge gained in respective discipline
CO4: Illustrate the ideas of Civil and Mechanical Engineering applications.
CO5: Appraise the material, Structures, machines and energy.

TEXT BOOKS:
1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018

REFERENCES:

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

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

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

#### LEADERSHIP
- **L 1**: Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ' Code | 3
- **L 2**: Case Studies: Shivaji, Jhasi Ki Rani | 2

#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT
- **SS 1**: Basics, Rural Development Programmes, NGOs, Contribution of Youth | 3
- **SS 4**: Protection of Children and Women Safety | 1
- **SS 5**: Road / Rail Travel Safety | 1
- **SS 6**: New Initiatives | 2
- **SS 7**: Cyber and Mobile Security Awareness | 1

**TOTAL: 30 PERIODS**

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### NCC Credit Course Level 1*

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

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

#### PERSONALITY DEVELOPMENT
- **PD 1**: Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving | 2
- **PD 2**: Communication Skills | 3
- **PD 3**: Group Discussion: Stress & Emotions | 2
LEADERSHIP  
L 1  Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code  
L 2  Case Studies: Shivaji, Jhasi Ki Rani  

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

TOTAL: 30 PERIODS

NCC Credit Course Level 1*  
NX3253 (AIR FORCE WING) NCC Credit Course Level I  

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TOTAL: 30 PERIODS
அண்டி I  நூல்கள் எண்ணறுப் பாடல்கள் வரலைப் பக்கமரப்புகள்: 3

அண்டி II கணினியியல் மற்றும் குமுழித் தொழில்நுட்பம்: 3

அண்டி III குமுழித் தொழில்: 3

அண்டி IV ஓர்கருப்பு கல்வி: 3

அண்டி V ஆண்டு முழுமைக் கல்விக்கழகம்: 3

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் இலக்கியம் - செகரகமுதல்நிலியாகான் - ஜே.சே. பிள்ளாக் (வேளிப்பொடு - பாதுகைத்துண்டு மற்றும் கொலத்தில் கொள்ளப்பட்டிருக்கு).
2. ஜேகனைசு தமிழ் - நேர்வாயுர்வு. கருவப்பு (சிற்றொழி பிள்ளாக்).
3. தமிழ் மற்றும் செல்வாத் திமுகக் கல்வி - தமிழ் தொழிலைப் பக்கத்திற்கு இடையே தண்டனை (ச்சங்கலெப்பு குறிக்குடும்பான).
4. பாதுகை - ஆய்வாளர் தலைவர் (வேளிப்பொடு தொலைநோக்கு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies).
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author).
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

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. தமிழக வரலை – மக்களும் பண்பொடும் – மக்க.மக்க.பிள்மள (தவளியீடு: தமிழ்தவளியீட்டுப் புனிதமலர் தேவரவிப்பன் பதிப்புத்தகம்).
2. கணினித் தமிழ் – முமனவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - மவமக நதிக்கமரயில் எங்ககொல நகர நொகரிகம் (ததொல்லியல் துமறதவளியீடு)
4. பாரளை – புரட்சிக்கிள நார்கிகம். (ததொல்லியல் துமறதவளியீடு)
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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3271 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:
The main learning objective of this course is to provide hands on training to the students in:
- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

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

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

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

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES
   15
   WELDING WORK:
      a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
      b) Practicing gas welding.
   BASIC MACHINING WORK:
      a) (simple)Turning.
      b) (simple)Drilling.
      c) (simple)Tapping.
   ASSEMBLY WORK:
      a) Assembling a centrifugal pump.
      b) Assembling a household mixer.
      c) Assembling an airconditioner.
   SHEET METAL WORK:
      a) Making of a square tray
   FOUNDRY WORK:
      a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES
   15
   SOLDERING WORK:
      a) Soldering simple electronic circuits and checking continuity.
   ELECTRONIC ASSEMBLY AND TESTING WORK:
      a) Assembling and testing electronic components on a small PCB.
   ELECTRONIC EQUIPMENT STUDY:
      a) Study an elements of smart phone..
      b) Assembly and dismantle of LED TV.
      c) Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

CO1 Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2 Wire various electrical joints in common household electrical wire work.

CO3 Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4 Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

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

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

BE3272 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY

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
CO’s, PO’s & PSO’s MAPPING

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GE3272 COMMUNICATION LABORATORY L T P C 0 0 4 2

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

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

UNIT II
Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons-understanding common technology terms-Writing: - writing different types of emails.

UNIT III
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages- making comparisons-discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

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

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES
At the end of the course, learners will be able
CO1 Speak effectively in group discussions held in a formal/semi formal contexts.
CO2 Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions.
CO3 Write emails, letters and effective job applications.
CO4 Write critical reports to convey data and information with clarity and precision
CO5 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

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.

MA3391 PROBABILITY AND STATISTICS

COURSE OBJECTIVES
- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 9 + 3
Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9 + 3
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ESTIMATION THEORY 9 + 3

UNIT IV NON-PARAMETRIC TESTS 9 + 3
Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.
UNIT V  STATISTICAL QUALITY CONTROL

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

TOTAL: 60 PERIODS

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

CO1 Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.

CO2 Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.

CO3 Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO4 Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.

CO5 Have the notion of sampling distributions and statistical techniques used in engineering and management problems

TEXT BOOKS

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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81
COURSE OBJECTIVES:
- To educate the students in the area of water, air and soil chemistry
- To explain the theoretical basis and observational methods for study of contaminants and interactions in the environment

UNIT I  FUNDAMENTALS  9
Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp), heavy metal precipitation, amphoteric hydroxides, CO₂ solubility in water and species distribution – Ocean acidification, Chemical kinetics, First order- 12 Principles of green chemistry.

UNIT II  AQUATIC CHEMISTRY  9
Water and wastewater quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation- Degradation of synthetic chemicals - Metals, complex formation, oxidation and reduction, pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

UNIT III  ATMOSPHERIC CHEMISTRY  9

UNIT IV  SOIL CHEMISTRY  9
Nature and composition of soil - Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – agricultural chemicals in soil-reclamation of contaminated land; salt by leaching- Heavy metals by electrokinetic remediation.

UNIT V  EMERGING POLLUTANTS  9
Heavy metals-chemical speciation –Speciation of Hg & As- endocrine disturbing chemicals-Pesticides, Dioxins & Furan, PCBs . PAHs and Fluro compounds toxicity- Nano materials, CNT, titania, composites ,environmental applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1: Gain competency in solving environmental issues of chemicals based pollution
CO2: Determine chemicals mobility in aquatic systems
CO3: Identify contaminating chemicals in air and their fate
CO4: Understand the type of soil contaminants and provide remediation
CO5: Identify emerging environmental contaminants including speciation

REFERENCES:
EN3302 ENVIRONMENTAL MICROBIOLOGY L T P C 3 0 0 3

COURSE OBJECTIVES:

- The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
- The morphology, behaviour and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
- The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease causing organisms are also covered.
- An exposure to toxicology due to industrial products and by-products are also covered.

UNIT I  FUNDAMENTALS OF MICROBIOLOGY

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, importance, introduction to water, soil and air borne pathogens and Parasites and their effects on human, animal and plant health, transmission of pathogens, transmissible diseases – bacterial, viral, protozoan, and helminths parasites, concentration and detection of virus. control of microorganisms preservation of microorganisms, DNA, RNA, replication, recombinant DNA technology, their potential applications and intellectual property rights.

UNIT II  MICROBIAL DIVERSITY AND NUTRIENT TURNOVER


UNIT III  METABOLISM OF MICROORGANISMS

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb’s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, bioenergetics, disruption in metabolism and disease. biodegradation of organic pollutants

UNIT IV  MICROBIOLOGY OF WASTEWATER TREATMENT SYSTEMS

Microbiology of biological treatment processes – aerobic and anaerobic, α-oxidation, β-oxidation, nitrification and denitrification, eutrophication. nutrients removal – BOD, nitrogen, phosphate, microbiology of sewage sludge - indicator organisms of water – coliforms - total coliforms, E-coli, streptococcus, clostridium, Bioleaching
UNIT V  TOXICOLOGY
Ecotoxicology – toxicants and toxicity, factors influencing toxicity. effects – acute, chronic, test organisms – toxicity testing-lab and field testing methods, bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to

CO1 Explain the basic importance and functional elements of environmental microbiology including the potential applications in the environment and intellectual property rights.

CO2 Understand and describe the type of microorganisms in the environment, their importance in water supplies and the role of microorganisms in the cycling of nutrients in an ecosystem.

CO3 Understand the metabolic processes on carbohydrates, protein and lipids, importance of enzymes, production of energy and the various additional metabolic processes.

CO4 Select and apply appropriate methods for assessing the water, air and soil borne pathogens, their health implications, importance of microbes in aerobic and anaerobic cycles and deterioration of water bodies.

CO5 Conduct testing and research on toxicology, understand the importance of test organisms, environmental applications such as biomagnifications, biomonitoring and in developing risk based standards.

REFERENCES:
2. Gabriel Bitton, Wastewater Microbiology, 3rd Edition, 2005

CO"s-PO"s & PSO"s MAPPING

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84
COURSE OBJECTIVES:
- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mind-set for Sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES 9

UNIT II PRINCIPLES AND FRAME WORK 9

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING 9

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS 10

UNIT V ASSESSING PROGRESS AND WAY FORWARD 8

COURSE OUTCOMES
On completion of the course, the student is expected to
CO1 Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.
CO2 Identify and critically analyze the social environmental and economic dimensions of sustainability in terms of UN Sustainable development goals.

CO3 Develop a fair understanding of the social, economic and ecological linkage o Human wellbeing, production and consumption.

CO4 Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.

CO5 Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES:
1. Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2018

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.

EN3304 FLUID MECHANICS AND HYDRAULICS

COURSE OBJECTIVES:
- To introduce the students about the properties of the fluids, behaviour of fluids under static, kinematic and dynamic conditions through the control volume approach and expose them to the applications of the conservation laws and to impart basic knowledge of the dimensional analysis and model studies along with flow through pipes.
- The students will be exposed to the basic concepts of open channel flows with significance to steady uniform flows along with flow measurements in open channels.
- To expose the students to the classification of pumps the basic principles of working and to design centrifugal pump.

UNIT I FLUID PROPERTIES AND FLUID STATICS
Definition and properties of fluid - Fluid statics – Fluid pressure and measurement – Mechanical gauges - Forces on plane and curved surfaces - Buoyancy - Stability of floating bodies.
UNIT II  FLUID KINEMATICS AND FLUID DYNAMICS  9
Classification of fluid flows - Continuum hypothesis - System and Control volume approach - Streamline, streak-line and path-lines - Application of continuity, energy and momentum - Euler’s equation of motion along a stream line - Bernoulli’s equation - Linear momentum equation

UNIT III  FLOW THROUGH PIPES AND MODEL STUDIES  9
Reynolds experiment - Laminar flow through circular pipe - Darcy-Weisbach equation - Moody diagram - Major and minor losses in pipe flow - Total energy line - Hydraulic grade line - Siphon - Pipes in series and parallel - Equivalent pipes - Fundamental dimensions - Dimensional homogeneity - Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV  OPEN CHANNEL FLOWS  9
Types of flow - Characteristics of open channel - Chezy’s equation - Manning equation - Hydraulically efficient channel sections - Critical depth - Specific energy application to channel transitions - Flow measurement in channels and natural streams - Current meter - Classification of hydraulic jumps - momentum equation - Energy loss.

UNIT V  PUMPS  9
Types of pumps - Efficiencies - Selection of pump capacity - Centrifugal pump - Characteristics and working principle - Types of impellers - Priming - NPSH - Cavitation - Minimum speed to start the pump - Specific speed - Submersible pump - Jet pump - Air lift pump - Sludge pump - Reciprocating pump and its working principles.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017

REFERENCES:

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Demonstrate the properties of fluid and its behaviour in static conditions along with pressure measurements.
CO2 Apply the conservation laws applicable to fluid flows and its application through fluid kinematics and dynamics.
CO3 Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel and to understand the concept of application of dimensional analysis in model studies.
CO4 Describe the basics characteristics of open channel flows and analysis of steady uniform flow with hydraulically efficient channel sections and to measure the flows in artificial/natural channels.
CO5 Explain the classification, design and working principles of various pumps.
CO’s- PO’s & PSO’s MAPPING

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

CE3351 SURVEYING AND LEVELLING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the rudiments of plane surveying and geodetic principles to Environmental Engineers and to learn the various methods of plane and geodetic surveying to solve the real world problems. To introduce the concepts of Control Surveying. To introduce the basics of Astronomical Surveying

UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING 9

UNIT II LEVELLING 9

UNIT III THEODOLITE SURVEYING 9

UNIT IV CONTROL SURVEYING AND ADJUSTMENT 9

UNIT V MODERN SURVEYING 9

TOTAL 45 PERIODS
COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Introduce the rudiments of various surveying and its principles.
CO2 Imparts knowledge in computation of levels of terrain and ground features
CO3 Imparts concepts of Theodolite Surveying for complex surveying operations
CO4 Understand the procedure for establishing horizontal and vertical control
CO5 Imparts the knowledge on modern surveying instruments

TEXTBOOKS:

REFERENCES:

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

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COURSE OBJECTIVE:
- To provide hands on experience in calibration of flow meters, performance characteristics of pumps and turbines.

LIST OF EXPERIMENTS
A. FLOW MEASUREMENT
1. Bernoulli’s Experiment
2. Calibration of Rotameter
3. Flow through Orifice meter/Mouthpiece,
4. Flow through Venturi meter and Notches

B. LOSSES IN PIPES
5. Determination of friction factor in pipes.
6. Determination of minor losses

C. PUMPS
7. Characteristics of Centrifugal pumps
8. Characteristics of Gear pump
9. Characteristics of Submersible pump
10. Characteristics of Reciprocating pump

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to

- CO1 Understand and Apply the concept of Bernoulli equation in fluid flow
- CO2 Calibrate the flow measuring devices in a pipe line/channel
- CO3 Measure friction factor in pipes and compare with Moody diagram
- CO4 Determine the performance characteristics of rotodynamic pumps.
- CO5 Determine the performance characteristics of positive displacement pumps.

REFERENCES:
1. Hydraulic Laboratory Manual

CO’s-PO’s & PSO’s MAPPING

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TOTAL : 45 PERIODS
COURSE OBJECTIVES:
- At the end of the course the student will possess knowledge about survey field techniques

LIST OF EXPERIMENTS:

**Chain Survey**
1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset
2. Setting out works – Foundation marking using tapes single Room and Double Room

**Compass Survey**
3. Compass Traversing – Measuring Bearings & arriving included angles

**Levelling - Study of levels and levelling staff**
4. Fly levelling using Dumpy level & Tilting level
5. Check levelling

**Theodolite - Study of Theodolite**
6. Measurements of horizontal angles by reiteration and repetition and vertical angles
7. Determination of elevation of an object using single plane method when base is Accessible/inaccessible.

**Tacheometry – Tangential system – Stadia system**
8. Determination of Tacheometric Constants
9. Heights and distances by stadia Tacheometry
10. Heights and distances by Tangential Tacheometry

**Total Station - Study of Total Station, Measuring Horizontal and vertical angles**
11. Traverse using Total station and Area of Traverse
12. Determination of distance and difference in elevation between two inaccessible points using Total station

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course, the student is expected to

CO1 Impart knowledge on the usage of basic surveying instruments like chain/tape, compass and levelling instruments

CO2 Able to use levelling instrument for surveying operations

CO3 Able to use theodolite for various surveying operations

CO4 Able to carry out necessary surveys for social infrastructures

CO5 Able to prepare planimetric maps

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GE3361 PROFESSIONAL DEVELOPMENT

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

**MS WORD:**

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

**MS EXCEL:**

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

**MS POWERPOINT:**

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

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**

On successful completion the students will be able to

**CO1** Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements

**CO2** Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding

**CO3** Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.
COURSE OBJECTIVES:

- To explain the role of law, policy and institutions in the conservation and management of natural resources as well as pollution control
- To introduce the laws and policies both at the national and international level relating to environment
- To equip the students with the skills needed for interpreting laws, policies and judicial decisions

UNIT I  INTRODUCTION TO ENVIRONMENTAL LEGISLATIONS AND INTERNATIONAL SCENARIO 9

UNIT II  INDIAN CONSTITUTIONS AND ENVIRONMENTAL PROTECTION 9
Indian Constitution and Environmental Protection -Constitutional provisions concerning Environment Articles 14,15,(2) (b) 19 (e),21,31,32,38,39,42,47, 48-A,49,51,51-A: Indian Environmental Policy 2006 Administrative machinery for pollution control Common Law & Criminal Law Nuisance, Negligence, Strict liability and Absolute liability, Provisions of IPC relating to environmental problems (public nuisance u/s 268 and others (Sections 269,270,277,284,285,286,425 to 440) Section 133 of Cr.P.C.

UNIT III  REMEDIES FOR ENVIRONMENTAL POLLUTION 9

UNIT IV  MAJOR INDIAN LEGISLATIONS 9

UNIT V  ENVIRONMENT AND DEVELOPMENT CASE LAWS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Understand origins and sources of environmental laws, and understand how and by whom environmental laws are made and interpreted
CO2 Understand the key principles of, and actors within, environmental laws
CO3 Understand the National Environmental Policy and Various Legislations enacted in line with Policy
CO4 Critically analyze environmental laws within various contexts and to evaluate laws against procedural and substantive criteria.
CO5 Understand the Legal system operating in India and will be in a position to prepare compliance reports for getting environmental clearance.

REFERENCES:
1. Leelakrishnan P., Environmental Law in India, Butterworths Wadhwa, 3rd Edition 2010
2. Leelakrishnan P., Environmental Case Book, Lexis Nexis, 2010

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

EN3402 WATER SUPPLY ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
- The course objective is to identify the sources and quantity of surface and ground water bodies and their demand for the public and also to study the quality of water and their treatment techniques.

UNIT I PUBLIC WATER SUPPLY SCHEMES AND QUANTITY OF WATER 8

UNIT II HYDROLOGICAL CONCEPTS AND SOURCES OF WATER 9

UNIT III QUALITY OF WATER AND TRANSPORTATION OF WATER 8
UNIT IV  PURIFICATION OF WATER  
Treatment of water- working principles of all the unit process of water treatment. Purpose and its design – screening – plain sedimentation – coagulation sedimentation – filtration – disinfection – water softening and Desalination– Operation & Maintenance aspects of all the unit process.

UNIT V  OTHER TREATMENTS AND DISTRIBUTION OF WATER  

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Understand the various components of water supply scheme
CO2 Design of intake structure and conveyance system for water transmission
CO3 Understand the process of conventional treatment of water and design of water treatment system.
CO4 Understand and design the various advanced treatment system and knowledge about the recent advances in water treatment process
CO5 Design and evaluate water distribution system and water supply in buildings

TEXTBOOKS :

REFERENCES :

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EN3403   ENVIRONMENTAL MANAGEMENT SYSTEMS   L T P C  3 0 0 3

COURSE OBJECTIVES:
- To impart an understanding of systems approach to Environmental Management as per ISO 14001 and skills for environmental performance assessment in terms of legal compliance, pollution prevention and continual improvement.

UNIT I  ENVIRONMENTAL MANAGEMENT STANDARDS  9

UNIT II  PREVENTIVE ENVIRONMENTAL MANAGEMENT  9
Pollution control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies – Four Stages and nine approaches of Pollution Prevention - Getting management commitment – Analysis of Process Steps- source reduction, raw material substitution, toxic use reduction and elimination, process modification –Material balance – Technical, economical and environmental feasibility evaluation of Pollution Prevention options in selected industries – Preventive Environmental Management over Product cycle.

UNIT III  ENVIRONMENTAL MANAGEMENT SYSTEM  10
ISO 14000 family: EMS as per ISO 14001-- benefits and barriers of EMS – Understanding the organisation and its context- Understanding the needs and expectations of interested parties- Determining the scope of the environmental management system- Leadership and commitment- Environmental policy- Organizational roles, responsibilities and authorities- Actions to address risks and opportunities- Environmental objectives and planning – Resources- Competence-Awareness- Communication- Documented Information – Operational Planning and Control- Emergency preparedness and response- Monitoring, measurement, analysis and evaluation - Management review

UNIT IV  ENVIRONMENTAL AUDIT  8
Environmental management system audits as per ISO 19011-Internal Audits and Certification Audits – Principles of auditing- Roles and qualifications of auditors - Determining auditor competence- Managing an audit programme – Establishing and Implementing audit programme- Selecting audit team members and Assigning responsibility - Conducting an audit- opening meeting, Audit evidence gathering - Collecting and verifying information - Managing and maintaining audit programme records- closing meeting and reporting - Non conformance – Corrective and preventive actions - Continual improvement - compliance audits – waste audits and waste minimization planning – Environmental statement (form V) - Due diligence audit

UNIT V  CASE STUDIES  9
Case studies on applications of EMS, Waste Audits and Pollution Prevention in Textile industry , Tanning industry, Electroplating, Pulp & Paper, Dairy, Chemical industries and service organizations.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
- On completion of the course, the student is expected to
  CO1 Explain the various elements of Corporate Environmental Management systems and audits complying to international environmental management system standards
  CO2 Apply the knowledge of science and engineering fundamentals to pollution prevention assessment and environmental performance evaluation
  CO3 Develop environmental management systems for organisations
  CO4 Conduct environmental management system audits taking into account the sustainability context
  CO5 Conduct research pertinent to pollution prevention and communicate effectively to different stakeholders as well as engage in independent life-long learning

REFERENCES:

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EN3404 MUNICIPAL SOLID WASTE MANAGEMENT

COURSE OBJECTIVES:
- To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.

UNIT I SOURCES AND TYPES
Sources and types of municipal solid wastes—waste generation rates-factors affecting generation, characteristics—methods of sampling and characterization; Effects of improper disposal of solid wastes—Public health and environmental effects. Elements of solid waste management – Social and Financial aspects – Municipal solid waste (M&H) rules – integrated management—Public awareness; Role of NGO’s.
UNIT II ON-SITE STORAGE AND PROCESSING 8

UNIT III COLLECTION AND TRANSFER 8
Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.

UNIT IV OFF-SITE PROCESSING 12
Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and bio-methanation; Thermal processing options – case studies under Indian conditions.

UNIT V DISPOSAL 9
Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students completing the course will have
CO1 understand the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management
CO2 explains the segregation of solid waste and the onsite storage methods
CO3 explains the various transfer methods and to know the site condition for the transfer station
CO4 select appropriate methods for processing and disposal of solid and hazardous wastes, taking into account the impact of the solutions in a sustainability context
CO5 knowledge about selection of appropriate disposal methods and its handling in an efficient manner

TEXTBOOKS:

REFERENCES:
2. Bhide A.D. and Sundaresan, B.B. Solid Waste Management Collection, Processing and Disposal, 2001

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EN3405 FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT

L T P C

3 0 0 3

COURSE OBJECTIVE:

• To educate the students on the mechanism of transport and fate of contaminants in the geosphere of the environment.

UNIT I EQUILIBRIUM AND TRANSPORT MECHANISMS

10


UNIT II EXCHANGE RATES BETWEEN AIR AND WATER

8

Desorption of gases and liquids from aerated basins and rivers – completely mixed basin – plug flow basin – gas exchange rates between the atmosphere and the surface of rivers – exchange of chemical across the air – water interface of lakes and oceans.

UNIT III EXCHANGE RATES BETWEEN WATER AND THE EARTHERN MATERIAL

9

Dissolution of chemicals -natural convection dissolution – water interface – mass transfer coefficients at the sediment – water interface. Flux of chemicals between sediment and the overlying seawater – movement of chemicals through the benthic boundary layer.

UNIT IV EXCHANGE RATES BETWEEN AIR AND SOIL

9

Turbulence above the air – soil interface – the Richardson number – chemical flux rates through the lower layer of the atmosphere –evaporation of liquid chemicals spilled on land – chemical flux rates through the upper layer of earthen material.

UNIT V CONTAMINANT TRANSPORT ANALYSIS

9

Potential theory- Potential Functions- Stream Function – Travel time along with Stream Functions- Residential Time Distribution Theory- Analysis of Chemical Spills and Contaminant plumes – Fourier analysis of Initial value – point spill analysis- vertically mix spill analysis- Horizontal Plane Source analysis

TOTAL: 45 PERIODS

COURSE OUTCOME

On completion of the course, the student is expected to

CO1 Understand the equilibrium and transport mechanisms
CO2 Have a knowledge of gas exchange rates between air and water
CO3 Have a knowledge of gas exchange rates between water and soil
CO4 Have a knowledge of gas exchange rates between air and soil.
CO5 Understand contaminant transport analysis

TEXT BOOKS:

REFERENCES:

CCE331 AIR AND NOISE POLLUTION CONTROL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution.

UNIT I GENERAL
Atmosphere as a place of disposal of pollutants – Air Pollution – Definition - Air Pollution and Global Climate.- Units of measurements of pollutants - Air quality criteria - emission standards - National ambient air quality standards - Air pollution indices - Air quality management in India.

UNIT II SOURCES, CLASSIFICATION AND EFFECTS
Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods. Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale.

UNIT III SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING

UNIT IV AIR POLLUTION CONTROL MEASURES
Control - Source correction methods - Control equipments - Particulate control methods – Bag house filter - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator - scrubbers - Control of gaseous emissions - Absorption - Absorption equipment - adsorption and combustion devices (Theory and working of equipment only).
UNIT V  NOISE POLLUTION AND ITS CONTROL

Sources of noise – Units and Measurements of Noise - Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures – Effects of noise pollution – auditory effects, non-auditory effects. Noise Menace– Prevention and Control of Noise Pollution – Control of noise at source, control of transmission, protection of exposed person - Control of other types of Noise Sound Absorbent

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1  Understand various types and sources of air pollution and its effects
CO2  Know the dispersion of air pollutants and their modeling
CO3  Know about the principles and design of control of particulate pollutants
CO4  Understand the principles and design of control of gaseous pollutant
CO5  Know the sources, effects and control of vehicular, indoor air and noise pollution

TEXTBOOKS:

REFERENCES:
2.  Air Pollution act, India, 1987
4.  Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986

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

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## DISASTER MANAGEMENT

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## ENVIRONMENTAL AWARENESS & CONSERVATION

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## ADVENTURE

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## BORDER & COASTAL AREAS

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BORDER & COASTAL AREAS
BCA 1 History, Geography & Topography of Border/Coastal areas 2

TOTAL: 45 PERIODS

EN3411 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY LABORATORY L T P C 0 0 4 2

COURSE OBJECTIVES:
• To train in the analysis of physico-chemical parameters with hands on experience
• To train the students in the analysis of various microbiological techniques, microbiological analysis, enzyme assay, pollutant analysis and operation of bioreactors.

A: Environmental Chemistry
1. Estimation of hardness in Water sample by volumetric titration
2. Estimation of Chloride in Water sample by volumetric titration
3. Determination of sulphate
4. Determination of phosphate
5. Determination of Total Solids, Total suspended solids, Total dissolved solids
6. Determination of COD in the wastewater sample
7. Determination of BOD in the wastewater sample

B: Environmental Microbiology
1. Preparation of culture media
2. Isolation and Culturing of Microorganisms
3. Gram Staining of bacteria
4. Bacteriological analysis of wastewater (Coliforms & Streptococcus) – MPN Technique
5. Bacteriological analysis of wastewater (Coliforms & Streptococcus MF technique

TOTAL: 60 PERIODS

COURSE OUTCOMES
CO1 Analyze the water quality parameters such as hardness chloride and sulphate
CO2 Characterize the wastewater parameters like phosphate, solids COD and BOD
CO3 Prepare culture media necessary for microbial growth
CO4 Isolate and culture the bacteria - identify the bacteria - able to handle microscope
CO5 Analyze the coliform count in the wastewater.

REFERENCES

CO’s, PO’s & PSO’s MAPPING

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Note: The average value of this course to be used for program articulation matrix.
EN3501 SOIL MECHANICS AND FOUNDATION ENGINEERING 3 0 0 3

COURSE OBJECTIVES:
- To understand the basic properties and strength nature of various soils and their settlement behavior in foundations.

UNIT I SOIL PROPERTIES AND COMPACTION OF SOIL

UNIT II SOIL MOISTURE—PERMEABILITY, STRESSE’S IN SOILS

UNIT III SHEARSTRENGTH ANDSLOPE STABILITY

UNIT IV SOILEXPLORATION
Scope and objectives—Methods of exploration—Averaging and boring—Wash boring and rotary drilling—Depth of boring—Spacing of boreholes—Sampling—Representative and undisturbed sampling—sampling techniques—Split spoon sampler, Thin tube sampler, Stationary piston sampler—Bore log report—Penetration tests (SPT and SCPT)—Data interpretation (Strength parameters and Liquefaction potential).

UNIT V FOUNDATION—BEARING CAPACITY AND SETTLEMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course, the student is expected to be able to
CO1 Graduates will demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering Problems
CO2 Graduate will show the basic understanding of flow through soil medium and its impact of engineering solution
CO3 Graduate to understand about the basic concept of stress distribution in loaded soil medium and soil settlement due to consolidation
CO4 Graduate will show the understanding of shear strength of soils and its impact of engineering solutions to the loaded soil medium and also will be aware of contemporary issues on shear strength of soils.
CO5. Graduate will demonstrate an ability to plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation
TEXTBOOKS:

REFERENCES:

CO’s, PO’s & PSO’s MAPPING

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EN3502 LIFE CYCLE ASSESSMENT

COURSE OBJECTIVES:
- To impart knowledge and skills on the concept and methodology of Life Cycle Assessment as per international standards and its potential applications to develop sustainable products and promote sustainable consumption.

UNIT I LIFE CYCLE THINKING AND LIFE CYCLE MANAGEMENT
Introduction to Life Cycle Thinking – Industrial ecology – Life cycle management (LCM) and Stakeholder Expectations - LCM drivers and issues - materials flow analysis - Life cycle of Products and services - International organizations and networks - History and definition of LCA - analytical tools for product and service systems — Value creation along the life cycle – technical characteristics – applications – limitations

UNIT II LCA GOAL, SCOPE AND INVENTORY
UNIT III LIFE CYCLE IMPACT ANALYSIS AND INTERPRETATION

UNIT IV DESIGN FOR ENVIRONMENT AND ECOLABELLING

UNIT V LCA SOFTWARES AND CASE STUDIES

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course, the student is expected to be able to
CO1 Explain the various functional elements of Life Cycle Analysis and Design for Environment
CO2 Apply the knowledge of science and engineering fundamentals to characterize the environmental interactions of products and services
CO3 Design of engineering systems taking into account the material flow and pollutant interactions between engineering decisions and the environment
CO4 Select appropriate LCA tools to support product/process design and decision making, taking into account the impact of the solutions in a sustainability context
CO5 Conduct research pertinent to Life Cycle Management and communicate effectively to different stakeholders in terms of eco labels as well as engage in independent life-long learning

REFERENCES:
CO’s-PO’s & PSO’s MAPPING

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EN3503 WASTEWATER ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVE:
- The objectives of this course is to help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena for successful design, operation and maintenance of sewage treatment plants.

UNIT I PLANNING AND DESIGN OF SEWERAGE SYSTEM 9

UNIT II PRIMARY TREATMENT OF SEWAGE 9
Objectives – Unit Operations and Processes – Selection of treatment processes — Onsite sanitation - Septic tank- Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks –Operation and Maintenance aspects.

UNIT III SECONDARY TREATMENT OF SEWAGE 10

UNIT IV ADVANCES IN SEWAGE TREATMENT 8
Sequencing Batch Reactor – Moving bed biofilm reactor-Membrane Bioreactor - UASB - Biogas recovery- Reclamation and Reuse of sewage – Constructed Wetland –Nutrient removal systems.

UNIT V SEWAGE DISPOSAL AND SLUDGE MANAGEMENT 10

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations

CO2 Select type of treatment system and able to perform basic design of the unit operations that are used in sewage treatment. knowledge of septic tank design
CO3 Gain knowledge of selection of treatment process and biological treatment process
CO4 Acquire knowledge of advance treatment technology and reuse of sewage
CO5 Understand the, self-purification of streams and sludge and septage disposal methods.

TEXTBOOKS:

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.

EN3511 ENVIRONMENTAL ENGINEERING LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:
- This subject includes the list of experiments to be conducted for characterization of water and municipal sewage. At the end of the course, the student is expected to be aware of the procedure for quantifying quality parameters for water and sewage.

LIST OF EXPERIMENTS: ANALYSIS OF WATER SAMPLE
1. Sampling and preservation methods for water and wastewater (Demonstration only)
2. Measurement of Electrical conductivity and turbidity
3. Determination of fluoride in water by spectrophotometric method /ISE
4. Determination of iron in water (Demo)
5. Determination of Sulphate in water
6. Determination of Optimum Coagulant Dosage by Jar test apparatus
7. Determination of available Chlorine in Bleaching powder and residual chlorine in water
ANALYSIS OF WASTEWATER SAMPLE
8. Estimation of suspended, volatile and fixed solids
9. Determination of Sludge Volume Index in waste water
10. Determination of Dissolved Oxygen
11. Estimation of B.O.D.
12. Estimation of C.O.D.
13. Determination of Ammonia Nitrogen in wastewater
14. Determination of coliform (Demonstration only)

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 calibrate and standardize the equipment
CO2 collect proper sample for analysis
CO3 know the sample preservation methods
CO4 perform field oriented testing of water, wastewater
CO5 perform coliform analysis

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.

EN3512 ENVIRONMENTAL ENGINEERING DESIGN AND DRAWING LT P C 0 0 4 2

COURSE OBJECTIVES:
- To train the students on preparing layout to for water and wastewater treatment plants as well as general arrangement diagrams for units in water and wastewater treatment.

LIST OF DRAWINGS:
- i. Layout of Water treatment plant
- ii. Infiltration gallery and pumping station.
- iii. Flash mixer
- iv. Clarifier
- v. Slow and rapid sand filters
- vi. Layout for Sewage Treatment Plants
- vii. Primary and secondary settling tanks
- viii. Activated sludge process

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ix. Sequencing Batch Reactor  
x. Sludge digestion tank  
xi. Septic tank with dispersion trench  
xii. Flow Chart of ETP for selected Industries.  
xiii. Flow Chart for CETP  

OUTCOMES  
CO1 Ability to prepare flow charts and layouts of water and waste water treatment plants  
CO2 Ability to draw the filtration units required for treatment  
CO3 Ability to design and detail structures and reactors required for water and wastewater treatment  
CO4 Ability to design the pumping station and infiltration gallery  
CO5 Ability to prepare flow charts for ETP and CETP  

REFERENCES  
3. Mannualon wastewater and treatment CPHEECO, Ministry of Urban Affairs and Employment, Govt.ofIndia,NewDelhi,1990.  

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.

EN3601 ENVIRONMENTAL MONITORING INSTRUMENTS L T P C 3 0 0 3  

COURSE OBJECTIVES:  
• To educate the students on the sample collection and various instrumental methods of monitoring the quality of air, water and solid waste.  

UNIT I MONITORING AND CHARACRATERIZATION OF ENVIRONMENT 9  
General approach to environmental analysis, Choice of Lab. Vs. Field analysis, Environmental monitoring-current and future status, Lab. Standards, Data quality objectives, statistics in environmental monitoring, Accuracy and precision, detection limit, types of errors, Automated Data acquisition and processing-sensors and transducers , Monitoring Network and real time monitoring

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UNIT II  ENVIRONMENTAL SAMPLING  
Location, planning, sampling equipment’s for water, solids and air, sample storage for physical and chemical contaminants, types of sampling, representative samples, sample preparation techniques-Solvent Extraction, SPE, Head space, Purge and trap and SPME

UNIT III  WATER ANALYSIS  
Techniques for analysis of major ions-UV-visible Spectrophotometer, Flame photometer, AAS, ICP (AES and MS), Trace organic pollutants (PCB, dioxins, pesticides) GC and HPLC (Columns Detectors and Application)

UNIT IV  ATMOSPHEREIC ANALYSIS  
Ambient air and flue gas, Gaseous pollutants-Determination of time weighted average concentration (Absorption trains, solid adsorbents and differential tubes), Direct reading instruments(Fluorescence ,chemiluminescent, IR and Electrochemical sensors, GC-MS for trace organics, Particulate sampling methods- High volume sampler, personal sampler, PM 10 and 2.5, Metals Direct (XRF) and dissolution methods (AAS/AES)

UNIT V  ANALYSIS OF SOIL AND WASTE  
Problem in analysis of soil and Waste -sampling, pretreatment -extraction and clean up, New extraction techniques, Automated soxhlet and solvent extraction, microwave digestion and sonication, SCF(CO2), Analysis for trace pollutants, Analysis of leachate.

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Able to select appropriate instrumental method for chemical analysis
CO2: Understand spectroscopic methods of analysis of pollutants
CO3: Select correct method for toxic organics estimation using chromatography methods
CO4: Understand electro and nondestructive methods of analysis
CO5: Familiar with online analyzers

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.
COURSE OBJECTIVES:
- To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.
- Understand principles of various processes applicable to industrial wastewater treatment
- Identify the best applicable technologies for wastewater treatment from the perspective of yield production.

UNIT I INTRODUCTION

UNIT II INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION

UNIT III INDUSTRIAL WASTEWATER TREATMENT

UNIT IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT

UNIT V CASE STUDIES
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries

COURSE OUTCOMES:
After completion of this course, the students is expected to be able to,
CO1 Explain the source and types of industrial wastewater and their environmental impacts and choose the regulatory laws pertaining to environmental protection
CO2 Identify industrial wastewater pollution and implement pollution prevention, waste minimization in industries
CO3 Apply knowledge and skills to design industrial wastewater treatment schemes
CO4 Audit and analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques
CO5 Conduct research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable

TOTAL: 45 PERIODS
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.

NCC Credit Course Level 3*

NX3651 (ARMY WING) NCC Credit Course – III

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TOTAL : 45 PERIODS
NCC Credit Course Level 3*

NX3653  (AIR FORCE WING) NCC Credit Course Level - III  L T P C
        3 0 0 3

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

BORDER & COASTAL AREAS  5
BCA 2  Security Setup and Border/Coastal management in the area  2
BCA 3  Security Challenges & Role of cadets in Border management  2

AIRMANSHP  1
A 1  Airmanship  1

BASIC FLIGHT INSTRUMENTS  5
FI 1  Basic Flight Instruments  3

AERO MODELLING  5
AM 1  Aero Modelling Capsule  3

GENERAL SERVICE KNOWLEDGE  5
GSK 4  Latest Trends & Acquisitions  2

AIR CAMPAIGNS  5
AC 1  Air Campaigns  6

PRINCIPLES OF FLIGHT  5
PF 1  Principles of Flight  3
PF 2  Forces acting on Aircraft  3

NAVIGATION  5
NM 1  Navigation  2
NM 2  Introduction to Met and Atmosphere  3

AERO ENGINES  5
E 1  Introduction and types of Aero Engine  3
E 2  Aircraft Controls  3

TOTAL : 45 PERIODS

EN3611  ENVIRONMENTAL INSTRUMENTATION LABORATORY  L T P C
        0 0 4 2

COURSE OBJECTIVES:
- To train the students on the use of different instruments used for performance monitoring and testing of equipment in wastewater treatment, air pollution control, effluent analysis and emission monitoring.

LIST OF EXPERIMENTS:
A. Sample Collection, Handling and Preservation
   - Sampling Protocol: Planning a Sampling Strategy
   - The Representative Sample: Random vs. Judgmental Sampling
   - Sampling Equipment: Devices and Containers for soil, air and water.
   - Sampling Techniques: soil and water
• Sampling Techniques: gases and vapors
• Sample Documentation and Preservation, Chain of Custody (COC)

B. Methods of Analysis
• Sample Preparation: Interferences and Detection Limits
• Quality Control
• Field Quality Control: Duplicate Samples
• Quality Control in the Laboratory: Equipment Calibration, Matrix spike and Blank samples.
• Calibration

C. Electrode (potentiometric) Methods:
• Use of bench top and field model pH meters
• Use of Dissolved Oxygen Meters.
• Use of TDS Meters.

D. Spectrophotometry
• Estimation of Phosphate.
• Estimation of Hydrocarbon.
• Estimation of Nitrogen.
• Estimation of Heavy Metals.

E. Chromatography
• Liquid/Gas Chromatography.
• Gas Chromatograph.
• HPLC

F. High Volume Sampler
• PM and Gas Pollutant analysis

TOTAL: 60 PERIODS

COURSE OUTCOMES:
The students completing the course will have
CO1 To conduct treatability studies on water and wastewater treatment
CO2 To determine the removal / degradation of pollutants from water and wastewater and arrive at kinetics
CO3 To design scaled up reactors for treatment of water and wastewater treatment based on laboratory studies
CO4 To determine ambient air quality of given study area in terms of Particulate and Gaseous Pollutants

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.
COURSE OBJECTIVES:
- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
- To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 carry out scoping and screening of developmental projects for environmental and social assessments
CO2 explain different methodologies for environmental impact prediction and assessment
CO3 asses socio-economic investigation of the environment in a project
CO4 plan environmental impact assessments and environmental management plans
CO5 knowledge to prepare environmental impact assessment reports for various projects

REFERENCES:
3. World Bank –Source book on EIA

CO’s- PO’s & PSO’s MAPPING

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CCE332 ENVIRONMENTAL HEALTH AND SAFETY L T P C 3 0 0 3

COURSE OBJECTIVES:
- To educate overview of EHS in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System

UNIT I INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses – Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV HAZARDS AND RISK MANAGEMENT

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Structue and Clauses-Case Studies

TOTAL: 45 PERIODS
COURSE OUTCOMES:
After completion of this course, the students are expected to be able to understand:

CO1 Need for EHS in industries and related Indian regulations
CO2 Various types of Health hazards, effect, assessment and control methods
CO3 Various safety systems in working environments
CO4 The methodology for preparation of Emergency Plans and Accident investigation
CO5 EHS Management System and its elements

REFERENCES
1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India
2. Fundamentals of Industrial Safety and Health by Dr.K.U. Mistry, Siddharth Prakashan, 2012
5. Environmental and Health and Safety Management by Nicholas P.Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995

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GE3791 HUMAN VALUES AND ETHICS

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

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

UNIT I DEMOCRATIC VALUES


Reading Text: Excerpts from John Stuart Mills’ *On Liberty*
UNIT II SECULAR VALUES
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani

UNIT III SCIENTIFIC VALUES

Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R

UNIT IV SOCIAL ETHICS
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari

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


TOTAL: 30 PERIODS

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

COURSE OUTCOMES
Students will be able to
CO1 : Identify the importance of democratic, secular and scientific values in harmonious functioning of social life
CO2 : Practice democratic and scientific values in both their personal and professional life.
CO3 : Find rational solutions to social problems.
CO4 : Behave in an ethical manner in society
CO5 : Practice critical thinking and the pursuit of truth.

GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING

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

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

UNIT II  PRODUCTION AND COST ANALYSIS  9

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009
### EN3811 PROJECT WORK/INTERNSHIP

#### COURSE OBJECTIVE:
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

#### STRATEGY:
The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

#### TOTAL: 300 PERIODS

#### COURSE OUTCOMES:
- On Completion of the project works students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**CO1** Identify Environmental engineering problems reviewing available literature.

**CO2** Identify appropriate techniques to analyze complex Environmental engineering problems.

**CO3** Apply engineering and management principles through efficient handling of Project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way.

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

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PSO1 | Knowledge of Environmental Engineering discipline | 3 | 3 | 1 | 3
PSO2 | Critical analysis of Environmental Engineering problems and innovation | 3 | 3 | 1 | 3
PSO3 | Conceptualization and evaluation of engineering solutions to Environmental Engineering Issues | 3 | 3 | 1 | 3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: WATER AND WASTEWATER ENGINEERING

CAI333 GROUNDWATER AND WELL ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES
• To acquaint and equip the students with the techniques of groundwater development and management

UNIT I GROUND WATER OCCURRENCE 9
Occurrence of groundwater, temporal and spatial variability of groundwater, methods for groundwater exploration, determination of aquifer parameters, pumping tests, assessment of groundwater potential

UNIT II WELL CONSTRUCTION 9
Groundwater structures, groundwater development and utilization, types of water wells, design and construction of water wells, drilling methods, well development, well maintenance and rehabilitation, groundwater monitoring, monitoring wells, design and construction of monitoring wells

UNIT III GROUNDWATER POLLUTION 9
Groundwater development and quality considerations, groundwater contamination, sources and causes of groundwater pollution, contaminated systems and their rehabilitation, groundwater bioremediation, management of salt water ingress in inland and coastal aquifers.

UNIT IV GROUNDWATER MANAGEMENT 9
Management of declining and rising water table, Natural and artificial groundwater recharge, Groundwater recharge basins and injection wells. Groundwater management in irrigation command, conjunctive water use, water lifting, different types of pumps, selection of pumps, pump characteristics curve, cost of groundwater pumping, comparative economics of surface and groundwater use for irrigation

UNIT V GROUNDWATER DEVELOPMENT POLICIES 9
Major issues related to groundwater development and management in India, Legal aspects of groundwater exploitation, Diagnostic survey of sick wells/tube wells and their rehabilitation.

TOTAL:45 PERIODS

COURSE OUTCOMES
CO1 The students will be able to describe the concepts of aquifer parameters
CO2 The students will be able to describe the components involved in Groundwater structures
CO3 The students will be able to describe the Groundwater development and quality considerations
CO4 The students will be able to describe the Management of declining and rising water table
CO5 The students will be able to prioritize and execute the Groundwater development programme
TEXT BOOKS :

REFERENCES

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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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EN3001 FUNCTIONAL DESIGN OF RAINWATER HARVESTING SYSTEMS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To meet the increasing demand of water.
- To avoid the flooding of roads.
- Supplement domestic water needs.
- To raise the underground water table.
UNIT I  GENERAL  8
Objectives of rainwater harvesting - principles, importance and issues. Water harvesting
techniques – classification based on source, storage and use. Runoff harvesting – short-term
and long - tem techniques. Short - term harvesting techniques

UNIT II  GROUNDWATER  9
Over-exploitation of groundwater - Need for artificial recharge and rainwater harvesting - types
of wells - drilling technology - design, construction and development of water wells: dug wells
and bore wells; direct and reverse rotary drilling; cable tool and DTH hammer drilling; gravel
packing and well development procedures.

UNIT III  ARTIFICIAL RECHARGE STRUCTURES  10
Types of pumps - various artificial recharge structures: recharge ponds - recharge pits -
percolation ponds - basin spreading - surface and subsurface dykes - recharge wells -
recharge borewells. Rainwater harvesting in urban areas : RWH structures - design -
construction.

UNIT IV  MAINTENANCE AND MONITORING OF RWH  9
Estimation of probable runoff from an area including from roof tops - maintenance and
monitoring of RWH structures. Study of benefits - effects on local groundwater environments
- remedial measures. Recycling of domestic water - sources of water for recharge in urban
areas.

UNIT V  CONSTRUCTION AND ESTABLISHING RWH  9
Precautions for source, construction and establishing RWH structures. Exploration techniques
and selection of artificial recharge zones - electrical resistivity investigations using horizontal
profiling and vertical sounding techniques: interpretation of resistivity data in terms of
subsurface geology.

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the completion of the course,
CO1 The student will be able to understand the importance rainwater harvesting Systems
CO2 The students shall be aware of the issues related to over exploitation of groundwater
CO3 Apply knowledge and skills to design various rainwater recharging structures
CO4 Understand the issues pertaining to monitoring and maintenance of rainwater harvesting
structures.
CO5 Gain an overarching understanding of construction and establishment of rainwater
harvesting structures.

REFERENCES
2. E. G. Williams, 1999, Fourier Acoustics: Sound Radiation and Near Field Acoustic

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1. low, 2-medium, 3-high, '-' no correlation
Note: The average value of this course to be used for program articulation matrix.
COURSE OBJECTIVE:
- To educate the student on the various operation & maintenance aspects of water treatment systems, sewer systems, sewage treatment plants and effluent treatment plants.

UNIT I ELEMENTS OF OPERATION AND MAINTENANCE
Strategy for good operation and maintenance- preventive and corrective maintenance scheduling - operation and maintenance Plan - proper and adequate tools, spare units and parts - training requirements- laboratory control- records and reports- housekeeping – sampling procedureanalytical techniques- code of practice for analytical laboratories- measurement of flows, pressures and Levels -safety in O&M operations - management information system - measures for conservation of energy

UNIT II OPERATION AND MAINTENANCE OF WATER SUPPLY SYSTEMS
Operational problems, O&M practices and records of operation of reservoir and intakes - causes of failure of wells- rehabilitation of tube wells & bore wells- prevention of incrustation and corrosion - problems in transmission mains- maintenance of pipelines and leakage control- repair method for different types of pipes- preventive and corrective maintenance of water pumps - problems in the water distribution system and remedies- water quality monitoring and surveillance

UNIT III OPERATION AND MAINTENANCE OF SEWERAGE SYSTEMS

UNIT IV OPERATION AND MAINTENANCE OF PHYSICO-CHEMICAL TREATMENT UNITS
Operation and maintenance in screen chamber, grit chamber and clarifiers- operation issues, trouble shooting guidelines and record keeping requirements forclarifier, equalization basins, neutralization unit - chemical storage and mixing equipment - chemical metering equipment - flash mixer --filters, thickeners and centrifuges- filter press - start-up and maintenance inspection - motors and pumps - hazards in chemical handling – jar test - chlorination equipment - membrane process systems- SDI and LSI determination- process chemistry and chemical dosage calculations- SOP-case studies

UNIT V OPERATION AND MAINTENANCE OF BIOLOGICAL TREATMENT UNITS
Construction, operation and maintenance aspects of activated sludge process, trickling filters, anaerobic digester, SBR, UASBR, MBRs- startup and shutdown procedures-DO, MLSS and SVI monitoring- trouble shooting guidelines –planning, organizing and controlling of plant operations – capacity building, case studies of retrofitting- SOP-case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Understand the O&M issues pertaining to STP and WTP
CO2 Understand operation and maintenance of water intakes and supply systems
CO3 Recognize the O&M issues relevant to sewerage system
CO4 Understand operation and maintenance of physico-chemical treatment units
CO5 Understand operation and maintenance of biological treatment units
REFERENCES:

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

EN3003 SLUDGE AND SEPTAGE MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES
• To gain knowledge and skills on sources, characteristics and treatment of sludge
• To understand the importance of septage management.

UNIT I SOURCES AND CHARACTERISTICS OF SLUDGE
Objectives of sludge treatment – sources of sludge- Sludge from WTP, STP and CETP- Sludge- Quantification-generation from various treatment plants – Characteristics in each stage of treatment —Physico-chemical and biological- Mass balance in sludge treatment

UNIT II SLUDGE THICKENING AND DEWATERING
Sludge thickening- Gravity thickening - Drum thickener - Air floatation – Centrifugation-conditioning - Sludge Dewatering- Centrifuge- Vacuum Filtration-Sludge drying bed-performance of thickener and dewatering systems-operation and maintenance

UNIT III SLUDGE STABILIZATION
Objectives-Aerobic and Anaerobic Sludge digestion processes – Types of anaerobic digesters – design of Low rate and High rate digesters – Two stage digester-Aerobic digestion- Pure oxygen and thermophilic aerobic digestion - Chemical and Thermal stabilization process

UNIT IV REUSE AND LAND APPLICATION OF SEWAGE SLUDGE

129
Introduction- beneficial use-requirements and associated risks-handling and management-storage - operation aspects of transport and application of biosolids application land-Lagooning- Landfilling- land farming-Composting-windrow composting -Vermicomposting - Laws and regulations on sludge management

UNIT V SEPTAGE MANAGEMENT
Sources of Septage – characteristics- Public health and environmental hazards- Elements of septage management- Pumping and Desludging Septic Tanks-Transportation- Treatment- Dewatered septage sludge reuse- Operation and maintenance - Planning and implementation of septage management schemes-Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Understand sources and characteristics of various sources of sludge.
CO2 Design sludge thickening and dewatering units
CO3 Design of sludge stabilization units
CO4 Know about the requirements and associated risk while reusing sewage sludge
CO5 Plan and implement septage management scheme

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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EN3004 MARINE POLLUTION AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES:
- To educate the Coastal and Marine environment.
- To educate the ocean dynamics
- To sources of marine pollution and methods for monitoring, modeling and control.
UNIT I  MARINE AND COASTAL ENVIRONMENT  9
Seas and oceans, continental area, coastal zone, properties of sea water, principles of marine
geology, coastal features – beaches, estuaries, lagoons, salt marshes, mangroves and sand
dunes—the oceans and climate, coastal zone regulation in india- national and international
treaties.

UNIT II  OCEAN HYDRODYNAMICS  9
Wave theory, waves in shallow waters – refraction, diffraction and shoaling, approximations
for deep and shallow water conditions – tidal classification - general circulation of ocean waters
- ocean currents - coastal sediment transport - onshore offshore sediment transport - beach
formation and coastal processes - Tsunamis, storm surge, El Nino effect.

UNIT III  MARINE POLLUTION  9
Sources of marine pollution – point and non-point sources, pollution caused by effluent
discharge, oil exploration, dredging, offshore mining, port and harbour activities, power plants,
agriculture runoff, plastic waste, marine debris and marine litter - effects of marine pollution on
marine water quality and coastal ecosystems.

UNIT IV  MARINE POLLUTION MONITORING  9
Basic measurements - sounding boat, echo sounders – current meters - tide gauge - use of
GPS – measurement of coastal water characteristics – sea bed sampling – modelling of
pollutant transport and dispersion - oil spill models - ocean monitoring satellites – applications
of remote sensing and GIS in monitoring marine pollution – online marine pollution monitoring,

UNIT V  MARINE POLLUTION CONTROL MEASURES  9
Marine discharges and effluent standards, pollution control strategies – marine outfall design
selection of optimal marine outfall locations - Total Maximum Daily Load (TMDL) applications
– protocols in marine pollution control– Integrated Coastal Zone Management (ICZM) and
sustainable development.

COURSE OUTCOMES:
CO1 Ability to know about marine environment.
CO2 Understand the physical concepts lying behind the oceanic currents and natural
processes of various activities happening over the marine environment.
CO3 Acquired knowledge on the marine pollution and the effect of the same on the ecology.
CO4 Should have gained knowledge on remote sensing and various other techniques for
measuring and monitoring oceanic environment parameters.
CO5 Should have acquired knowledge on control of marine pollution and sustainable
development.

REFERENCES:
2001
   Corporation, Delhi, India, 2005
   2018.
### CO's-PO's & PSO's MAPPING

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

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**EN3005**  
**NATURAL WASTEWATER TREATMENT SYSTEMS**  
**L T P C**  
3 0 0 3

**COURSE OBJECTIVE**

- To gain knowledge and understanding of wetlands on types of wetlands, constructed wetland - application, design, method of treatment of both domestic and industrial wastewaters and case studies.
- To gain knowledge on design, construction and operation of waste stabilization pond and sludge disposal.

**UNIT I**  
**INTRODUCTION TO WETLAND TREATMENT SYSTEM**  
9

Definition and concept of wetland - types of wetland. Wetland - ecology, flora and fauna, ecological aspects, human health and wetland, onsite applications. Introduction to constructed wetland-types - free water surface, subsurface wetland-horizontal and vertical flow - wastewaters and their application in wetland - constructed wetland plants - media in constructed wetland.

**UNIT II**  
**CONSTRUCTED WETLAND AND REMOVAL MECHANISMS**  
9

Site identification - construction and design of constructed wetland, startup, operation and maintenance of wetland system-wetland hydrology - hydraulics. Treatment of domestic wastewater and its performance, mechanisms of pollutant removal - suspended solids, organic matter, nitrogen, phosphorus, pathogen and other contaminants. Reuse of treated wastewater and its applications - limitation of constructed wetland system.

**UNIT III**  
**CASE STUDIES ON CONSTRUCTED WETLAND SYSTEM**  
8


**UNIT IV**  
**DESIGN OF WASTEWATER POND SYSTEMS**  
10

UNIT V  SLUDGE MANAGEMENT AND TREATMENT

Sludge quantity and characteristics - stabilization and dewatering - sludge freezing - reed beds - Vermi stabilization - comparison of bed type operations - composting land application and surface disposal of bio solids onsite wastewater systems - effluent disposal and reuse. Sludge quantity and characteristics-stabilization and dewatering-sludge freezing reed beds-Vermi stabilization- Comparison of bed-type operations-composting land application and surface disposal of biosolids- on-site wastewater systems- effluent disposal and reuse.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to

CO1  Explain the various aspects of wetland system, its function and its application in the treatment of wastewaters

CO2  Apply the knowledge of science and engineering fundamentals to know the types of wetlands, construction and operation of wetlands, wetland hydraulics and design of wetland and its performance Understand the process of treatment of domestic waste in the removal of solids, organic matter, phosphate, nitrogen, pathogens and its reuse

CO3  Understand the process of treatment of industrial wastewater in the removal of solids, organic matter, phosphate, nitrogen, heavy metals, phenolics and feasibility for reuse

CO4  Understand the various pond system available for wastewater treatment. design of pond system - removal mechanism

CO5  Manage and dispose the sludge naturally and economically.

REFERENCES:
1. EPA Design Manual on constructed wetland and aquatic plant system for municipal wastewater treatment system
5. Constructed wetlands for industrial wastewater treatment system by Alexandros I. Stefanakis (editor), Wiley black well.2018

CO’s-PO’s & PSO’s MAPPING

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

EN3006  DESIGN OF WATER AND WASTEWATER TREATMENT PLANTS

COURSE OBJECTIVES:
- To educate the students on the principles and process designs of various treatment systems for water and wastewater.
- Develop an understanding of the characteristics of water and wastewater that must be considered during design of a treatment plant.
Students will gain competency in the iterative process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process equipment items.

UNIT I  
PRINCIPLES OF TREATMENT  

UNIT II  
DESIGN OF WATER TREATMENT PLANTS  

UNIT III  
DESIGN OF CONVENTIONAL WASTEWATER TREATMENT PLANTS  

UNIT IV  
DESIGN OF ADVANCED WASTEWATER TREATMENT PLANTS  

UNIT V  
RESIDUAL MANAGEMENT OPERATION AND MAINTENANCE ASPECTS  

TOTAL 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to

CO1 Understand the principle of water and wastewater treatment
CO2 Design and sizing the different components of water treatment plant.
CO3 Design of conventional wastewater treatment units
CO4 understand in detail about the design of advanced wastewater treatment units
CO5 design the different elements of sludge treatment systems and understand the importance O&M issues pertaining to WTP and STP

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

VERTICAL II : AIR POLLUTION ENGINEERING

EN3007 INDOOR AIR QUALITY MANAGEMENT L T P C 3 0 0 3

OBJECTIVES
- The main objective of this course is to provide an indoor setting that is healthy for the occupants, and enhances well-being, performance and productivity.

UNIT I INTRODUCTION
Introduction-sources and type of indoor pollutants-types-effects-Building related illness-Sick building syndrome—fundamental calculations -contaminant exposure level-Indoor air quality standards.

UNIT II TYPE OF INDOOR ENVIRONMENT

UNIT III MONITORING AND MEASUREMENT TECHNIQUES

UNIT IV PREVENTION AND CONTROL OF INDOOR POLLUTION
Air cleaning – Removal of gases and vapours-Adsorption-Chemisorption- other process- Particle removal by Filters, air cleaners, cyclones and scrubbers HVAC systems –Principle, function and type, air purifiers, bio filters –Current trends

UNIT V INDOOR AIR QUALITY MANAGEMENT AND MODELING
Factor for designing healthy building- ventilation strategy- ventilation requirement-Indoor air quality model-well mixed model-statistical model- mass balance model- computational fluid dynamics model- modelling of air flows with gaseous contaminants-recurrent trends.

TOTAL :45 PERIODS

COURSE OUTCOME:
Upon completion of this course, students should be able to:
CO1 : Identify the Common indoor air pollutants and their sources
CO2: Understand human responses to indoor environment
CO3: Estimate pollutant emission rates using emission factors and fundamental mass balance techniques.
CO4: Understand prevention and control of indoor pollution
CO5: Develop mathematical models for indoor air quality.

TEXT BOOKS:

REFERENCE:

CO’s, PO’s & PSO’s MAPPING

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EN3008                   NOISE POLLUTION CONTROL IN INDUSTRIES  
L T P C 3 0 0 3

COURSE OBJECTIVES:
• To regulate and control noise producing and generating sources.
• To maintain the ambient air quality standards in respect of noise.

UNIT I SOURCES OF NOISE POLLUTION  
Noise pollution – global implications of noise pollution-Sources-classification of noise pollutants-units of noise-effects of noise pollution on human animals and property and plants

UNIT II PROPAGATION OF NOISE  
Noise pollution chemistry-basics of acoustics-specification of sound-power intensity-sound pressure levels-point and line sources-multiple sources-outdoor and indoor noise propagation-psychoacoustics-noise criteria.

UNIT III EFFECTS OF NOISE POLLUTION  

UNIT IV CONTROL OF NOISE POLLUTION  

UNIT V STANDARD FOR NOISE POLLUTION  

TOTAL: 45 PERIODS
COURSE OUTCOME:
The students completing the course will have

CO1 an understanding of the nature and characteristics of, noise pollution and basic concepts of air quality management
CO2 ability to identify, formulate and solve air and noise pollution problems
CO3 ability to design stacks and particulate air pollution control devices to meet applicable laws.
CO5 Explain the source and types of industrial air pollution and their environmental impacts and choose the regulatory laws pertaining to environmental protection
CO6 Conduct research to develop effective management systems for industrial air pollution that are technically sound, economically feasible and socially acceptable

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

CAI332 CLIMATE CHANGE AND ADAPTATION L T P C 3 0 0 3

COURSE OBJECTIVES:
• To know the basics, importance of global warming
• To know the concept of mitigation measures against global warming
• To learn about the global warming and climate change

UNIT I EARTHS CLIMATE SYSTEM 9
Role of ozone in environment ozone layer ozone depleting gases Green House Effect, Radiative effects of Greenhouses Gases Hydrological Cycle Green House Gases and Global Warming Carbon Cycle

UNIT II ATMOSPHERE AND ITS COMPONENTS 9
UNIT III  IMPACTS OF CLIMATE CHANGE  9
Causes of Climate change : Change of Temperature in the environment Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarios Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes.

UNIT IV  CLIMATE CHANGES AND ITS CAUSES  9
Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.

UNIT V  CLIMATE CHANGE AND MITIGATION MEASURES  9

FOR FURTHER READINGS
Sequestration of carbon through renewable energy technologies

COURSE OUTCOMES
CO1 Demonstrate an understanding of how the threats and opportunities of predicted climate changes will influence specific sectors at global and regional scale
CO2 Identify the relationship between atmosphere and its components
CO3 Analyze the impacts of climate change on environment parameters
CO4 Evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation
CO5 Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

TEXTBOOKS
2. Intergovernmental Panel on Climate Change: https://www.ipcc.ch/

REFERENCES

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<td>To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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**EN3009 LOW CARBON ECONOMY**

**COURSE OBJECTIVES:**
- To impart knowledge on different sources of carbon emission, carbon reduction opportunities, low carbon technologies and Indian Missions on Climate Change

**UNIT I CARBON EMISSION**
Sources – Primary sectors – Agriculture, Livestock, Forestry – Mining. Secondary sectors – metal processing – non metallic product processing, wood processing – paper and pulp making – food processing, Tertiary sectors – Transportation services, health services

**UNIT II CARBON REDUCTION OPPORTUNITIES**

**UNIT III LOW CARBON TECHNOLOGIES**

**UNIT IV ENERGY EFFICIENT PROGRAMMES**

**UNIT V INTEGRATED ENERGY POLICY**
Policy for renewable and non-conventional energy sources – Household energy security – Energy environment linkages – Energy supply-side and demand-side environment concern – Environmental impacts of renewable energy – India’s approach to climate change

**TOTAL: 45 PERIODS**
COURSE OUTCOMES:
The students completing the course will have the ability to
**CO1:** Identify sources of carbon emissions and outline the carbon reduction opportunities, low carbon technologies
**CO2:** Explore the carbon reduction opportunities
**CO3:** Develop low carbon technologies
**CO4:** Develop energy efficient programmes and integrated energy policy in line with national and global approach to climate change mitigation.
**CO5** Develop policy for renewable and non-conventional energy sources

TEXTBOOKS:

REFERENCES:

**CO’s-PO’s & PSO’s MAPPING**

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EN3010 CLIMATATOLOGY AND METEOROLOGY

COURSE OBJECTIVES:
- To expose the students the various aspects of Climatology and Meteorology.

UNIT I EARTH’S CLIMATE SYSTEM

UNIT II OBSERVED CHANGES AND ITS CAUSES
Observation of Climate Change- Changes in patterns of temperature- Precipitation and sea level rise- Observed effects of Climate Changes- Patterns of Large scale Variability- Drivers of climate change- Climate Sensitivity and Feedbacks- The Montreal Protocol- UNFCCC- IPCC- Evidences of changes in Climate and Environment- On a Global Scale and in Indian.

UNIT III IMPACTS OF CLIMATE CHANGE
Impacts of Climate Change on Various sectors- Agriculture, Forestry and Ecosystem-Water Resources- Human Health- Industry, Settlement and Society- Methods and
Scenarios - Projected Impacts for Different Regions - Uncertainties in the Projected Impacts of Climate change - Risk of Irreversible Changes.

UNIT IV MEETEOROLOGY

UNIT V PLUME BEHAVIOR AND POLLUTANT DISPERSION

COURSE OUTCOMES:
The students completing the course will have ability to
CO1 Understand earth’s climate system
CO2 describe the pattern of changes in climate
CO3 Understand the impacts of climate change
CO4 Understand meteorology and weather meteorological parameters
CO5 predict plume behavior and pollutant dispersion

TEXTBOOKS:
1. Stanley E.Manahan, “Environmental Science and Technology”, Lewis Publisher, 1997

REFERENCES:
4. IPCC, Fourth Assessment Report- the AR4 synthesis report.

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

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TOTAL: 45 PERIODS

COURSE OBJECTIVES:
- To introduce the fundamentals of air pollution with a background on historical perspective on air pollution.
- To introduce the theory of dispersion of air pollution in the atmosphere.
- To discuss the major approaches for air pollution modeling
- To demonstrate the features and the use of most widely used commercial and freely available air quality models
UNIT I  MODELING CONCEPT
Overview of different types of models-deterministic and stochastic approach- Steps in model development- numerical and simulations models- calibration and validation of models- Limitations- Transport phenomena- Mass balance analysis-Model development and decision making.

UNIT II  AIR POLLUTION MODELING
Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants - Meteorological settling for dispersal of air pollutants – Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self-cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack

UNIT III  AIR QUALITY MODELS
Types modeling technique, modeling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation- modifications of Gaussian plume equation- long term average-multiple cell model- receptor oriented and source oriented air pollution models- model performance, accuracy and utilization-air Quality Index -air quality mapping

UNIT IV  INDOOR AIR QUALITY MODELS

UNIT V  SOFTWARE PACKAGE APPLICATIONS
Commercial air quality models -ADMS, Airviro and USEPA models

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students completing the course will have ability to
CO1 understand modelling concept
CO2 Comprehend the fate and transport of air pollutants
CO3 understand air quality modelling techniques
CO4 develop indoor air quality models
CO5 Apply soft computing techniques in air quality modelling

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CO’s-PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:
- To introduce the emerging concepts of climate modelling and projecting future climate change, understand data analysis and application.

UNIT I CLIMATE CHANGE AND CLIMATE VARIABILITY
Introduction- atmosphere - weather and climate - climate parameters (Temperature, Rainfall, Humidity, Wind etc.,) Equations governing the atmosphere - numerical weather prediction models - introduction to GCMs - applications in climate change projections

UNIT II IPCC CLIMATE SCENARIOS
Intergovernmental PANEL on Climate Change (IPCC) - an overview - key assumptions – Representative Concentration Pathways (RCP 2.6, 4.5, 6.0, 8.5)

UNIT III GLOBAL CLIMATE MODEL AND REGIONAL CLIMATE MODEL
Climate model – types of model- General Circulation Models (GCM) - Issues with GCMs - Introduction to RCMs and LAMs - RCMs modellers -advantages and disadvantages of GCMs and RCMs

UNIT IV DOWNSCALING GLOBAL CLIMATE MODEL - AN OVERVIEW
Need for downscaling - selection of GCMs for regional climate change studies - ensemble theory selection of ensembles, model domain (Spatial domain and temporal domain), Resolution and climate variables - lateral boundary conditions - methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

UNIT V ANALYSIS AND POST PROCESSING
Model validation and calibration- evaluating model performance- post processing - introduction to analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS - climate change impact - vulnerability assessment-case studies-Adaptation strategies

TOTAL: 45 PERIODS

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

CO1: Understand the basics of climate change and variability
CO2: Comprehend the latest IPCC climate scenarios
CO3: Gain in-depth knowledge on climate models
CO4: Downscale of climate scenarios through different modelling techniques, and validate climate models
CO5: Post process the model outputs for climate impact assessment, know about adaptation strategies

REFERENCES:
CO’s-PO’s & PSO’s MAPPING

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VERTICAL III: SOLID WASTE MANAGEMENT

CAI331 BIOCHEMICAL AND THERMOCHEMICAL CONVERSION OF BIOMASS

COURSE OBJECTIVE:
- To expose the students with different bio and thermal conversion of biomass.

UNIT I BIOMASS CHARACTERIZATION

UNIT II BIOCHEMICAL CONVERSION

UNIT III THERMO CHEMICAL CONVERSION BY COMBUSTION

UNIT IV THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS

UNIT V COGENERATION AND WASTE HEAT RECOVERY

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES

COURSE OUTCOMES:
CO1 Biomass identification and classes
CO2 Biomass characters and biochemical conversion.
CO3 Thermo chemical conversion techniques and cogeneration from waste
CO4 To know about application of biomass conversion
CO5 Analyse the energy generated from waste

CO’s-PO’s & PSO’s 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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EN3013  BIOMEDICAL WASTE MANAGEMENT  LT P C  3 0 0 3

COURSE OBJECTIVES
- To collect & receive the biomedical waste from health care facilities.
- To analyze and decide the treatment and disposal scheme of wastes as per the guidelines

UNIT I  SOURCES OF BIOMEDICAL WASTE  9

UNIT II  BIOMEDICAL WASTE MANAGEMENT  9
Need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.

UNIT III  HAZARDOUS MATERIALS  9

UNIT IV  FACILITY SAFETY  9

UNIT V  INFECTION CONTROL, PREVENTION AND PATIENT SAFETY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Have an overview biomedical waste and its categorization.
CO2 Understand the need for disposal of biomedical waste, segregation and labeling
CO3 Have an in-depth understanding of the hazardous materials, its regulation
CO4 Have an overview on the facility guidelines
CO5 Understand the infection control, prevention and patient safety.

REFERENCES:
2. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous, McGraw-Hill Publication

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

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Note: The average value of this course to be used for program articulation matrix.
COURSE OBJECTIVE:
- To understand the important characteristics and design principles of the waste containment and remediation industry as well as know the relevant regulations and engineering design requirements of landfills and contaminated site remediation

UNIT I  LANDFILL BASICS
Waste management Hierarchy- Need for landfills –Environmental Protection by Landfills-Landfill Classification – Sanitary and Secure Landfills - Components and Configuration - Legal frame work for landfilling – Landfill Site investigation- Regional Landfills- Environmental control using site design — Landfill Design Tasks

UNIT II  LANDFILL LINERS AND COVER SYSTEMS

UNIT III  LEACHATE AND LANDFILL GAS MANAGEMENT

UNIT IV  LANDFILL OPERATION AND CLOSURE

UNIT V  CONTAMINATED SITE REMEDIATION

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Have an overview of the Indian and international landfill regulations and guidelines for
the design, construction, operation and management of landfills
CO2 Understand the design and construction of landfills, processes in landfills, methods for
management and treatment of landfill gas and leachate
CO3 Have an in-depth understanding of the key pollutants in leachate and gas, their potential
environmental impacts and the
CO4 Make engineering design and study performance of control systems used to manage
and treat pollutant and waste emissions from sites.
CO5 Be able to apply a risk based assessment of contaminated sites and implement site
remediation technologies

REFERENCES:
1. Robert M. Koerner and Donald H Gray (2002), "Geotechnical aspects of Landfill Design and
Construction", Prentice Hall, New Jersey.
Atascadero, CA – ISBN 0-9646956-0-x
construction Quality Assurance and Construction Quality Control of Liner and Cover
Systems, American Society of Civil Engineers, ASCE Press.
Contaminated Soils, Marcel Dekker Inc., New York
5. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste
Remediation, Waste Containment, and Emerging Waste Management Technolgies, John
Wiely, New Jersey
Publishing Co., Boston, MA

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

EN3015 PLASTIC AND E WASTE MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
• To know various sources of plastics waste generation and the segregation methods for
recycling the plastics and recycling codes of commodity and engineering plastics
• To learn about primary recycling techniques with examples/case studies.
• To understand the recycling of various commodity and engineering plastics.
UNIT I SOURCES AND CHARACTERIZATION

UNIT II PRIMARY RECYCLING OF PLASTIC WASTES
Primary recycling – Equipment’s for primary recycling. Specific recycling techniques – PE films, PP battery case – Crushing and separation – PET films.

UNIT III SECONDARY RECYCLING OF PLASTIC WASTES

UNIT IV TERTIARY RECYCLING OF PLASTIC WASTES

UNIT V E WASTE MANAGEMENT
E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completing this course, the students would understand the impact of plastic waste on environment and learn the technologies available for recycling and reusing of both commercial and engineering plastics. They also become familiarize with various

CO1 Sources of plastics waste generation and the segregation methods for recycling the plastics
CO2 Learn about various equipment for recycling of plastics
CO3 Understand the process involved in secondary recycling of plastics
CO4 Comprehend the tertiary recycling of plastics
CO5 Understand the process involved in E waste management

TEXT BOOKS:

REFERENCES:
2. John Schiles, Polymer Recycling.
CO’s-PO’s & PSO’s MAPPING

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EN3016  INDUSTRIAL HAZARDOUS WASTE MANAGEMENT  L T P C

COURSE OBJECTIVES:
- To impart knowledge on the identification, characterization, source reduction, storage, transport, processing and safe disposal of hazardous wastes.

UNIT I  WASTE IDENTIFICATION  9
Hazardous waste definition – Physical and Health hazards wastes – Hazardous Waste Management and Handling Rules

UNIT II  CHARACTERISATION  9
Characterization of hazardous wastes – Analytical– Analytical methods – Hazardous waste inventory - Source reduction of hazardous wastes

UNIT III  STORAGE AND TRANSPORT PROCESSING OF HAZARDOUS WASTES  9

UNIT IV  TREATMENT OF HAZARDOUS WASTES  9
Hazardous waste treatment technologies – Physical, chemical and thermal treatment of hazardous waste – Solidification – Chemical fixation – Encapsulation – Incineration

UNIT V  SECURE LANDFILLS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students completing the course will have
- CO1 Ability to understand the legal framework of hazardous wastes management
- CO2 An insight into the characterization of hazardous wastes and the role of different stakeholders under the national legal framework
- CO3 Ability to design facilities for the storage and transport of hazardous wastes
- CO4 Understand the processing of hazardous wastes
- CO5 Know the disposal methods of hazardous wastes
TEXTBOOKS:

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

EN3017 RESOURCE RECOVERY FROM WASTE L T P C 3 0 0 3

COURSE OBJECTIVE:
• To understand the principles and design of recovering materials and energy from wastes through mechanical, biological and thermal methods and manage the undesirable by-products.

UNIT I MECHANICAL PROCESSING FOR MATERIAL RECYCLING 10

UNIT II BIOLOGICAL PROCESSING FOR RESOURCE RECOVERY 10

UNIT III BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9
Principles and Design of Anaerobic Digesters – Process characterization and control- The biochemistry and microbiology of anaerobic treatment - Toxic substances in anaerobic treatment - Methane generation by Anaerobic Digestion- Anaerobic reactor technologies -
Commercial anaerobic Technologies- Single stage and multistage digesters- Digester design and performance-Gas collection systems-Methane Generation and Recovery in Landfills – Biofuels from Biomass

UNIT IV THERMO-CHEMICAL CONVERSION OF WASTE TO ENERGY 8
Principles and Design of Energy Recovery Facilities -Types and principles of energy conversion processes - Incinerator design - Mass Burn and RDF Systems- Composition and caloric value of fuels and waste, Determination of the stoichiometric air consumption, Calculation of the flue gas composition - grate firing designs, boiler design, removal of bottom ash, heat recovery- Emission Controls – flue gas cleaning, de-dusting, flue gas scrubbers, DeNOx processes, dioxins and furans - Alternative thermal processes: co-incineration, pyrolysis, gasification, plasma arc - Process characterization and control- waste heat recovery- Bottom ash: Quantity, quality, treatment, utilization, disposal- Facility design- decentralized mobile plants- Planning and construction of incineration plants

UNIT V CASE STUDIES ON WASTE RECYCLING 8

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On Completion of the Course, the Candidate should:

CO1 Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of materials and energy from waste

CO2 Appreciate the increasing importance of waste and resource management in achieving environmental sustainability

CO3 Be able to analyze and describe the potential of solid waste as a secondary raw material, and the associated problems and possibilities in a sustainable society.

CO4 Understand thermo-chemical conversion of waste to energy

CO5 Conceptualize recycling options for waste to energy

REFERENCES:
3 Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein, Modern Composting Technologies JG Press October 2005

CO’s-PO’s & PSO’s MAPPING

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

- This course aims to train the student in understanding and familiarization of different heat flow calculations and building simulation software. Several case studies will be presented to demonstrate how the various passive, low energy and energy saving concepts have been applied to real life buildings. The concepts of green buildings will be introduced and different rating systems for green buildings will be explained.

UNIT I  INTRODUCTION TO GREEN BUILDINGS  9
Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT II  SITE SELECTION AND PLANNING  9
Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc. Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, wastewater treatment, recycle and reuse systems.

UNIT III  ENERGY EFFICIENCY  9
Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT IV  BUILDING MATERIALS  9
Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT V  INDOOR ENVIRONMENTAL QUALITY  9
Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students are expected to be able to

- CO1 Understand the rating of green building
- CO2 Recognise the criteria for site section for green buildings
- CO3 Reduce adverse environmental impact
- CO4 Reduce embodied energy in building materials
- CO5 Understand the environmental quality pertaining to green building

REFERENCES

2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.

CO’s-PO’s & PSO’s MAPPING

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

VERTICAL IV: ENVIRONMENTAL MANAGEMENT

EN3019 SURFACE AND GROUNDWATER QUALITY MODELLING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce the fundamentals of mathematical models for water quality and the importance of model building.
- To educate about the water parameters modeling and various ground water quality modelling.
- To demonstrate the features and the use of most widely used computerized models for water quality

UNIT I MODELING PERCEPTIONS 9
Engineers and Mathematical Models-Water quality models – Historical development - Different types of models-- Steps in model development - Importance of model building. - Calibration and verification of models- conservation of mass and momentum - Chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT II POLLUTANT TRANSPORT AND REACTOR MODELING 10
Transport phenomena – Advection, diffusion, dispersion- simple transport models – Plug flow models- Application of PFR and MFR model - Steady state and time variable solutions- completely mixed systems, concept and models in Completely Stirred Tank Reactors, mass balance equations, loading types, feed forward vs. feedback reactor systems

UNIT III SURFACE WATER QUALITY MODELING 10

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UNIT IV  GROUNDWATER QUALITY MODELING  8
Groundwater flow and mass transport of solutes, Degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modelling

UNIT V  WATER QUALITY MODELING SOFTWARE  8
Exposure to surface water and groundwater quality modelling software – MIKE 21, QUAL2E and MODFLOW Models and their application, Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOME:
CO1  Know about the principles of water quality modelling.
CO2  Understand the pollutant transport phenomena in surface and groundwater.
CO3  Apply the knowledge of surface water quality modelling to predict the water quality of rivers, lakes and estuary.
CO4  Predict the groundwater contamination transport.
CO5  Predict water quality of surface and sub surface water using numerical solution.

REFERENCES:

EN3020  REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To educate the students on aspects of Remote Sensing
- Develop the different remote sensing technique
- To educate the students on aspects of GIS and data management.
- Develop the GIS Applications for monitoring and management of environment

UNIT I  ELEMENTS OF REMOTE SENSING  9
UNIT II    REMOTE SENSING TECHNOLOGY  9
Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

UNIT III    SATELLITE REMOTE SENSING  9
Satellites and their sensors, satellite orbits, Indian space programme - Research and development - ISRO satellites, LANDSAT, ERS, SPOT, TERRA and NOAA satellite series, Characteristics of Remote Sensing data, Satellite data Products

UNIT IV    REMOTE SENSING APPLICATIONS AND CASE STUDIES  9
Visual image interpretation, Digital image processing – Image rectification, Enhancement, transformation, Classification, Data merging – Remote sensing applications in Monitoring and management of environment - Conservation of resources, Disaster management, Sustainable urban land use, Agriculture, EIA, Marine and Coastal zone management – Case studies

UNIT V    GEOGRAPHICAL INFORMATION SYSTEM CASE STUDIES  9
GIS - Concepts and components, Spatial and non-spatial data, Vector and raster data structures, Data analysis, Database management – RS – GIS Integration, Image processing software, GIS software GIS applications in Monitoring and management of environment - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students are able to
CO1 Know the remote sensing principle and the different stages of remote sensing
CO2 Understand the various type remote sensing technology.
CO3 Apply the knowledge of satellite sensing system for different environmental issues.
CO4 Apply the knowledge of GIS and image analysis for environmental applications.
CO5 Develop the GIS data base. And work with multi-disciplinary team.

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EN3021  OCCUPATIONAL HEALTH, SAFETY AND RISK ASSESSMENT  L T P C
3 0 0 3

COURSE OBJECTIVES:
• To educate overview of EHS in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System

UNIT I INTRODUCTION  9
Need for developing Environment, Health and Safety systems in work places - International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE  10
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses – Exposure Assessment - occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS  11

UNIT IV HAZARDS AND RISK MANAGEMENT  8

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT  7
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Structure and Clauses-Case Studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students are expected to be able to understand:
CO1 Need for EHS in industries and related Indian regulations
CO2 Various types of Health hazards, effect, assessment and control methods
CO3 Various safety systems in working environments
CO4 The methodology for preparation of Emergency Plans and Accident investigation
CO5 EHS Management System and its elements

REFERENCES:
1. ISO 45001:2018 Occupational health and safety management systems - Requirements with guidance for use, International Organisation for Standardisation, 2018
2. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India
3. Fundamentals of Industrial Safety and Health by Dr. K. U. Mistry, Siddharth Prakashan, 2012
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EN3022 PLANNING, DESIGN AND MANAGEMENT OF LARGE HOUSING COMPLEXES

COURSE OBJECTIVES:
• Expose students about origin growth and development of human settlements.
• Understand the character of rural and urban housing.
• Outline the issues concerning housing in the Indian context.
• Understand the housing policies and agencies responsible for housing development.

UNIT I EVOLUTION OF HUMAN SETTLEMENTS

UNIT II RURAL AND URBAN HOUSING
Rural housing in India - Typology of housing and housing character in Indian context – Early urban centers / cities, Mughal period, Before independence and After independence – Industrial townships - Satellite towns / New towns – Residential neighborhoods.

UNIT III HOUSING AND INFRASTRUCTURE
Formal and informal settlements – Homelessness - Housing standards for various income category – Housing development – Slum housing and redevelopment programmes – Sites and services schemes – Socio - economic and special aspects of housing – Community facilities.

UNIT IV HOUSING DESIGN AND CONCEPTS

UNIT V HOUSING GOVERNANCE
National housing policy – Demand and supply – Housing development agencies and their role – Finance– Housing information system – Cost effective materials and technologies for housing.

TOTAL: 45 PERIODS

COURSE OUTCOME:
Students are introduced to
CO1 The evolution of settlements housing and community living.
CO2 Understand the types of housing during various time period.
CO3 Explore the past and relate with the technology and culture towards living environment of modern society.
CO4 Understand the design concepts of housing
CO5 Comprehend housing governance
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EN3023 ENERGY MANAGEMENT IN INDUSTRIES L T P C 3 0 0 3

COURSE OBJECTIVES:
- To provide an understanding of the basics of energy conservation method and energy auditing in industries
- To understand the environmental and economical benefits associated management.

UNIT I INTRODUCTION

UNIT II AUDITING AND INSTRUMENTATION IN ENERGY MANAGEMENT
Energy Audit – Purpose, Types, Methodologies, Barriers with respect to Process Industries, Power Plants, Boilers and Certain Energy Intensive Industries; Energy Audit Questionnaire - Role of instrumentation in energy conservation - total energy systems - concept of total energy – advantages, limitations & Application.

UNIT III ENERGY MANAGEMENT
UNIT IV  ENERGY ECONOMICS

UNIT V  APPLICATIONS
Case studies on sugar Industry – Co generation, Thermal power plant; Petrochemical Industries.

COURSE OUTCOME:
On completion of this course, the students will be able to exhibit
CO2. Understand the basics of energy conservation method and energy auditing.
CO3. Capability to integrate various options for energy management in various Industries.
CO4. Understand energy economics
CO5. Energy management studies with respect to industries

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

EN3024  PUBLIC HEALTH ENGINEERING SERVICES IN BUILDINGS  L T P C
3 0 0 3

COURSE OBJECTIVES
- To introduce and give knowledge about the different public health engineering services for human environment- water supply, sewerage, drainage, waste management and plumbing systems.
- To give familiarity about sustainable practices and systems for public health engineering services.
- To enable the conceptual design of large housing complexes for public health engineering services.
UNIT I  WATER SUPPLY
Water supply system at macro level - sources, pumping, reservoirs, water treatment, tanks, piping systems and materials. Quantitative and qualitative requirements of water for different activities in a small building/campus of simple typologies. Overhead tanks, underground sumps, fire fighting storage, water meter, R.O. Plant, water heating systems, solar water heaters, fixtures and fittings for a small building/campus. Design calculations for the same and related mechanical equipment. Sustainable practices and systems.

UNIT II  SEWERAGE
Sewage and sullage. Sewerage systems. Different types/stages of sewage treatment at city level-Sewer line, gradients, manholes, inspection chambers. One pipe/two pipe plumbing systems. Sewage treatment at campus/building level-sewage treatment plants, septic tank, leach pits. Sustainable practices and systems.

UNIT III  DRAINAGE AND WASTE MANAGEMENT
Solid waste- types, segregation and refuse collection. Disposal - Incinerator, composting, vermicomposting, sanitary land filling, bio gas system, modern renewable energy system. Site visits with documentation in the form of sketches/drawings/photos.

UNIT IV  PLUMBING SYSTEMS IN BUILDINGS

UNIT V  DESIGN FOR ENVIRONMENTAL SERVICES
Site planning, building and room design principles for water supply, sewage and storm water in an integrated manner for a small building and campus. Understanding of service drawings. Site visits and documentation in the form of sketches/drawings. Conceptual design for a small building and large housing complexes.

TOTAL: 45 PERIODS

COURSE OUTCOME
CO1: Ability to understand environmental services from macro to micro level human environment.
CO2: Ability to adopt sustainable practices and systems for public health engineering services.
CO3: Understand drainage systems in small building and large housing complexes
CO4: Understand Plumbing, sanitary fittings and their requirements for a small building and large housing complexes
CO5: Ability to design environmental services in a small buildings and large housing complexes.

TEXT BOOKS:
5. 'National Building Code', Bureau of Indian Standards.
REFERENCES

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

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

EN3025 ENVIRONMENTAL SYSTEM ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce about ecological modeling, single and multi-species modeling on a brief.
- To educate about the modeling of CSTR and the kinetics of reaction taking place in it.
- Introduce the concepts of river and stream water modeling, water quality parameters modeling.
- To educate about the microbial energetic in various reactors systems.
- To elaborate the computational techniques for modeling

UNIT I ECOLOGICAL SYSTEM 9

UNIT II CONTINUOUS-FLOW REACTOR MODELING 9

UNIT III WATER QUALITY MODELING 9

UNIT IV MICROBIAL DYNAMICS AND ENERGETICS 9
UNIT V  COMPUTER BASED SOLUTIONS  9
TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students are able to
CO1 Understand the principle of system modeling
CO2 Conceptualize the principle of reactor design
CO3 Develop water quality models.
CO4 Model microbial dynamics
CO5 Apply the knowledge of soft computing techniques to environmental system modeling

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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VERTICAL V

DIVERSIFIED COURSES

EN3026  COASTAL ZONE MANAGEMENT  L T P C
3 0 0 3

COURSE OBJECTIVES:
• At the end of the semester, the student shall be able to understand the coastal processes, coastal dynamics, impacts of structures like docks, harbours and quays leading to simple management perspectives along the coastal zone.

UNIT I  COASTAL PROCESSES AND RESOURCES  9

UNIT II  WAVE DYNAMICS  9
UNIT III  WAVE FORECASTING AND TIDES  9

UNIT IV  COASTAL POLLUTION  8
Coastal Pollution – Causes – Effects - Coastal aquifers – Sea water intrusion – Marine Outfall - Impact of sewage disposal in seas.

UNIT V  COASTAL ZONE MANAGEMENT  9
Pollution Control strategies – National and International Treaties, Coastal Zone Regulation – Total Maximum Daily Load applications – Protocols in Marine Pollution – ICZM and Sustainable Development

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students completing the course will have ability to:
CO1  Describe the Coastal zone regulations, coastal processes and wave dynamics
CO2  Forecast waves and tides and plan coastal structures including harbours
CO3  Identify natural, engineering and human components on the coast
CO4  Functions of components and relationship between them
CO5  Able to integrate the interpretation and analysis of coastal issues to determine appropriate approaches in coastal management and able to communicate effectively in speech and writings.

TEXTBOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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

CAI334  IRRIGATION WATER QUALITY AND WASTEWATER MANAGEMENT  3 0 0 3

COURSE OBJECTIVES:
• To know the basics concepts of irrigation water quality
• To impart knowledge on water quality for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts.
• To understand the importance of water quality for irrigation and major uses of water and the role environmental issues.
UNIT I       WATER QUALITY

UNIT II      IRRIGATION WATER QUALITY
Water quality for irrigation – Salinity and permeability problem – Root zone salinity – Irrigation practices for poor quality water – Saline water irrigation – Future strategies

UNIT III     WATER POLLUTION

UNIT IV      RECYCLING AND REUSE OF WATER
Multiple uses of water – Reuse of water in agriculture – Low cost waste water treatment technologies - Economic and social dimensions - Packaged treatment units – Reverse osmosis and desalination in water reclamation

UNIT V       WATER QUALITY MANAGEMENT

TOTAL: 45 PERIODS

TEXT BOOKS:

COURSE OUTCOMES
CO1 The students will be able to describe the parameters of water quality
CO2 The students will be able to describe the concepts of water quality for irrigation
CO3 The students will be able to describe the water pollution and quality considerations
CO4 The students will be able to describe the recycling and reuse of water
CO5 The students will be able to describe the management of water quality

CAI335      SOLAR AND WIND ENERGY SYSTEM
L T P C
3 0 0 3

COURSE OBJECTIVES:–
• To learn about the fundamental aspects of solar energy availability, solar energy conversion technologies
• To understand about the fundamental aspects of wind energy availability and wind power generators
• To acquire the knowledge on the alternate sources of energy such as geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and energy storage
UNIT I Solar Energy Radiation and Solar Thermal Collectors 9

UNIT II Solar Concentrating Collectors and PV Technology 9
Optically concentrating collectors - types reflectors - solar thermal power stations principle and applications - solar stills - types - solar pond performance - characteristics applications. Photovoltaitics types characteristic - load estimation batteries invertors operation system controls. PV system installations standalone systems - PV powered water pumping system sizing and optimization hybrid system solar technologies in green buildings.

UNIT III Wind Mapping Analysis and Characteristics of Wind 9
Nature of wind - wind structure and measurement - wind power laws - velocity and power duration curves - aero foil - tip speed ratio - torque and power characteristics power coefficients - Betz coefficient

UNIT IV Wind Mill Design and Applications 9
Turbines - Wind mill - classification - power curve. Upwind and downwind systems - transmission rotors - pumps - generators - standalone system - grid system - batteries. Wind energy storage - wind farms - wheeling and banking - testing and certification procedures.

UNIT V Alternate Energy Sources 9

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

COURSE OUTCOMES:
CO1 Understand the basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers
CO2 Analyse the principles and applications of solar thermal power stations, solar pond, and solar stills
CO3 Understand the wind power laws and calculate the torque and power characteristics of wind energy
CO4 Design wind mills and test the units for certification
CO5 Understand the principles of geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and analyse their applications
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### EN3027 EPIDEMIOLOGY AND CONTROL OF COMMUNICABLE DISEASES

**COURSE OBJECTIVES:**
- To impart knowledge on diseases transmitted through air, water, food, vectors and pollution sources as well as major components of health services

#### UNIT I GENERAL

#### UNIT II RESPIRATORY, WATER, AND FOOD BORNE DISEASES
Respiratory diseases - Definition - Group - control of source. Water and Food borne diseases – General reservoir of infection — agents - food decomposition - vehicle or transmission of diseases -control of water and food-borne diseases.

#### UNIT III VECTOR BORNE DISEASES
Vector borne diseases and Zoo noses — Infections from mosquitoes, house flies, rats, louse, pubic louse and other insects - General, insect borne diseases, zoo noses and their spread - control at source - control of mode of transmission.
UNIT IV  MISCELLANEOUS DISEASES AND ILLNESSES

Miscellaneous diseases and illnesses - Ringworm, hookworm infections, ancylostomiasis, tetanus, amoebiasis. Other illnesses associated with environment and food - Lead poisoning, carbon monoxide poisoning - mercury poisoning - Illnesses associated with air pollution - nutritional deficiency diseases — Illness associated with building material

UNIT V  ASPECTS OF HEALTH SERVICES

The Organization of Health services – Tasks for the health services - the major components of health services (curative, preventive, special services, statistics and health education) - resources for the health services – community participation in health services. Declaration of ALMA-ATA.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students completing the course will have the ability to

CO1: Outline the dynamics of disease transmission and different aspects of health services
CO2: Explain the different types of diseases transmitted through air, water and food,
CO3: Comprehend miscellaneous diseases and illnesses
CO4: Understand the mode of transmission and control of vector borne diseases
CO5: Understand major components of health services

TEXTBOOK:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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

EN3028  CLEANER PRODUCTION

COURSE OBJECTIVES:

• To introduce the importance, and different approaches of cleaner production in industries and to impart knowledge on environmental management tools applying cleaner production principle.
UNIT I INTRODUCTION
Sustainable development – Indicators of Sustainability – Sustainability Strategies – Barriers to Sustainability – Industrial activities and Environment – Industrialization and sustainable development – Industrial Ecology – Cleaner Production (CP) in Achieving Sustainability – Prevention versus Control of Industrial Pollution – Environmental Policies and Legislations – Regulation to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market Based Approaches.

UNIT II CLEANER PRODUCTION

UNIT III CLEANER PRODUCTION PROJECT DEVELOPMENT & IMPLEMENTATION

UNIT IV SUPPORT INSTURMENTS OF PREVENTION METHODS

UNIT V CASE STUDIES
Industrial Applications of CP, LCA, EMS and Environmental Audits.

COURSE OUTCOMES:
The students completing the course will have
CO1 Ability to describe and comment the evolution of corporate environmental management strategies and its relation to the concept of sustainable development
CO2 Ability to describe Cleaner Production measures applicable to different industries
CO3 Ability to conduct energy and material balances for processes as part of a Cleaner Production assessment
CO4 Understand integrated pollution prevention
CO5 Implantation of cleaner production project development

TEXTBOOKS:

REFERENCES:
CO’s-PO’s & PSO’s MAPPING

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EN3029 ORGANIC FARMING FOR SUSTAINABLE AGRICULTURAL PRODUCTION

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<td>• To educate the students about the fundamental principles of organic farming, the ways to design resource efficient farming system and sustain food production adequate for the world’s population.</td>
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UNIT I INTRODUCTION TO ORGANIC FARMING

UNIT II COMPONENTS, CONCEPTS AND PRINCIPLES OF ORGANIC FARMING

UNIT III ORGANIC CROP PRODUCTION
Crop production plan – Conversion requirements and duration – Landscape - Choice of crops and varieties – Diversity in crop production and management plan – Nutrient management – Pest, disease and weed management – Contamination control – Soil and water conservation – Products/ additional inputs for use in fertilising, soil conditioning, pest, disease and weed control

UNIT IV ORGANIC ANIMAL HUSBANDRY, FOOD PROCESSING AND HANDLING
Livestock living condition – Length of conversion period – Animal sources/origin – Breeds and breeding – Mutilations – Animal nutrition – Veterinary medicine – Transport and slaughter – Bee keeping – Food processing ingredients and methods – Storage pest management – Packaging – Labelling - Cleaning and sanitizing of food processing facilities
UNIT V  ORGANIC CERTIFICATION AND MARKETING

Guidelines and procedures for organic certification – Organic certification agencies – Grower group certification for organic agriculture – Tamil Nadu Organic Certification Department – Agricultural and Processed Food Products Export Development Authority – National Programme for Organic Production standards – Organic food marketing, growing opportunities and regulations

TOTAL: 45 PERIODS

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

CO1 Define ‘organic farming’ from multiple perspectives
CO2 Understand about the concepts, principles and components of organic farming
CO3 Get knowledge on the organic crop production practices for sustainable agriculture
CO4 Suggest the sustainable ways of animal production and know about the standard requirements for the processing, handling and storage of organic foods
CO5 Learn about organic certification systems, process to be followed for domestic sales/exports, and opportunities/challenges in marketing of organic produce

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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1 – Low; 2 – Medium; 3 – High; “-” – No correlation

EN3030  PROJECT FORMULATION AND IMPLEMENTATION

COURSE OBJECTIVES:
• To Examine the techniques and procedures relevant for project planning and implementation in developing countries, especially infrastructure projects pertaining to environmental sector
• To enable the students to understand about project identification, feasibility analysis, design, financing, implementation, monitoring and evaluation

UNIT I  INTRODUCTION TO PROJECT FORMULATION

Overview of the project cycle – Planning Process and project planning – Search for Project ideas – Strategies in Capital allocation – Key elements in project formulation – Methods and tools for Project formulation – Project identification and selection – Preparation of feasibility reports as per Government policies (AMRUT / JnNURM)
UNIT II PROJECT ANALYSIS 8

UNIT III PROJECT APPRAISAL 10
Time and value of money – Investment Criteria – Internal Rate of Return – Net Present Value, Cost Benefit Analysis, and social cost benefit analysis – Project risk analysis – Appraisal of marketing strategy – Pricing and credit worthiness and management capabilities

UNIT IV PROJECT FINANCING AND IMPLEMENTATION 10
Funding options for urban and rural development projects – Tender Procedure – Transparency in Government Tender rules – Organizational aspects in Project management – Network techniques for project management – Resource management - Risk management

UNIT V PROJECT MONITORING AND EVALUATION 8
Need and techniques for monitoring – Service Level Benchmark Performance and process monitoring – Monitoring Schedules – Penalty and Bonus points

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1: Understand key elements of project formulation
CO2: Develop knowledge on important aspects of project formulation
CO3: Develop criteria for project appraisal,
CO4: know about the funding agencies and project management
CO5 : Get an idea about service level bench mark performances, Penalty and bonus clauses and its importance in project execution

REFERENCES:
3. John M Nicholas “Project Management For Business And Technology” Prentice Hall OfIndia Pvt Ltd
4. James P Lewis “ Project Planning ,Scheduling And Control” Tata Mcgraw-Hill
5. Detailed Project Report : Preparation Toolkit (Sub-mission for Urban Infrastructure and Governance), Government of India
6. www.india.gov.in national portal for India

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.
MANDATORY COURSES I

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

COURSE OUTLINE

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

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

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

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

UNIT V  GENDER AND REPRESENTATION
Advertising and popular visual media.

Gender and Representation in Alternative Media. Gender and social media.

TOTAL : 45 PERIODS

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

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

1. COURSE CONTENTS
Introduction to Elements of Literature

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

2. Elements of fiction
a) Fiction, fact and literary truth.
b) Figurative language.

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.

**MX3083 FILM APPRECIATION**

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.

MX3084 DISASTER RISK REDUCTION AND MANAGEMENT L T P C 3 0 0 0

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 HAZARDS, 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)
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
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

UNIT V DISASTER MANAGEMENT: CASE STUDIES
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 L T P C 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 health.


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 4+6

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 BMI

**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.legit.ng/1163909-classes-food-examples-functions.html
6. Food additives
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 L T P C 3 0 0 0

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

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

OBJECTIVES:
- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:
Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each)

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures)

(Refs: Adam smith, J S Mill)

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

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.
(Refs: Marx, Lenin, Mao, M N Roy) (5 lectures)
Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature. (6 lectures)

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)

(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

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

Conclusion (2 lectures)

Total lectures: 39
Preferred Textbooks: See Reference Books

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

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

TOTAL : 45 PERIODS

OUTCOME:
- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

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?

TOTAL : 45 PERIODS

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:

MX3089 INDUSTRIAL SAFETY L T P C
3 0 0 0

OBJECTIVES
- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.
UNIT I  SAFETY TERMINOLOGIES
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II  STANDARDS AND REGULATIONS

UNIT III  SAFETY ACTIVITIES

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

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

Course outcomes on completion of this course the student will be able:
- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TOTAL : 45 PERIODS

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
CO’s-PO’s & PSO’s MAPPING

<table>
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<tr>
<th>Course Outcomes</th>
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OPEN ELECTIVE I AND II

OCS351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS

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<th>COURSE OBJECTIVES:</th>
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<td>The main objectives of this course are to:</td>
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<td>- Understand the importance, principles, and search methods of AI.</td>
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<td>- Provide knowledge on predicate logic and Prolog.</td>
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<td>- Introduce machine learning fundamentals.</td>
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<td>- Study of supervised learning algorithms.</td>
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<td>- Study about unsupervised learning algorithms.</td>
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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  6
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV  SUPERVISED LEARNING  6

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

TOTAL : 30 PERIODS

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 naive 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.

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

TOTAL PERIODS: 60

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

OCS352 IOT CONCEPTS AND APPLICATIONS

COURSE 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 I INTRODUCTION TO INTERNET OF THINGS

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)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT

UNIT IV OPEN PLATFORMS AND PROGRAMMING

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

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system
COURSE OUTCOMES:
CO1: Explain the concept of IoT.
CO2: Understand the communication models and various protocols for IoT.
CO3: Design portable IoT using Arduino/Raspberry Pi/open platform.
CO4: Apply data analytics and use cloud offerings related to IoT.
CO5: 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

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:

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 PERIODS: 60

TEXT BOOKS


REFERENCES

CCS333  AUGMENTED REALITY/VIRTUAL REALITY  L T P C

2 0 2 3

COURSE 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  7

UNIT II  VR MODELING  6

UNIT III  VR PROGRAMMING  6
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV  APPLICATIONS  6

UNIT V  AUGMENTED REALITY  5
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 PERIODS: 60

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

CO1: Understand the basic concepts of AR and VR
CO2: Understand the tools and technologies related to AR/VR
CO3: Know the working principle of AR/VR related Sensor devices
CO4: Design of various models using modeling techniques
CO5: Develop AR/VR applications in different domains

TEXTBOOKS:
1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018

CO’s-PO’s & PSO’s MAPPING

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OPEN ELCTIVE III

OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS L T P C
3 0 0 3

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.

COURSE 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
CO1 expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required
CO2 identify errors with precision and write with clarity and coherence
CO3 understand the importance of task fulfilment and the usage of task-appropriate vocabulary
CO4 communicate effectively in group discussions, presentations and interviews
CO5 write topic based essays with precision and accuracy

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:
REFERENCES:

Websites
http://civilservicementor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/

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.

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT

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

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

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

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

UNIT IV NGO’S FOR SUSTAINABILITY
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on
Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V LEGAL FRAMEWORKS
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO’s in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL 45 : PERIODS

COURSE 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

CO3 present strategies for NGOs in attaining sustainable development

CO4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment

CO5 understand the environmental legislations

REFERENCES


OMG353 DEMOCRACY AND GOOD GOVERNANCE

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.

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

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

UNIT II  SOLAR ENERGY

UNIT III  WIND ENERGY

UNIT IV  BIO-ENERGY

UNIT V  OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students would be able to
CO1 Discuss the Indian and global energy scenario.
CO2 Describe the various solar energy technologies and its applications.
CO3 Explain the various wind energy technologies.
CO4 Explore the various bio-energy technologies.
CO5 Discuss the ocean and geothermal technologies.

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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OME354 Applied Design Thinking

COURSE 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:
CO1 Define & test various hypotheses to mitigate the inherent risks in product innovations.
CO2 Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.
CO3 Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching
CO4 Apply system thinking in a real-world scenario

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

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
6. https://blog.forgeforward.in/star-tup-failure-is-like-true-lie-7812c9e9b85

MF3003  REVERSE ENGINEERING
COURSE OBJECTIVES:
• The main learning objective of this course is to prepare students for:
• Applying the fundamental concepts and principles of reverse engineering in product design and development.
• Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
• Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
• Analysing the various legal aspect and applications of reverse engineering in product design and development.
• Understand about 3D scanning hardware & software operations and procedure to generate 3D model
UNIT I  INTRODUCTION & GEOMETRIC FORM  9

UNIT II  MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION  9

UNIT III  DATA PROCESSING  9

UNIT IV  3D SCANNING AND MODELLING  9

UNIT V  INDUSTRIAL APPLICATIONS  9

TOTAL : 45 PERIODS

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

CO1 Apply the fundamental concepts and principles of reverse engineering in product design and development.

CO2 Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.

CO3 Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.

CO4 Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.

CO5 Analyze the various legal aspect

CO6 Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:
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

Industrial Revolution—Economic sustainability: globalization and international issues

UNIT II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY

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

UNIT III SUSTAINABILITY PRACTICES

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

UNIT IV MANUFACTURING STRATEGY FOR SUSTAINABILITY

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

UNIT V TRENDS IN SUSTAINABLE OPERATIONS


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.

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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AU3791 ELECTRIC AND HYBRID VEHICLES L T P C 3 0 0 3

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 sub system design and hybrid vehicle control.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

UNIT II ENERGY SOURCES

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

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

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UNIT V HYBRID AND ELECTRIC VEHICLES

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the student will be able to
CO1 Understand the operation and architecture of electric and hybrid vehicles
CO2 Identify various energy source options like battery and fuel cell
CO3 Select suitable electric motor for applications in hybrid and electric vehicles.
CO4 Explain the role of power electronics in hybrid and electric vehicles
CO5 Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

REFERENCES:

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OAS352 SPACE ENGINEERING

COURSE 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  9
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations - thrust/power available and thrust/power required.

UNIT IV  AIRCRAFT STABILITY AND STRUCTURAL THEORY  10

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1  Illustrate the history of aviation & developments over the years
CO2  Ability to identify the types & classifications of components and control systems
CO3  Explain the basic concepts of flight & Physical properties of Atmosphere
CO4  Identify the types of fuselage and constructions.
CO5  Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

REFERENCE:

OIM351  INDUSTRIAL MANAGEMENT  L T P C
3 0 0 3

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

UNIT I  INTRODUCTION  9

UNIT II  FUNCTIONS OF MANAGEMENT  9
UNIT III ORGANIZATIONAL BEHAVIOUR

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

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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CO’s-PO’s & PSO’s MAPPING

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OIE354 QUALITY ENGINEERING
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  9

UNIT II  CONTROLCHARTS  9
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  9
Warning and modified control limits, control chart for individual measurements, multi-vari chart, Xchart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV  STATISTICAL PROCESS CONTROL  9
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V  ACCEPTANCESAMPLING  9
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

REFERENCES:

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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING L T P C 3 0 0 3

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

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

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

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY
Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.
UNIT IV ULTRASONIC TESTING & AET 9
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration.

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
CO1 Realize the importance of NDT in various engineering fields.
CO2 Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
CO3 Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
CO4 Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
CO5 Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

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

UNIT I  INTRODUCTION AND SENSORS  9

UNIT II  8085 MICROPROCESSOR  9

UNIT III  PROGRAMMABLE PERIPHERAL INTERFACE  9

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

UNIT V  ACTUATORS AND MECHATRONICS SYSTEM DESIGN  9

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.
CO4: Apply PLC as a controller in mechatronics system.
CO5: Design and develop the apt mechatronics system for an application.

TEXT BOOKS

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1 – Slight, 2 – Moderate, 3 – Substantial

ORA351 FOUNDATION OF ROBOTICS

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COURSE OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- 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  9

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  9

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  9
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL : 45 PERIODS

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

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

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING L T P C 3 0 0 3

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  8
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  10
Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III  BASICS OF AERODYNAMICS  9

UNIT IV  BASICS OF AIRCRAFT STRUCTURES  9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1 Illustrate the history of aircraft & developments over the years
CO2 Ability to identify the types & classifications of components and control systems
CO3 Explain the basic concepts of flight & Physical properties of Atmosphere
CO4 Identify the types of fuselage and constructions.
CO5 Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS

REFERENCE
1. SADHU SINGH, "INTERNAL COMBUSTION ENGINES AND GAS TURBINE"-, SS Kataraia & sons, 2015

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

COURSE 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
  CO1 Understand the concepts and laws related to remote sensing
  CO2 Understand the interaction of electromagnetic radiation with atmosphere and earth material
  CO3 Acquire knowledge about satellite orbits and different types of satellites
  CO4 Understand the different types of remote sensors
  CO5 Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

REFERENCES:
CO’s-PO’s & PSO’s MAPPING

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OAI351 URBAN AGRICULTURE

COURSE 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

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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

**CO1** Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops

**CO2** Explain different methods of crop production on roof tops

**CO3** Explain nutrient and pest management for crop production on roof tops

**CO4** Illustrate crop water requirement and irrigation water management on roof tops

**CO5** Explain the concept of waste management on roof tops

TEXT BOOKS:


REFERENCES:


CO’s-PO’s & PSO’s MAPPING

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<tr>
<th>PO/PSO</th>
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<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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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

OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES L T P C

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

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

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

UNIT III CORE CONCEPTS IN LEAN

UNIT IV LEAN TOOLS AND TECHNIQUES

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:
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:

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
Magnetic circuits- DC machine and AC machine – Working principle of Generator and Motor, DC and AC - Voltage and torque equations – Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM.

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
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles
(HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

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 spilt 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.

REFERENCES:

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OEI353 INTRODUCTION TO PLC PROGRAMMING

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

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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  9
Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT V  CASE STUDIES  9
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 Petruzella, 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

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List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108105063

CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
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OCH351 NANO TECHNOLOGY

UNIT I INTRODUCTION
General definition and size effects—important nano structured materials and nano particles—importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials – Ionic properties of nanomaterials–Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermostet based and elastomer based- influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots-Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS
COURSE OUTCOMES:
CO1 understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.
CO2 able to acquire knowledge about the different types of nano material synthesis
CO3 describes about the shape, size, structure of composite nano materials and their interference
CO4 understand the different characterization techniques for nanomaterials
CO5 develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

REFERENCES

CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<td>acquire knowledge about the different types of nano material synthesis</td>
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<td>describes about the shape, size, structure of composite nano materials and their interference</td>
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<td>understand the different characterization techniques for nanomaterials</td>
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<td>CO5</td>
<td>develop a deeper knowledge in the application of nanomaterials in different fields</td>
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</table>
COURSE OBJECTIVE:
- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I INTRODUCTION

UNIT II MOLECULAR SELF ASSEMBLY

UNIT III BIO-INSPIRED MATERIALS

UNIT IV SMART OR INTELLIGENT MATERIALS
Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.

UNIT V MATERIALS FOR POLYMER ELECTRONICS
Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS

COURSE OUTCOME:
- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOK:

REFERENCE:
UNIT I  HISTORICAL AND CULTURAL PERSPECTIVES
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

UNIT III  TRADITIONAL FOOD PATTERNS
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
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
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 patterns.

TEXT BOOKS:

OFD353 INTRODUCTION TO FOOD PROCESSING

COURSE 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 9
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 9
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 12
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 6
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V FOOD HYGIENE 9
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.

TEXT BOOKS/REFERENCES:
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
CO1 Understand and differentiate the categories of intellectual property rights.
CO2 Describe about patents and procedure for obtaining patents.
CO3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
CO4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
CO5 Provide different organizations role and responsibilities in the protection of IPR in the international level.

CO6 Understand the interrelationships between different Intellectual Property Rights on International Society

CO’s-PO’s & PSO’s MAPPING

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OTT351 BASICS OF TEXTILE FINISHING

L T P C 3 0 0 3

COURSE 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.

TOTAL: 45 PERIODS

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

CO1 Basics of Resin Finishing Process.

CO2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.

CO3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
CO4 Concept of Mechanical finishing.
CO5 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

COURSE 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 9
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 9
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 9
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 9
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 9
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.

TOTAL: 45 PERIODS
COURSE 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

TEXTBOOKS:

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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

OTT353 BASICS OF TEXTILE MANUFACTURE L T P C
3 0 0 3

COURSE OBJECTIVES:
- To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing
UNIT I  NATURAL FIBRES
Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres.

UNIT II  REGENERATED AND SYNTHETIC FIBRES
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.

UNIT III  BASICS OF SPINNING
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering calculations

UNIT IV  BASICS OF WEAVING
Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,

UNIT V  BASICS OF KNITTING AND NONWOVEN

TOTAL : 45 PERIODS

COURSE 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

CO’s-PO’s & PSO’s MAPPING

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

OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

COURSE 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 Terephathalate (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

COURSE 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
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

COURSE OUTCOMES:

Upon completion of this course, the students can able to analyze the energy data of industries.

CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.

CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.

CO3: Skills on combustion thermodynamics and kinetics.

CO4: Apply calculation and design tube still heaters.

CO5: Studied different heat treatment furnace.

CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:


REFERENCES:


OPT351 BASICS OF PLASTICS PROCESSING

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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

Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing. Additives for plastics compounding and processing: antioxidants, light stabilizers,
UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization.

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 PERIODS

COURSE OUTCOMES
CO1 Ability to find out the correlation between various processing techniques with product properties.
CO2 Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.
CO3 Acquire knowledge on additives for plastic compounding and methods employed for the same
CO4 Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.
CO5 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
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids-Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant, Causal & Non-causal, Stable & Unstable.

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

UNIT III LINEAR TIME INVARIANT 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 INVARIANT-DISCRETE TIME SYSTEMS 9

TOTAL: 45 PERIODS

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:

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OEC352 FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS  
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
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:

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CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

COURSE 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  9

UNIT II  REQUIREMENTS AND SYSTEM DESIGN  9

UNIT III  DESIGN AND TESTING  9

UNIT IV  SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT  9

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to:
CO1 Define, formulate, and analyze a problem
CO2 Solve specific problems independently or as part of a team
CO3 Gain knowledge of the Innovation & Product Development process in the Business Context
CO4 Work independently as well as in teams
CO5 Manage a project from start to finish

TEXT BOOKS:
1. Book specially prepared by NASSCOM as per the MoU.

REFERENCES:
CBM333       ASSISTIVE TECHNOLOGY       L T P C

COURSE 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         9
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               9
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis,
portable dialyser monitoring and functional parameters.

UNIT III   HEARING AIDS               9
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      9
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              9
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

TOTAL :45 PERIODS

COURSE 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
   Set, CRC Press,2006
2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and
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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COURSE OBJECTIVES:
This course will help the students to
• determine the optimum solution for Linear programming problems.
• study the Transportation and assignment models and various techniques to solve them.
• acquire the knowledge of optimality, formulation and computation of integer programming problems.
• acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
• determine the optimum solution for non-linear programming problems.

UNIT I LINEAR PROGRAMMING

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS

UNIT III INTEGER PROGRAMMING

UNIT IV DYNAMIC PROGRAMMING PROBLEMS
UNIT V  NON - LINEAR PROGRAMMING PROBLEMS

TOTAL:45 PERIODS

COURSE 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:

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OMA353 ALGEBRA AND NUMBER THEORY

COURSE 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 MUTIPLICATIVE FUNCTIONS  
Wilson’s theorem - Fermat’s Little theorem - Euler’s theorem - Euler’s Phi functions - Tau and Sigma functions.

COURSE OUTCOMES:
CO1 Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
CO2 Demonstrate accurate and efficient use of advanced algebraic techniques.
CO3 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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COURSE OBJECTIVES:
- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 9

UNIT II VECTOR SPACES 9
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III LINEAR TRANSFORMATION 9
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.

UNIT IV INNER PRODUCT SPACES 9
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION 9

COURSE OUTCOMES:
After the completion of the course the student will be able to
CO1 Test the consistency and solve system of linear equations.
CO2 Find the basis and dimension of vector space.
CO3 Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
CO4 Find orthonormal basis of inner product space and find least square approximation.
CO5 Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

TEXT BOOKS

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OBT352      BASICS OF MICROBIAL TECHNOLOGY        L T P C

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, Dengu, 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
Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermicompost, Pharmaceutical products - Antibiotics, Vaccines

TOTAL: 45 PERIODS

COURSE OUTCOME:
At the end of the course the students will be able to
CO1 Microbes and their types
CO2 Cultivation of microbes
CO3 Pathogens and control measures for safety
CO4 Microbes in different industry for economy.
TEXT BOOKS

OBT353 BASICS OF BIOMOLECULES L T P C
3 0 0 3

COURSE 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
9
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
9
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.
9

UNIT IV NUCLEIC ACIDS
9
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
9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 Students will learn about various kinds of biomolecules and their physiological role.
CO2 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

REFERENCES

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

COURSE 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 reticulum, golgi apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalisation.

UNIT III BIO-MEMBRANE TRANSPORT 9

UNIT IV CELL CYCLE 9
Cell cycle- Cell division by mitosis and meiosis, 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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 Understanding of cell at structural and functional level.
CO2 Understand the central dogma of life and its significance.
CO3 Comprehend the basic mechanisms of cell division.
TEXTBOOKS:

REFERENCES:

OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING

COURSE OBJECTIVE
The Course will enable Learners to,
- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNIT I

UNIT II

UNIT III
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV

UNIT V

TOTAL: 45 PERIODS
COURSE OUTCOMES
By the end of the course, learners will be able to
CO1 Write effective project reports.
CO2 Use statistical tools with confidence.
CO3 Explain the purpose and intension of the proposed project coherently and with clarity.
CO4 Create writing texts to suit achieve the intended purpose.
CO5 Master the art of writing winning proposals and projects.

REFERENCES

CO's – PO's & PSO's MAPPING

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

OMA355 ADVANCED NUMERICAL METHODS

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<td>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.</td>
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UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM 9

UNIT II INTERPOLATION 9
Central difference: Stirling and Bessel's interpolation formulae ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline ; Least square approximation for continuous data (upto 3rd degree).
UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS

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's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes.

UNIT V FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;
CO2: understand the interpolation theory;
CO3: understand the concepts of numerical methods for ordinary differential equations;
CO4: demonstrate the understandings of common numerical methods for elliptic equations;
CO5: understand the concepts of numerical methods for time dependent partial differential equations

TEXT BOOKS:

REFERENCES:

CO’s – PO’s & PSO’s MAPPING

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COURSE 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  9

UNIT II  RANDOM PROCESSES  9

UNIT III  SPECIAL RANDOM PROCESSES  9

UNIT IV  CORRELATION AND SPECTRAL DENSITIES  9

UNIT V  LINEAR SYSTEMS WITH RANDOM INPUTS  9
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL:  45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1 Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
CO2 Apply the concept random processes in engineering disciplines.
CO3 Understand and apply the concept of correlation and spectral densities.
CO4 Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
CO5 Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS

REFERENCES

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**OMA357 QUEUEING AND RELIABILITY MODELLING**

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**COURSE 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**

**UNIT II MARKOVIAN QUEUEING MODELS**
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms.

**UNIT III ADVANCED QUEUEING MODELS**
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E_k/1 as special cases – Series queues – Open Jackson networks.

**UNIT IV SYSTEM RELIABILITY**

**UNIT V MAINTAINABILITY AND AVAILABILITY**
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**
Upon successful completion of the course, students should be able to:
- **CO1** Enable the students to apply the concept of random processes in engineering disciplines.
- **CO2** Students acquire skills in analyzing various queueing models.
CO3 Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.

CO4 Students can analyze reliability of the systems for various probability distributions.

CO5 Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

TEXT BOOKS

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

COURSE 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 9
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 9

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT 9

TOTAL 45 : PERIODS

COURSE OUTCOMES
Upon completion of this course the learners will be able:
CO1 To understand the basics and functions of Production and Operation Management for business owners.
CO2 To learn about the Production & Operation Systems.
CO3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
CO4 To known about the Production & Operations Management Processes in organisations.
CO5 To comprehend the techniques of controlling , Production and Operations in industries.

REFERENCES

OMG355 MULTIVARIATE DATA ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVE:
- To know various multivariate data analysis techniques for business research.

UNIT I INTRODUCTION 9
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

COURSE OUTCOMES:
CO1 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.
CO2 Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
CO3 Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
CO4 Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
CO5 Make better business decisions by using advanced techniques in data analytics.

REFERENCES:

OME352 ADDITIVE MANUFACTURING

COURSE OBJECTIVES:
- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
- To be acquainted with vat polymerization and material extrusion processes
- To be familiar with powder bed fusion and binder jetting processes.
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies.
UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

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

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 LT P C

3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- 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

UNIT II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III ESSENTIALS OF NPD

UNIT IV CRITERIONS OF NPD
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT V REPORTING & FORWARD-THINKING OF NPD
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in
shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL :45 PERIODS

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

CO1 Discuss fundamental concepts and customer specific requirements of the New Product development

CO2 Discuss the Material specification standards, analysis and fabrication, manufacturing process Develop Feasibility Studies & reporting of New Product development

CO3 Analyzing the New product qualification and Market Survey on similar products of new product development

CO4 Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:
Product Development – Sten Jonsson
Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:
Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
Change by Design
Toyota Product Development System – James Morgan & Jeffrey K. Liker
Winning at New Products – Robert Brands 3rd Edition
Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

CO’s – PO’s & PSO’s MAPPING

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OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES L T P C
3 0 0 3

COURSE OOBJECTIVES:
The course aims to

- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices
UNIT I  UI/UX  9

UNIT II  APP DEVELOPMENT  9
SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup - Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III  INDUSTRIAL DESIGN  9
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV  MECHANICAL RAPID PROTOTYPING  9
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V  ELECTRONIC RAPID PROTOTYPING  9
Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to:
CO1 Create quick UI/UX prototypes for customer needs
CO2 Develop web application to test product traction / product feature
CO3 Develop 3D models for prototyping various product ideas
CO4 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
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
CO1 Select suitable precision machine tools and operate
CO2 Apply the macro and micro components for fabrication of micro systems.
CO3 Apply suitable machining process
CO4 Able to work with miniature models of existing machine tools/robots and other instruments.
CO5 Apply metrology for micro system

TEXT BOOKS:

REFERENCES:

OMF354  COST MANAGEMENT OF ENGINEERING PROJECTS  LT 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:
COURSE OBJECTIVES:
The objective of this course is to make the students

- To understand the working and characteristics of different types of batteries and their management.

UNIT I ADVANCED BATTERIES
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics- SOC, DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries- NCM and NCA Batteries. NCR18650B specifications.

UNIT II BATTERY PACK
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III BATTERY MODELLING

UNIT IV BATTERY STATE ESTIMATION

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray- CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL :45 PERIODS

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

CO1 Acquire knowledge of different Li-ion Batteries performance.

CO2 Design a Battery Pack and make related calculations.

CO3 Demonstrate a Battery Model or Simulation.

CO4 Estimate State-of-Charges in a Battery Pack.

CO5 Approach different BMS architectures during real world usage.

TEXT BOOKS

258
REFERENCES
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

COURSE OBJECTIVES:
- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1 List common types of sensor and actuators used in vehicles.
CO2 Design measuring equipment’s for the measurement of pressure force, temperature and flow.
CO3 Generate new ideas in designing the sensors and actuators for automotive application
CO4 Understand the operation of the sensors, actuators and electronic control.
CO5 Design temperature control actuators for vehicles.
TEXT BOOKS:

REFERENCES:

OAS353 SPACE VEHICLES

COURSE OBJECTIVES:
- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of space vehicle configuration design.
- To explain Engine system and support of space vehicle.
- To interpret nose cone configuration of space vehicle.

UNIT I FUNDAMENTAL ASPECTS
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION

UNIT IV THRUST VECTOR CONTROL

UNIT V NOSE CONE CONFIGURATION
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1 Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
CO2 Apply knowledge in selecting the appropriate rocket propulsion systems.
CO3 Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
CO4 Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
CO5 Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352 MANAGEMENT SCIENCE

COURSE OBJECTIVES:
Of this course are
• To introduce fundamental concepts of management and organization to students.
• To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
• To make students familiarize with the concepts of human resources management.
• To acquaint students with the concepts of project management and cost analysis.
• To make students familiarize with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION

UNIT II OPERATIONS AND MARKETING MANAGEMENT

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, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels.

UNIT IV PROJECT MANAGEMENT
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
Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carryout production operations through Work-study.
CO2: Survey the markets, customers and competition better and price the given products appropriatey
CO3: Ensure quality for a given product or service.
CO4: Plan, schedule and control projects through PERTandCPM.
CO5: Evaluate strategy forabusiness orserviceorganisation.

TEXTBOOKS:

REFERENCES:

CO’s – PO’s & PSO’s MAPPING

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OIM353 PRODUCTION PLANNING AND CONTROL

COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION
Objectives and benefits of planning and control- Functions of production control- Types of production- job- batch and continuous- Product development and design- Marketing aspect - Functional aspects- Operational aspect- Durability and dependability aspect aesthetic aspect.
Profit consideration- Standardization, Simplification & specialization- Break even analysis- Economics of a new design.

UNIT II WORK STUDY 9
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 9
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 9

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course,
CO1: The students can able to prepare production planning and control act work study,
CO2: The students can able to prepare product planning,
CO3: The students can able to prepare production scheduling,
CO4: The students can able to prepare Inventory Control.
CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

REFERENCES
OIE353 OPERATIONS MANAGEMENT

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit, framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS

UNIT IV MATERIALS MANAGEMENT
UNIT V  SCHEDULING AND PROJECT MANAGEMENT

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.

CO3: The students will 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.

TEXT BOOKS


REFERENCES


CO’s- PO’s & PSO’s MAPPING

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

UNIT I: INTRODUCTION AND SCOPE

UNIT II: MONITORING FOR SAFETY, HEALTH & ENVIRONMENT

UNIT III: OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV: OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT-V INDUSTRIAL HAZARDS

TOTAL: 45 PERIODS

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.
TEXT BOOKS:

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

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OSF353 CHEMICAL PROCESS SAFETY L T P C

COURSE OBJECTIVES
- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES
Types of storage - general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self -
heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 9
Design principles - Process design development - types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares - new concepts in safety design and operation - Pressure vessel testing standards - Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 9
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards - standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures - condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS 9
Safety vs reliability - quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about

TEXT BOOK

REFERENCES:
OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- 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, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis.

UNIT III SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques. Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, 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

TOTAL: 45 PERIODS
COURSE OUTCOMES:
After completion of this course, the students will be able to
CO1 Understand various types of dielectric materials, their properties in various conditions.
CO2 Evaluate magnetic materials and their behavior.
CO3 Evaluate semiconductor materials and technologies.
CO4 Select suitable materials for electrical engineering applications.
CO5 Identify right material for optical and optoelectronic applications

TEXT BOOKS:

REFERENCES:

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OML353  NANOMATERIALS AND APPLICATIONS  L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS  9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.
UNIT II  THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS 9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III  PROCESSING 9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV  STRUCTURAL CHARACTERISTICS 9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V  APPLICATIONS 9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
CO1 Evaluate nanomaterials and understand the different types of nanomaterials
CO2 Recognise the effects of dimensionality of materials on the properties
CO3 Process different nanomaterials and use them in engineering applications
CO4 Use appropriate techniques for characterising nanomaterials
CO5 Identify and use different nanomaterials for applications in different engineering fields.

TEXT BOOKS:

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271
OMR352 HYDRAULICS AND PNEUMATICS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To knowledge on fluid power principles and working of hydraulic pumps
- To obtain the knowledge in hydraulic actuators and control components
- To understand the basics in hydraulic circuits and systems
- To obtain the knowledge in pneumatic and electro pneumatic systems
- To apply the concepts to solve the trouble shooting

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO2: Recognize the concepts in hydraulic actuators and control components
CO3: Obtain the knowledge in basics of hydraulic circuits and systems
CO4: Know about the basics concept in pneumatic and electro pneumatic systems
CO5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

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1 – Slight, 2 – Moderate, 3 – Substantial

OMR353  
Sensors  
L T P C  
3 0 0 3

COURSE OBJECTIVES:
- To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
- To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
- To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
- To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
- 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.

TEXT BOOKS

REFERENCES

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1 – Slight, 2 – Moderate, 3 – Substantial
COURSE OBJECTIVES

- To introduce mobile robotic technology and its types in detail.
- To learn the kinematics of wheeled and legged robot.
- To familiarize the intelligence into the mobile robots using various sensors.
- To acquaint the localization strategies and mapping technique for mobile robot.
- To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT I  INTRODUCTION TO MOBILE ROBOTICS  9

UNIT II  KINEMATICS  9

UNIT III  PERCEPTION  9

UNIT IV  LOCALIZATION  9

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:

MV3501 MARINE PROPULSION

COURSE OBJECTIVES:
- To impart knowledge on basics of propulsion system and ship dynamic movements
- To educate them on basic layout and propulsion equipment’s
- To impart basic knowledge on performance of the ship
- To impart basic knowledge on Ship propeller and its types
- To impart knowledge on ship rudder and its types

UNIT I BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II SHIPS MOVEMENTS AND SHIP STABILIZATION
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stablizer, fin stablizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III SHIPS SPEED AND ITS PERFORMANCE
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV BASICS OF PROPELLER

UNIT V BASICS OF RUDDER
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder

TOTAL: 45 PERIODS
TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”, 2015

REFERENCES BOOKS:

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OMV351 MARINE MERCHANT VESSELS                LT P C  
                                                                                       3 0 0 3

COURSE OBJECTIVES:
At the end of the course, students are expected to acquire
- Knowledge on basics of Hydrostatics
- Familiarization on types of merchant ships
- Knowledge on Shipbuilding Materials
- Knowledge on marine propeller and rudder
- 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 Safetyof Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ) , MLC (Maritime Labour Convention), STCW 2010 (International Convention on
Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, students would
CO1 Acquire Knowledge on floatation of ships
CO2 Acquire Knowledge on features of various ships
CO3 Acquire Knowledge of Shipbuilding Materials
CO4 Acquire Knowledge to identify the different types of marine propeller and rudder
CO5 Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352 ELEMENTS OF MARINE ENGINEERING

COURSE OBJECTIVES:
At the end of the course, students are expected to
- Understand the role of Marine machinery systems
- Be familiar with Marine propulsion machinery system
- Acquaint with Marine Auxiliary machinery system
- Have acquired basics of Marine Auxiliary boiler system
- Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
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
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
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
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students should able to,
CO1 Distinguish the role of various marine machinery systems
CO2 Relate the components of marine propulsion machinery system
CO3 Explain the importance of marine auxiliary machinery system
CO4 Acquire knowledge of marine boiler system
CO5 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 LT P C 3 0 0 3

COURSE OBJECTIVES:
• To understand the basics of drone concepts
• To learn and understand the fundamentals of design, fabrication and programming of drone
• To impart the knowledge of an flying and operation of drone
• To know about the various applications of drone
• To understand the safety risks and guidelines of fly safely

UNIT I INTRODUCTION TO DRONE TECHNOLOGY
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.
UNIT III  DRONE FLYING AND OPERATION  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

TEXT BOOKS
1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and
Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and
Implementation”, 2021 John Wiley & Sons, Inc.

REFERENCES
1. John Baichtal, “Building Your Own Drones: A Beginners’ Guide to Drones, UAVs, and
ROVs”, Que Publishing, 2016
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for

CO’s – PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>COs/Pos&amp;PS</th>
<th>POS</th>
<th>PSOs</th>
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<td>CO1</td>
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<td>CO5</td>
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<tr>
<td>CO/PO &amp; PSO Average</td>
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1 – Slight, 2 – Moderate, 3 – Substantial
**COURSE OBJECTIVE:**

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

**UNIT I  FUNDAMENTALS OF GIS**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Introduction to GIS - Basic spatial concepts, Coordinate Systems, GIS and Information Systems - Definitions, History of GIS, Components of a GIS - Hardware, Software, Data, People, Methods - Proprietary and open source Software - Types of data: Spatial, Attribute data - types of attributes - scales/levels of measurements.</td>
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**UNIT II  SPATIAL DATA MODELS**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Database Structures - Relational, Object Oriented - Entities - ER diagram - data models - conceptual, logical and physical models - spatial data models - Raster Data Structures - Raster Data Compression - Vector Data Structures - Raster vs Vector Models - TIN and GRID data models.</td>
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</table>

**UNIT III  DATA INPUT AND TOPOLOGY**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Credits</th>
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</table>

**UNIT IV  DATA QUALITY AND STANDARDS**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage - Metadata - GIS Standards - Interoperability - OGC - Spatial Data Infrastructure</td>
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</table>

**UNIT V  DATA MANAGEMENT AND OUTPUT**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>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.</td>
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</table>

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to
  
  **CO1** Have basic idea about the fundamentals of GIS.
  
  **CO2** Understand the types of data models.
  
  **CO3** Get knowledge about data input and topology.
  
  **CO4** Gain knowledge on data quality and standards.
  
  **CO5** Understand data management functions and data output.

**TEXTBOOKS:**


**REFERENCE:**

CO’s – PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>Course Outcome</th>
<th>Average</th>
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<td>PO1</td>
<td>Engineering Knowledge</td>
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<td>PO2</td>
<td>Problem Analysis</td>
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<td>PO3</td>
<td>Design/Development of Solutions</td>
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<td>PO4</td>
<td>Conduct Investigations of Complex</td>
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<td>Problems</td>
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<td>PO5</td>
<td>Modern Tool Usage</td>
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<td>PO6</td>
<td>The Engineer and Society</td>
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<td>PO7</td>
<td>Environment and Sustainability</td>
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<td>Individual and Team Work</td>
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<td>PO10</td>
<td>Communication</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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<td>PSO1</td>
<td>Knowledge of Geoinformatics discipline</td>
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<td>PSO2</td>
<td>Critical analysis of Geoinformatics</td>
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<td>Engineering problems and innovations</td>
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<td>PSO3</td>
<td>Conceptualization and evaluation of</td>
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<td>Design solutions</td>
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OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT  L T P C  3 0 0 3

COURSE 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
measures-Payback period-proceeds per rupee of outlay, Discounted measures-Net Present Value (NPV)-Benefit-Cost Ratio (BCR)-Internal Rate of Return (IRR)-Net benefit investment ratio (N/K ratio)-sensitivity analysis.

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE

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

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 Judge about agricultural finance, banking and cooperation
CO2 Evaluate basic concepts, principles and functions of financial management
CO3 Improve the skills on basic banking and insurance schemes available to customers
CO4 Analyze various financial data for efficient farm management
CO5 Identify the financial institutions

TEXT BOOKS


REFERENCES


CO’s – PO’s & PSO’s MAPPING

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<tr>
<th>PO/PSO</th>
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<td>To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<td>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>To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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**OCE354 BASIC OF INTEGRATED WATER RESOURCES MANAGEMENT**  
**L T P C**  
3 0 0 3

**COURSE OBJECTIVES**
- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

**UNIT I OVERVIEW OF IWRM**  
9

**UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION**  
9
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

**UNIT III WATER ECONOMICS**  
9
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

**UNIT IV RECENT TREANDS IN WATER MANAGEMENT**  
9
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.
UNIT V IMPLEMENTATION OF IWRM

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

COURSE 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).


OEE353 INTRODUCTION TO CONTROL SYSTEMS

COURSE 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


285
UNIT III FREQUENCY RESPONSE ANALYSIS 9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

UNIT V STATE VARIABLE ANALYSIS 9
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

COURSE 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.

CO’s – PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO1</th>
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OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 0 3

COURSE OBJECTIVES:
- To educate on design of signal conditioning circuits for various applications.
- To Introduce signal transmission techniques and their design.
- Study of components used in data acquisition systems interface techniques
- To educate on the components used in distributed control systems
- 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)
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)

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

CO’s- PO’s & PSO’s MAPPING

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OCH353 ENERGY TECHNOLOGY

UNIT I INTRODUCTION
8
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

UNIT II CONVENTIONAL ENERGY
8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY
10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY
10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.
UNIT V ENERGY CONSERVATION

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL : 45 PERIODS

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

CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.

CO2: Students will excel as professionals in the various fields of energy engineering

CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.

CO4: Explain the technological basis for harnessing renewable energy sources.

CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

REFERENCES

CO's – PO's & PSO's MAPPING

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<th>Course Outcomes</th>
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<td>CO3</td>
<td>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>CO4</td>
<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<td>CO5</td>
<td>Identify and critically evaluate current</td>
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development and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level

| OVERALL CO | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 3 |

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

OCH354 SURFACE SCIENCE L T P C 3 0 0 3

COURSE OBJECTIVE:
- To enable the students to analyze properties of a surface and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES 9
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES 9
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES 9
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS 9
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fischer-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES 9

TOTAL: 45 PERIODS

COURSE OUTCOME:
- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena
COURSE 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
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, tumbler 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.

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:

COURSE 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

OFD355 FOOD SAFETY AND QUALITY REGULATION L T P C

COURSE 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

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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

OPY353 NUTRACEUTICALS

COURSE 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
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
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
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
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 OUTCOMES
CO1 acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.
CO2 acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes
CO3 attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
CO4 distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources.
CO5 gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.
CO6 Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

CO’s – PO’s & PSO’s MAPPING

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<th>Course outcome</th>
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</table>
COURSE 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

COURSE 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
### CO's – PO's & PSO’s MAPPING

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcomes 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</th>
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<td>Classification of fibres and production of natural fibres</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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**FT3201 FIBRE SCIENCE**

**COURSE OBJECTIVE**

- To enable the students to learn about the types of fibre and its properties

**UNIT I INTRODUCTION TO TEXTILE FIBRES**

Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool - Physical and chemical structure of the above fibres.

**UNIT II REGENERATED FIBRES**

Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel

**UNIT III SYNTHETIC FIBRES**

Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization

**UNIT IV SPECIALITY FIBRES**

Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres
UNIT V  FUNCTIONAL SPECIALITY FIBRES

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

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the student would be able to
CO1 Understand the process sequence of various fibres
CO2 Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:

OTT355  GARMENT MANUFACTURING TECHNOLOGY  L T P C
3  0  0  3

COURSE OBJECTIVE:
• To enable the students to understand the basics of pattern making, cutting and sewing.
• To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING
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
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
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
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
Garment pressing – categories and equipment, packing; care and labelling of apparels
TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing, and care labelling

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

REFERENCES:

CO’s – PO’s & PSO’s MAPPING

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OPE353  INDUSTRIAL SAFETY  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I  INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.
UNIT II  OCCUPATIONAL HEALTH AND HYGIENE  9

UNIT III  WORKPLACE SAFETY AND SAFETY SYSTEMS  9

UNIT IV  HAZARDS AND RISK MANAGEMENT  9

UNIT V  ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT  9

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:

CO1 Describe, with example, the common work-related diseases and accidents in occupational setting

CO2 Name essential members of the Occupational Health team

CO3 What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354  UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I  FLUID MECHANICS CONCEPTS  9
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal’s law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems).Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II  FLOW MEASUREMENTS & MECHANICAL OPERATIONS  9
Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids –

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER 9
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER 9

UNIT V MASS TRANSFER OPERATIONS 9
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

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

CO1 State and describe the nature and properties of the fluids.
CO2 Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
CO3 Comprehend the laws governing the heat and mass transfer operations to solve the problems.
CO4 Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCES
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

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
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II  ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III  THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

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

UNIT V  PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- polylactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 To study the importance, advantages and classification of plastic materials
CO2 Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
CO3 To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
CO4 Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
CO5 To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES
COURSE OBJECTIVES

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS


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

CO1 Understand the relevance of standards and specifications.
CO2 Summarize the various test methods for evaluating the mechanical properties of the polymers.
CO3 To know the thermal, electrical & optical properties of polymers.
CO4 Identify various techniques used for characterizing polymers.
CO5 Distinguish the processability tests used for thermoplastics, thermosets and elastomers.
REFERENCES

OEC353 VLSI DESIGN

COURSE 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

COURSE 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

REFERENCES

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CBM370  WEARABLE DEVICES  L T P C

COURSE OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I  INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

UNIT II  SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES
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
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

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CBM356  MEDICAL INFORMATICS  L T P C  3 0 0 3

Preamble:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I  INTRODUCTION TO MEDICAL INFORMATICS  9
Introduction - Structure of Medical Informatics – Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics
UNIT II  COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING  9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III  COMPUTERISED PATIENT RECORD  9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING  9
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS  9
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health-Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1 Explain the structure and functional capabilities of Hospital Information System.
CO2 Describe the need of computers in medical imaging and automated clinical laboratory.
CO3 Articulate the functioning of information storage and retrieval in computerized patient record system.
CO4 Apply the suitable decision support system for automated clinical diagnosis.
CO5 Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCE:

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TOTAL: 45 PERIODS
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 - Lignocellulosytic 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
CO1 To learn the various methods biological treatment
CO2 To know the details of waste biomass and its value addition
CO3 To develop the bioconversion processes to convert wastes to energy
CO4 To synthesize the chemicals and enzyme from wastes
CO5 To produce the biocompost from wastes
CO6 To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCES
UNIT I INTRODUCTION 9
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 9
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES 9
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse — Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY 9
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES 9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

UNIT I PUBLIC HEALTH 9

UNIT II CLINICAL DISEASES 9
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  9
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  9
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  9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

VERTICAL 1: FINTECH AND BLOCK CHAIN

CMG331  FINANCIAL MANAGEMENT  LT P C  3 0 0 3

COURSE OBJECTIVES
- To acquire the knowledge of the decision areas in finance.
- To learn the various sources of Finance
- To describe about capital budgeting and cost of capital.
- To discuss on how to construct a robust capital structure and dividend policy
- To develop an understanding of tools on Working Capital Management.

UNIT I  INTRODUCTION TO FINANCIAL MANAGEMENT  9
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  9
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: 9
Cost of Capital - Cost of Specific Sources of Capital - Equity - Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV  FINANCING AND DIVIDEND DECISION 9

UNIT V  WORKING CAPITAL DECISION 9

TEXT BOOKS

REFERENCES .
2. Prasanna Chandra, Financial Management,

CMG332  FUNDAMENTALS OF INVESTMENT LT P C 3 0 0 3
COURSE OBJECTIVES:
- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities
- Explain the various approaches to value securities
- Describe how to create efficient portfolios through diversification
- Discuss the mechanism of investor protection in India.

UNIT I  THE INVESTMENT ENVIRONMENT 9
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II  FIXED INCOME SECURITIES 9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III  APPROACHES TO EQUITY ANALYSIS 9
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.
UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V INVESTOR PROTECTION 9
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism

TOTAL : 45 PERIODS

REFERENCES

CMG333 BANKING, FINANCIAL SERVICES AND INSURANCE LT P C 3 0 0 3

COURSE OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS 9

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9

UNIT IV FINANCIAL SERVICES 9
UNIT V INSURANCE

TOTAL : 45 PERIODS

REFERENCES :
UNIT I  CURRENCY EXCHANGE AND PAYMENT  9

UNIT II  DIGITAL FINANCE AND ALTERNATIVE FINANCE  9
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  9
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  9
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  9

REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016
UNIT I  INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II  PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III  INSURANCE INDUSTRY

UNIT IV  FINTECH AROUND THE GLOBE

UNIT V  FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL : 45 PERIODS

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018
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

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1 Learn the basics of Entrepreneurship
CO2 Understand the business ownership patterns and environment
CO3 Understand the Job opportunities in Industries relating to Technopreneurship
CO4 Learn about applications of technopreneurship and successful technopreneurs
CO5 Acquaint with the recent and emerging trends in entrepreneur ship

TEXT BOOKS:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,
REFERENCES:
5) JumpStart: A Technoprenuership Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009
6) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
7) 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 Decision 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

316
COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1 Learn the basics of managing teams for business.
CO2 Understand developing effective teams for business management.
CO3 Understand the fundamentals of leadership for running a business.
CO4 Learn about the importance of leadership for business development.
CO5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP  
L T P C  3 0 0 3

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

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1 Learn the basics of creativity for developing Entrepreneurship
CO2 Understand the importance of creative intelligence for business growth
CO3 Understand the advances through Innovation in Industries
CO4 Learn about applications of innovation in building successful ventures
CO5 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

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


UNIT II MARKETING ENVIRONMENT


UNIT III PRODUCT AND PRICING MANAGEMENT

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price
Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBUTUION MANAGEMENT

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT

TOTAL 45 : PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO1 Have the awareness of marketing management process
CO2 Understand the marketing environment
CO3 Acquaint about product and pricing strategies
CO4 Knowledge of promotion and distribution in marketing management.
CO5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:

CMG341 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS

COURSE OBJECTIVES:
- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
- To create an awareness of the roles, functions and functioning of human resource department.
- To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM
UNIT II HUMAN RESOURCE PLANNING 9
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 9
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -Recruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT 9

UNIT V CONTROLLING HUMAN RESOURCES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course the learners will be able:
CO1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO2 To learn about the HR Planning Methods and practices.
CO3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO4 To known about the methods of Training and Employee Development.
CO5 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 equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE 9
UNIT II  INTRODUCTION TO VENTURE FINANCING

UNIT III  SOURCES OF DEBT FINANCING

UNIT IV  SOURCES OF EQUITY FINANCING
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V  METHODS OF FUND RAISING FOR NEW VENTURES

COURSE OUTCOMES:
Upon completion of this course, the students should be able to:
CO1 Learn the basics of starting a new business venture.
CO2 Understand the basics of venture financing.
CO3 Understand the sources of debt financing.
CO4 Understand the sources of equity financing.
CO5 Acquaint with the methods of fund raising for new business ventures.

REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018
UNIT I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach: Elton Mayo
3. Ecological Approach: Riggs

UNIT V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.
UNIT III
1. President
2. Parliament
3. Supreme Court

UNIT IV
1. Governor
2. State Legislature
3. High Court

UNIT V
1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345  PUBLIC PERSONNEL ADMINISTRATION  L T P C
3 0 0 3

UNIT I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT II
1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

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

UNIT IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

TOTAL: 45 PERIODS
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

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<td>CMG346</td>
<td>ADMINISTRATIVE THEORIES</td>
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UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

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

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker

TOTAL: 45 PERIODS

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

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<td>CMG347</td>
<td>INDIAN ADMINISTRATIVE SYSTEM</td>
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UNIT I
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government
UNIT III (9)
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV (9)
Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V (9)
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

REFERENCES:
1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

TOTAL: 45 PERIODS

CMG348 PUBLIC POLICY ADMINISTRATION
L T P C
3 0 0 3

UNIT I (9)

UNIT II (9)
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT III (9)

UNIT IV (9)
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT V (9)
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

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

TOTAL: 45 PERIODS
COURSE 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 - PARAMETRIC 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
Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.

UNIT V CORRELATION AND REGRESSION

TOTAL:45 PERIODS

COURSE OUTCOMES:
C01 To facilitate objective solutions in business decision making.
C02 understand and solve business problems
C03 To apply statistical techniques to data sets, and correctly interpret the results.
C04 To develop skill-set that is in demand in both the research and business environments
C05 To enable the students to apply the statistical techniques in a work setting.

REFERENCES:
UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data warehouse.

UNIT II DATA MINING PROCESS
Data mining 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

COURSE OUTCOMES:
CO1 Learn to apply various data mining techniques into various areas of different domains.
CO2 Be able to interact competently on the topic of data mining for business intelligence.
CO3 Apply various prediction techniques.
CO4 Learn about supervised and unsupervised learning technique.
CO5 Develop and implement machine learning algorithms

REFERENCES:
1. Jiawei Ham and Micheline Kamber, Data Mining concepts and techniques, Kaufmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011

CMG351 HUMAN RESOURCE ANALYTICS

COURSE 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

COURSE OUTCOME:
CO1 The learners will be conversant about HR metrics and ready to apply at work settings.
CO2 The learners will be able to resolve HR issues using people analytics.

REFERENCES:

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS
L T P C
3 0 0 3

COURSE 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

COURSE 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

COURSE OBJECTIVE:
• To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

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

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

UNIT III INVENTORY MANAGEMENT
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.
UNIT IV TRANSPORTATION NETWORK MODELS


UNIT V MCDM MODELS

Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

COURSE OUTCOME:
CO1 To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

CMG354 FINANCIAL ANALYTICS

COURSE OBJECTIVE:
- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I CORPORATE FINANCE ANALYSIS

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

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

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


UNIT V CREDIT RISK ANALYSIS

Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS
COURSE OUTCOME

CO1 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

COURSE OBJECTIVE:
- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS

UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS
Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


TOTAL: 45 PERIODS

COURSE 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

COURSE 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  9
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  9
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  9
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  9
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  9
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
COURSE 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’s- PO’s & PSO’s MAPPING

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CES333 SUSTAINABLE BIOMATERIALS L T P C
3 0 0 3

COURSE 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- Biocompatibility-Hydrogels-pyrolictic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface
properties and adhesion of materials – strength of biological tissues – performance of implants – tissue response to implants – Impact and Future of Biomaterials

UNIT II   BIO POLYMERS
Molecular structure of polymers - Molecular weight - Types of polymerization techniques – Types of polymerization reactions – Physical states of polymers - Common polymeric biomaterials - Polyethylene - Polymethylmethacrylate (PMMA) - Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers – Polyurethane - reactions polymers for medical purposes - Collagens - Elastins - Cellulose and derivatives - Synthetic polymeric membranes and their biological applications

UNIT III   BIO CERAMICS AND BIOCOMPOSITES
General properties - 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   NANOBIOIMATERIALS

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1 Students will gain familiarity with Biomaterials and they will understand their importance.
CO2 Students will get an overview of different biopolymers and their properties
CO3 Students gain knowledge on some of the important Bioceramics and Biocomposite materials
CO4 Students gain knowledge on metals as biomaterials
CO5 Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
COURSE OBJECTIVES
- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT I SUSTAINABLE ENERGY SOURCES
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III FUEL CELLS

UNIT IV PHOTOVOLTAICS

UNIT V SUPERCAPACITORS
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame
work (MOF), activated carbon fibres (ACF) - Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1 Students will acquire knowledge about energy sustainability.
CO2 Students understand the principles of different electrochemical devices.
CO3 Students learn about the working of fuel cells and their application.
CO4 Students will learn about various Photovoltaic applications and the materials used.
CO5 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
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
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
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS

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

UNIT II: MONITORING OF ENVIRONMENTAL PARAMETERS

UNIT III: ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING
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) & RISK ASSESSMENT


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

CO1 Basic concepts of environmental standards and monitoring.
CO2 The ambient air quality and water quality standards;
CO3 The various instrumental methods and their principles for environmental monitoring
CO4 The significance of environmental standards in monitoring quality and sustainability of the environment.
CO5 The various ways of raising environmental awareness among the people.
CO6 Know the standard research methods that are used worldwide for monitoring the environment.

TEXTBOOKS

2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

CO’s- PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:

- To create awareness on the energy scenario of India with respect to world
- To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation

CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

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- Familiarisation on the concept of sustainable development and its benefits
- Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
- 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
CO1 Understand the world and Indian energy scenario
CO2 Analyse energy projects, its impact on environment and suggest control strategies
CO3 Recognise the need of Sustainable development and its impact on human resource development
CO4 Apply renewable energy technologies for sustainable development
CO5 Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy
COURSE OBJECTIVES:
- To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
- To create awareness on energy audit and its impacts
- To acquaint the techniques adopted for performance evaluation of thermal utilities
- To familiarise on the procedures adopted for performance evaluation of electrical utilities
- 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, benchmarking, 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
- CO1 Understand the prevailing energy scenario
- CO2 Familiarise on energy audits and its relevance
- CO3 Apply the concept of energy audit on thermal utilities
- CO4 Employ relevant techniques for energy improvement in electrical utilities
- CO5 Understand Sustainable development and its impact on human resource development

REFERENCES: