PROGRAM EDUCATIONAL OBJECTIVES (PEOs)
Bachelor of Instrumentation and Control Engineering curriculum is designed to prepare the graduates to acquire knowledge, skills and attitudes in order to:
- Succeed in their professional career and develop innovative products
- Intrigue in the life-long learning to get flourished with the upcoming state of art technologies.
- Demonstrate leadership capability and social responsibility.

PROGRAMME OUTCOMES (POs):
The graduates will have the ability to

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

After completion of Electronics and Instrumentation Engineering program, students will gain core competency skills in domains such as Electronics, Instrumentation and Process Control:

1. Exhibit the fundamental concepts of measurement and control to varied measurement systems, industrial processes and configuring industrial automation system.

2. Select and apply cutting-edge technologies and adapt towards the changing interdisciplinary technologies to endow with a achievable solution.

3. Understand and analyze control problem for the interdisciplinary applications and provide suitable state of art solutions.

PEO's – PO's & PSO's MAPPING

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$ Skill Based Course

# SEMESTER – II

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# NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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# NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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| **PRACTICALS** |            |              |          |                  |                        |         |
| 8.     | EI3561      | Process Control and Instrumentation Laboratory | PCC | 0                | 0                      | 4       | 4       | 2       |
|        |             |              |          |                  |                        |         |
| **TOTAL** |            |              |          |                  |                        | 21      | 4       | 25      | 20      |

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

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| **PRACTICALS** |            |              |          |                  |                        |         |
| 10.    | EI3661      | Industrial Automation Systems Laboratory | PCC | 0                | 0                      | 4       | 4       | 2       |

| **TOTAL** |            |              |          |                  |                        | 24      | 0       | 4       | 28      | 23      |

* 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
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*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.
# Elective - Management shall be chosen from the Elective Management Courses
**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 RANGE : 167**
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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

### ELECTIVE - MANAGEMENT COURSES

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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

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

**OPEN ELECTIVE I AND II**
(EMERGING TECHNOLOGIES)
To be offered other than Faculty of Information and Communication Engineering

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<td></td>
<td>CBM370</td>
<td>Wearable Devices</td>
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<td>Biotechnology for Waste Management</td>
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Summary

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<th>SubjectArea</th>
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Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

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

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

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

Complete details are available in clause 4.10 (Amendments) of Regulations 2021.
**VERTICALS FOR MINOR DEGREE** (In addition to all the verticals of other degree 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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</thead>
<tbody>
<tr>
<td><strong>Fintech and Block Chain</strong></td>
<td>Entrepreneurship</td>
<td>Public Administration</td>
<td>Business Data Analytics</td>
<td>Environment and Sustainability</td>
</tr>
<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>
</tr>
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<td>Fundamentals of Investment</td>
<td>Team Building and Leadership Management for Business</td>
<td>Constitution of India</td>
<td>Data Mining 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>
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<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>-</td>
<td>Energy Efficiency for Sustainable Development</td>
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</table>
**VERTICALS FOR MINOR DEGREE**

(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 I : FINTECH AND BLOCK CHAIN**

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<tr>
<th>SL. NO.</th>
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<th>COURSE TITLE</th>
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**VERTICAL II : ENTREPRENEURSHIP**

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<tr>
<th>SL. NO.</th>
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<th>COURSE TITLE</th>
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<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
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<tbody>
<tr>
<td>1</td>
<td>CMG343</td>
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<td>2</td>
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<td>Constitution of India</td>
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### VERTICAL IV: BUSINESS DATA ANALYTICS

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<td>Human Resource Analytics</td>
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<td>4</td>
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<td>Marketing And Social Media Web Analytics</td>
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<td>6</td>
<td>CMG354</td>
<td>Financial Analytics</td>
<td>PEC</td>
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### Vertical V: Environment and Sustainability

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<tr>
<td>1.</td>
<td>CES331</td>
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<td>Sustainable Agriculture and Environmental Management</td>
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</table>
This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

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

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

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

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

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

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

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

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'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
COURSE OBJECTIVES:
- To improve the communicative competence of learners
- To learn to use basic grammatical structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

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

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

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

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

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

UNIT V EXPRESSION
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.
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 grammatic structures and use them in right context.
CO3: To read and infer the denotative and connotative meanings of technical texts
CO4: To write definitions, descriptions, narrations and essays on various topics

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

REFERENCE BOOKS:

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

MAPPING OF COs WITH POs AND PSOs

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<th>POs</th>
<th>PSOs</th>
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</table>

TOTAL: 45 PERIODS
COURSE OBJECTIVES:
- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES

UNIT II DIFFERENTIAL CALCULUS

UNIT III FUNCTIONS OF SEVERAL VARIABLES

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

UNIT V MULTIPLE INTEGRALS

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:

MAPPING OF COs WITH POs AND PSOs

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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 an 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:

MAPPING OF COs WITH POs AND PSOs

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CY3151 ENGINEERING CHEMISTRY L T P C 3 0 0 3

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

UNIT I WATER AND ITS TREATMENT 9
UNIT II NANO CHEMISTRY 9
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles-working principles; Fuel cells: H₂-O₂ fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples. TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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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  9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V          FILES, MODULES, PACKAGES  9
Files and exceptions: 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 loops for solving problems.
  CO4: Decompose a Python program into functions.
  CO5: Represent compound data using Python lists, tuples, dictionaries etc.
  CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/

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35
UNIT I  LANGUAGE AND LITERATURE 3

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

UNIT III  FOLK AND MARTIAL ARTS 3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, 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. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
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TOTAL : 15 PERIODS
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:
5. https://www.python.org/

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PHYSICAL AND CHEMISTRY LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:

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

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

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

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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, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:
- CO1: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- CO2: To determine the amount of metal ions through volumetric and spectroscopic techniques
- CO3: To analyse and determine the composition of alloys.
- CO4: To learn simple method of synthesis of nanoparticles
- CO5: To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOKS:

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
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 PATTERN**
- One online / app based assessment to test listening / speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

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SEMESTER II

HS3252  PROFESSIONAL ENGLISH - II  L  T  P  C
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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  6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH  6

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

TOTAL : 30 PERIODS

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

REFERENCE BOOKS:
New Delhi.
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd.
1990, Delhi.

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

MAPPING OF COs WITH POs AND PSOs

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MA3251 STATISTICS AND NUMERICAL METHODS

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  

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:

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PH3255                            PHYSICS FOR INSTRUMENTATION ENGINEERING        L T P C
                                          (Common to E & I and I & C)                     3 0 0 3

COURSE OBJECTIVES:
- To make the students to understand the basics of electricity and magnetism and vectors.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.
UNIT I  ELECTRICITY AND MAGNETISM  9
Coulomb’s law, electric field intensity, electric flux density, Gauss’ law, divergence, electric field and potential due to point, line, plane, and spherical charge distributions, effect of the dielectric medium, capacitance of simple configurations, Biot-Savart’s law, Ampere’s law, curl, Faraday’s law, Lorentz force, Inductance, Magneto motive force, reluctance, magnetic circuits, self and mutual inductance of simple configurations.

UNIT II  ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS  9

UNIT III  SEMICONDUCTORS AND TRANSPORT PHYSICS  9

UNIT IV  OPTICAL PROPERTIES OF MATERIALS  9

UNIT V  NANODEVICES AND QUANTUM COMPUTING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES :
At the end of the course, the students should be able to
CO1: know basics of electricity and magnetism and the influence of vectors in EMT.
CO2: gain knowledge on the electrical and magnetic properties of materials and their applications
CO3: understand clearly of semiconductor physics and functioning of semiconductor devices
CO4: understand the optical properties of materials and working principles of various optical devices
CO5: appreciate the importance of nanotechnology and nanodevices.

TEXT BOOKS :
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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

UNIT I PART B: OVERVIEW OF MECHANICAL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS

UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE
Building plans – Setting out of a Building - Foundations: Types of foundations -


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

TOTAL: 45 PERIODS

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

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

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

UNIT I PLANE CURVES  
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANES SURFACE  
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  
Projection of simplesolidslikeprisms,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.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES  
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 trueshape of section. Development of lateralsurfaces 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  
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 BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

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

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COURSE OBJECTIVES:
- To introduce electric circuits and its analysis
- To provide key concepts to analyze and understand electrical circuits
- To impart knowledge on solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of single & three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS
Network reduction: voltage and current division, source transformation – star delta conversion. Theorems – Superposition, Thevenin’s and Norton’s Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman’s theorem - Tellegen’s Theorem - Statement, application to DC and AC Circuits.

UNIT III TRANSIENT RESPONSE ANALYSIS

UNIT IV RESONANCE AND COUPLED CIRCUITS

UNIT V THREE PHASE CIRCUITS
Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits – Power Factor Calculations.

COURSE OUTCOMES:
After completing this course, the students will be able to:
CO1: Explain circuit’s behavior using circuit laws.
CO2: Apply mesh analysis/ nodal analysis / network theorems to determine behavior of the given DC and AC circuit
CO3: Compute the transient response of first order and second order systems to step and sinusoidal input
CO4: Compute power, line/ phase voltage and currents of the given three phase circuit
CO5: Explain the frequency response of series and parallel RLC circuits
CO6: Explain the behavior of magnetically coupled circuits.

TEXT BOOKS:
REFERENCES

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**TOTAL : 30 PERIODS**
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<td>Factors Affecting National Integration</td>
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<td><strong>PERSONALITY DEVELOPMENT</strong></td>
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<td>Self-Awareness, Empathy, Critical &amp; Creative Thinking, Decision Making and Problem Solving</td>
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<td>Communication Skills</td>
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<td><strong>LEADERSHIP</strong></td>
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<td>Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code</td>
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<td>Case Studies: Shivaji, Jhasi Ki Rani</td>
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**TOTAL : 30 PERIODS**
## NCC Credit Course Level 1*

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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 worshipplaces - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)-Thirumalai Nayakar Mahal - Chettinadu 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. Social Life of Tamils (Dr.K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of Tamils - The Classical Period (Dr.S. Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contribution of the Tamils to Indian Culture (Dr.M. Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
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 Textbook and Educational Services Corporation, Tamil Nadu)


GE3252

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) – A joint publication of TNTB & ESC and RMRL – (in print)

2. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies)

3. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)

TOTAL : 15 PERIODS
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)
COURSE OBJECTIVES:
The main learning objective of this course is to provide hands on training to the students in:
1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

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

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

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

PART II ELECTRICAL ENGINEERING PRACTICES 15

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

PART III  MECHANICAL ENGINEERING 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

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

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

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

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

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

TOTAL : 60 PERIODS
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**EE3271**  
**ELECTRIC CIRCUITS LABORATORY**  
**L T P C**  
**0 0 4 2**

**COURSE OBJECTIVES:**
- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab
- To gain practical experience on electric circuits and verification of theorems

**LIST OF EXPERIMENTS**

- Familiarization of various electrical components, sources and measuring instruments
  1. Simulation and experimental verification of series and parallel electrical circuit using fundamental laws.
  2. Simulation and experimental verification of electrical circuit problems using Thevenin’s theorem.
  4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
  5. Simulation and experimental verification of Maximum Power transfer theorem.
  6. Simulation and Experimental validation of R-C,R-L and RLC electric circuit transients
  7. Simulation and Experimental validation of frequency response of RLC electric circuit.
  8. Design and implementation of series and parallel resonance circuit.
  9. Simulation and experimental verification of three phase balanced and unbalanced star, delta networks circuit (Power and Power factor calculations).

**TOTAL: 60_PERIODS**

**COURSE OUTCOMES:**
- **CO1:** Use simulation and experimental methods to verify the fundamental electrical laws for the given DC/AC circuit (Ex 1)
- **CO2:** Use simulation and experimental methods to verify the various electrical theorems (Superposition, Thevenin, Norton and maximum power transfer) for the given DC/AC circuit (Ex 2-5)
- **CO3:** Analyze transient behavior of the given RL/RC/RLC circuit using simulation and experimental methods (Ex 6)
CO4: Analyze frequency response of the given series and parallel RLC circuit using simulation and experimentation methods (Ex 7-8)

CO5: Analyze the performance of the given three-phase circuit using simulation and experimental methods (Ex 9)

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

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Assessment Pattern
- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.
MA3353 TRANSFORMS AND DIFFERENTIAL EQUATIONS

(FOR III - SEMESTER EIE AND ICE)

COURSE OBJECTIVES:
- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS


UNIT II PARTIAL DIFFERENTIAL EQUATIONS

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

UNIT III FOURIER SERIES

Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square values - Parseval’s identity – Harmonic analysis.

UNIT IV LAPLACE TRANSFORMS


UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS


TOTAL : 60 PERIODS
COURSE OUTCOMES:
Students able to
CO1 To acquaint the students with Differential Equations which are significantly used in engineering problems.
CO2 Understand how to solve the given standard partial differential equations.
CO3 Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
CO4 Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
CO5 Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
CO6 Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

REFERENCES:

MAPPING OF COs WITH POs AND PSOs

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COURSE OBJECTIVES:

- To understand the structure, operation and applications of electronic devices.
- To familiarize biasing of BJT & JFET devices.
- To explore the frequency response of amplifiers in various configurations.
- To learn the function of power amplifiers and negative feedback amplifiers.
- To design RC and LC tuned oscillators for a given frequency.

UNIT I  PN JUNCTION DEVICES (8+1 SKILL)  9

UNIT II  BJT AND SMALL SIGNAL AMPLIFIERS (8+1 SKILL)  9
BJT - structure, operation of NPN and PNP transistor, Input and output characteristics of CE, CB and CC configurations. DC Load Line and operating point, Need for biasing – Bias stabilization -Fixed and Voltage divider biasing. Single stage BJT amplifiers – AC analysis of CE and CC amplifier with Voltage divider bias using h-parameters - Gain and frequency response.

UNIT III  FIELD EFFECT TRANSISTORS AND THYRISTORS (8+1 SKILL)  9
JFET, MOSFET - structure, operation and characteristics, JFET Biasing - self and voltage divider biasing. FET small signal model - Analysis of CS, CG and Source follower. Thyristor - SCR operation and characteristics, UJT - operation and characteristics.

UNIT IV  DIFFERENTIAL AMPLIFIERS AND LARGE SIGNAL AMPLIFIERS (8+1 SKILL)  9
Cascade amplifier, BJT Differential amplifier – DC and AC analysis of common mode gain, differential mode gain and CMRR - Single tuned amplifier - construction, operation and frequency response. Power amplifiers – class A, class B and class C (Qualitative analysis only).

UNIT V  FEEDBACK AMPLIFIERS AND OSCILLATORS (8+1 SKILL)  9
Feedback concepts, feedback topologies - voltage / current, series / shunt feedback - Transfer gain with feedback - effect of negative feedback on R.Load and R. – Condition for oscillations, RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL 45 PERIODS  5

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Interpretation of Data Sheet of transistors and diodes with respect to their Static and Dynamic Characteristics.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware
5. Introduction to other advanced logic circuits not covered in the above syllabus

COURSE OUTCOMES:

CO1 Explain the operation and characteristics of PN junction diode, Zener diode, LED and Laser diode. (L2)

CO2 Formulate the expression for voltage gain, current gain, input resistance and output resistance of a BJT CE and CC amplifier using h-parameter model. (L5)

CO3 Formulate the expression for voltage gain, input resistance and output resistance of FET amplifier under CS, CG and Source follower. (L5)

CO4 Explain the operation of cascade amplifier, differential amplifier, single tuned amplifier and power amplifiers. (L2)

CO5 Analyze the operation of negative feedback amplifiers and to design RC and LC tuned oscillators for a given frequency range. (L4)

TEXT BOOKS:


REFERENCES:


List of Open Source Software/Learning website:

1. https://nptel.ac.in/courses/117101105.
3. https://nptel.ac.in/courses/117106030
4. https://nptel.ac.in/courses/117102012
5. https://nptel.ac.in/courses/117106093
MAPPING OF COs WITH POs AND PSOs

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

EI3352 DIGITAL SYSTEM DESIGN AND APPLICATIONS  L  T  P  C
2  1  0  3

COURSE OBJECTIVES:

- To study various number systems and basic theorems of Boolean algebra and gate level minimization and implementation.
- To outline the formal procedures for the analysis and design of combinational circuits.
- To analyze and design synchronous sequential circuits.
- To introduce the concept of asynchronous sequential circuits, PLCs and Logic Families.
- To introduce digital simulation techniques for development of application oriented logic circuit.

UNIT I BOOLEAN ALGEBRA AND GATE LEVEL MINIMIZATION (8+1 SKILL)  9
Review of number systems, types and conversion, binary codes, error detection and correction codes (Parity and Hamming code). Boolean theorems and properties – Boolean functions - Logic gates – Gate Level Minimization using Karnaugh Map, SOP & POS simplification, Don’t Care conditions. Implementations of Logic Functions using gates-NAND–NOR implementations.

UNIT II COMBINATIONAL LOGIC (8+1 SKILL)  9
Design of adders, subtractors, Multiplexers - Combinational logic design using Multiplexers - Demultiplexers and their use in combinational logic design –2 bitMagnitude comparator, Code Converters - BCD to Binary and Binary to BCD, Encoder, Priority Encoder - Decimal to BCD, Octal to Binary, Decoders- BCD to Decimal and BCD to Seven Segment display decoder.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC (8+1 SKILL)  9
Sequential logic - SR, JK, JKMS, D and T flip flops – characteristics and excitation table - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS, MEMORY AND LOGIC FAMILIES (8+1 SKILL)  9
Asynchronous sequential logic circuits - Transition and flow table - race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits. Memories: PROM, PLA – PAL, CPLD
- FPGA. Digital Logic gate realization and characteristics of TTL, ECL, CMOS families.

**UNIT V VHDL (8+1 SKILL)**


**TOTAL 45 PERIODS**

**SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)**

1. Interpretation of Data Sheet of all logic gates.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware.
5. Introduction to other advanced logic circuits not covered in the above syllabus.

**COURSE OUTCOMES:**

CO1 Convert various types of codes and number system & gate level implementation of Boolean functions.(L2)

CO2 Apply K –Map for simplification and implementation of combinational logic circuit (L3)

CO3 Design the synchronous Sequential logic circuits namely counters, registers etc, (L5)

CO4 Analyze the asynchronous sequential circuits and explain the operation of memories and digital logic families (L4)

CO5 Design the VHDL coding for combinational logic and Sequential circuits. (L5)

**TEXT BOOKS:**


**REFERENCES:**


**List of Open Source Software/ Learning website:**

1. https://nptel.ac.in/courses/117106114
2. https://nptel.ac.in/courses/117106086
3. https://nptel.ac.in/courses/106102181
MAPPING OF COs WITH POs AND PSOs

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EI3353 TRANSUDCERS ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES:

- To know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS (8+1 SKILL) 9

UNIT II CHARACTERISTICS OF TRANSDUCERS (8+1 SKILL) 9

UNIT III VARIABLE RESISTANCE TRANSDUCERS (8+1 SKILL) 9
Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND CAPACITANCE TRANSDUCERS (8+1 SKILL) 9
types & signal conditioning – Applications: - capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT V OTHER SENSORS AND TRANSDUCERS (8+1 SKILL)

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Interpretation of Data Sheet of sensors with respect to their Static and Dynamic Characteristics.
2. Selection of Sensors for applications.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).
4. Design and verification of simple signal conditioning circuit thro simulation.
5. Realization of signal conditioning circuit in hardware.
6. Introduction to other advanced sensors not covered in the above syllabus.

COURSE OUTCOMES:
Students able to
CO1 Understand the working principles of various types of transducers (L2).
CO2 Gain knowledge on the application areas of different sensors (L2).
CO3 Select the right sensor/transducer for a given application (L3).
CO4 Determine the static and dynamic characteristics of transducers using software packages (L4)
CO5 Design simple signal conditioning circuits for the R,L and C type of sensors (L3).
CO6 Summarize the advanced sensor technologies and sensors for specific applications.(L2)

TEXT BOOKS:

REFERENCES:
List of Open Source Software/ Learning website:

1. http://nptel.iitm.ac.in/courses.php
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/ mod2.pdf
5. https://www.analog.com
6. https://electronics-tutorials.ws/io/io-

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EI3354 LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

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COURSE OBJECTIVES:

- To discuss the IC fabrication procedure.
- To learn the characteristics of Op-Amp.
- To design and construct the basic applications of Op–amp.
- To interpret the internal functional blocks and the applications of special ICs.
- To illustrate the operation of application ICs

UNIT I IC FABRICATION (8+1 SKILL)

IC classification - fundamentals of monolithic IC technology – basic planar processes - fabrication of typical circuit - Fabrication of diodes, resistance, capacitance and FETs.

UNIT II CHARACTERISTICS AND APPLICATIONS OF OPAMP (8+1 SKILL)

UNIT III    SPECIAL ICs(8+1 SKILL)
555 Timer - Functional block, characteristics – IC NE/SE 566 Voltage Controlled Oscillator - IC NE/SE 565 Phase Locked Loop - Analog multiplier and Divider IC AD633.

UNIT IV APPLICATION ICs(8+1 SKILL)

UNIT V SIGNAL CONDITIONING CIRCUITS (8+1 SKILL)
V/I and I/V converters.- differential amplifier Instrumentation amplifier -S/H circuit – DAC and ADC characteristics - D/A converter (R- 2R ladder and weighted resistor types) - A/D converter (Flash and Successive approximation types)- Design of signal conditioning circuit for RTD and strain Gauge.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Interpretation of Data Sheet of ICs.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware.
5. Introduction to other advanced logic circuits not covered in the above syllabus.

COURSE OUTCOMES:

- Explain the IC fabrication process and discuss the fabrication of active and passive components. (L2)
- CO1 Compute the gain and output voltage of the given Op-Amp circuits. (L3)
- CO2 Explain the internal functional blocks and applications of ICs 555, 566, 565, and AD633 . (L2)
- CO3 Explain the operation of voltage regulator ICs namely LM78XX, LM79XX, LM317 and LM723. (L2)
- CO4 Explain the operation and design of various signal conditioning circuits. (L2)
- CO5

TEXT BOOKS:
3. David A. Bell, ‘Operational Amplifiers and Linear ICs, Oxford higher education, 2013.

REFERENCES:

List of Open Source Software/ Learning website:
3. https://nptel.ac.in/courses/108108111

MAPPPING OF COs WITH POs AND PSOs

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

CS3353 C PROGRAMMING AND DATA STRUCTURES L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS (8+1 SKILL) 9

UNIT II C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL) 9

UNIT III LINEAR DATA STRUCTURES (8+1 SKILL) 9
UNIT IV  NON-LINEAR DATA STRUCTURES (8+1 SKILL)

UNIT V   SORTING AND SEARCHING TECHNIQUES (8+1 SKILL)
Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL    45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)   5

COURSE OUTCOMES:
CO1    Develop C programs for any real world/technical application.
CO2    Apply advanced features of C in solving problems.
CO3    Write functions to implement linear and non–linear data structure operations.
CO4    Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.
CO5    Appropriately use sort and search algorithms for a given application.
CO6    Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
https://www.coursera.org/specializations/data-structures-algorithms
https://nptel.ac.in/courses/112107243
https://nptel.ac.in/courses/112105598
## MAPPING OF COs WITH POs AND PSOs

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- COs: Core Objectives
- POs: Performance Objectives
- PSOs: Program Success Objectives
COURSE OBJECTIVES:

- To understand the behavior of semiconductor devices experimentally.
- To design the amplifiers and oscillators.
- To analyze the rectifier and filters.

LIST OF EXPERIMENTS

2. Characteristics of Zener diode and Zener as series voltage regulator.
3. Single Phase half-wave and full wave rectifiers with capacitive filters.
4. Characteristics of JFET.
5. Characteristics of UJT and generation of saw tooth waveform.
6. Characteristics of a BJT under common emitter and common base configurations.
8. Design and testing of Common Source amplifier.
9. Differential amplifier using FET.
10. Design and testing of RC phase shift and LC oscillators.
11. Design and testing of Feedback amplifiers (Any one type)
12. Simulation of rectifier circuits using PSIM/SIMULINK

TOTAL: 45 PERIODS

COURSE OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

CO1 Determine the Breakdown voltage, forward and reverse resistance of PN junction diode and Zener diode and calculate the ripple factor of rectifier circuits with filter.

CO2 Calculate the hybrid parameters of BJT under CE and CB configuration.

CO3 Obtain the frequency response of CE amplifier and CS amplifier.

CO4 Obtain the UJT and JFET parameters from the characteristics and also to calculate the gain of differential amplifier using JFET.

CO5 Design the RC and LC tuned oscillators for a given oscillating frequency.

CO6 Analyze the input and output performance of the given diode based circuit using simulation tools.

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1-low, 2-medium, 3-high, '-'- no correlation
COURSE OBJECTIVES:

- To develop applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

1. Practice of C programming using statements, expressions, decision making and iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 Use different constructs of C and develop applications

CO2 Write functions to implement linear and non-linear data structure operations

CO3 Suggest and use the appropriate linear / non-linear data structure operations for a given problem

CO4 Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval

CO5 Implement Sorting and searching algorithms for a given application

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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: 10 Hours

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

MS EXCEL: 10 Hours

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

MS POWERPOINT: 10 Hours

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

TOTAL: 30 PERIODS

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

- To introduce the measurement techniques of viscosity, humidity and moisture.
- To introduce the measurement of temperature and pressure.
- To introduce the flow measurement techniques.
- To introduce the electrical flow measurement techniques.
- To introduce the level measurement techniques and transmitters.

UNIT I MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers.

UNIT II TEMPERATURE & PRESSURE MEASUREMENT


UNIT III FLOW MEASUREMENT


UNIT IV ELECTRICAL TYPE FLOW METERS


UNIT V LEVEL MEASUREMENT AND TRANSMITTER

Level measurement: Float gauges - Displacer type, Ultrasonic gauge – Boiler drum level measurement:– Differential pressure method and Hydrastep method - Solid level measurement, Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.

TOTAL: 45 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Design of signal conditioning circuits for industrial instruments used for measurement of temperature, pressure, flow, level.
2. Calibration of sensor and transmitters along with uncertainty measurement.
3. Configuration of smart transmitters with HART communicator.
4. Selection, installation and commissioning of transducers

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:

CO1 Understand Principles and working of Viscosity, Humidity, Moisture, temperature, pressure, flow and level measuring Instruments. (L2)

CO2 Calibrate temperature, flow, level and Pressure measuring devices. (L3)

CO3 Apply measurement of Viscosity, Humidity, Moisture, temperature, pressure, flow and level in Industrial Applications. (L3)

CO4 Select and install Industrial instruments for various applications (L4)

CO5 Understand various Electrical type Industrial Instruments (L2)

TEXT BOOKS:

REFERENCES:
5. https://swayam.gov.in/ Principles of Industrial Engineering

List of Open Source Software/ Learning website:

1. http://instrumentationtoolbox.com
3. Home Instrumentation Tools.
MAPPING OF COs WITH POs AND PSOs

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IC3451 AUTOMATIC CONTROL SYSTEMS L T P C
3 1 0 4

COURSE OBJECTIVES:

- To introduce the control system components and transfer function model with their graphical representation.
- To understand the analysis of system in time domain along with steady state error.
- To introduce frequency response analysis of systems.
- To accord basic knowledge in design of compensators.
- To introduce the state space models.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION (11+1 SKILL) 12
Control System: Terminology and Basic Structure- Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchro.

UNIT II TIME RESPONSE ANALYSIS (11+1 SKILL) 12
Transient response-steady state response-Measure of performance of the standard first order and second order system-Time domain specifications -Effect on an additional zero and an additional pole-Steady state error - Type number-PID control-Effect of PD, PI, PID control systems.

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS (11+1 SKILL) 12
UNIT IV CONCEPTS OF STABILITY ANALYSIS (11+1 SKILL) 12
Concept of Stability-Bounded – Input Bounded – Output Bounded-Routh Hurwitz stability Criterion-

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHOD (11+1 SKILL) 12
State variable Representation-Conversion of state variable models to transfer Functions-
Conversion of transfer functions to state variable Models-Solution of state Equations-Concepts of
Controllability and Observability -Equivalence between transfer function and state variable
representations.

TOTAL 60 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content
Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Explore various controllers presently used in industries.
2. Develop control structures for industrial processes.
3. Implement the controllers for various transfer functions of industrial systems.
4. Using software tools for practical exposures to the controllers used in industries by undergoing
   training.
5. Realisation of various stability criterion techniques for economical operation of process.

COURSE OUTCOMES:
CO1 To represent and develop systems in different forms using the knowledge gained (L5).
CO2 To analyses the system in time and frequency domain (L4).
CO3 To discuss the effect of PID controller in closed loop systems (L2).
CO4 To construct compensator for the linear systems in frequency domain (L5)
CO5 To analyses the stability of physical systems (L4).
CO6 To acquire and analyses knowledge in State variable model for MIMO systems (L4)

TEXT BOOKS:

REFERENCES:
4. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and
List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/112107240
2. https://onlinecourses.nptel.ac.in/noc20_me25/preview
3. https://onlinecourses.nptel.ac.in/noc20_ee90/preview

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IC3401 MODERN ELECTRONIC INSTRUMENTATION L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce the meters used to measure current and voltage.
- To provide detailed study of digital interfaces and signal conditioning.
- To study electronic instruments for measurement of certain important mechanical parameters.
- To understand the basic principles in MEMS and wireless devices.
- To gain knowledge on case studies on design of typical measurement systems.

UNIT I BASIC ELECTRICAL MEASUREMENTS

UNIT II DIGITAL INTERFACES AND SIGNAL CONDITIONING
UNIT III MECHANICAL MEASUREMENTS

UNIT IV MECHANICAL MICROSENSORS AND WIRELESS INSTRUMENTATION

UNIT V DESIGN OF MEASUREMENT SYSTEMS

TOTAL 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Able to select instruments based on description of process and performance requirements.
2. Able to design and analyze signal conditioning circuits for conditioning, conversion and transmission of analog measurement signals.
3. Able to conduct measurements using appropriate instruments along with error analysis.
4. Perform calibration of given instrument using appropriated calibrations.

COURSE OUTCOMES:
CO1 To understand the principle behind measurement of Electrical/ mechanical quantities..(L1)
CO2 To interpret the specifications of different ADCs/DACs/ Digital interfaces. (L2)
CO3 To gain knowledge on different types of MEMS Sensors and their merits/ demerits. (L2)
CO4 To learn the basics of wireless instrumentation. (L1)
CO5 To analyze and design measurement system for simple applications.(L3)
CO6 To develop simple measurement solutions for the measuring given physical quantity.(L4)

TEXT BOOKS:

REFERENCES:
Online course
1. https://nptel.ac.in/courses/108105153/
3. https://pdphonline.com/courses/e244/e244_new.htm
4. https://swayam.gov.in/nd1_noc19_ee44/
6. https://www.youtube.com/watch?v=xLjk5DrScEU

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

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

UNIT I ENVIRONMENT AND BIODIVERSITY
UNIT II  ENVIRONMENTAL POLLUTION  6

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

UNIT IV  SUSTAINABILITY AND MANAGEMENT  6
Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols - Sustainable Development Goals-targets, indicators and intervention areas Climate change-Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V  SUSTAINABILITY PRACTICES  6

TOTAL: 30 PERIODS

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

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

REFERENCES

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COURSE OBJECTIVES:
- To get familiarized with the embedded hardware architecture.
- To understand the basics of RTOS and the attributes of various communication protocols.
- To build knowledge on Embedded C programming and realize the concept of peripheral interfacing.
- To get introduced with the concept of IoT and architecture of IoT systems.
- To acquire knowledge over IoT implementation tools and the core elements of IIoT.

UNIT I EMBEDDED HARDWARE ARCHITECTURE

UNIT II REAL TIME OPERATING SYSTEM & COMMUNICATION INTERFACES
Types of RTOS - Functions of RTOS - Task, Process and Threads, Interrupt handling, Multiprocessing & Multitasking and Task scheduling - Serial communication interfaces - RS232, RS485, I²C SPI and USB.

UNIT III EMBEDDED PROGRAMMING AND PERIPHERAL INTERFACING

UNIT IV INTRODUCTION TO INTERNET OF THINGS
IoT Definition and Characteristics - Physical Design of IoT - Logical Design of IoT - IoT Enabling Technologies - Levels of IoT Deployment - IoT Device Management- Domain specific IoTs.

UNIT V IoT IMPLEMENTATION TOOLS AND IIoT
IoT gateways - IoT analytics platforms - IoT application development using Raspberry Pi - Introduction to IIoT - IIoT Middleware Platforms - Industrial Internet Security.

TOTAL: 45+30 = 75 PERIODS

1. Implementation of specific tasks using Embedded C/Python programming
2. Interfacing input devices with 8051/PIC16F877A/LPC4088.
3. Interfacing ADC & DAC with 8051 microcontroller.
4. PWM generation using PIC16F877A/LPC4088.
5. Interfacing input and output devices with Raspberry Pi using Python.
6. IoT enabled field sensing using Raspberry Pi.

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Interpretation of Embedded systems architecture.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).
3. Design and verification of embedded systems and rtos applications in any of the software.
4. Realization of embedded and rtos in hardware.
5. Able to gather and process data from IOT devices, and perform data analysis and prediction.

**COURSE OUTCOMES:**
The students will be able to

- **CO1** Understand the concept of embedded system and its architectural features
- **CO2** Develop embedded software using Embedded C and Python.
- **CO3** Integrate/Interface real world field devices with microcontrollers.
- **CO4** Utilize the power of RTOS for embedded applications.
- **CO5** Acquire real world signals and perform remote process monitoring utilizing the concept of IoT.
- **CO6** Design and implement IoT enabled embedded control strategy for a given application.

**TEXT BOOKS:**
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun(editor)

**REFERENCES:**

**List of Open Source Software/ Learning website:**
1. https://nptel.ac.in/courses/108105057
2. https://nptel.ac.in/courses/128108016
3. https://nptel.ac.in/courses/106105193
4. https://nptel.ac.in/courses/106105172
7. https://nptel.ac.in/courses/108108123
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IC3452 ELECTRICAL MACHINES AND DRIVES L T P C 2023

COURSE OBJECTIVES:
To impart basic knowledge on different AC& DC Machines.
- To introduce the concept of special machines to motivate the students to solve complex problems related to machines.
- To impart knowledge on testing and controlling of different machines.
- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics.
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT I DC MACHINES

UNIT II TRANSFORMERS

UNIT III THREE PHASE INDUCTION MOTOR

UNIT IV POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS
Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC.

UNIT V DRIVES AND CONTROL
Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives- Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only)
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Differentiate the switching characteristics of the semiconductor devices.
2. Design the SCR circuit with the help of two BJT and explain the switching characteristics for the same.
3. Elaborate the speed control of Induction motor and starting methods for the same.
4. Practically compare the characteristics of $3 \varphi$ induction motor and DC machines.
5. Discuss the no load and load test on transformers [Group seminar].

LIST OF EXPERIMENTS FOR MACHINES LAB

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Speed control of D.C. shunt motor.
5. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 Ability to understand the terms associated with electrical machines
CO2 Ability to understand basic concepts and working principle of electrical machines
CO3 Ability to understand the performance characteristics of machines
CO4 Ability to identify suitable machines for carrying out interdisciplinary projects.
CO5 Ability to understand the motor operating principle and characteristics of motor
CO6 Ability to understand the motor operating principle and characteristics of transformer

TEXT BOOKS:

REFERENCES:

3. Lecture series on “Electrical Machines I” and “Electrical Machines II” by Dr.KrishnaVasudevan, IIT Madras.
4. NPTEL Lecture Series on “Power Electronics” by Dr.B.G.Fernandes, IIT Bombay.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/108106072
2. https://nptel.ac.in/courses/108105131

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

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

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

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

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

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

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

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

TOTAL: 45 PERIODS
### PERSONALITY DEVELOPMENT

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<td>Introduction to Adventure Activities</td>
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### BORDER & COASTAL AREAS

<table>
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<tr>
<th>Code</th>
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<tr>
<td>BCA 1</td>
<td>History, Geography &amp; Topography of Border/Coastal areas</td>
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**TOTAL**: 45 PERIODS
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<td>L 2  Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965</td>
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<td>DM 1  Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation</td>
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**Total: 45 Periods**
COURSE OBJECTIVES:
- To design, test and characterize circuit behavior with digital and analog ICs.
- To design and test various combinational and sequential circuits.
- To introduce the functions of counter, shift register.
- To interpret and realize the basic applications of Op–amp and timer.
- To explain the behavior of special ICs.

LIST OF EXPERIMENTS:
1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Implementation of Binary to Gray code converter and vice-versa.
3. Implementation of Encoders, Decoders using logic gates and MSI devices
4. Implementation of multiplexer and de multiplexer using logic gates and MSI devices.
7. Design and testing of inverting , non-inverting amplifier and Adder
8. Design and testing of comparator and Schmitt trigger.
9. Design and testing of Integrator and Differentiator.
10. Design and testing of Astable and Monostable operation using 555 timer.
12. Simulation of combinational circuits using VHDL codes
13. Simulation of any one of the Op amp application circuit using PSPICE/SIMULINK

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to:

CO1: Design and implement the given Boolean function using logic gates.
CO2: Design and verify the truth table of combinational logic circuits (code converters, encoders, decoders, multiplexer and demultiplexer).
CO3: Design and implement the Counters and Shift registers.
CO4: Design and testing of Op-Amp circuits and to simulate the op-amp application circuit using simulation tools.
CO5: Design and testing of as table and monostable circuits using Timer IC NE/SE 555.
CO6: Design and testing of variable voltage regulator using IC LM317/LM723.

MAPPING OF COs WITH POs AND PSOs

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1-low, 2-medium, 3-high, ‘-‘- no correlation
COURSE OBJECTIVES:

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students study on the design of signal conditioning circuit for different transducers.

LIST OF EXPERIMENTS

1. Determination of Static and Dynamic characteristics of Thermocouple (J,K,E) with and without thermo-well.
2. Determination of Static and Dynamic characteristics of RTD and Thermistor.
5. Determination of Characteristic study of load cell and pressure cell.
6. Sensitivity analysis of strain gauge bridges (quarter, half and full).
7. a. Determination of Static characteristic of flapper-nozzle system
b. Loading effect on resistive potentiometer.
8. Determination of Characteristic of seismic type accelerometer.
9. Measurement of inductance (Anderson), capacitance (Schering) and resistance (Kelvin double) using bridges.
10. Design of signal conditioning circuits for resistive & capacitive sensors
11. Design of signal conditioning circuits for inductive sensors
12. Design of cold junction compensation for Thermocouples and lead wire compensation schemes for RTD

TOTAL 45 PERIODS

COURSE OUTCOMES:

CO1 Ability to perform error analysis and uncertainty analysis.
CO2 Ability to evaluate the static and dynamic characteristics of measuring instruments.
CO3 Ability to design and construct measurement systems using different types of resistance, capacitance and inductance transducers.
CO4 Ability to apply special transducers for measurement applications.
CO5 Ability to interface and analyze different signal conditioning units.
CO6 Ability to present the results in oral form as well as in written form as a report and graph.
### MAPPING OF COs WITH P Os AND PSOs

| CO  | PO0 1 | PO0 2 | PO0 3 | PO0 4 | PO0 5 | PO0 6 | PO0 7 | PO0 8 | PO0 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| CO1 | 3     | 2     | 2     |       |       |       |       | 1     | 1     | 1     | 2     | 2     | 3     | 2     |       |       |
| CO2 | 3     | 2     | 2     | 2     |       |       |       | 1     | 1     | 1     | 2     | 2     | 3     | 2     |       |       |
| CO3 |       |       |       |       |       |       |       | 3     | 2     |       | 1     | 1     |       | 2     | 2     | 3     | 2     |
| CO4 |       |       |       |       |       |       |       | 3     | 2     |       | 1     | 1     |       | 2     | 2     | 3     | 2     |
| CO5 |       |       |       |       |       |       |       | 3     | 2     | 2     |       | 1     | 1     |       | 2     | 2     | 3     | 2     |
| CO6 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| AVG | 3     | 2     | 2     | 2.75  | 2     | 2     | 2     | 1     | 1     | 2     | 1     | 2     | 2     | 3     | 2     |       |

1-low, 2-medium, 3-high, ‘-’ - no correlation
COURSE OBJECTIVES:
1. To introduce technical terms and nomenclature associated with Process control domain.
2. To introduce the fundamentals of mathematical modeling of processes.
3. To familiarize the students with characteristics, selection and sizing of control valves.
4. To provide an overview of the features associated with Industrial type PID controller.
5. To make the students understand the various PID tuning methods.
6. To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes.

UNIT I  PROCESS DYNAMICS (7+2*)

UNIT II  CONTROL VALVE (7+2*)
Actuators: Pneumatic and electric actuators – I/P converter – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Valve body: Commercial valve bodies – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing– Control Valve selection.

UNIT III  CONTROL ACTIONS (7+2*)

UNIT IV  PID CONTROLLER TUNING AND ADVANCED CONTROL SYSTEMS (7+2*)

UNIT V  MODEL BASED CONTROL SCHEMES & INTRODUCTION TO MULTI-LOOP REGULATORY CONTROL & CASE STUDIES (7+2*)

TOTAL: 45 PERIODS
1. List the hardware involved in a control system.
2. Find the importance of digital computers for the present and future implementation of advanced control techniques.
3. Outline the steps that should be considered during the development of a mathematical model for chemical processes.
4. Analyse the strength and weaknesses of a feedback control system using MATLAB software.
5. Elaborate your answer how the stability characteristics of the closed loop response of a cascade control system is better than a simple feedback?
6. Examine the similarities and differences between MRAC and STRs using MATLAB software.
7. Explore various types of controllers presently used in industries.

**COURSE OUTCOMES:**

Students able to

**CO1** Develop models using first principles approach for processes such as level, flow, temperature and pressure as well as analyze models. L5

**CO2** Recommend the right type of control valve along with its characteristics for a given application. L5

**CO3** Design a control valve following the procedure outlined in the ISA S 75.01 standard. L5

**CO4** Design & implement a suitable control scheme for a given process and validate through simulations. L5

**CO5** Analyze various control schemes and recommend the right control strategy for a given application. L4

**CO6** Use appropriate software tools (Example: MATLAB/SCILAB) for analysis, design and implementation of Process Control System. L5

**TEXT BOOKS:**


**REFERENCES:**


**List of Open Source Software/Learning website:**

1. https://plcip-coep.vlabs.ac.in/List%20of%20experiments.html
2. https://plchla-coep.vlabs.ac.in/List%20of%20experiments.html
3. https://plctt-coep.vlabs.ac.in/List%20of%20experiments.html
4. https://plccom-coep.vlabs.ac.in/
5. https://pc-coep.vlabs.ac.in/List%20of%20experiments.html
IC3501 ADVANCED CONTROL THEORY  L  T  P  C  3  0  0  3

COURSE OBJECTIVES:
- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT - I  STATE VARIABLE DESIGN (7+2*)  9
Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for ArbitraryPole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT -II  PHASE PLANE ANALYSIS (7+2*)  9

UNIT - III  DESCRIBING FUNCTION ANALYSIS(7+2*)  9

UNIT - IV  OPTIMAL ESTIMATION (7+2*)  9
Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti’sequation – Application examples.

UNIT - V  OPTIMAL ESTIMATION (7+2*)  9
Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems-Kalman Filter-Application examples.

TOTAL: 45 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Seminar on different non-linear process.
2. Design a state observer and state feedback controller for any process.
3. Analyze the effect of various non-linearities on the system.
4. Apply optimal estimation techniques for any application to meet the objective.
5. Design of LQR control for any application.

COURSE OUTCOMES:
Students able to

CO1 Ability design observer of state feedback controller.
CO2 Ability to analyze the non-linear systems.
CO3 Ability to design optimal controller for any application.
CO4 Apply optimal estimation techniques for specific objective functions.
CO5 Apply advanced control to practical engineering problems

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108103007
2. https://nptel.ac.in/courses/108102043
3. https://nptel.ac.in/courses/108102044

MAPPING OF COs WITH POs AND PSOs

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1-low, 2-medium, 3-high, ‘-‘= no correlation
COURSE OBJECTIVES:
To impart theoretical and practical skills in
- Tuning of PID controller and PID Enhancements.
- Design and Implementation of Cascade, Feed-forward Control Schemes and advanced Control schemes using the facilities available in the Process Control lab
- To make the students aware about calibration of meter, sensors and transmitters
- To make the students conscious about the working and operation of different types of analytical sensors.
- To use research-based knowledge and research methods for interpretation of data from sensors

LIST OF EXPERIMENTS

PROCESS CONTROL:
1. Design and implementation of Interacting and non-interacting system
2. Design and implementation of ON-OFF controller for the Temperature Process
3. Determination of characteristics of a Pneumatically Actuated Control valve (with and without Positioner)
5. Control of flow process using industrial type PID controller
6. Tuning of PID Controller for mathematically described processes
7. Design and Implementation of Feed forward and Cascade control schemes on the simulated model of a Typical Industrial Process.
   (i) Analysis of MIMO system
   (ii) Design and implementation of Multi-loop PID schemes on the simulated model of a Typical Industrial Process.
   (iii) Interpretation of P & ID (ISA S5.1)
8. [Additional experiments]

INSTRUMENTATION:
1. (i) Measurement of humidity and viscosity
   (ii) Design and testing of Electromagnetic flow meters.
   (i) Measurement of speed, torque and vibration
2. (ii) Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator
   (i) Calibration of pressure gauge using dead weight tester.
   (ii) Estimation of discharge coefficient of an Orifice plate
   (i) Measurement of Absorbance and Transmittance of Test solutions using UV-Visible Spectrometer.
   (ii) Measurement of Conductivity and pH of Test solutions
3. (i) Interfacing different types of flow meters with PC.
   (ii) Configuration of flow Transmitter
4. (i) Measurement and analysis of ECG and pulse rate.
   (ii) Assessment of electrical safety of devices.

Minimum of twelve experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 60 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Differentiate working of the different types of control valve
2. Study the performance of ON-OFF, P, PI and PID Controllers using simulation packages
3. Performance evaluation of industry process such as level, flow, temperature
4. Develop P&I diagram for a typical industrial process.
5. List and explain the functioning of different types of sensors and control strategies used in process industry.
6. Analyse the importance of pH measurement in the food and beverage industry, cosmetic industry and pharmaceutical sector.

COURSE OUTCOMES:
Students able to

CO1 Estimate work and measure parameter of flow/ level / temperature / pressure from pilot plant (L2)
CO2 Analyze, design suitable control schemes for industrial type process.(L4)
CO3 Design ON-OFF, feed forward, cascade and Multiloop PID controllers for the typical industrial process.(L5)
CO4 Use appropriate software tools for design, analysis and implementation of control scheme.(L3)
CO5 Experimentally measure industrial process parameters (such as flow, viscosity and humidity) and physiological parameters of the human body.(L4)
CO6 Validate electrical safety of an instrument.(L6)

List of Open Source Software/ Learning website:
1. https://www.vlab.co.in/broad-area-electrical-engineering
2. https://sourceforge.net/projects/dwsim/
3. https://www.scilab.org/

MAPPING OF COs WITH POs AND PSOs

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1-low, 2-medium, 3-high, ‘-’- no correlation
COURSE OBJECTIVES:

1. To educate on design of signal conditioning circuits for various applications.
2. To introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems and interface techniques.
4. To educate on the components used in distributed control systems.
5. To introduce the communication buses used in automation industries.

UNIT I  INTRODUCTION (7+2 SKILL)  

UNIT II  AUTOMATION COMPONENTS (7+2 SKILL)  
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 (7+2 SKILL)  
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 (7+2 SKILL)  
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 (7+2 SKILL)  
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL 45 PERIODS

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

**COURSE OUTCOMES:**

**Students able to**

**CO1** Explain the working of communication buses used in automation industries.

**CO2** Explain the working of sensors and drives used in automation applications

**CO3** Describe about computer aided measurements and various signal transmission techniques

**CO4** Acquire detailed knowledge on data acquisition system interface

**CO5** Explain architecture of PLC and develop ladder program for a given sequence of operation

**CO6** Explain the basics and Importance of communication buses in applied automation Engineering

**TEXT BOOKS:**


**REFERENCES:**


**List of Open Source Software/ Learning website:**

1. [https://archive.nptel.ac.in/courses/108/105/108105062/](https://archive.nptel.ac.in/courses/108/105/108105062/)

2. [https://nptel.ac.in/courses/108105063](https://nptel.ac.in/courses/108105063)


4. [https://realdpars.com/what-is-industrial-automation/](https://realdpars.com/what-is-industrial-automation/)

5. [https://automationforum.co/what-is-industrial-automation-2/](https://automationforum.co/what-is-industrial-automation-2/)
MAPPING OF COs WITH POs AND PSOs

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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.

EI3652 INTRODUCTION TO INDUSTRIAL PROCESSES, MEASUREMENT AND CONTROL L T P C 3 0 0 3

COURSE OBJECTIVES:

- To introduce common unit operations carried out in process industries.
- To impact knowledge about the important unit operations taking place in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes.
- Facilitate the students to apply knowledge to select appropriate measurement technique and control strategy for a given process.

UNIT I COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I (7+2 SKILLS)
Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators - Crystallizers-Dryers.

UNIT II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II (7+2 SKILLS)
Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors.

UNIT III PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY (7+2 SKILLS)
Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit

UNIT IV PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY (7+2 SKILLS)
Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum -
UNIT V PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP INDUSTRY (7+2 SKILLS)

Process flow diagram of paper and pulp industry – Batch digester – Continuous sulphate digester –
Control problems on the paper machine.

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Study the characteristics of various processing units involved in chemical plant.
2. Develop the process model by using predefined unit operations (e.g. mixing, distillation, heating) from the library of any process simulator.
3. Analyse the functioning of each processing units with help of virtual unit operations packages.
4. Perform a physical property analysis using simulation packages
5. Implement distillation column analysis using simulation software.
6. Create process flow models and diagrams

COURSE OUTCOMES:
Students able to
CO1 Understand common unit operations in process industries. L2
CO2 Identify the dynamics of important unit operations in petro chemical industry. L2
CO3 Develop understanding of important processes taking place selected case studies namely petrochemical industry, power plant industry and paper & pulp industry. L5
CO4 Select appropriate measurement techniques for selective processes. L5
CO5 Develop controller structure based on the process knowledge. L5
CO6 Analyze the operation and challenges in integrated industrial processes. L4

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
MAPPING OF COs WITH POs AND PSOs

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## NCC Credit Course Level 3*

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### BORDER & COASTAL AREAS

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### ARMED FORCES

| AF 2 | Modes of Entry to Army, CAPF, Police | 3 |

### COMMUNICATION

| C 1 | Introduction to Communication & Latest Trends | 3 |

### INFANTRY

| INF 1 | Organisation of Infantry Battalion & its weapons | 3 |

### MILITARY HISTORY

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**TOTAL: 45 PERIODS**
# NCC Credit Course Level 3*

**NX3652** (NAVAL WING) NCC Credit Course Level - III

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**TOTAL : 45 PERIODS**
## NCC Credit Course Level 3*

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

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

### AIRMANSHP
- A 1 Airmanship 1

### BASIC FLIGHT INSTRUMENTS
- FI 1 Basic Flight Instruments 3

### AERO MODELLING
- AM 1 Aero Modelling Capsule 3

### GENERAL SERVICE KNOWLEDGE
- GSK 4 Latest Trends & Acquisitions 2

### AIR CAMPAIGNS
- AC 1 Air Campaigns 6

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

### NAVIGATION
- NM 1 Navigation 2
- NM 2 Introduction to Met and Atmosphere 3

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

**TOTAL : 45 PERIODS**
COURSE OBJECTIVES:
1. Programming of PLC and DCS.
2. Sensor data acquisition, data processing and visualization.
3. Interfacing the various field devices with PLC.

LIST OF EXPERIMENTS
1. Study of PLC field device interface modules (AI, AO, DI, DO modules)
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations in PLC
4. Programming Jump-to-subroutine & return operations in PLC
5. PLC Exercises: 1. Traffic Light Control and Filling/Draining Control Operation
6. PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
7. PC based control of Level Process
8. On-line Monitoring and Control of a Pilot plant using DCS
9. PLC based Control of Flow Process
10. Study of Foundation Fieldbus /IoT/Wireless HART Enabled Transmitter
11. Interfacing Limit switches and a Pump with PLC.
12. Implementation of Alarm-Annunciator sequences (ISA 18.1 Standard) using all IEC 61131-3 PLC Programming Languages.

(Any 10 for Conduct of end semester examination)

TOTAL 60 PERIODS

COURSE OUTCOMES:

CO1 Understand and Programming of PLC, SCADA and DCS (L2)
CO2 Work with industrial automation system (L3)
CO3 Design and implement control schemes in PLC & DCS (L5)
CO4 Interface field devices with PLC & DCS (L3)

MAPPING OF COs WITH POs AND PSOs

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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 understand the significance of data communication.
- To gain fundamental knowledge over computer networking.
- To get familiarized with various serial communication standards.
- To obtain an insight over various industrial data communication.
- To build knowledge on wireless technology for industrial applications.

UNIT – I NETWORKING FUNDAMENTALS (7+2 SKILLS) 9

UNIT -II SERIAL COMMUNICATION INTERFACES II (7+2 SKILLS) 9

UNIT - III MODBUS AND HART (7+2 SKILLS) 9

UNIT - IV FOUNDATION FIELDBUS AND PROFIBUS (7+2 SKILLS) 9
FIELDBUS:- Architecture - Communication protocols - Topology - Standards - PROFIBUS:-
Introduction - Types - Operational Characteristics - Transmission technology - Introduction to
PROFINET

UNIT - V

WIRELESS TECHNOLOGIES FOR INDUSTRIAL APPLICATIONS(7+2
SKILLS)

Wireless sensor networks:- Hardware components – Energy consumption of sensor nodes –
Network architecture - ISA100 - Wireless HART - IEEE 802.11 - IEEE 802.15.4.

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini
Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE)

1. Investigation of recent trends in networking technologies relating to industrial data
communication.
2. Study of protocol converters available in the industry.
3. Transfer of real time process data using different communication protocols.
4. Survey of proprietary protocols not covered in the syllabus.
5. Introduction to Industrial Internet of Things.

COURSE OUTCOMES:
Students able to
CO1 Acquire adequate knowledge over computer networking and communication protocols
CO2 Choose suitable networking architecture and the associated protocols for industrial data
communication.
CO3 Analyze the requirements of a given application and use appropriate communication
protocols.
CO4 Adopt best practices in installation and commissioning of industrial data communication
links
CO5 Realize the nature of the industrial application in hand and employ suitable wired
solution.
CO6 Ability to infer the requirements of an industry and select a wireless solution for installing
Industrial data network.

TEXT BOOKS:
1. Mackay, S., Wright,E., Reynders,D., and Park,J., “Practical Industrial Data Networks:

REFERENCES:
3. Lawrence (Larry) M. Thompson and Tim Shaw, “Industrial Data Communications”, 5th
4. NPTEL Lecture notes on,” Computer Networks” by Department of Electrical Engg, IIT
Kharagpur.

List of Open Source Software/ Learning website:
8. https://nptel.ac.in/courses/106108098
10. https://nptel.ac.in/courses/106108056

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EI3752 APPLIED MACHINE LEARNING  
120

COURSE OBJECTIVES:
1. To give an introduction on several fundamental concepts and methods for machine learning.
2. To familiarize with some basic learning algorithms and techniques and their applications.
3. To provide the knowledge related to processing, analyzing and handling data sets.
4. To illustrate the typical applications of various clustering based learning algorithms

UNIT I INTRODUCTION TO MACHINE LEARNING

UNIT II DATA PREPROCESSING
Data quality – Data preprocessing: - Data Cleaning:– Handling missing data and noisy data – Data integration:– Redundancy and correlation analysis – Continuous and Categorical Variables – Data Reduction:– Dimensionality reduction (Linear Discriminant Analysis – Principal Components Analysis).
UNIT III  SUPERVISED LEARNING  9

UNIT IV  CLUSTERING AND UNSUPERVISED LEARNING  9
Introduction – Clustering:- Partitioning Methods:- K-means algorithm – Mean Shift Clustering – Hierarchical clustering – Clustering using Gaussian Mixture Models – Clustering High-Dimensional Data:- Problems – Challenges

UNIT V  NEURAL NETWORKS  9

TOTAL  45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  10
1. Explore the areas and applications where machine learning is used.
2. Collect data for any application and apply data preprocessing techniques.
3. Develop prediction model using the Machine learning techniques.
4. Design controller using Neural Network for any one application

COURSE OUTCOMES:
CO1 Ability to understand the basic theory underlying machine learning.
CO2 Ability to understand a range of machine learning algorithms along with their strengths and weaknesses.
CO3 Ability to formulate machine learning problems corresponding to different applications.
CO4 Ability to apply machine learning algorithms to solve problems of moderate complexity.
CO5 Ability to read current research papers and understand the issues raised by current research.

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1- https://lecturenotes.in/materials/64801-machine-learning-for-engineering-and-science-applications
2- https://nptel.ac.in/courses/106105152
3- https://nptel.ac.in/courses/106106139
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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.

IC3811 PROJECT WORK/INTERNSHIP  L  T  P  C  0 0 20 10

COURSE OBJECTIVES:
The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product; prepare a good technical report. Gain Motivation to present the ideas behind the project with clarity.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design/fabrication of Sensor/Activator/Controller, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report. TOTAL : 300 PERIODS

COURSE OUTCOMES:
CO1 Ability to identify, formulate, design, interpret, analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering.
CO2 Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of electronics, process automation, instrumentation and control by exploring suitable engineering and IT tools.
CO3 Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects understanding commitment towards sustainable development.
CO4 Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.
CO5  Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.

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AUTOMATION – VERTICAL

CEI331 PLC PROGRAMMING  L T P C

3 0 0 3

COURSE OBJECTIVES:
1. To know about the basics of PLC and Automation
2. To understand the importance of Automation
3. To explore various types and manufactures of PLCs.
4. To introduce types of programming languages of PLC and some exercise few programs.

UNIT I INTRODUCTION (7+2 SKILL)
Programmable Logic Controller (PLC) - Block diagram of PLC- Programming languages of PLC-
Basic instruction sets- Design of alarm and interlocks- Networking of PLC- Overview of safety of
PLC with case studies- Process Safety Automation: Levels of process safety through use of
PLCs- IEC 61131-3 Standard - Application of international standards in process safety control.

UNIT II IEC 61131-3 (7+2 SKILL)
Rails- Rungs- Relay Logic- Latch switch- Timers- Counters- Boolean logics- Math Instructions-
Data manipulation Instructions- Requirement of communication networks for PLC, PLC to PC
Communication to computer- FBD equivalent to LL- FBD Programming- IL- SFC-ST

UNIT III SCADA (7+2 SKILL)
Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control- Analog
control, Master Terminal Unit- Operator interface.

UNIT IV HART and Field Bus (7+2 SKILL)
Introduction- Evolution of signal standards- HART communication protocol- communication
modes- HART networks- HART commands- HART and OSI model- Field bus- Architecture-
Basic requirements of field Busstandard- Field bus Topology- Interoperability- Interchangeability.

UNIT V PLC PROGRAMMING (7+2 SKILL)
Exercise in Programming Languages from IEC 61131-3: Traffic Light Control- Two way- Four
way – Water Level Control- Automatic Material Sorting System- Automatic Bottle Filling System,
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Taking Local area to implement simple closed loop system for any system using PLC.
2. Making a complete automated control loop with Supervisory and HMI system.
3. Implementing an Alarm based control scheme and run in a simulated environment.
4. Designing an entire PLC logic for filling and draining water tank automatically.

COURSE OUTCOMES:

CO1  Understand the basics and need for Automation in industries (L2).
CO2  Explain the logic and flow of any particular programming written for a process (L2).
CO3  Apply the knowledge to design or improve an existing program to increase productivity of any process (L3).
CO4  Breakdown SCADA architecture and communication protocols (L4).
CO5  Build and logic in any of the programming languages from IEC- 61131- 3 standard (L3).

REFERENCES

2. List of Open-Source Software/ Learning website:
   1. https://nptel.ac.in/courses/108105062
   2. https://nptel.ac.in/courses/108105088
   4. https://nptel.ac.in/courses/108106022
   6. https://componentssearchengine.com/library/proteus?qclid=CjwKCAjw_1SWSBhBkEiwAdqxb9o kU2ZZHcQoa9fSRK2Uq41Rq0GzdGUP6_6GIBv77p4JqGt_iDAijhoCksEQAvD_BwE

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COURSE OBJECTIVES:

1. To study the various parts of robots and fields of robotics.
2. To study the various kinematics & inverse kinematics of robots, the Euler & Lagrangian formulation of Robot dynamics.
3. To study the trajectory planning and the control of robots for some specific applications.
4. To educate on various path planning techniques and introduce the dynamics & control of manipulators.

UNIT I   BASIS CONCEPTS (7+2 SKILL)
Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov’s laws of robotics – dynamic stabilization of robots

UNIT II   POWER SOURCES, SENSORS AND ACTUATORS (7+2 SKILL)

UNIT III   MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION (7+2 SKILL)

UNIT IV   KINEMATICS AND PATH PLANNING (7+2 SKILL)
Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment BalanceSolution kinematics problem – robot programming languages.

UNIT V   DYNAMICS AND CONTROL AND APPLICATIONS (7+2 SKILL)

TOTAL   45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  10
1- Learn any one programming language (C/C++, Python, Java etc.)
2- Kinds of sensors for industrial robot applications.
3- Familiarization with relevant software tool (MATLAB) and programming language
4- Controlling Arduino Robot using Android Smartphone
5- Real time robotics projects (Soccer robots, line follower etc)

COURSE OUTCOMES:

CO1  Understand the evolution of robot technology and mathematically represent different types of robot (L2).
CO2  Get exposed to the case studies and design of robot machine interface (L3).
CO3  Analyze various control schemes of Robotics control (L4).
CO4  Ability to select appropriate configuration of rotor for a specific application. (L3)
CO5  Ability to choose actuator/sensor for robot. (L1)
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/112105249
2. https://nptel.ac.in/courses/107106090
3. https://nptel.ac.in/courses/112101098

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CEI333 INDUSTRY 4.0

COURSE OBJECTIVES:
1. To offer learners an introduction to Industry 4.0 and its applications.
2. To gain deep insights into how smartness is being harnessed from data.
3. To understand what needs to be done in order to overcome the challenges.
4. To familiarize in Industry 4.0 in healthcare services.

UNIT I INTRODUCTION (7+2 SKILL)
Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today’s Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

128
UNIT II  INTEGRATED IoT (7+2 SKILL)  9
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT III  ROBOTICS AND SECURITY (7+2 SKILL)  9

UNIT IV  CLOUD COMPUTING (7+2 SKILL)  9
Role of data, information, knowledge and collaboration in future organizations – Resource based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics - Cloud Computing and Industry 4.0

UNIT V  CASE STUDY AND APPLICATIONS (7+2 SKILL)  9
Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1  A Seminar on case studies, cloud computing, security and IoT.
2  Quiz on different types of industrial 4.0 applications.
3  Familiarization with relevant software tool (MATLAB, AR/VR, PLM)
4  Creating a cloud computing platform and work on it.
5  Introduction to other industry and security not covered in the above syllabus

COURSE OUTCOMES:
CO1  Understand the drivers and enablers of Industry 4.0 (L2).
CO2  Appreciate the smartness in smart factories, smart cities, smart products and smart services (L2).
CO3  Outlines the various systems used in a manufacturing plant and their role in an Industry 4.0 world (L1).
CO4  Describe a strategic framework to exploit new technologies to enable Healthcare 4.0 (L1)
CO5  Ability to apply industry 4.0 concepts to real time applications. (L4)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1  https://nptel.ac.in/courses/106105167
2  https://nptel.ac.in/courses/106105195
CEI334 INTELLIGENT AUTOMATION

COURSE OBJECTIVES:
1. To identify potential areas for automation and justify need for automation
2. Study the concepts of Artificial Intelligence.
3. Learn the methods of solving problems using Artificial Intelligence.
4. Apply the concept of AI to attain industrial automation

UNIT I INTRODUCTION TO AUTOMATION (7+2 SKILL)

UNIT II INTRODUCTION TO ARTIFICAL INTELLIGENCE (7+2 SKILL)

UNIT III KNOWLEDGE AND REASONING (7+2 SKILL)

UNIT IV EXPERT SYSTEMS (7+2 SKILL)
UNIT V AI IN CONTROL SYSTEMS (7+2 SKILL)

Industrial AI applications and Case studies - Applications of Industrial AI in Monitoring-optimization and control- AI applications in Industry Automation using -natural language processing-computer vision-speech recognition-computer vision.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1 A seminar on detailed study about existing control methods using AI
2 Designing an AI to recognize face and to authenticate.
3 Train an AI to read alarm codes and take action.

COURSE OUTCOMES:
CO1 Understand the basics AI algorithms (L2).
CO2 Identify appropriate AI methods to solve a given problem (L1).
CO3 Illustrate about AI/ML/DL techniques in Industrial Automation (L3).
CO4 Summarize the levels of automation (L2).
CO5 Ability to apply AI concepts for industrial optimization and control. (L4)

TEXT BOOKS:

REFERENCES

List of Open-Source Software/ Learning website:
1 https://nptel.ac.in/courses/106102220
2 https://nptel.ac.in/courses/108105063
3 https://aws.amazon.com/free/machine-learning
4 https://www.tensorflow.org/

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CEI335 SMART MANUFACTURING

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COURSE OBJECTIVES:
1. To introduce students to fundamentals of Manufacturing
2. To familiarize with selection of sensors for various application
3. To learn the basics of agent-based manufacturing
4. Understand Cyber physical systems
5. Provide brief understanding about industry 4.0 concepts in Manufacturing systems

UNIT I SENSORS IN SMART MANUFACTURING (7+2 SKILL) 9

UNIT II DATA ANALYTICS (7+2 SKILL) 9
Introduction to Data and Analytics in a Digital Context (Internet of Things), Product Data Management for Design and Manufacturing (PLM Tools), Typical data challenges (data quality, enrichment, integration of ERP & PLM data), Preparing data for analytics (techniques to improve data quality, integration - ETL) Advances in data visualization & related tools-Statistical Techniques for Analytics, Descriptive Statistics, Inferential statistics, Regression and ANOVA

UNIT III CYBER PHYSICAL SYSTEMS (7+2 SKILL) 9
Concept of Cyber Physical Systems (CPS) and Cyber Physical Production System (CPPS), System Architecture for implementation of CPPS, Components for CPPS, Communication for CPPS.

UNIT IV E- MANUFACTURING (7+2 SKILL) 9

UNIT V INDUSTRY 4.0 (7+2 SKILL) 9
Evaluation of industries, Introduction to Industry 4.0, Challenges in industry 4.0, Impact of Industry 4.0, Case studies on industry 4.0, Introduction to Internet of Things (IoT) and its applications, Smart supply chain and Case studies.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Learn any one programming language (C/C++, Python, Java etc.)
2. Kinds of sensors for industrial robot applications.
3. Familiarization with relevant software tool (MATLAB) and programming language
4. Controlling Arduino Robot using Android Smartphone
5. Real time robotics projects (Soccer robots, line follower etc)

COURSE OUTCOMES:
Students able to
CO1 Appraise concepts and basic framework necessary for smart manufacturing (L5).
CO2 Discuss current trends at system level in manufacturing organizations (L2).
CO3 Selection of sensors for various applications (L4).
CO4 Dramatise IoT based manufacturing systems (L3)
CO5 Describe industry 4.0 concepts at manufacturing systems (L1).

TEXT BOOKS:
REFERENCES:


List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/106105195
2. https://archive.nptel.ac.in/courses/106/105/106105195/

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COURSE OBJECTIVES:
1. To understand the Industrial security environment and cyberattacks
2. To analyze and assess risks in the industrial environment
3. To access, design and implement cybersecurity
4. To test and troubleshoot the industrial network security system

UNIT I INTRODUCTION (7+2 SKILL) 9
Industrial security environment-Industrial automation and control system(IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks

UNIT II RISK ANALYSIS (7+2 SKILL) 9
Risk identification, classification and assessment, Addressing risk: Cybersecurity Management System(CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.

UNIT III ACCESSING THE CYBERSECURITY OF IACS(7+2 SKILL) 9
Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results

UNIT IV CYBERSECURITY DESIGN AND IMPLEMENTATION(7+2 SKILL) 9
Cybersecurity lifecycle- conceptual design process- detailed design process- firewall design-remote access design- intrusion detection design

UNIT V TESTING AND MAINTENANCE(7+2 SKILL) 9
Developing test plans- cybersecurity factory acceptance testing- site acceptance testing-network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation/ Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Analysis of various security tools.
2. Standards in cyber security.
3. Study the steps to remove Passwords from Microsoft Word.
4. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome).
5. Analysis the security vulnerabilities of E-Mail Application.

COURSE OUTCOMES:
CO1 Apply basis of science and engineering to understand Industrial security environment and cyberattacks (L3).
CO2 Analyze and assess risks in the industrial environment (L4).
CO3 Access the cybersecurity of IACS (L3)
CO4 Design and implement cyber security (L3)
CO5 Identify the tests and troubleshoots of industrial network security system (L1).
CO6 Understand, investigate and explore feasible solution for a moderate industrial problem (L2).
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/106106129
3. https://www.techtarget.com/searchsecurity/definition/cybersecurity

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CEI337 BUILDING AUTOMATION

L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To brief students with origin and evolution of building automation.
2. To train them with architecture and operation of BAS.
3. To facilitate them for designing automation system for intelligent building
4. Develop technique for preparation of various documents required for design requirement of safety building.

UNIT I INTRODUCTION (7+2 SKILL)

UNIT II HVAC SYSTEM (7+2 SKILL)
Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH.
UNIT III  ENERGY MANAGEMENT SYSTEM (7+2 SKILL)  9

UNIT IV  SAFETY SYSTEM (7+2 SKILL)  9

UNIT V  INTEGRATED SYSTEMS (7+2 SKILL)  9

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. A Seminar on case studies and other security systems.
2. Quiz on different types of industrial 4.0 applications.
3. Familiarization with relevant software tool (MATLAB, AR/VR, PLM)
4. Creating a cloud computing platform and work on it.
5. Introduction to other industry and security not covered in the above syllabus.

COURSE OUTCOMES:
CO1  Explain the concept of intelligent building and BAS (L2).
CO2  Select the hardware and design of HVAC in building automation system (L4).
CO3  Discuss the concept of energy management system (L2).
CO4  Illustrate the safety system for building (L3).
CO5  Design and integrate the different system in BAS (L5).

TEXT BOOKS:

REFERENCES:
137


List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/105/102/105102176/
2. https://www.resonai.com/blog/what-are-intelligent-buildings
3. https://www.designingbuildings.co.uk/wiki/Building_Automation_and_Control_System_BACS

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

CEI338 SMART FARMING L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To know about the basics of sensing and control algorithm in farming.
2. To understand the efficiency of farming through technology.
3. To explore image processing and Machine learning for agriculture.
4. To introduce types of sensors and software to implement in field.

UNIT I INTRODUCTION

UNIT I MACHINE LEARNING IN AGRICULTURE

UNIT III IoT IN AGRICULTURE

UNIT IV DRONES IN AGRICULTURE
Drones in Agriculture- Agricultural Drones- Types of Drones and Classifications – Definitions and Terminologies- Study of Natural Resources and Vegetation- Mapping and Monitoring.

UNIT V AGRICULTURE 5.0

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini 5
1. Taking Local area to implement simple closed loop system for irrigation and water management.
2. Using Machine Learning to forecast weather and predicting yield for particular field with previous data.
3. Mapping and Monitoring of particular area.
4. Drafting a policy and protocol to adopt farmers to new technologies.

COURSE OUTCOMES:
CO1 Relate to a farming with industrial problem and solving it (L2).
CO2 Explain the process in growing a particular crop varieties and challenges associated with it. (L5)
CO3 Apply the knowledge to select suitable sensors and software for particular test case (L3).
CO4 Analyze anomaly and weather change beforehand (L4).
CO5 Build an exclusive irrigation and harvest plan for particular zone (L3).

REFERENCES

List of Open - Source Software/ Learning website:
1. https://onlinecourses.nptel.ac.in/noc22_bt25/preview
2. https://www.intechopen.com/chapters/76652
5. https://archive.nptel.ac.in/courses/126/104/126104002/

MAPPING OF COs WITH POs AND PSOs

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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 make the students familiarize about role of IoT in industry
▪ To impart knowledge about various data monitoring and control techniques.
▪ To teach theoretical and practical skills in IIoT
▪ To provide students with good depth of IIoT design platform.
▪ To educate design and analysis of Industry 4.0 Systems

UNIT I  INTRODUCTION TO IMPLEMENTATION OF INDUSTRIAL IOT (IIOT) SYSTEMS
Fundamentals of Control System: Introduction, Components, Closed loop and Open loop System - Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Smart Factories, Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT.

UNIT II  IIOT DATA MONITORING & CONTROL
Communication Protocols- IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID Industry standards Communication technology(LoRAWAN, OPC UA, MQTT) connecting into existing Modbus and Proflibus technology - Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems. IoT Gate way, IoT Edge Systems and It’s Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

UNIT III  CYBER PHYSICAL SYSTEMS

UNIT IV  INDUSTRIAL IOT- APPLICATIONS
Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, IoT smart city, Robot surveillance, Smart irrigation.

UNIT V  CASE STUDIES OF IIOT SYSTEMS
IIoT application development with Embedded PC based development boards. Development of mini Project on new version of Operating systems and Edge development board.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
2. Familiarization with relevant hardware tool(Raspberry PI) and programming language
3. Application design and development.
4. Microprocessor and controller
5. Knowledge of sensor transducer actuator interfacing
6. Familiar in communication module like ESP modules, ZigBee, Ethernet shield, nrf, BLE.
7. Educate in open-source technology (ThingSpeak, Eclipse, KAA IoT etc…)

COURSE OUTCOMES:

Students able to
CO1 Relate the elements of IoT to build a total control plane in an Industrial application. L4
CO2 Explain IIot data monitoring and control techniques. L2
CO3 Apply the concept of digitalization and data acquisition. L3
CO4 Analyse smart factory based on the concepts. L4
CO5  Design IIoT applications. L5

TEXT BOOKS:
1. Industry 4.0: The Industrial Internet of Things Alasdair GilchristPublications: Apress
2. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018
3. The Internet of Things in the Industrial Sector by Mahmood, Zaigham(Ed.) (Springer Publication)
4. Industrial Internet of Things: Cybermanufacturing System by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
5. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun(editor)

REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/106105195
4. https://www.udemy.com/course/introduction-to-industrial-iot-for-it-professionals/
5. Industrial IoT platform: Eurotech Everyware IoT.

MAPPING OF COs WITH POs AND PSOs

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

CEI340  SENSOR FOR IoT APPLICATION  L  T  P  C
3 0 0 3
COURSE OBJECTIVES:
▪ To introduce the basics of technology and its applications.
▪ To understand the concept of M2M (machine to machine) interfacing with necessary protocols
▪ To develop the Python Scripting Language for IoT devices
▪ To familiarize with the Raspberry PI platform based IoT applications.
▪ To provide the knowledge on web based services using IoT devices.

UNIT - I  INTRODUCTION TO INTERNET OF THINGS  9

UNIT - II  IOT AND M2M  9
Introduction, M2M, Software defined networks, network function virtualization, difference between SDN and NFV for IoT, IoT System Management with NETCONF - YANG –Need for IoT System Management, SNMP, NETCONF, YANG,NETOPEER.

UNIT - III  IOT SYSTEMS AND IOT PHYSICAL DEVICES & ENDPOINTS  9
Introduction to python, Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, and reading input from pins.

UNIT - IV  PREPARING OUR IOT PROJECTS AND HARDWARE DESIGN  9

UNIT - V  IOT PHYSICAL SERVERS AND CLOUD OFFERINGS  9
Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API, Amazon Web service for IoT

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES  (Group Seminar/Mini Project/Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  5
1. Familiarize with Machine learning and Artificial Intelligence
2.  JavaScript and Python
3. Knowledge about How Sensors Work
4.  UI-Centric Approach
5.  Educate in Node.js Development
6. Know about IoT Security
7. Develop knowledge in GPS System, Cloud computing
8.  Mobile Hardware Environment

COURSE OUTCOMES:
Students able to
CO1  Relate IoT application areas and technologies involved. L1
CO2  Explain IoT sensors and technological challenges. L5
CO3  Apply Python program with Raspberry PI on IoT devices. L3
CO4  Analyze Market forecast for IoT devices L4
CO5  Design Internet of Things based projects using Raspberry Pi. L5

**TEXT BOOKS:**

**REFERENCES:**

**List of Open Source Software/ Learning website:**
3. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
4. Open source software: Arduino, Devicehub.net, IoT Toolkit, OpenWSN, Particle, SiteWhere, ThingSpeak, Webinos etc…

**MAPPING OF COs WITH POs AND PSOs**

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**CEI341  IOT FOR INDUSTRY AUTOMATION**

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**COURSE OBJECTIVES:**
- To understand the basics of sensors used for various applications
- To develop the concept of signal conditioning circuits and implementation
- To study the role IoT sensors for automotive industries
- To familiarize about the functioning of IoT based sensors in healthcare industry
- To knowledge on unmanned Arial vehicle

**UNIT I  SENSORS & TRANSDUCERS**
Introduction to IoT Sensors- Temperature sensors, Proximity sensor, Pressure sensor, Water quality sensor, Chemical sensor, Gas sensor, Smoke sensor, IR sensors, Level sensors, Image sensors, motion sensor, Humidity sensor, Ultrasonic Sensor, MQ2 Sensor, Digital switch, Electro Mechanical switches.

**UNIT II  SIGNAL CONDITION CIRCUITS**
UNIT III  INTERNET OF THINGS IN AUTOMOTIVE INDUSTRIES
Role of IoT automotive industries, interfacing of digital and analog sensors in automotive industries, Biometric car door opening, accident monitoring, Engine management system, driver management system, real time vehicle tracking system, 5G advanced driver assistance systems (ADAS), Augmented road sign information, In-vehicle Infotainment and Telematics, Automotive Maintenance System, Truck’s performance statistics like fuel and mileage, Tracking traffic conditions on the road.

UNIT IV  INTERNET OF THINGS FOR THE HEALTHCARE INDUSTRY
Emerging Technologies in Smart Healthcare, Fog Computing in Healthcare, Technologies Used in Software Defined Networking (SDN) and HealthCare, WSN and IoT Based Smart Surveillance Systems for Patients, Security and Privacy Issues in Smart Healthcare System, IoMT- Based Smart Remote Monitoring System.

UNIT V  IoT FOR UNMANNED AERIAL VEHICLES

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
2. Familiar with Artificial intelligence and machine learning.
3. Mobile applications development
4. Skills in Cloud computing, Cybersecurity, Datascience
5. knowledge in process control and automation in different industries

COURSE OUTCOMES:
Students able to
CO1 Categorize sensors and transducers used in industry.L5
CO2 Explain about signal conditioning circuits. L2
CO3 Apply IoT design concept on automotive industry. L3
CO4 Analyse used of IoT technology in health care industry. L4
CO5 Design unmanned aerial vehicles. L5

TEXT BOOKS:

REFERENCES:
4. IoT in Automotive Industry: https://www.biz4intellia.com/blog/iot-applications-in-automotive-industry/

List of Open Source Software/ Learning website:
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1-low, 2-medium, 3-high, '-'- no correlation

CE1342 DATA ANALYTICS FOR IOT

COURSE OBJECTIVES:
- To learn the concepts of big data analytics.
- To get exposure on IoT cloud analytics environment.
- To be familiar with general strategies on IoT analytics.
- To get exposure on social impact of multimedia.
- To identify applications that makes use of multimedia Big Data and IoT.

UNIT - I INTRODUCTION TO TECHNOLOGICAL DEVELOPMENTS

UNIT - II CLOUD ANALYTICS ENVIRONMENT
The AWS Cloud Formation, The AWS Virtual Private Cloud (VPC), terminate and clean up the Environment, data processing for analytics, big data technology to storage, Apache Spark for data processing, Handling change, Exploring and visualizing data, Techniques to understand data quality Techniques to understand data quality, R and RStudio.
UNIT - III  GENERAL STRATEGIES ON EXTRACTING VALUE FROM DATASETS  9
Decorating Your Data, Communicating with Others Visualization and Dashboarding, Applying Geospatial Analytics to IoT Data, Data Science for IoT Analytics- Machine learning (ML), Deep learning.

UNIT - IV  SOCIETAL IMPACT OF MULTIMEDIA BIG DATA  9

UNIT - V  APPLICATION ENVIRONMENTS  9
Big Data Computing for IoT Applications-Precision Agriculture, Machine Learning in Improving Learning Environment, Network-Based Applications of Multimedia Big Data Computing, Recent Trends in IoT-Based Analytics and Big Data, Future Directions and Challenges of Internet of Things.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  10
1. Skills in Data mining, Data cleaning, Data analysis.
2. Educate in Data and System maintenance.
3. Develop knowledge in Competitive edge, Streaming Analytics, Spatial Analytics, Time Series Analytics, and Prescriptive analysis.

COURSE OUTCOMES:
Students able to
CO1 Describe big data and IoT. L2
CO2 Define cloud based IoT analytic environment. L1
CO3 Apply various Big data strategies. L3
CO4 Analyse social impact of multimedia big data. L4
CO5 Design smart IoT systems with big data. L5

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
2. https://www.cognixia.com/course/iot-analytics/
5. https://www.educba.com/iot-analytics/
6. Open source software: Countly, ThingsBoard, ThingSpeak, Apache StreamPipes, WSO2 IoT Server
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1-low, 2-medium, 3-high, '-'- no correlation

CEI343 IoT FOR SMART AGRICULTURE L T P C

COURSE OBJECTIVES:
- To understand soil science and sensors used
- To study about functions of actuators for automation and control.
- To explain the role of telemetry system in agriculture
- To impart knowledge on plant heath
- To learn various technologies used in smart farming system.

UNIT - I INTRODUCTION TO SOIL SCIENCE AND SENSORS 9
Soil Science: Nature and origin of soil; soil minerals, classification and composition, soil reaction, soil properties including structure, pH, surface tension and soil nutrient.

UNIT - II ACTUATORS FOR AUTOMATION 9

UNIT - III TELEMETRY 9
Wireless communication modules and topology, Zig-bee, Bluetooth, LORA, RFID, Zero power devices, Energy Harvesting technology.

UNIT - IV PLANT HEALTH MONITORING 9
Measurement of leaf health, chlorophyll detection, ripeness level, crop mapping, fertilizing, Drone technology for soil field analysis and assistive operations.

UNIT - V TECHNOLOGIES FOR FARMING 9
Water quality monitoring, micro-irrigation system, solar pump and lighting system, Fencing, Android based automation, Agricultural Robots, Climate Conditions, Precise Farming(livestock monitoring, vehicle tracking, field observation and inventory monitoring), Smart Greenhouses, Agricultural Drones, Automatic watering system.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/ 5
Content Preparation / Quiz / Surprise Test / Solving GATE questions / etc

1. Able to select and perform electrical/electronic measurement of meters and Instruments.
2. Educate in the principle of sensors and transducers for various smart agriculture applications.
3. Familiarize with different wireless communication modules like Zigbee, Bluetooth, wifi etc. and topology to generate and record the data.
4. Perform installation, configuration and check working of IoT devices, network, database, app and web services.

COURSE OUTCOMES:

Students able to

CO1 Express nature of soil science and the various sensors used. L2
CO2 Explain Sensors and actuators used for farming tools. L2
CO3 Analyse sensor data acquisition and telemetry system. L4
CO4 Understand plant anatomy and health monitoring system. L2
CO5 Design Advanced technologies for smart farming. L5

TEXT BOOKS:


REFERENCES:

2. Brian Wahlin and Darell Zimbelman, Canal Automation for Irrigation Systems, American Society of Civil Engineers, 2014

List of Open Source Software/ Learning website:

5. Open source software: Smart Agrifood, Krishi IoT, thethings.iO, Agrosense.

MAPPING OF COs WITH POs AND PSOs
COURSE OBJECTIVES:

▪ To understand the security requirements in IoT.
▪ To learn the fundamentals of cryptographic in IoT
▪ To understand the working of embedded devices in the IoT
▪ To familiarize with IoT protocols in security
▪ To realize security issues for various applications using case studies

UNIT I INTRODUCTION

UNIT II SECURITY MANAGEMENT & CRYPTOLOGY

UNIT III EMBEDDED DEVICES

UNIT IV IoT PROTOCOLS

UNIT V IoT APPLICATIONS
Case Studies and Discussion: Smart Agriculture, Cities, Grid, Healthcare, Smart Homes, smart street lighting, Smart building, Smart parking, smart irrigation, Supply Chain, and Transportation, Application of Security Concepts to Create IoT system.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/ 5
Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Needed to grasp business intelligence include sensor data analysis, data center management, predictive analytics, and programming in Hadoop and NoSQL.
2. Knowledge in UX and UI Design
3. Develop well-versed in both iOS and Android app development
4. Ability to program interfaces such as GPIO and I2C
5. Should have basic OSI stack knowledge, especially connectivity protocols
6. Ability to connect automatic API testing with manual testing
7. Ability to read and interpret data meaningfully in healthcare.
8. Familiar with machine learning and AI.
9. cognizant of changes in programming languages and evolving hardware platforms.

COURSE OUTCOMES:
Students able to
CO1 Define the security requirements in IoT Architecture. L1
CO2 Explain the different cryptographic techniques in IoT Security. L5
CO3 Classify various embedded devices related to IoT. L2
CO4 Analyze IoT protocols. L4
CO5 Interpret IoT applications in several fields. L3

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://www.cybrary.it/course/iot-security/
5. https://stalwartlearning.com/iot-security/#1571760778613-fb76c66d-5ce2f2dc-0b723b65-c1c6
6. IoT Security Software: Quantum Armor, Azure IoT Hub, AWS IoT, SonicWall Capture Client, nuPSYS, Forescout, Sectrio, Microsoft defender for IoT, Cruz IoT Device Director, OverWatch, Google cloud IoT core, Darktrace, EJBCA, DxOdyssey, Cisco cyber vision, Tempered etc…

MAPPING OF COs WITH POs AND PSOs

149
CEI345  

IoT FOR SMART CITIES

L  T  P  C

3  0  0  3

COURSE OBJECTIVES:

▪ To know the concept of smart city and associated challenges.
▪ To understand latest technologies used in intelligent building.
▪ To get familiarization about the role of artificial intelligence for smart city.
▪ To understand the importance of water management system.
▪ To realize the importance of different smart systems.

UNIT I  INTRODUCTION TO IOT FOR SMART CITIES  9
Introduction-Characteristics of Smart Cities, IoT-Based Solutions for Smart Cities, Smart Home, Transport and Traffic Management, Challenges, Smart City Planning and Management, The Fundamentals of Smart Infrastructure, Role of Machine Learning and Deep Learning in Internet of Things enabled Smart Cities.

UNIT II  TECHNOLOGIES FOR INTERNET OF THINGS  9

UNIT III  AI FOR SMART CITIES  9
Overview of Artificial Intelligence, Machine Learning and deep learning algorithms for smart cities, case study: smart street lighting, Smart building, Smart parking, smart irrigation, smart waste and storm water management, Vehicle Payload Monitoring System.

UNIT IV  TRANSPORTATION SYSTEM IN SMART CITY  9

UNIT V  SECURITY AND PRIVACY IN SMART CITY  9
Privacy and Social Values in Smart Cities, Information Security in the Smart City, IoT Security Challenges, Blockchain Technology FOR IoT, Case Studies: Smart Homes, Food Supply Chain Traceability System, smart street lighting, Smart building, Smart parking, smart irrigation, Security and Privacy Threats in IoT-Enabled Smart Cities
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Knowledge in Artificial Intelligence, Machine Learning and deep learning algorithms
2. Should develop Community skills, Data skills, Technology skills.
3. Develop and organize well Transportation system

COURSE OUTCOMES:
Students able to

CO1 Relate the necessity of infrastructural development for smart cities. L1
CO2 Explain the components of infrastructure plan for smart city. L5
CO3 Choose AI based intelligent system in smart city. L3
CO4 Analyze water resources systems for smart city. L4
CO5 Construct and work in the smart city projects. L5

TEXT BOOKS:

REFERENCES:
4. Artificial Intelligence, Machine Learning, and Deep Learning, Oswald Campesato, Memory Learning and Information, 2020.

List of Open Source Software/ Learning website:
5. https://www.futurelearn.com/info/courses/gettingstartedwiththeiot/0/steps/149743
7. Open source software: Node-RED, PubNub, IoT-AWS, PlatformIO, OpenIoT, CityOS etc...

MAPPING OF COs WITH POs AND PSOs
CEI346  |  **IoT AND EDGE COMPUTING**  |  L  |  T  |  P  |  C  
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COURSE OBJECTIVES: 
- To discuss the fundamental concepts of IoT and Edge computing. 
- To examine the concept of communication and information theory. 
- To understand edge routing and networking layers. 
- To describe the fog topologies in IoT. 
- To discuss the security issues of protocols in IoT. 

UNIT - I  |  **IoT AND EDGE COMPUTING**  |  9  

UNIT - II  |  **COMMUNICATIONS AND INFORMATION THEORY**  |  9  

UNIT - III  |  **EDGE COMPUTING**  |  9  
Edge purpose and definition, Edge hardware architectures, Operating systems, Edge platforms, Edge Routing and Networking, Edge to Cloud Protocols. 

UNIT - IV  |  **CLOUD AND FOG TOPOLOGIES**  |  9  

UNIT - V  |  **IoT AND EDGE SECURITY**  |  9  
Cybersecurity- Attack and threat terms, definitions of different cyber defense mechanisms and technologies, Anatomy of IoT cyber-attacks, Physical and hardware security, Cryptography, Blockchain and cryptocurrencies in IoT, Consortiums and Communities. 

**TOTAL: 45 PERIODS**

**SKILL DEVELOPMENT ACTIVITIES** (Group Seminar/Mini Project/Assignment/Content Preparation/Quiz/Surprise Test/Solving GATE questions/ etc): 
2. Knowledge in Edge computing and cloud computing.

**COURSE OUTCOMES:**

Students able to

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<td>CO1</td>
<td>Identify the evolving IoT Standards.</td>
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<td>Explain the functions of communication and information theory in IoT.</td>
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<td>Practice the concept of edge computing protocols.</td>
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<td>CO4</td>
<td>Analyze the purpose of machine learning in IoT.</td>
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<td>CO5</td>
<td>Construct hardware security for IoT applications.</td>
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</tbody>
</table>

**TEXT BOOKS:**


**REFERENCES:**

2. Rajkumar Buyya, Satish Narayana Srirama, Fog and Edge Computing: Principles and Paradigms, wiley publication, 2019

**List of Open Source Software/ Learning website:**

1. [https://www.udemy.com/course/introduction-to-edge-computing/](https://www.udemy.com/course/introduction-to-edge-computing/)

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1-low, 2-medium, 3-high, ’-‘ no correlation
COURSE OBJECTIVES:
- To understand the important of mathematical models for Industrial processes
- To acquaint students with different forms of mathematical models.
- To develop and simulate mathematical models for different Industrial processes.
- To apply Mathematical tools while developing mathematical models.
- To analyze the graphical response of developed mathematical models.

UNIT I  GENERAL PRINCIPLES OF MODELLING (7+2 SKILL)
Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs Nonlinear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODEBVP.

UNIT II  MODELLING OF DISTRIBUTED PROCESSES (7+2 SKILL)
Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based Approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.

UNIT III  INTRODUCTION TO PROCESS MODELLING (7+2 SKILL)
Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, PersistentRecycle.

UNIT IV  MODELLING OF INDUSTRIAL PROCESSES (7+2 SKILL)
Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, -steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

UNIT V  SIMULATION OF MATHEMATICAL MODELLING (7+2 SKILL)
Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries.- Case Studies.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Developing steady state /Dynamic mathematical model of different unit processes (ODE or PDE)
2. Simulation of steady state/ dynamic models using appropriate software
3. Open loop study based on the developed mathematical model.

COURSE OUTCOMES:
CO1  Will be able to understand different methods of developing models for industrial processes.
CO2  Able to build mathematical models by applying relevant mathematics.
**CO3**  Able to implement mathematical models using relevant software.

**CO4**  Effectively perform analysis and subsequent conclusion for the developed mathematical models.

**CO5**  Able to interpret the results obtained from the mathematical model in terms of original real world problem

**TEXT BOOKS:**

**REFERENCES:**

**List of Open Source Software/ Learning website:**
https://archive.nptel.ac.in/courses/103/107/103107096/
https://nptel.ac.in/courses/103101111
https://nptel.ac.in/courses/111107105
https://www.academia.edu/37228967/Process_Modeling_Simulation_and_Control_for_Chemical_Engineers

**MAPPING OF COs WITH POs AND PSOs**

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1-low, 2-medium, 3-high, '-'- no correlation -
COURSE OBJECTIVES:
- To represent the linear time invariant system in discrete state space form
- To analyze the controllability, observability and stability of a discrete time system.
- To estimate model parameters from input-output measurements
- To design digital controllers
- To design multi-loop and multivariable controllers for multivariable systems

UNIT I  DISCRETE STATE-VARIABLE TECHNIQUE (7+2 SKILL)  9
State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data systems – Stability tests of discrete-data system.

UNIT II  SYSTEM IDENTIFICATION (7+2 SKILL)  9

UNIT III  DIGITAL CONTROLLER DESIGN (7+2 SKILL)  9
Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin's controller – Kalman's algorithm, Pole Placement Controller

UNIT IV  MULTI-LOOP REGULATORY CONTROL (7+2 SKILL)  9

UNIT V  MULTIVARIABLE REGULATORY CONTROL (7+2 SKILL)  9
Introduction to multivariable control – Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Case studies: Distillation Column, CSTR and Four-tank system.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/ Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Calculate the RGA to determine the recommended pairing between controlled and manipulated variables for any system.
2. Seminar on LS, RLS methods.
3. Design of DMC for distillation Column, CSTR and Four-tank system in MATLAB.
4. Design a multi-loop & multivariable controller for MIMO system.
5. Design a model for any industrial process using parametric & non-parametric system.

COURSE OUTCOMES:
CO1 Develop mathematical models for discrete time systems using state variable techniques and analyze the stability of the systems. L4
CO2 Construct models from input-output data by least square and recursive least square method. L5
CO3 Ability to design different digital controllers to satisfy the required criterion. L5
CO4 Design a multi-loop controller and multivariable controller for multi-variable systems. L5
CO5 Ability to design multivariable dynamic matrix controller for industrial processes. L5
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
https://nptel.ac.in/courses/103104050
https://in.mathworks.com/help/ident/
https://ctms.engin.umich.edu/CTMS/index.php?example=Introduction&section=ControlDigital

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CIC333 SYSTEM IDENTIFICATION

COURSE OBJECTIVES:
- To elaborate the concept of estimating the state variables of a system using state estimation algorithms.
- To elaborate the concept of estimating the parameters of the Input-output models using parameter estimation algorithms.
- To make the student understand the various closed loop system identification techniques.
- To provide the background on the practical aspects of conducting experiments for real time system identification.

UNIT I  NON PARAMETRIC METHODS(7+2 SKILL)  9
Nonparametric methods: Transient analysis - frequency analysis - Correlation analysis - Spectral analysis.

UNIT II  PARAMETRIC METHODS(7+2 SKILL)  9

UNIT III  RECURSIVE IDENTIFICATION METHODS(7+2 SKILL)  9

UNIT IV CLOSER LOOP IDENTIFICATION(7+2 SKILL)  9

UNIT V  NONLINEAR SYSTEM IDENTIFICATION(7+2 SKILL)  9
Modeling of nonlinear systems using ANN- NARX & NARMAX - Training Feed-forward and Recurrent Neural Networks – TSK model – Adaptive Neuro-Fuzzy Inference System (ANFIS) - Introduction to Support Vector Regression.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Familiarization of various system identification methods in MATLAB.
2. Seminar on ANFIS
3. Exploration of other advanced system identification methods.

COURSE OUTCOMES:
- CO1  Ability to design and implement state estimation schemes. L5
- CO2  Ability to develop various models (Linear & Nonlinear) from the experimental data. L5
- CO3  Be able to choose a suitable model and parameter estimation algorithm for the identification of systems. L3
CO4  Be able to illustrate verification and validation of identified model. L3
CO5  Ability to develop the model for prediction and simulation purposes using suitable control schemes. L5

TEXT BOOKS:

REFERENCE

List of Open Source Software/ Learning website:
https://in.mathworks.com/help/ident/
https://nptel.ac.in/courses/103106149
https://in.mathworks.com/help/curvefit/nonparametric-fitting.html
https://nptel.ac.in/courses/111102143

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CIC 334  NON LINEAR CONTROL  L  T  P  C
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COURSE OBJECTIVES
- To provide knowledge on design in state variable form.
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter.

UNIT I  STATE VARIABLE DESIGN (7+2 SKILL)  9
Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT II  PHASE PLANE ANALYSIS(7+2 SKILL)  9

UNIT III  DESCRIBING FUNCTION ANALYSIS (7+2 SKILL)  9

UNIT IV  OPTIMAL CONTROL (7+2 SKILL)  9
Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti’s equation – Application examples.

UNIT V  OPTIMAL ESTIMATION (7+2 SKILL)  9
Optimal estimation – KalmanBucy Filter-Solution by duality principle-Discrete systems-Kalman Filter-Application examples.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)10
1  Design of linear quadratic regulator (LQR) control system for any application of your own
2  Familiarization of Kalman filter in MATLAB
3  Seminar on pole placement design

COURSE OUTCOMES:
Students able to
CO1  Able to apply the knowledge gained on state feedback control and nonlinear control. (L3)
CO2  Ability to carryout analysis for common non-linearities in a system. (L4)
CO3  Apply advanced control theory to practical engineering problems. (L3)
CO4  Design optimal controller. (L5)
CO5  Understand the basics and Importance of Kalman filter. (L2)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
- https://onlinecourses.nptel.ac.in/noc22_ee24/preview

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COURSE OBJECTIVES

- To impart knowledge on how to recursively estimate the parameters of discrete input–output models using recursive parameter estimation methods
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To make the student design simple adaptive controllers for linear systems using STR, MRAC and Gain scheduling

UNIT I  INTRODUCTION(7+2 SKILL)  9

UNIT II  GAIN SCHEDULING(7+2 SKILL)  9
Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations- application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback.

UNIT III  DETERMINISTIC SELF-TUNING REGULATORS(7+2 SKILL)  9
Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics

UNIT IV  STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS(7+2 SKILL)  9

UNIT V  MODEL – REFERENCE ADAPTIVE SYSTEM(7+2 SKILL)  9

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  10
1. Learn any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Equivalent open source software)
2. Design of gain scheduling adaptive control using any one software tool
3. Analysis/Problem Solving - Ability to identify and define problems and solutions
4. Design and verification of MRAC by simulation.

COURSE OUTCOMES:

Students able to
CO1  Ability to apply the estimation algorithm to estimate the parameters of the process.(L3)
CO2  Ability to apply the adaptive control concepts to control a process. (L3)
CO3  Use appropriate software tools for design of adaptive controllers and analysis of the process. (L5)
CO4  Identify, formulate, carry out research by designing suitable adaptive schemes for complex instrumentation problem. (L5)
CO5  Apply the concepts to design adaptive control for multidisciplinary problem(L3)
CO6  Choose the techniques for self and lifelong learning to keep in pace with the new technology(L3)

TEXT BOOKS:
REFERENCE BOOKS

List of Open Source Software/ Learning website:
5. https://www.vlab.co.in/

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CIC336  MODEL BASED CONTROL  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To introduce the Knowledge about Multivariable and Multiloop systems.
- To understand the Model predictive control schemes and its elements.
- Get exposed to state space MPC along with case studies.
- To acquire knowledge on various constrained MPC.
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To make the student design simple adaptive controllers for linear systems

UNIT I  INTRODUCTION TO MIMO CONTROL (7+2 SKILL) 9
Introduction to MIMO Systems-Multivariable control-Multiloop Control-Multivariable IMC-IMCPID-Case studies

UNIT II  MODEL PREDICTIVE CONTROL SCHEMES (7+2 SKILL) 9
Introduction to Model Predictive Control - Model Predictive Control Elements - Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme Case Studies

UNIT III  STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME (7+2 SKILL) 9
State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies

UNIT IV  CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME (7+2 SKILL) 9
Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT V  ADAPTIVE CONTROL SCHEME (7+2 SKILL) 9
Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators–MARS-Adaptive Model Predictive Control Scheme – Case Study

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1 Explore various MIMO controllers presently used in industries.
2 Develop MPC, Adaptive and MIMO controllers for industrial processes.
3 Implement the controllers for MIMO systems.
4 Using software tools for practical exposures to the controllers used in industries by undergoing training.
5 Realisation of various optimization techniques for economical operation of process.

COURSE OUTCOMES:
Students able to
CO1 Ability to apply engineering knowledge to understand the control schemes on MIMO systems L3.
CO2 Ability to design controller for MIMO systemL5.
CO3 Ability to analyze the control schemes available in industries L4.
CO4 Ability to design MPC, Adaptive controllers for practical engineering problems L5.
CO5 Ability to choose suitable controllers for the given problems L5.
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1 https://nptel.ac.in/courses/103103037
2 https://nptel.ac.in/courses/108103007
3 https://onlinecourses.nptel.ac.in/noc21_ge01/preview
4 https://nptel.ac.in/courses/127106225

MAPPING OF COs WITH POs AND PSOs

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COURSE OBJECTIVES

- To provide an exposure to different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To provide an exposure to various types of fault tolerant control schemes such as Passive and active approaches.
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

UNIT I  CALCULUS OF VARIATIONS AND OPTIMAL CONTROL(7+2 SKILL) 9

UNIT II  LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM(7+2 SKILL) 9
Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case

UNIT III  DISCRETE TIME OPTIMAL CONTROL SYSTEMS(7+2 SKILL) 9
Variational calculus for Discrete time systems – Discrete time optimal control systems: Fixedfinal state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system

UNIT IV  PONTRYAGIN MINIMUM PRINCIPLE(7+2 SKILL) 9

UNIT V  CONSTRAINED OPTIMAL CONTROL SYSTEMS(7+2 SKILL) 9

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10
1. Interactive MATLAB based project learning in an optimal control system.
2. Familiarize yourself with optimal control software tool boxes.
3. Arrange a group brainstorming process to generate new ideas and possible solutions to an optimal control problem in any field.
4. Analyse the difference between optimal control systems with other types of control system.
5. Homework assignment on optimal control.
COURSE OUTCOMES:
Students able to

CO1 Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.

CO2 Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)

CO3 Design optimal controller using Dynamic Programming Approach and H-J-B equation.

CO4 Explain the Pontryagin Minimum Principle.

CO5 Design optimal controller in the presence of state constraints and time optimal controller.

CO6 Understand the concepts of dynamic programming

TEXT BOOKS:

REFERENCE BOOKS

List of Open Source Software/ Learning website:
1. https://in.mathworks.com/discovery/optimal-control.html#lqrlqg
2. https://www.codeproject.com/Articles/863257/Simple-Software-for-Optimal-Control
5. https://www.vlab.co.in/

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1. low, 2-medium, 3-high, ‘-‘- no correlation
COURSE OBJECTIVES:

- To make the students familiarize with the concept of condition-based maintenance for effective utilization of machines.
- To impart the knowledge of artificial intelligence for machinery fault diagnosis.
- To give basic knowledge on vibration monitoring.
- To study the machinery vibrations using signal processing techniques.
- To provide knowledge on FMECA.

UNIT I INTRODUCTION TO MACHINE CONDITION MONITORING (7+2 SKILL) 9
Machinery condition monitoring - Present status - Fault prognosis - Future needs.

UNIT II MACHINERY MAINTENANCE (7+2 SKILL) 9

UNIT III INTRODUCTION TO MACHINERY VIBRATION AND MONITORING (7+2 SKILL) 9

UNIT IV SIGNAL PROCESSING IN MACHINERY MONITORING (7+2 SKILL) 9

UNIT V MACHINE LEARNING FOR CONDITION MONITORING (7+2 SKILL) 9
Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components, Distillation column.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)10
1 Survey of critical machinery that requires monitoring system.
2 Exposure to practical machinery vibration & monitoring system presently in use.
3 Carryout FMECA using software.
4 Analyze the health condition of any machinery.

COURSE OUTCOMES:

CO1 Ability to identify the faults in machinery L1.
CO2 Choose the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine L3.
CO3 Construct a classifier model for machine learning based fault diagnosis L5.
CO4 Predict the faulty component in a machine by analyzing the acquired vibration signals L2.
CO5 Ability to analyze & build a model using modern tools L4.
REFERENCES:

List of Open Source Software/ Learning website:
1. https://onlinecourses.nptel.ac.in/noc22_cs29/preview

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APPLIED INSTRUMENTATION

CIC339 FIBER OPTICS INSTRUMENTATION  L  T  P  C
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COURSE OBJECTIVES
1. To provide knowledge on the theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics, and losses associated with optical fibers.
2. To provide an overview of recent advances in fiber optic sensor technology.
3. To provide knowledge on principles of laser generation, laser systems and its types.
4. To emphasize how lasers have been used for industrial applications.
5. To provide knowledge on the fundamentals of holography and medical applications of lasers.

UNIT I OPTICAL FIBER AND THEIR PROPERTIES 9

UNIT II FIBER OPTIC SENSORS 9
Fiber optic sensors – Fiber optic instrumentation system for measurement of fiber characteristics – Different types of modulators – Interferometric method for measurement of length – Measurement of pressure, temperature, electric field, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

UNIT V HOLOGRAPHY AND MEDICAL APPLICATIONS OF LASERS 9

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Interpretation of various Laser instruments failure case studies
3. Design and Development of Fiber Optics Cables/Sensors in Large Industries/Database Center.
4. Modelling and understanding of Laser Instruments using hardware
5. Introduction to other Laser Instruments not covered in the above syllabus

170
COURSE OUTCOMES (COs)
- Ability to utilize the principles of light transmission, characteristics and losses in optical fibers for measurement applications.
- Ability to apply the concepts of optical fibers for its use in sensor development as well as important applications in production, manufacturing and industrial applications.
- Ability to compare the lasing theory of various laser generation systems.
- Ability to design laser systems for measurement of physical quantities and for industrial applications.
- Ability to select lasers for a specific Industrial and medical application.
- Ability to apply the principles of lasers for creating new sensors and measurement systems.

TEXT BOOKS:

REFERENCE BOOKS:

LIST OF OPEN SOURCE SOFTWARE/ LEARNING WEBSITE:
1. https://nptel.ac.in/courses/115102124

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1-low, 2-medium, 3-high, ‘-“ - no correlation
COURSE OBJECTIVES:
1. To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
2. To impart fundamental knowledge on gas chromatography and liquid chromatography.
3. To integrate a fundamental understanding of the underlying principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
4. To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
5. To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I SPECTROPHOTOMETRY (7+2 SKILL) 9

UNIT II CHROMATOGRAPHY (7+2 SKILL) 9

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS (7+2 SKILL) 9
Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT IV pH METERS AND DISSOLVED COMPONENT ANALYZERS (7+2 SKILL) 9

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY (7+2 SKILL) 9

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. A seminar on applications of various analytical techniques.
2. Selection of Chromatography for applications.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
4. Realization of spectroscopy and analyzers in hardware.
5. Introduction to other advanced spectroscopy and analyzer not covered in the above syllabus

COURSE OUTCOMES:

CO1 Understand the basic concept of qualitative and quantitative analysis of a given sample. L2

CO2 Explain the working knowledge of analytical instrumentation typically employed in chemical/biochemical research and industry laboratories. L2

CO3 Apply the fundamental principles of selective analytical instruments for separation, identification and quantitative analysis of chemical substances. L4

CO4 Differentiate between online and offline process and identify suitable instruments for analysis. L4

CO5 Describe the relative strengths and limitations of different instrumental based analysis methods. L2

CO6 Identify and suggest a suitable analytical method for a specific application. L1

TEXT BOOKS:


REFERENCES:

4. NPTEL lecture notes on, “Modern Instrumental methods of Analysis” by Dr.J.R. Mudakavi, IISC, Bangalore

List of Open Source Software/ Learning website:

https://nptel.ac.in/courses/103108100
https://nptel.ac.in/courses/103108139
https://instrumentationtools.com/oxygen-analyzer-working-principle/
https://www.excedr.com/blog/spectrometer-vs-spectrophotometer/
https://nptel.ac.in/courses/104106122
http://www.premierbiosoft.com/tech_notes/mass-spectrometry.html
https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumental_Analysis/Chromatography/Gas_Chromatography

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COURSE OBJECTIVES:

1. General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, subsystem design and hybrid vehicle control.
2. Understand about vehicle dynamics,
3. Design the required energy storage devices,
4. Select the suitable electric propulsion systems and Understand of hybrid electric vehicles.

UNIT I  
NEED FOR ALTERNATIVE SYSTEM (7+2 SKILL)  
Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II  
DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES (7+2 SKILL)  

UNIT III  
ENERGY SOURCES (7+2 SKILL)  

UNIT IV  
MOTORS AND CONTROLLERS (7+2 SKILL)  
Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT V  
SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES (7+2 SKILL)  

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Driving cycle development for electric vehicle simulation
2. Selection of components for electrical vehicle applications.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open-source software)
4. Design and verification of electric vehicle through simulation
5. Analysis of recent trend in electric vehicles
6. Introduction to other advanced electric vehicle system not covered in the above syllabus

COURSE OUTCOMES:

CO1 Outline of electric and hybrid vehicle operation and architectures. L1
CO2  Design of hybrid and electric vehicles. L5
CO3  Summarize the energy requirement for vehicles. L2
CO4  Illustrate the vehicle characteristics, operating modes, and performance parameters of the vehicle. L3
CO5  Analyze the different subsystems of hybrid and electric vehicles. L4

TEXT BOOKS:
1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2010

REFERENCES:

List of Open Source Software/ Learning website:
http://nptel.iitm.ac.in/courses.php
https://nptel.ac.in/courses/108103009
https://archive.nptel.ac.in/courses/108/106/108106182/
https://archive.nptel.ac.in/content/storage2/courses/downloads_new/LectureNotes/108103009/108103009.zip
https://nptel.ac.in/courses/108106170

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1-low, 2-medium, 3-high, '-' - no correlation
COURSE OBJECTIVES:

1. Gain knowledge on different types of power plants.
2. Study about the important process variables and their measurements.
3. To understand the important control loops involved in thermal power plants.
4. To analyze the various parameters related to steam turbines.

UNIT I  OVERVIEW OF POWER GENERATION (7+2 SKILL)  9

UNIT II  MEASUREMENTS IN POWER PLANTS (7+2 SKILL)  9

UNIT III  BOILER CONTROL – I (7+2 SKILL)  9

UNIT IV  BOILER CONTROL – II (7+2 SKILL)  9

UNIT V  TURBINE MONITORING AND CONTROL (7+2 SKILL)  9
Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient speed rise – Free governor mode operation – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  10
1. A seminar on Role of control and instrumentation in thermal power plant.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
3. Design and verification of any simple power plant circuit through simulation.
4. Introduction to other power plants in the world not covered in the above syllabus
5. Quiz on power plants, boiler control and turbine monitoring.

COURSE OUTCOMES:

CO1  Understand and analyze the process diagram of hydel, thermal, nuclear, wind andsolar power plants. L2

CO2  Identify the instruments for monitoring various parameters related to thermal power plant. L1

CO3  Analyze and select appropriate control strategy for various systems involved in thermal power plant. L4
CO4 Recognize the important terms related to turbine monitoring system and able to analyze the problems related to turbine governing.(L1)

CO5 Ability to understand the concepts of safety interlocks applied for combustion process.(L1)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
https://nptel.ac.in/courses/112107291
https://instrumentationtools.com/drum-level-control-systems/
https://nptel.ac.in/courses/112103243
https://jntua.ac.in/gate-online-classes/registration/downloads/material/a159185656721.pdf
https://kanchiuniv.ac.in/coursematerials/LECTURENOTESEIEPHASE2/POWER%20PLANT%20INSTRUMENTATION%20-%20TS.pdf

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1-low, 2-medium, 3-high, '-' - no correlation
COURSE OBJECTIVES:
1. To introduce the students the method of oil recovery and the steps involved in oil gas production process.
2. To make the students understand the process behavior of some of the important unit operations in petrochemical industry through mathematical model.
3. To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
4. To provide information about the most important derivatives obtained from petroleum products.
5. To help the students in understanding selection and maintenance of instruments in petrochemical industry.

UNIT I  OIL EXTRACTION AND OIL GAS PRODUCTION (7+2 SKILL)  9
Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.

UNIT II  IMPORTANT UNIT OPERATIONS IN REFINERY (7+2 SKILL)  9

UNIT III  DERIVATIVES FROM PETROLEUM (7+2 SKILL)  9
Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene — Derivatives from ethylene – Derivatives from propylene.

UNIT IV  IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS(7+2 SKILL)  9

UNIT V  SAFETY IN INSTRUMENTATION SYSTEMS (7+2 SKILL)  9

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1 A Seminar on Role of Instrumentation in petrochemical industry.
2 Selection of petroleum products for applications.
3 Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
4 Quiz on derivatives, refinery and other petroleum products.
5 Introduction to other advanced detectors not covered in the above syllabus
COURSE OUTCOMES:
CO1 Sketch the oil gas production process and important unit operations in a refinery. L3
CO2 Infer the process knowledge, ability to develop and analyze mathematical model of selective processes. L2
CO3 Analyze and select appropriate control strategy for selective unit operations in a refinery. L4
CO4 Identify the most important chemical derivatives obtained from petroleum products. L1
CO5 Understand safety instrumentation followed in process industries. L2

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
https://whatissiping.com/safety-instrumented-systems-sis/
https://www.britannica.com/technology/petroleum-refining/Petroleum-products-and-their-uses
https://uma.ac.ir/files/site1/m_ghorbanpour_6ffe535/refinery_3.pdf
https://www.omicsonline.org/conferences-list/petroleum-derivatives-synthesis-and-application
https://folk.ntnu.no/onshus/Oil%20and%20gas%20production%20handbook%20ed1x3a5%20comp.pdf
https://nptel.ac.in/courses/114106039
https://library.e.abb.com/public/34d5b70e18f7d6c8c1257be500438ac3/Oil%20and%20gas%20production%20handbook%20ed3x0_web.pdf

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COURSE OBJECTIVES:

1. To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
2. To make the students understand different layers of protection.
3. To make student conscious about safety instrumentation applications.
4. To make the students aware of potential events and impact of failures.
5. To make students aware of design, installation and maintenance procedures.

UNIT I  INTRODUCTION (7+2 SKILL)


UNIT II  PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS (7+2 SKILL)


UNIT III  SAFETY INTEGRITY LEVEL (SIL) (7+2 SKILL)

Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.

UNIT IV  SYSTEM EVALUATION (7+2 SKILL)


UNIT V  CASE STUDY (7+2 SKILL)


TOTAL : 45 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Interpretation of various standards and safety regulations
2. Selection of Safety system for applications.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
4. Seminar on interpretation of safety system failure case studies
5. Realization of safety regulation in immediate environment
6. Introduction to other advanced safety system not covered in the above syllabus

COURSE OUTCOMES:
CO1 Analyse the role of safety instrumented system in the industry. L4
CO2 Define various hazards in industry environment. L1
CO3 Summarize the safety integrity level for an application. L2
CO4 Distinguish the safety environment in industry. L2
CO5 Analyse the failure modes, failure rates and MTBF using various reliability engineering tools. L4
CO6 Apply the design, installation and maintenance procedures for SIS applied to industrial processes. L3

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
http://nptel.iitm.ac.in/courses.php
https://nptel.ac.in/courses/110105094
https://nptel.ac.in/courses/110105160
https://nptel.ac.in/courses/112106177
http://nptel.iitm.ac.in/courses.php

MAPPING OF COs WITH POs AND PSOs

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

181
CIC345  RENEWABLE SYSTEMS  

COURSE OBJECTIVES:
1. Awareness about renewable Energy Sources and technologies.
2. Adequate inputs on a variety of issues in harnessing renewable Energy.
3. Recognize current and possible future role of renewable energy sources.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies

UNIT I  RENEWABLE ENERGY (RE) SOURCES (7+2 SKILL)  
Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II  WIND ENERGY (7+2 SKILL)  
Power in the Wind – Types of Wind Power Plants (WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT III  SOLAR PV AND THERMAL SYSTEMS (7+2 SKILL)  

UNIT IV  BIOMASS ENERGY (7+2 SKILL)  

UNIT V  OTHER ENERGY SOURCES (7+2 SKILL)  

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. A Seminar on different types of renewable energy.
2. Quiz on different types of renewable energy systems.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
4. Design and verification of any power plant circuit through simulation.
5. Introduction to other renewable resources not covered in the above syllabus

COURSE OUTCOMES:
CO1 Recognize the Indian and global energy scenario. L1
CO2 Classify the various solar energy technologies and its applications. L2
CO3 Analyze the various wind energy technologies. L4
CO4 Outline the various bio-energy technologies. L4
CO5 Describe the ocean and geothermaltechnologies. L1
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
https://nptel.ac.in/courses/103103206
https://nptel.ac.in/courses/113104084
https://www.vssut.ac.in/lecture_notes/lecture1428910296.pdf
https://personal.ems.psu.edu/~radovic/Chapter16.pdf
https://nptel.ac.in/courses/103103207
https://nptel.ac.in/courses/115103123

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1-low, 2-medium, 3-high, ‘-’ - no correlation
COURSE OBJECTIVES:
1. To define the glossary related to vehicle electrical and electronic system.
2. To understand the need for starter batteries, starter motor and alternator in the vehicle.
3. To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
4. To list common types of sensor and actuators used in vehicles.
5. To understand networking in vehicles

UNIT I  INTRODUCTION AND AUTOMOTIVE BATTERIES  9
Introduction - Overview of vehicle electrical systems- Electrical circuits - Electrical power supply in conventional vehicle- Dimensioning of wires- Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing- Maintenance -free batteries – Battery – Substitute, versions, special cases.

UNIT II  STARTING AND CHARGING SYSTEM  9

UNIT III  IGNITION, LIGHTING AND AUXILLARY SYSTEM  9

UNIT IV  AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS  9

UNIT V  VEHICLE NETWORKING  9
Data transfer between automotive Electronics systems - Basic principles of networking- Network topology- Network organization- OSI reference model- Control mechanisms - communication protocols in embedded systems-- Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems- Classification of bus systems- Applications in the vehicle - Coupling of networks- Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL : 45 PERIODS
COURSE OUTCOMES:
CO1 Define the glossary related to vehicle electrical and electronic system
CO2 Understand the need for starter batteries, starter motor and alternator in the vehicle.
CO3 Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
CO4 List common types of sensor and actuators used in vehicles.
CO5 Understand networking in vehicles.

TEXT BOOKS:

REFERENCES:

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HEALTH CARE INSTRUMENTATION

BM3491

BIOMEDICAL INSTRUMENTATION

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals.
- To understand the design of bioamplifiers
- To explain the different techniques used for measurement of non-electrical bio-parameters
- To explain the biochemical measurement techniques as applicable for diagnosis and treatment.

UNIT I  ELECTRODE CONFIGURATION


UNIT II  BIOSIGNAL CHARACTERISTICS

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven’s triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT III  BIOAMPLIFIERS


UNIT IV  MEASUREMENT OF BIO SIGNALS


UNIT V  BIOCHEMICAL MEASUREMENTS


COURSE OUTCOMES:

On successful completion of this course, the student will be able to
CO1 : Illustrate the origin of various biological signals and their characteristics.
CO2: Gain knowledge on characteristics of bio signals.
CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of biosignals.
CO4: Explain the different measurement techniques for non-electrical bio-parameters
CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment.

TOTAL: 45 PERIODS
TEXT BOOKS:

REFERENCE BOOKS

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CBM335 BIO SIGNAL PROCESSING L T P C
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OBJECTIVES:
The student should be made to:
- To study the characteristics of different biosignals
- To learn linear and non-linear filtering techniques to extract desired information
- To understand various techniques for automated classification and decision making to aid diagnosis

UNIT I BIO SIGNAL AND SPECTRAL CHARACTERISTICS

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION
Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.
UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA,ICA.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Preprocess the Biosignals.
CO2: Analyze biosignals in time domain & to estimate the spectrum.
CO3: Apply wavelet detection techniques for biosignal processing.
CO4: Classify Biosignals using neural networks and statistical classifiers.
CO5: Extract the features using multivariate component analysis.

TOTAL PERIODS:45

TEXT BOOKS

REFERENCES

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OBJECTIVES:
1. To provide information about various medical imaging modalities.
2. To understand the basic concepts of image enhancement, image restoration, morphological image processing, image segmentation, feature recognition in medical images.
3. To provide information about classification and image visualization in medical image processing projects.
4. To familiarize the student with the image processing facilities in Matlab and its equivalent open source tools.

UNIT I  FUNDAMENTALS OF IMAGE PROCESSING  9
Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

UNIT II  BIO-MEDICAL IMAGE PREPROCESSING  9

UNIT III  MEDICAL IMAGE RECONSTRUCTION  9
Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultrasound imaging. 3D Ultrasound imaging. Nuclear Medical Imaging modalities – SPECT, PET, Molecular Imaging.

UNIT IV  IMAGE ANALYSIS AND CLASSIFICATION  9
Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature Extraction and Representation-Statistical, Shape, Texture features. Statistical and Neural Network based image classification.

UNIT V  IMAGE REGISTRATIONS AND VISUALIZATION  9
Image Registration: Rigid body transformation – Affine transformation, Principal axes registration, Iterative principal axes registration, Feature based registration, Elastic deformation based registration, Registration of Images from Different modalities, Evaluation of Registration Methods. Image visualization: 2-D display methods, 3-D display methods, surface and volume based 3-D display methods – Surface Visualization and Volume visualization, 3-D Echocardiography, 3D+time Echocardiography, virtual reality based interactive visualization.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/MiniProject/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATEquestions/ etc)
1. Survey different algorithms for segmentation of various medical images.
2. Identify suitable open source software for 2D and 3D visualization of medical images.
3. Compare various segmentation techniques and its suitability for the given medical image.
4. Conduct a literature survey and find the best preprocessing technique for medical images.
5. Develop the best Machine learning algorithm to preprocess and classify different images.
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2825001/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2039808/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2825001/

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:

CO1 Apply basic medical image processing algorithms. [L3]
CO2 Image pre-processing applications that incorporates different concepts of filters for medical Image Processing. [L3]
CO3 Summarize about medical imaging and reconstruction for high dimensionality visualization. [L2]
CO4 Analysis of image segmentation, feature extraction and image classification. [L4]
CO5 Relate the knowledge in image registration and visualization and possibility of applying Image processing concepts in modern hospitals. [L3]

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OBJECTIVES:
- To understand the generation of X-ray and its uses in Medical imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety

UNIT I X RAYS

UNIT II COMPUTED TOMOGRAPHY

UNIT III MAGNETIC RESONANCE IMAGING
Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR IMAGING

UNIT V RADIATION THERAPY AND RADIATION SAFETY

COURSE OUTCOMES:
At the end of the course the student will be able to:
CO1: Describe the working principle of the X-ray machine and its application.
CO2: Illustrate the principle computed tomography
CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
CO4: Demonstrate the applications of radionuclide imaging.
CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

TEXT BOOKS:
1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and
REFERENCE BOOKS

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OBJECTIVES:
1. To explain the basic concepts of robots and types of robots
2. To discuss the designing procedure of manipulators, actuators and grippers.
3. To impart knowledge on various types of sensors and power sources.
4. Explore various applications of Robots in Medicine.

UNIT I  INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II  MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor.

UNIT III  SURGICAL ROBOTS

UNIT IV  REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication, Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study.

UNIT V  WEARABLE ROBOTS

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/MiniProject/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATEquestions/ etc)
1. Compare PD and PID feedback actuator models.
2. Explore and compare the specifications of various Sensors and Actuators used in Medical robotics.
3. Find the wearable medical robots which are commercially available.
4. List out the recent trends in surgical robots and their advancements.
5. Develop a design methodology for wearable medical robots

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
- https://www.mdpi.com/journal/sensors/special_issues/mb_sensors
- https://builtin.com/robotics/surgical-medical-healthcare-robotics-companies
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8401039/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3779610/

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:

CO1 Describe the configuration, applications of robots and the concept of grippers and actuators. [L1]
CO2 Explain the functions of manipulators and basic kinematics. [L2]
CO3 Describe the application of robots in various surgeries. [L1]
CO4 Design and analyze the robotic systems for rehabilitation. [L5]
CO5 Design the wearable robots. [L5]

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OBJECTIVES:
The student should be made to:
- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT I INTRODUCTION TO BCI

UNIT II ELECTROPHYSIOLOGICAL SOURCES

UNIT III FEATURE EXTRACTION METHODS

UNIT IV FEATURE TRANSLATION METHODS

UNIT V APPLICATIONS OF BCI

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe BCI system and its potential applications.
CO2: Analyze event related potentials and sensory motor rhythms.
CO3: Compute features suitable for BCI.
CO4: Design classifier for a BCI system.
CO5: Implement BCI for various applications.

TOTAL PERIODS:45

TEXT BOOKS

REFERENCES
OBJECTIVES:
The student should be made to:
- Understand the devices for measurement of parameters related to cardiology.
- Illustrate the recording and measurement of EEG
- Demonstrate EMG recording unit and its uses.
- Explain diagnostic and therapeutic devices related to respiratory parameters.
- Understand the various sensory measurements that hold clinical importance.
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the working and recording setup of all basic cardiac equipment.
CO2: Understand the working and recording of all basic neurological equipment’s.
CO3: Discuss the recording of diagnostic and therapeutic equipment’s related to EMG.
CO4: Explain about measurements of parameters related to respiratory system.
CO5: Describe the measurement techniques of sensory responses.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

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Progress Through Knowledge
OBJECTIVES:
The student should be made to:

- To explain the application of Physiological models and vital organs.
- To Formulate the methods and techniques for analysis and synthesis of dynamic models
- To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.
- To describe nonlinear models of physiological systems
- To compute the Simulation of physiological systems

UNIT I  INTRODUCTION TO PHYSIOLOGICAL MODELING  9
Approaches to modelling: The technique of mathematical modelling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modelling. Introduction to physiology (homeostasis, cell biology) Modelling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.

UNIT II  MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM  9
Dynamic systems and their control, modelling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.

UNIT III  NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS  9

UNIT IV  COMPARTMENTAL PHYSIOLOGICAL MODEL  9
Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modelling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation. Mathematical modelling of the system: Thermo regulation, Theremoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

UNIT V  SIMULATION OF PHYSIOLOGICAL SYSTEMS  9
Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to

- CO1: Explain the application of Physiological models
- CO2: Describe the methods and techniques for analysis and synthesis of Linear and dynamic system
- CO3: Develop differential equations to describe the compartmental physiological model
- CO4: Describe Nonlinear models of physiological systems
- CO5: Illustrate the Simulation of physiological systems

TOTAL PERIODS: 45
TEXT BOOKS

REFERENCES

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SEMICONDUCTOR / COMMUNICATION

CEI349 DIGITAL VLSI L T P C

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COURSE OBJECTIVES:
1. To learn the fundamentals of VLSI design
2. To familiarize with VLSI combinational logic circuits design
3. To familiarize with VLSI sequential logic circuits design
4. To learn the various arithmetic circuits and testing methodologies
5. To familiarize with the different FPGA architectures

UNIT I MOS TRANSISTOR PRINCIPLES (7+2 SKILL) 9

UNIT II COMBINATIONAL LOGIC CIRCUITS (7+2 SKILL) 9
Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic, Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NORA logic

UNIT III SEQUENTIAL LOGIC CIRCUITS (7+2 SKILL) 9
Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING (7+2 SKILL) 9
Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing-Manufacturing test principles- Design for testability. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multiplier.

UNIT V IMPLEMENTATION STRATEGIES (7+2 SKILL) 9
Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fabrication cost)

TOTAL 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10
1. Interpretation of Data Sheet of transistors and ICs with respect to their Static and Dynamic Characteristics.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware
   Introduction to other advanced logic circuits not covered in the above syllabus
COURSE OUTCOMES:
CO1 Relate characteristics and realize modeling of MOS transistors. (L1)
CO2 Explain the design combinational logic using various logic styles, satisfying static and dynamic requirements (L2)
CO3 Apply timing issues of sequential logic and design memories. (L3)
CO4 Analyse and design data path elements (L4)
CO5 Build FPGA architecture and interconnect methodology (L3)

REFERENCES:

List of Open Source Software/ Learning website:
1. https://lecturenotes.in/subject/1159/digital-vlsi
2. https://edurev.in/studytube/Digital-VLSI-design--Lecture-Notes--ECE--Engineer/7565abc5-b92d-4f7b-bc7c-6e029807cdab_p
3. https://nptel.ac.in/courses/117103066
4. https://nptel.ac.in/courses/117106086
5. https://archive.nptel.ac.in/courses/117/101/117101004/

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COURSE OBJECTIVES:
1. To understand basic semiconductor manufacturing technology
2. To know Integrated Circuit Fabrication
3. To introduce the basic semiconductor manufacturing processes
4. To familiarize with steps involved in CMOS IC chip fabrication
5. To explain major processing technology used IC manufacturing.
6. 

UNIT - I INTRODUCTION TO SEMICONDUCTOR MANUFACTURING 9
Historical perspective, processing overview, semiconductor materials, semiconductor devices, process technology, fabrication steps.

UNIT - II MANUFACTURING PROCESS: CRYSTAL GROWTH, SILICON 9
OXIDATION, PHOTOLITHOGRAPHY
Silicon crystal growth, material characterization, thermal oxidation process, impurity redistribution, masking properties of silicon dioxide, oxidation thickness characteristics.

UNIT - III MANUFACTURING PROCESS: ETCHING, DIFFUSION, ION 9
IMPLANTATION, FILM DEPOSITION
Wet chemical etching, Dry etching, basic diffusion process, extrinsic diffusion, lateral diffusion, Photolithography, Ion Implantation, implanted damage and annealing, epitaxial growth techniques, structures and defects, dielectric deposition, metallization.

UNIT - IV PROCESS INTEGRATION 9
Passive components, bipolar technology, MOSFET Technology, MESFET Technology, MEMS Technology.

UNIT - V IC MANUFACTURING 9
Electrical testing, packing, statistical process control, computer integrated manufacturing, challenges for integration, system-on-a-chip.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10
Interpretation of Data Sheet of transistors and ICs with respect to their Static and Dynamic Characteristics.
Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software)
Design and verification of simple signal conditioning circuit through simulation
Realization of signal conditioning circuit in hardware
Introduction to other advanced logic circuits not covered in the above syllabus

COURSE OUTCOMES:
Students able to
CO1 Relate technology changes from semiconductor manufacturing industry.
CO2 Explain steps for making silicon wafers from sand.
CO3 Apply various technology involved in manufacturing.
CO4 Analyze the integration of steps in CMOS IC chip fabrication.
CO5 Build CMOS-based used in the electronics industry.
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108106181
2. https://nptel.ac.in/courses/117102061
4. https://nptel.ac.in/courses/108108112

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1-low, 2-medium, 3-high, ‘-‘-no correlation
OBJECTIVES:
1. To define the glossary related to vehicle electrical and electronic system.
2. To understand the need for starter batteries, starter motor and alternator in the vehicle.
3. To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
4. To list common types of sensor and actuators used in vehicles.
5. To understand networking in vehicles

UNIT I  INTRODUCTION AND AUTOMOTIVE BATTERIES  9
Introduction - Overview of vehicle electrical systems - Electrical circuits - Electrical power supply in conventional vehicle - Dimensioning of wires - Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing - Maintenance -free batteries – Battery – Substitute, versions, special cases

UNIT II  STARTING AND CHARGING SYSTEM  9
Alternators – Generation of electrical energy in vehicle - physical principles - Alternator and voltage regulations versions – power losses – characteristics curve - Alternator operation in the vehicle - Alternator circuitry. Starter Motors – Development and Starting requirements in the IC engines- starter motor design – Starter motor design variations – starter motor control and power circuits

UNIT III  IGNITION, LIGHTING AND AUXILLARY SYSTEM  9

UNIT IV  AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS  9

UNIT V  VEHICLE NETWORKING  9
Data transfer between automotive Electronics systems - Basic principles of networking- Network topology- Network organization- OSI reference model- Control mechanisms - communication protocols in embedded systems- Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems- Classification of bus systems- Applications in the vehicle - Coupling of networks- Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL PERIODS: 45
COURSE OUTCOMES:
CO1 Define the glossary related to vehicle electrical and electronic system
CO2 Understand the need for starter batteries, starter motor and alternator in the vehicle.
CO3 Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
CO4 List common types of sensor and actuators used in vehicles
CO5 Understand networking in vehicles.

TEXT BOOKS:

REFERENCES:

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COURSE OBJECTIVES:
1. To understand knowledge on the theories and eco-design concepts of green electronics
2. To familiarize with green electronic materials and products
3. To design sustainable green electronic products
4. To gain knowledge on Flip-Chip Assembly Process
5. To address issues on environmental impact; product design, operating life, and the 3R concept (reduce, reuse, and recycle).

UNIT I INTRODUCTION TO GREEN ELECTRONICS (7+2 SKILL) 9
Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT II GREEN ELECTRONICS MATERIALS AND PRODUCTS (7+2 SKILL) 9

UNIT III GREEN ELECTRONICS ASSEMBLY AND RECYCLING (7+2 SKILL) 9
Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments used. Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT IV FLIP-CHIP ASSEMBLY AND BONDING FOR LEAD-FREE ELECTRONICS(7+2 SKILL) 9

UNIT V CASE STUDIES (7+2 SKILL) 9

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Interpretation of Data Sheet of electronics with respect to their Static and Dynamic Characteristics.
2. Selection of green electronics for product design.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/...
Equivalent open source software)
4 Design and verification of simple signal conditioning circuit thro simulation.
5 Realization of signal conditioning circuit in hardware
6 Introduction to other advanced green electronics not covered in the above syllabus

COURSE OUTCOMES:
CO1 Relate theories, eco-design concepts and methods of green electronics (L1)
CO2 Explain the various materials used in green electronic products (L2)
CO3 Apply technology related to e-waste recycle system (L3)
CO4 Analyze eco-design processes involved in electronic industry. (L4)
CO5 Build environment friendly electronic manufacturing systems. (L3)

TEXT BOOKS:

REFERENCES:
2. Green Communications and Networks, by Yuhang yang and Maode Ma, Springer Publication.

List of Open Source Software/ Learning website:
1 http://tid.uio.no/kurs/fys4260/4260-Green_electronics.pdf
2 https://web.stanford.edu/class/ee152/resources/Course_Notes_092416.pdf

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1-low, 2-medium, 3-high, '-'- no correlation
COURSE OBJECTIVES:
1. To study the architecture and programming of ARM processors
2. To introduce the basic concepts of hard real time multiprocessing.
3. To introduce the analytical concepts for effective programming
4. To know about operating systems
5. To familiarize with networks for embedded

UNIT I  INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS  9
(7+2 SKILL)
Complex systems and microprocessors – Embedded system design process – Formalism for
system design– Design example: Model train controller- ARM Processor Fundamentals-
Instruction Set and Programming using ARM Processor.

UNIT II  COMPUTING PLATFORM (7+2 SKILL)  9
CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor –
Memory system mechanism – CPU performance – CPU power consumption- CPU buses –
Memory devices – I/O devices – Component interfacing- System Level Performance Analysis-
Parallelism. Design Example: Data Compressor.

UNIT III  PROGRAM DESIGN AND ANALYSIS (7+2 SKILL)  9
Program design – Model of programs – Assembly and Linking – Basic compilation techniques –
Program Optimization- Analysis and optimization of execution time, power, energy, program size
– Program validation and testing- Example: Software Modem.

UNIT IV  PROCESS AND OPERATING SYSTEMS (7+2 SKILL)  9
Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems –
Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms –
Evaluating operating system performance – Power optimization strategies for processes.

UNIT V  HARDWARE ACCELERATORS & NETWORKS (7+2 SKILL)  9
Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded
based design – Internet enabled systems. Design Example: Elevator Controller.

TOTAL PERIODS 45

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1 Interpretation of Processors.
2 Selection of Processor for applications.
3 Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/
Proteus/ Equivalent open source software)
4 Design and verification of simple signal conditioning circuit thro simulation.
5 Realization of signal conditioning circuit in hardware
6 Introduction to other advanced Processors not covered in the above syllabus

COURSE OUTCOMES:
CO1 Design and develop ARM processor based systems (L5)
CO2 Explain role of microcontrollers in embedded systems.(L2)
CO3 Apply program design and optimization and proper scheduling of the process. (L3)
CO4 Analyse the concept of process, multiprocesses and operating systems in embedded
system design. (L4)
CO5 Build various communication protocols in distributed embedded computing platform.
(L3)
REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/117106111
2. https://onlinecourses.nptel.ac.in/noc20_cs16/preview
5. https://nptel.ac.in/courses/117106112

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CEI354 SOLAR PV FUNDAMENTAL AND APPLICATIONS L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To various solar PV and solar thermal technologies
2. To know the basic parameters of solar PV panels and systems
3. To familiarize the standard test conditions under which the parameters are measured
4. To design of solar PV system for electrical energy requirements, sizing of PV modules, battery, electronics, etc.
5. To design of solar thermal system for given thermal energy requirements

UNIT I OVERVIEW OF SEMICONDUCTOR (7+2 SKILL) 9
Review of Semiconductor Physics, Charge carrier generation and recombination, p-n junction model and depletion capacitance, Current voltage characteristics in dark and light, Equivalent Circuits of Solar Cells, Fill Factor, Fabrication Process of Semiconductor Grade Silicon
UNIT I SOLAR PV TECHNOLOGY (7+2 SKILL)  9

UNIT III DESIGN OF SOLAR PV SYSTEM (7+2 SKILL)  9
Design of solar hot water system: solar thermal system components, use of thermo syphon effect, estimation of the energy required for heating water, collector area, typical losses in conversion, efficiency equation of solar thermal system, solar PV system components, block diagram of simple (no storage, no electronics) and complicated systems (grid tied with diesel and wind generators), sizing solar PV, battery and power conditioning units required in solar system, configuration of battery and panels, fixing input and output parameters of all system components.

UNIT IV FABRICATION OF ORGANIC SOLAR CELLS (7+2 SKILL)  9

UNIT V FABRICATION OF PEROVSKITE SOLAR CELLS (7+2 SKILL)  9
Perovskite Solar Cells, Fabrication of perovskite solar cells, Photophysics in perovskite solar cells, Stability in perovskite solar cells, Lead free perovskite solar cells, Photovoltaic system engineering, Thermo-Photovoltaic generation of electricity, Concentration and storage of electrical energy, Photovoltaics modules, system and application, Green energy building.  TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  10
1. Interpretation of Data Sheet of solar cells.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ PV system design Software
   https://www.pvsyst.com/
   https://www.homerenergy.com/homer/software
   https://solargis.com/ Equivalent open source software)
3. Design and verification of simple signal conditioning circuit thro simulation.
4. Realization of signal conditioning circuit in hardware
5. Introduction to other advanced solar cells not covered in the above syllabus

COURSE OUTCOMES:
CO1 Understand various solar energy technologies, how sun light can be converted in electrical and heat energy (L2)
CO2 Discuss the efficiency of technologies measured. (L2)
CO3 Relate various components of solar PV system to fulfill given electricity requirements. (L1)
CO4 Relate organic solar system to fulfill given organic energy requirements. (L1)
CO5 Relate perovskite solar system to fulfill given perovskite energy requirements. (L1)

TEXT BOOKS:

REFERENCES:
List of Open Source Software/ Learning website:

3. https://www.uprm.edu/aret/docs/Ch_5_PV_systems.pdf

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EC3491 COMMUNICATION SYSTEMS

COURSE OBJECTIVES:
- To introduce Analog Modulation Schemes
- To impart knowledge in random process
- To study various Digital techniques
- To introduce the importance of sampling & quantization
- To impart knowledge in demodulation techniques
- To enhance the class room teaching using smart connectivity instruments

UNIT I AMPLITUDE MODULATION

UNIT II RANDOM PROCESS & SAMPLING
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.
Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM

UNIT III DIGITAL TECHNIQUES
Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder

UNIT IV DIGITAL MODULATION SCHEME
Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK

UNIT V DEMODULATION TECHNIQUES

COURSE OUTCOMES:
At the end of the course students will be able to
- CO1: Gain knowledge in amplitude modulation techniques
- CO2: Understand the concepts of Random Process to the design of communication systems
- CO3: Gain knowledge in digital techniques
- CO4: Gain knowledge in sampling and quantization
- CO5: Understand the importance of demodulation techniques

TEXTBOOKS:

TOTAL: 45 PERIODS
REFERENCES:
5. H P Hsu, Schaum Outline Series - “Analog and Digital Communications” TMH 2006

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CEC365 WIRELESS SENSOR NETWORK DESIGN L T P C 3 0 0 3

OBJECTIVES:
- To understand the fundamentals of wireless sensor network
- To gain knowledge on the MAC and Routing Protocols of WSN
- To get exposed to 6LOWPAN technology
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.
- To gain knowledge about operating system related to WSN and 6LOWPAN

UNIT I INTRODUCTION 9
Principle of Wireless Sensor Network - Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II MAC AND ROUTING PROTOCOLS 9
MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC, TRAMA, Routing protocols – Requirements, Classification - SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT III 6LOWPAN 9
UNIT IV APPLICATION
Design Issues, Protocol Paradigms - End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols - Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry Specific protocols.

UNIT V TOOLS
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: To be able to design solutions for WSNs applications
CO2: To be able to develop efficient MAC and Routing Protocols
CO3: To be able to design solutions for 6LOWPAN applications
CO4: To be able to develop efficient layered protocols in 6LOWPAN
CO5: To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications

REFERENCES:

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COURSE OBJECTIVES:
- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

UNIT I  
INTRODUCTION  
9
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  
DESCRIBING DATA  
9
Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores

UNIT III  
DESCRIBING RELATIONSHIPS  
9

UNIT IV  
PYTHON LIBRARIES FOR DATA WRANGLING  
9

UNIT V  
DATA VISUALIZATION  
9

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Define the data science process
CO2: Understand different types of data description for data science process
CO3: Gain knowledge on relationships between data
CO4: Use the Python Libraries for Data Wrangling
CO5: Apply visualization Libraries in Python to interpret and explore data

TOTAL:45 PERIODS

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CCS333 AUGMENTED REALITY/VIRTUAL REALITY

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

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

30 PERIODS

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

TOTAL:60 PERIODS

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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CEI355 COMPUTER ARCHITECTURE

COURSE OBJECTIVES:
1. To learn the basic structure and operations of a computer
2. To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit
3. To learn the basics of pipelined execution
4. To understand parallelism and multi-core processors
5. To understand the memory hierarchies, cache memories and virtual memories
6. To learn the different ways of communication with I/O devices

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM (7+2 SKILLS)

UNIT II ARITHMETIC FOR COMPUTERS (7+2 SKILLS)
Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

UNIT III PROCESSOR AND CONTROL UNIT(7+2 SKILLS)
A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISIM (7+2 SKILLS)

UNIT V MEMORY & I/O SYSTEMS (7+2 SKILLS)

TOTAL: 45 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Fundamentals of computer architecture
2. Basic arithmetical operations
3. Organization of computer system
4. Analysis of challenges parallel processing
5. Interfacing and storage systems in the computer

COURSE OUTCOMES:
Students able to
CO1 Understand the basics structure of computers, operations and instructions. (L2)
CO2 Design arithmetic and logic unit. (L5)
CO3 Understand pipelined execution and design control unit. (L2)
CO4 Understand parallel processing architectures. (L2)
CO5 Understand the various memory systems and I/O communication. (L2)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://exploringbits.com/basic-structure-of-computer-system/

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COURSE OBJECTIVES:
- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I  INTRODUCTION TO IMAGE FORMATION AND PROCESSING  6

UNIT II  FEATURE DETECTION, MATCHING AND SEGMENTATION  6
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III  FEATURE-BASED ALIGNMENT & MOTION ESTIMATION  6

UNIT IV  3D RECONSTRUCTION  6
Shape from X - Active rangefinding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

UNIT V  IMAGE-BASED RENDERING AND RECOGNITION  6

PRACTICAL EXERCISES:  30 PERIODS
LABORATORY EXPERIMENTS:
Software needed:
OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent
- OpenCV Installation and working with Python
- Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Blob detection
- Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
- Image Enhancement - Understanding Color spaces, color space conversion, Histogram equalization, Convolution, Image smoothing, Gradients, Edge Detection
- Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
- Image segmentation using Graphcut / Grabcut
- Camera Calibration with circular grid
- Pose Estimation
- 3D Reconstruction – Creating Depth map from stereo images
- Object Detection and Tracking using Kalman Filter, Camshift
1. docs.opencv.org
2. https://opencv.org/opencv-free-course/

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

CO1: To understand basic knowledge, theories and methods in image processing and computer vision.

CO2: To implement basic and some advanced image processing techniques in OpenCV.

CO3: To apply 2D a feature-based based image alignment, segmentation and motion estimations.

CO4: To apply 3D image reconstruction techniques

CO5: To design and develop innovative image processing and computer vision applications.

TEXT BOOKS:

REFERENCES:
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

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CCS336 CLOUD SERVICES MANAGEMENT L T P C 2 0 2 3

COURSE OBJECTIVES:
- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 6
UNIT II  CLOUD SERVICES STRATEGY  6
Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III  CLOUD SERVICE MANAGEMENT  6

UNIT IV  CLOUD SERVICE ECONOMICS  6
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V  CLOUD SERVICE GOVERNANCE & VALUE  6
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

COURSE OUTCOMES:

CO1: Exhibit cloud-design skills to build and automate business solutions using cloud technologies.

CO2: Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services

CO3: Solve the real world problems using Cloud services and technologies

PRACTICAL EXERCISES: 30 PERIODS

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one

TEXT BOOKS
1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES
1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
### CO’s – PO’s & PSO’s MAPPING

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### CEI356 BLOCKCHAIN TECHNOLOGY

**COURSE OBJECTIVES:**

1. To learn the fundamentals of Blockchain.
2. To obtain knowledge about technologies of Blockchain.
3. To incorporate the models of Blockchain - Ethereum.
4. To learn the models of Hyperledger Fabric.

**UNIT I INTRODUCTION (7+2 SKILLS)**

Basic Cryptographic primitives used in Blockchain – Secure Collision Resistant hash functions - Digital signature - Public key cryptosystems - Zeroknowledge proof systems - Need for Distributed Record Keeping – Modelling faults and adversaries - Byzantine Generals problem – Briefing of Consensus algorithms and their scalability problems - Why Nakamoto Came up with Blockchain based cryptocurrency.

**UNIT II TECHNOLOGIES BORROWED IN BLOCKCHAIN (7+2 SKILLS)**


**UNIT III MODELS FOR BLOCKCHAIN (7+2 SKILLS)**


**UNIT IV ETHEREUM (7+2 SKILLS)**

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges - Using smart contracts to enforce legal contracts Comparing Bitcoin scripting vs. Ethereum Smart Contracts - Some attacks on smart contracts.

**UNIT V HYPERLEDGER FABRIC (7+2 SKILLS)**

Hyperledger fabric - the plug and play platform and mechanisms in permissioned block chain - Beyond Cryptocurrency – applications of block chain in cyber security - integrity of information - E-Governance and other contract enforcement mechanisms - Limitations of block chain as a technology and myths vs reality of blockchain technology.

**TOTAL: 45 PERIODS**

**SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)**
1. Fundamentals of blockchain technology
2. Understanding of technologies in block chain
3. Interpretation of models in block chain
4. Platforms to build decentralized applications
5. Demonstration of hyperledger fabric

COURSE OUTCOMES:
Students able to
CO1 Define and Explain the fundamentals of Blockchain (L1)
CO2 Illustrate the technologies of Blockchain (L3)
CO3 Identify the models of Blockchain (L1)
CO4 Analyze and demonstrate the Ethereum (L4)
CO5 Analyze and demonstrate Hyperledger fabric (L4)

REFERENCES:
4 Pass et al,” Fruitchain- a fair blockchain”, PODC 2017

TEXT BOOKS:

List of Open Source Software/ Learning website:

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COURSE OBJECTIVES:
1. Understand complexity of Deep Learning algorithms and their limitations
2. Understand the theoretical foundations, algorithms, methodologies, and applications of neural networks and deep learning.
3. It will help to design and develop an application-specific deep learning models.
4. Be capable of confidently applying common Deep Learning algorithms in practice and implementing their own.
5. Be capable of performing experiments in Deep Learning using real-world data.

UNIT I MACHINE LEARNING BASICS (7+2 SKILLS) 9

UNIT II INTRODUCTION TO DEEP LEARNING & ARCHITECTURES (7+2 SKILLS) 9

UNIT III CONVOLUTIONAL NEURAL NETWORKS (7+2 SKILLS) 9

UNIT IV SEQUENCE MODELLING – RECURRENT AND RECURSIVE NETS (7+2 SKILLS) 9
Recurrent Neural Networks, Bidirectional RNNs – Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.

UNIT V AUTO ENCODERS AND DEEP GENERATIVE MODELS(7+2 SKILLS) 9

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Fundamentals of machine learning
2. Fundamentals of deep learning
3. Realization and understanding of CNN
4. Time series forecasting for data
5. Generating of synthetic images
COURSE OUTCOMES:
Students able to

**CO1** Have a good understanding of the fundamental issues and basics of machine learning. (L2)

**CO2** Ability to differentiate the concept of machine learning with deep learning techniques. (L4)

**CO3** Understand the concept of CNN and transfer learning techniques, to apply it in the classification problems. (L2)

**CO4** Learned to use RNN for language modelling and time series prediction. (L3)

**CO5** Use autoencoder and deep generative models to solve problems with high dimensional data including text, image and speech. (L3)

REFERENCES:

List of Open Source Software/ Learning website:

**TEXT BOOKS:**

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1-Low, 2-Medium, 3-High, ‘-‘ - no correlation
COURSE OBJECTIVES:
1. To understand the concepts of object-oriented, event driven, and concurrent programming paradigms and develop skills in using these paradigms using Java.

UNIT I  JAVA BASICS (7+2 SKILLS)  9

UNIT II  ARRAYS (7+2 SKILLS)  9

UNIT III  CLASSES AND GRAPHICS PROGRAMMING (7+2 SKILLS)  9

UNIT IV  EVENT, EXCEPTION HANDLING (7+2 SKILLS)  9

UNIT V  GENERIC PROGRAMMING (7+2 SKILLS)  9

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1  Fundamentals of java
2  Concepts of array
3  Basics of programming
4  Handling of unexpected error
5  Introduction to generic programming

COURSE OUTCOMES:
Students able to
On Completion of the course, the students should be able to:

CO1 Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism. (L4)

CO2 Design and develop java programs, analyze, and interpret object oriented data and report results. (L5)

CO3 Plan their career in java based technologies like HADOOP etc. (L5)

CO4 Able to apply the concepts of arrays, strings in Java programming. (L1)

CO5 Ability to apply generic programming concepts for effective coding. (L3)
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://www.w3schools.com/java/

MAPPING OF COs WITH POs AND PSOs

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1-Low, 2-Medium, 3-High, "-"- no correlation
MANDATORY COURSES I

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

COURSE OUTLINE

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

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

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

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

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

TOTAL : 45 PERIODS

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

OBJECTIVE:

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

1. COURSE CONTENTS

Introduction to Elements of Literature

1. Relevance of literature

   a) Enhances Reading, thinking, discussing and writing skills.

   b) Develops finer sensibility for better human relationship.

   c) Increases understanding of the problem of humanity without bias.
d) Providing space to reconcile and get a cathartic effect.

2. **Elements of fiction**
   a) Fiction, fact and literary truth.
   b) Fictional modes and patterns.
   c) Plot character and perspective.

3. **Elements of poetry**
   a) Emotions and imaginations.
   b) Figurative language.
   c) (Simile, metaphor, conceit, symbol, pun and irony).
   d) Personification and animation.
   e) Rhetoric and trend.

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

**3. READINGS:**


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

**4. OTHER SESSION:**

4.1 *Tutorials:

4.2 *Laboratory:

230
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**

L T P C

3 0 0 0

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   HAZRADS, VULNERABILITY AND DISASTER RISKS                                          9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals.

UNIT II   DISASTER RISK REDUCTION (DRR)                                                  9
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

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

UNIT IV   TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT                            9
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role

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 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 BM

Common cooking mistakes
Different cooking methods, merits and demerits of each method
UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

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

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

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

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


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

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

TOTAL : 45 PERIODS

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

REFERENCES:
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
   1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
   2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/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
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 versus evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

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

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

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA
Legacy of technology in Medieval India, Interactions with Arabs
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest
UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA
Science and the Empire
Indian response to Western Science
Growth of techno-scientific institutions

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

TOTAL: 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY L T P C

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 Sundararlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)
Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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TOTAL : 45 PERIODS

OUTCOME:

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA L T P C 3 0 0 0

OBJECTIVE:
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

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

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

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.
1857 and the national awakening.

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

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

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

SUGGESTED READING:

MX3089 INDUSTRIAL SAFETY

OBJECTIVES
- To Understand the Introduction and basic Terminologies of 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.

TOTAL : 45 PERIODS

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

TEXTBOOKS
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES
Indian Standard code of practice on occupational safety and health audit
Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006
https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf
## CO’s – PO’s & PSO’s MAPPING

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<td>CO2</td>
<td>Obtain knowledge of Statutory Regulations and standards.</td>
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<td>CO3</td>
<td>Know about the safety Activities of the Working Place.</td>
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<td>CO4</td>
<td>Analyze on the impact of Occupational Exposures and their Remedies.</td>
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<td>CO5</td>
<td>Obtain knowledge of Risk Assessment Techniques.</td>
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<td><strong>Industrial safety</strong></td>
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COURSE OBJECTIVES:
- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

UNIT II PLANNING

UNIT III ORGANISING

UNIT IV DIRECTING

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:
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**GE3752 TOTAL QUALITY MANAGEMENT**

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

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

**UNIT II TQM PRINCIPLES**

**UNIT III TQM TOOLS & TECHNIQUES I**

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

UNIT V QUALITY MANAGEMENT SYSTEM


TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.

CO2: Ability to apply TQM principles in a selected enterprise.

CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4: Ability to understand Taguchi’s Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Ability to apply QMS and EMS in any organization.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:

REFERENCES:
GE3753  ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING  L T P C
3 0 0 3

COURSE OBJECTIVES:

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

UNIT I  DEMAND & SUPPLY ANALYSIS  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:
GE3754                                      HUMAN RESOURCE MANAGEMENT                          L  T  P  C
3   0  0  3

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

UNIT I            INTRODUCTION TO HUMAN RESOURCE MANAGEMENT                                  9

UNIT II  HUMAN RESOURCE PLANNING                                                                            9

UNIT III  TRAINING AND EXECUTIVE DEVELOPMENT                                                      9
Types of training and Executive development methods – purpose – benefits.

UNIT IV  EMPLOYEE COMPENSATION                                                                                9

UNIT V  PERFORMANCE EVALUATION AND CONTROL                                                9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- **CO1**: Students would have gained knowledge on the various aspects of HRM
- **CO2**: Students will gain knowledge needed for success as a human resources professional.
**TEXT BOOKS:**

**REFERENCES:**

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**GE3755 KNOWLEDGE MANAGEMENT**

**COURSE OBJECTIVES:**

The student should be made to:

- Learn the Evolution of Knowledge management.
- Be familiar with tools.
- Be exposed to Applications.
- Be familiar with some case studies.

**UNIT I INTRODUCTION**

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

**UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING**


**UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS**

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.
UNIT IV KNOWLEDGE MANAGEMENT APPLICATION
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

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

TOTAL: 45 PERIODS

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

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:

REFERENCE:
COURSE OBJECTIVES

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

2. To study the planning; organizing and staffing functions of management in professional organization.

3. To study the leading; controlling and decision making functions of management in professional organization.

4. To learn the organizational theory in professional organization.

5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I  INTRODUCTION TO MANAGEMENT

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

UNIT II  FUNCTIONS OF MANAGEMENT - I

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

UNIT III  FUNCTIONS OF MANAGEMENT - II

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

UNIT IV  ORGANIZATION THEORY

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

UNIT V  PRODUCTIVITY AND MODERN TOPICS

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in
professional organizations.

**CO2** Discuss the planning; organizing and staffing functions of management in professional organization.

**CO3** Apply the leading; controlling and decision making functions of management in professional organization.

**CO4** Discuss the organizational theory in professional organization.

**CO5** Apply principles of productivity and modern concepts in management in professional organization.

**TEXTBOOKS:**


**REFERENCES:**

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

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH

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

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

UNIT IV SUPERVISED LEARNING

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

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

Supervised learning
5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier.
Unsupervised learning
9. Implementing neural network using self-organizing maps
10. Implementing k-Means algorithm to cluster a set of data.
11. Implementing hierarchical clustering algorithm.
Note:
- Installation of gnu-prolog, Study of Prolog (gnu-prolog).
- The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface
- Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

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

TOTAL 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 L T P C
2 0 2 3

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

UNIT 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

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

TOTAL PERIODS: 60

TEXTBOOKS

REFERENCES
1. Perry Lea, “Internet of things for architects”, Packt, 2018
OCS353 DATA SCIENCE FUNDAMENTALS L T P C 2 0 2 3

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 6

UNIT II DATA MANIPULATION 9

UNIT III MACHINE LEARNING 5
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 5

UNIT V HANDLING LARGE DATA 5
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

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

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

**COURSE OUTCOMES:**

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

- **CO1:** Gain knowledge on data science process.
- **CO2:** Perform data manipulation functions using Numpy and Pandas.
- **CO3:** Understand different types of machine learning approaches.
- **CO4:** Perform data visualization using tools.
- **CO5:** Handle large volumes of data in practical scenarios.

**TOTAL PERIODS:** 60

**TEXT BOOKS**


**REFERENCES**

OPEN ELECTIVE 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.

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

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

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

TEXTBOOKS:

REFERENCE BOOKS:

Websites
http://civilservicesmentor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/in/

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

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

UNIT I  ENVIRONMENTAL CONCERNS 9
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

UNIT II  ROLE OF NGOS 9
Role of NGO’s in national development, NGO’s and participatory management, Challenges and limitations of NGO’s, Community Development programmes, Role of NGO’s in Community Development programmes, Participation of NGO’s in environment management, Corporate Social responsibility, NGO’s and corporate social responsibility

UNIT III  SUSTAINABLE DEVELOPMENT 9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV  NGO’S FOR SUSTAINABILITY 9
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V  LEGAL FRAMEWORKS 9
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO’s in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL 45 : PERIODS

OUTCOMES

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

REFERENCE BOOKS


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

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

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

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

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

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

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

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

COURSE OBJECTIVES
1. To know the Indian and global energy scenario
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies.
UNIT I ENERGY SCENARIO
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT II SOLAR ENERGY

UNIT III WIND ENERGY

UNIT IV BIO-ENERGY

UNIT V OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students would be able to
- Discuss the Indian and global energy scenario.
- Describe the various solar energy technologies and its applications.
- Explain the various wind energy technologies.
- Explore the various bio-energy technologies.
- Discuss the ocean and geothermal technologies.

TEXT BOOKS:

REFERENCES:
CO’s – PO’s & PSO’s MAPPING

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

OME354                                  APPLIED DESIGN THINKING                  L T P C
3 0 0 3

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                                                                       9
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                                                                     9
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                                                                 9
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                                                                                       9
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                                                                                                   9
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

TOTAL: 45 PERIODS
Course Outcomes
At the end of the course, learners will be able to:

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

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

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd
6. https://blog.forgefor ward.in/star_tup-failure-is-like-true-lie-7812cdfe9b85

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

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION
UNIT III  DATA PROCESSING
9
Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of
Performance Evaluation – System Compatibility.

UNIT IV  3D SCANNING AND MODELLING
9
Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light -
Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for
Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step
procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT V  INDUSTRIAL APPLICATIONS
9
Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry.
Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
• Apply the fundamental concepts and principles of reverse engineering in product design and
development.
• Apply the concept and principles material characteristics, part durability and life limitation in
reverse engineering of product design and development.
• Apply the concept and principles of material identification and process verification in reverse
engineering of product design and development.
• Apply the concept and principles of data processing, part performance and system compatibility
in reverse engineering of product design and development.
• Analyze the various legal aspect
• Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New
5. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, Springer-

OPR351  SUSTAINABLE MANUFACTURING
3 0 0 3

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

**UNIT I ECONOMIC SUSTAINABILITY**

**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 formulation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

**UNIT V TRENDS IN SUSTAINABLE OPERATIONS**

**TOTAL: 45 PERIODS**

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

**TEXT BOOKS:**

**REFERENCES:**
AU3791 ELECTRIC AND HYBRID VEHICLES

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

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

TEXT BOOKS:

REFERENCES:

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OAS352  SPACE ENGINEERING  L T P C
3 0 0 3

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

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

UNIT II  AERODYNAMICS
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.
UNIT III PERFORMANCE AND PROPULSION
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations - thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCE:

OIM351 INDUSTRIAL MANAGEMENT

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

UNIT I INTRODUCTION
UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUPDYNAMICS

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

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

REFERENCES:

CO’s – PO's & PSO's MAPPING

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TOTAL: 45 PERIODS
COURSE OBJECTIVES

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

UNIT I INTRODUCTION


UNIT II CONTROL CHARTS

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

UNIT III SPECIAL CONTROL PROCEDURES

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

UNIT IV STATISTICAL PROCESS CONTROL

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

UNIT V ACCEPTANCE SAMPLING

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

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

**CO’s – PO’s & PSO’s MAPPING**

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

UNIT I INHERENT SAFETY CONCEPTS
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

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

UNIT IV  ULTRASONIC TESTING & AET  9

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.

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

TEXT BOOKS:

REFERENCES:
OMR351  MECHATRONICS  L  T  P  C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Selecting sensors to develop mechatronics systems.
2. Explaining the architecture and timing diagram of microprocessor, and also interpret and
develop programs.
3. Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Applying PLC as a controller in mechatronics system.
5. Designing and develop the apt mechatronics system for an application.

UNIT I  INTRODUCTION AND SENSORS  9
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of
Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic
Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges –

UNIT II  8085 MICROPROCESSOR  9
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set,
Timing diagram of 8085.

UNIT III  PROGRAMMABLE PERIPHERAL INTERFACE  9
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and
DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

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
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics,
Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design
Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot –
Engine Management system – Automatic Car Park Barrier.

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO 4: Apply PLC as a controller in mechatronics system.
CO 5: Design and develop the apt mechatronics system for an application.

TEXT BOOKS

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

UNIT I  FUNDAMENTALS OF ROBOT  9

UNIT II  ROBOT KINEMATICS  9
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT III  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9

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

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<thead>
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<td>CO/PO &amp; PSO</td>
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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
Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude
relationships, Newton’s Law of Motions applied to Aeronautics-Evolution of lift, drag and moment.
Aerofoils, Mach number, Maneuvers.

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

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

TOTAL : 45 PERIODS

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

TEXT BOOKS

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

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
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

UNIT V DATA PRODUCTS AND INTERPRETATION
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

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

TEXTBOOKS:

REFERENCES:

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

<table>
<thead>
<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>Course Outcome</th>
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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 Problems</td>
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<td>PO 7</td>
<td>Environment and Sustainability</td>
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<td>PO 8</td>
<td>Ethics</td>
<td>3 3 3 3 3</td>
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</table>
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 9
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 9

UNIT III SOIL LESS CULTIVATION 9
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping

UNIT IV MODERN CONCEPTS 9
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops.

UNIT V WASTE MANAGEMENT 9
Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes- solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

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

TEXT BOOKS:
REFERENCES:

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

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

UNIT I SOURCES OF WATER
UNIT II CONVEYANCE FROM THE SOURCE

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

UNIT IV ADVANCED WATER TREATMENT

UNIT V WATER DISTRIBUTION AND SUPPLY

TOTAL: 45 PERIODS

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

TEXTBOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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OEE352 ELECTRIC VEHICLE TECHNOLOGY L T P C 3 0 0 3

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 9

UNIT II STATIC POWER CONVERTERS 9
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 9
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 9

UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES 9
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:

OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES

OBJECTIVE:

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

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

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

UNIT III CORE CONCEPTS IN LEAN

UNIT IV LEAN TOOLS AND TECHNIQUES

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

TOTAL : 45 PERIODS
OUTCOME:
On completion of this course, the student is expected to be able to

CO1 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:

OCH351 NANO TECHNOLOGY  L T P C  3 0 0 3

UNIT I INTRODUCTION  8
General definition and size effects–important nano structured materials and nano particles-importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS  8
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES  10
Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based-influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES  10
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.
UNIT V APPLICATIONS OF NANO MATERIALS

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

TOTAL : 45 PERIODS

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

TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

<table>
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<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<td>CO1</td>
<td>understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications</td>
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<tr>
<td>CO2</td>
<td>acquire knowledge about the different types of nano material synthesis</td>
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<tr>
<td>CO3</td>
<td>describes about the shape, size, structure of composite nano materials and their interference</td>
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<tr>
<td>CO4</td>
<td>understand the different characterization techniques for nanomaterials</td>
<td>2 2 1 3 3 1 1 1 1 - 1 3 1 1 3</td>
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<tr>
<td>CO5</td>
<td>develop a deeper knowledge in the</td>
<td>2 2 1 3 3 1 1 1 1 - 1 3 2 1 3</td>
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OBJECTIVE:
- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I  INTRODUCTION

UNIT II  MOLECULAR SELF ASSEMBLY

UNIT III  BIO-INSPIRED MATERIALS

UNIT IV  SMART OR INTELLIGENT MATERIALS
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.

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

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

UNIT II  TRADITIONAL METHODS OF FOOD PROCESSING  9

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:
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:
COURSE OBJECTIVES:

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I  INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II  PATENTS
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III  PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS
Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV  ENFORCEMENT AND PRACTICAL ASPECTS OF IPR

UNIT V  INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY

TOTAL:45 PERIODS

TEXT BOOKS:

REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
**Course Outcome**
The student will be able to

C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
C6 Understand the interrelationships between different Intellectual Property Rights on International Society

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**OTT351**
**BASICS OF TEXTILE FINISHING**

**OBJECTIVE:**
- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

**UNIT I  RESIN FINISHING**

**UNIT II  FLAME PROOF & WATERPROOF**
Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

**UNIT III  SOIL RELEASE AND ANTISTATIC FINISHES**

**UNIT IV  MECHANICAL FINISHES**
UNIT V STIFFENING AND SOFTENING 9
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET.
Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO: 2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.
CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
CO: 4 Concept of Mechanical finishing.
CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62

OTT352 INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY

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
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V WORK STUDY APPLICATION
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

TOTAL: 45 PERIODS

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

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 9
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 9
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 9
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations
UNIT IV  BASICS OF WEAVING  
Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms.

UNIT V  BASICS OF KNITTING AND NONWOVEN  

TOTAL : 45 PERIODS

OUTCOMES:
On completion of this course, the students shall have the basic knowledge on
CO1: Classification of fibres and production of natural fibres
CO2: Regenerated and synthetic fibres
CO3: Yarn spinning
CO4: Weaving
CO5: Knitting and nonwoven

TEXTBOOKS

REFERENCES:
CO’s- PO’s & PSO’s MAPPING

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OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

OBJECTIVE:
The course is aimed to
Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL

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

UNIT III REFORMING AND HYDROTREATING

UNIT IV INTRODUCTION TO PETROCHEMICALS
Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.

UNIT V PRODUCTION OF PETROCHEMICALS
Production of Petrochemicals like Dimethyl Terephthalate(DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.

CO2: Understand the insights of primary treatment processes to produce the precursors.

CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.

CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.

CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.

CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS

REFERENCES

CPE334 ENERGY CONSERVATION AND MANAGEMENT  L T P C
3  0  0  3

OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- carry out energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I INTRODUCTION

UNIT II ELECTRICAL SYSTEMS

UNIT III THERMAL SYSTEMS

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

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

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3: Skills on combustion thermodynamics and kinetics.
CO4: Apply calculation and design tube still heaters.
CO5: Studied different heat treatment furnace.
CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:

REFERENCES:

OPT351 BASICS OF PLASTICS PROCESSING L T P C
3 0 0 3
COURSE OBJECTIVES
• Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
• To gain practical knowledge on the polymer selection and its processing
• Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
• To understand suitable additives for plastics compounding
• To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I INTRODUCTION TO PLASTICS PROCESSING 9

UNIT II EXTRUSION 9
UNIT III INJECTION MOLDING
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING
Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms- Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V BLOW MOLDING, THERMOFORMING AND CASTING

TOTAL: 45 PERIODS

COURSE OUTCOMES
- Ability to find out the correlation between various processing techniques with product properties.
- Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.
- Acquire knowledge on additives for plastic compounding and methods employed for the same
- Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.
- Select an appropriate processing technique for the production of a plastic product

REFERENCES
COURSE OBJECTIVES:
- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I    CLASSIFICATION OF SIGNALS AND SYSTEMS                                       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

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
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in
Analysis of CT systems - Systems connected in series / parallel.

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
Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z
Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and
parallel.

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:
New Delhi, 2015.(Units I - V)

REFERENCES :
# CO’s- PO’s & PSO’s MAPPING

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The table shows the mapping between CO (Criteria of Outcome), PO (Performance Objective), and PSO (Performance Standards of Outcome) across different scenarios.
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

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

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

**REFERENCES:**

**CO’s- PO’s & PSO’s MAPPING**

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**CBM333 ASSISTIVE TECHNOLOGY L T P C**

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**OBJECTIVES:**
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

**UNIT I CARDIAC ASSIST DEVICES**
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

**UNIT II HEMODIALYSERS**
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.
UNIT III HEARING AIDS
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery.

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2: Describe the underlying principles of hemodialyzer machine.
CO3: Indicate the methodologies to assess the hearing loss.
CO4: Evaluate the types of assistive devices for mobilization.
CO5: Explain about TENS and biofeedback system.

TEXT BOOKS

REFERENCES
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

CO’s- PO’s & PSO’s MAPPING

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AVg.
OBJECTIVES:
This course will help the students to
- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.

UNIT I    LINEAR PROGRAMMING

UNIT II    TRANSPORTATION AND ASSIGNMENT PROBLEMS

UNIT III INTEGER PROGRAMMING

UNIT IV DYNAMIC PROGRAMMING PROBLEMS

UNIT V NON-LINEAR PROGRAMMING PROBLEMS

OUTCOMES:
At the end of the course, students will be able to
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
- solve the integer programming problems using various methods.
- conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
- determine the optimum solution for non-linear programming problems.

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OMA353 ALGEBRA AND NUMBER THEORY LT P C 3 0 0 3

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 9
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 9
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 9
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 9
Linear Diophantine equations – Congruence’s – Linear Congruence’s - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.
UNIT V  CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS

Wilson’s theorem – Fermat’s Little theorem – Euler’s theorem – Euler’s Phi functions – Tau and Sigma functions.

TOTAL: 45 PERIODS

OUTCOMES:
- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text.

TEXT BOOKS:

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OMA354  LINEAR ALGEBRA

COURSE OBJECTIVES:
- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I  MATRICES AND SYSTEM OF LINEAR EQUATIONS

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

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

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

UNIT V  EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION

TOTAL : 45 PERIODS

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

TEXT BOOKS

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OBT352    BASICS OF MICROBIAL TECHNOLOGY                             L T P C 3 0 0 3

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

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

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

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

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

UNIT V  PRODUCTS FROM MICROBES  9
Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

OTAL: 45 PERIODS

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

TEXT BOOKS

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

OBJECTIVES:
• The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.
UNIT I  CARBOHYDRATES
Introduction to carbohydrate, classification, properties of monosaccharide, structural aspects of monosaccharides. Introduction to disaccharide (lactose, maltose, sucrose) and polysaccharide (Heparin, starch, and glycogen) biological function of carbohydrate.

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

UNIT III  AMINO ACIDS AND PROTEIN.

UNIT IV  NUCLEIC ACIDS
Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA & 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

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

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
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

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

TEXTBOOKS:

REFERENCES:
OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING

L T P C
3 0 0 3

COURSE 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

OUTCOMES
By the end of the course, learners will be able to

- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intension of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.
REFERENCES

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OMA355 ADVANCED NUMERICAL METHODS

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

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM 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 9

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 9
Laplace and Poisson’s equations in a rectangular region : Five point finite difference schemes - Leibmann’s iterative methods - Dirichlet’s and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes .
UNIT V  
FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS  


TOTAL : 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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OMA356  
RANDOM PROCESSES  

OBJECTIVES:
- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
• To understand the concept of correlation and spectral densities.
• To understand the significance of linear systems with random inputs.

UNIT I  RANDOM VARIABLES

UNIT II  RANDOM PROCESSES

UNIT III  SPECIAL RANDOM PROCESSES

UNIT IV  CORRELATION AND SPECTRAL DENSITIES

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

TOTAL: 45 PERIODS

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

• Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
• Apply the concept random processes in engineering disciplines.
• Understand and apply the concept of correlation and spectral densities.
• Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
• Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS

REFERENCES
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

OUTCOMES

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

- Enable the students to apply the concept of random processes in engineering disciplines.
- Students acquire skills in analyzing various queueing models.
- Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.
- Students can analyze reliability of the systems for various probability distributions.
- Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.
TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

OBJECTIVES:
- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9
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 9
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

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT

Upon completion of this course the learners will be able : CO 1 To understand the basics and functions of Production and Operation Management for business owners. CO 2 To learn about the Production & Operation Systems. CO 3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries. CO 4 To known about the Production & Operations Management Processes in organisations. CO 5 To comprehend the techniques of controlling , Production and Operations in industries.

REFERENCES

OMG355 MULTIVARIATE DATA ANALYSIS

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

UNIT I INTRODUCTION
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS
Conceptualization of research model with variables, collection of data —Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.
UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS

Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. -Approaches to factor analysis – interpretation of results.

UNIT IV LATENT VARIABLE TECHNIQUES

Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V ADVANCED MULTIVARIATE TECHNIQUES

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL: 45 PERIODS

OUTCOMES:

- Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.
- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
- Make better business decisions by using advanced techniques in data analytics.

REFERENCES:


OME352 ADDITIVE MANUFACTURING

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION

UNIT II  VAT POLYMERIZATION AND MATERIAL EXTRUSION 9

UNIT III  POWDER BED FUSION AND BINDER JETTING 9

UNIT IV  MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.
CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

REFERENCES:
CME343  NEW PRODUCT DEVELOPMENT  L T P C
3 0 0 3

COURSE OBJECTIVES
1. To introduce the fundamental concepts of the new product development
2. To develop material specifications, analysis and process.
3. To Learn the Feasibility Studies & reporting of new product development.
4. To study the New product qualification and Market Survey on similar products of new product development
   To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT I  FUNDAMENTALS OF NPD  9

UNIT II  MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS  9
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis, ), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III  ESSENTIALS OF NPD  9

UNIT IV  CRITERIONS OF NPD  9
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT V  REPORTING & FORWARD-THINKING OF NPD  9
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL :45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

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

REFERENCES:
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
5. Product Design & Value Engineering – Dr. M.A. Bulsara & Dr. H.R. Thakkar

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

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

OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES

OBJECTIVES:
The course aims to
- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX

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

UNIT III INDUSTRIAL DESIGN
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D
MODELING TOOLS - PART CREATION – ASSEMBLY - PRODUCT DESIGN AND RENDERING BASICS - DIMENSIONING & TOLERANCING

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

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

Course Outcomes
At the end of the course, learners will be able to:
- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction/product feature
- Develop 3D models for prototyping various product ideas
- Built prototypes using Tools and Techniques in a quick iterative methodology

Text Books

References

MF3010 MICRO AND PRECISION ENGINEERING

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSYEMS
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 MICROSYSYEMS:
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
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

TEXT BOOKS:

REFERENCES:

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS

COURSE OBJECTIVES:
Summarize the costing concepts and their role in decision making
Infer the project management concepts and their various aspects in selection
Interpret costing concepts with project execution
Develop knowledge of costing techniques in service sector and various budgetary control techniques
Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts
UNIT III PROJECT EXECUTION AND COSTING CONCEPTS  
Project execution: Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  
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 understand the working and characteristics of different types of batteries and their management.

UNIT I ADVANCED BATTERIES

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
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design—whitepaper
2. Panasonic *NCR18650B- DataSheet*
3. bq76PL536A-Q1—IC DataSheet
4. CC2662R-Q1—IC DataSheet
COURSE OBJECTIVES:
- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I  INTRODUCTION TO MEASUREMENTS AND SENSORS  9

UNIT II  VARIABLE RESISTANCE AND INDUTANCE SENSORS  9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resitive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS  9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostriective, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS  9

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS  9
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.

TOTAL =45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment’s for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of the sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

TEXT BOOKS:

REFERENCES:
OAS353 SPACE VEHICLES

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

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

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

UNIT III  ENGINE SYSTEMS, CONTROLS, AND INTEGRATION

UNIT IV  THRUST VECTOR CONTROL
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

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

TOTAL: 45 PERIODS

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

OIM352 MANAGEMENT SCIENCE

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

TOTAL: 45 PERIODS
UNIT I  INTRODUCTION TO MANAGEMENT AND ORGANISATION  9

UNIT II  OPERATIONS AND MARKETING MANAGEMENT  9

UNIT III  HUMAN RESOURCES MANAGEMENT  9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels.

UNIT IV  PROJECT MANAGEMENT  9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V  STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carry out production operation through Work-study.
CO2: Survey the markets, customers and competition better and price the given product / service appropriately.
CO3: Ensure quality for the given product or service.
CO4: Plan, schedule and control projects through PERT and CPM.
CO5: Evaluate strategy for a business or service organization.

TEXTBOOKS:
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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
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.
UNIT IV PRODUCTION SCHEDULING

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

TOTAL : 45 PERIODS

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

TEXT BOOKS:

REFERENCES
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corp.1984

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COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9
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 9

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9

UNIT IV MATERIALS MANAGEMENT 9

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will 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

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OSF352 INDUSTRIAL HYGIENE L T P C 3 0 0 3

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

UNIT I INTRODUCTION AND SCOPE
UNIT II  MONITORING FOR SAFETY, HEALTH & ENVIRONMENT  
Occupational Health and Environment Safety Management System, ILO and EPA Standards
Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III  OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION  

UNIT IV  OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT  

UNIT V  INDUSTRIAL HAZARDS  

COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems.
CO2: Specify designs that avoid occupation related injuries.
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity.

TEXT BOOKS:

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**OSF353**

**CHEMICAL PROCESS SAFETY**

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**COURSE OBJECTIVES**

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

**UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES**

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

**UNIT II CHEMICAL REACTION HAZARDS**

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

**UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS**

Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers
and flares- new concepts in safety design and operation- Pressure vessel testing standards-Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 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

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of various materials used in electrical, electronics and magnetic applications
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application
4. Knowing the fundamental concepts in Semiconducting materials
5. Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I DIELECTRIC MATERIALS 9
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 9
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 9
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV MATERIALS FOR ELECTRICAL APPLICATIONS 9
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT V OPTICAL AND OPTOELECTRONIC MATERIALS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Select suitable materials for electrical engineering applications.
5. Identify right material for optical and optoelectronic applications.

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OML353  NANOMATERIALS AND APPLICATIONS

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

1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV STRUCTURAL CHARACTERISTICS
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis.
UNIT V  APPLICATIONS
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

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OMR352 HYDRAULICS AND PNEUMATICS

COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS
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

UNIT V TROUBLE SHOOTING AND APPLICATIONS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics
TEXT BOOKS

REFERENCES

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1 – Slight, 2 – Moderate, 3 – Substantial

OMR353
SENSORS

COURSE OBJECTIVES:
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT I
SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES
Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM.

UNIT II DISPLACEMENT, PROXIMITY AND RANGING SENSORS

UNIT III FORCE, MAGNETIC AND HEADING SENSORS

UNIT IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS

UNIT V SIGNAL CONDITIONING

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

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ORA352 CONCEPTS IN MOBILE ROBOTS L T P C
3 0 0 3

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT I INTRODUCTION TO MOBILE ROBOTICS 9

UNIT II KINEMATICS 9

UNIT III PERCEPTION 9

UNIT IV LOCALIZATION 9
UNIT V  PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS  9
Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle
Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition -
Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 PERIODS

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

CO1: Evaluate the appropriate mobile robots for the desired application.

CO2: Create the kinematics for given wheeled and legged robot.

CO3: Analyse the sensors for the intelligence of mobile robotics.

CO4: Create the localization strategies and mapping technique for mobile robot.

CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for
desired applications.

TEXTBOOK
1. Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT

REFERENCES:
1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and
Control”, Butterworth-Heinemann, 2018
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea,
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University
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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”,2015

REFERENCES BOOKS:

CO’s- PO’s & PSO’s MAPPING

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OMV351 MARINE MERCHANT VESSELS LT P C
3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I Introduction to Hydrostatics 9
Archimedes Principle- Laws of floatation – Meta centre – stability of floating and submerged bodies-
Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II Types of Ship 10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil
tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical
tankers - Passenger ships

UNIT III Shipbuilding Materials 9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel
sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys,
Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced
Composites

UNIT IV Marine Propeller and Rudder 8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its
effects on propeller

UNIT V Governing Bodies for Shipping Industry 9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the
Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from
Ships ), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards
of Training, Certification and Watch keeping for Seafarers), Classification societies Administration
authorities

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller
   and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
   USA,2015
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
1. Kemp & Young “Ship Construction Sketches & Notes”, Butter Worth Heinemann
   Publishing,USA, 2011
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018
OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM
9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM
9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM
9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM
9
Importance of 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

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015
CRA332  DRONE TECHNOLOGIES  L  T  P  C

3 0 0 3

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT I  INTRODUCTION TO DRONE TECHNOLOGY  9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses
Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT II  DRONE DESIGN, FABRICATION AND PROGRAMMING  9
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III  DRONE FLYING AND OPERATION  9
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT IV  DRONE COMMERCIAL APPLICATIONS  9
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT V  FUTURE DRONES AND SAFETY  9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization-Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones
TEXT BOOKS

REFERENCES

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OGI352 GEOGRAPHICAL INFORMATION SYSTEM L T P C 3 0 0 3

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

UNIT I FUNDAMENTALS OF GIS 9

UNIT II SPATIAL DATA MODELS 9

UNIT III DATA INPUT AND TOPOLOGY 9
connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

UNIT IV DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS-distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:
- On completion of the course, the student is expected to
- CO1 Have basic idea about the fundamentals of GIS.
- CO2 Understand the types of data models.
- CO3 Get knowledge about data input and topology
- CO4 Gain knowledge on data quality and standards
- CO5 Understand data management functions and data output

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OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT

Entrepreneur Development (ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)- Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE

Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities- Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE


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

1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

**TEXT BOOKS**

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<td>PO5 Modern Tool Usage</td>
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<td>PO6 The Engineer and Society</td>
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<td>PO7 Environment and sustainability</td>
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<td>PO8 Ethics</td>
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<td>PO9 Individual and team work:</td>
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<td>PO10 Communication</td>
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<td>PO11 Project management and finance</td>
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<td>PO12 Life-long learning:</td>
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<tr>
<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<td>PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
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<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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OEN352 BIODIVERSITY CONSERVATION  L T P C
3 0 0 3

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

UNIT I INTRODUCTION
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

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

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

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

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

<table>
<thead>
<tr>
<th>CO's</th>
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<th>PSO's</th>
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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.

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**OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT**

**OBJECTIVES**

- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

**UNIT I OVERVIEW OF IWRM**


**UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION**

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

**UNIT III WATER ECONOMICS**

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

**UNIT IV RECENT TREANDS IN WATER MANAGEMENT**

River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

**UNIT V IMPLEMENTATION OF IWRM**

Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

**TOTAL: 45 PERIODS**

**OUTCOMES**

- On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.
- **CO1** Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
- **CO2** Discuss on the different water uses; how it is impacted and ways to tackle these impacts.
- **CO3** Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO4 Illustrate the recent trends in water management.
CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

REFERENCES
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).

OCH353     ENERGY TECHNOLOGY       L T P C
3 0 0 3

UNIT I   INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

UNIT II  CONVENTIONAL ENERGY
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
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
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

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

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statements</th>
<th>PO O1</th>
<th>PO O2</th>
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<td>CO1</td>
<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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<td>CO2</td>
<td>Students will excel as professionals in the various fields of energy engineering</td>
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<td>CO3</td>
<td>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>CO4</td>
<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<td>CO5</td>
<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding</td>
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</table>
OBJECTIVE:
- To enable the students to analyze properties of surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, adsorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fischer-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:
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, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

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

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

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 understand the importance of food polymers
CO2 understand the effect of various methods of processing on the structure and texture of food materials
CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXTBOOKS:

OFD355 FOOD SAFETY AND QUALITY REGULATIONS LT P C 3 0 0 3

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 10
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 8
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 9
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.

TOTAL: 45 PERIODS

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

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 symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

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

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

COURSE OUTCOME

CO 1 acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.
CO 2 acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes
CO 3 attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
CO 4 distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources.
CO 5 gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.
CO 6 Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.
OTT354 BASICS OF DYEING AND PRINTING L T P C
3 0 0 3

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION 9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT 9

UNIT III DYEING 9

UNIT IV PRINTING 9
Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V MACHINERIES 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry
TEXT BOOKS:

REFERENCES:
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series

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

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcome</th>
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<td>CO1</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
COURSE OBJECTIVES

- To enable the students to learn 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
- Understand the process sequence of various fibres
- Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing.

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting.

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint.

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread- construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons.

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care labeling 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 labeling

TEXT BOOKS:

REFERENCES:
CO’s- PO’s & PSO’s MAPPING

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OPE353   INDUSTRIAL SAFETY  

L T P C  

3 0 0 3

OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION  
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE  

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS  

UNIT IV HAZARDS AND RISK MANAGEMENT  

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT  

TOTAL: 45 PERIODS
OUTCOMES:
After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES L T P C 3 0 0 3

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
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

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER
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

UNIT V MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS
Course Outcomes:
At the end of the course the student will be able to:
- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment's, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

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

COURSE OBJECTIVES
- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I  INTRODUCTION TO PLASTIC MATERIALS  9
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II  ENGINEERING THERMOPLASTICS AND APPLICATIONS  9
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)
UNIT III THERMOSETTING PLASTICS
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- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES
- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

OPT353 PROPERTIES AND TESTING OF PLASTICS

COURSE OBJECTIVES
- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.
UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS


UNIT II MECHANICAL PROPERTIES

Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers.

UNIT III THERMAL RHEOLOGICAL PROPERTIES

Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV ELECTRICAL AND OPTICAL PROPERTIES

Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE


TOTAL: 45 PERIODS

COURSE OUTCOMES

- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES

OBJECTIVES:

- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks.

UNIT I  MOS TRANSISTOR PRINCIPLES

MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II  COMBINATIONAL LOGIC CIRCUITS


UNIT III  SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES


UNIT IV  INTERCONNECT, MEMORY ARCHITECTURE

Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V  DESIGN OF ARITHMETIC BUILDING BLOCKS

Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS


REFERENCES

CBM370 WEARABLE DEVICES

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

UNIT V APPLICATIONS OF WEARABLE SYSTEMS
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL: 45 PERIODS

TEXT BOOKS

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CBM356  MEDICAL INFORMATICS    L T P C
30 03

Preamble:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I     INTRODUCTION TO MEDICAL INFORMATICS
Introduction - Structure of Medical Informatics – Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II     COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III   COMPUTERISED PATIENT RECORD
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.
UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING

Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

Course Outcomes:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:

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AVG.
UNIT I  BIOLOGICAL TREATMENT PROCESS  

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

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

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

UNIT V  BIOCOMPOSTING OF ORGANIC WASTES  
Overview of composting process - Benefitis 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

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

TEXT BOOKS  

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

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

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

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

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

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

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

UNIT V  BASICS OF IMAGING MODALITIES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANAGEMENT
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II SOURCES OF FINANCE
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:
Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy

UNIT V WORKING CAPITAL DECISION

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

TOTAL : 45 PERIODS
OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to value bonds and equities.
3. Explain the various approaches to value securities.
4. Describe how to create efficient portfolios through diversification.
5. Discuss the mechanism of investor protection in India.

UNIT I THE INVESTMENT ENVIRONMENT
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT V INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism.

REFERENCES

TOTAL: 45 PERIODS
OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY

UNIT IV FINANCIAL SERVICES

UNIT V INSURANCE

REFERENCES:

TOTAL : 45 PERIODS
UNIT I INTRODUCTION TO BLOCKCHAIN
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization - Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations - Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY

UNIT III ETHEREUM
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network.

UNIT IV WEB3 AND HYPERLEDGE

UNIT V EMERGING TRENDS

REFERENCE

TOTAL : 45 PERIODS
UNIT I  CURRENCY EXCHANGE AND PAYMENT

UNIT II  DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III  INSURETECH
InsurTech Introduction , Business model disruption AI/ML in InsurTech • IoT and InsurTech , Risk Modeling , Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV  PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in marketplace lending P2P Infrastructure and technologies , Concept of 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

TOTAL : 45 PERIODS

REFERENCE
5. IIBF, Digital Banking, Taxmann Publication, 2016
OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018
**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**


**UNIT IV  APPLICATIONS OF TECHNOPRENEURSHIP**


**UNIT V  EMERGING TRENDS IN ENTREPRENEURSHIP**


**OUTCOMES:**

Upon completion of this course, the student should be able to:

CO 1  Learn the basics of Entrepreneurship
CO 2  Understand the business ownership patterns and environment
CO 3  Understand the Job opportunities in Industries relating to Technopreneurship
CO 4  Learn about applications of technopreneurship and successful technopreneurs
CO 5  Acquaint with the recent and emerging trends in entrepreneurship

**TEXT BOOKS:**

2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,
REFERENCES:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338  TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS  L  T  P  C

3  0  0  3

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

Upon completion of this course, the student should be able to:

CO 1: Learn the basics of managing teams for business.
CO 2: Understand developing effective teams for business management.
CO 3: Understand the fundamentals of leadership for running a business.
CO 4: Learn about the importance of leadership for business development.
CO 5: Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

COURSE OBJECTIVES
- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT I CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training–Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION
UNIT IV  INNOVATION AND ENTREPRENEURSHIP  9

UNIT V  INNOVATIVE BUSINESS MODELS  9

TOTAL 45 : PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

Suggested Readings:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations - Course Era, Raj Echambadi.

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

COURSE OBJECTIVES:
• To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
• To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
• To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I  INTRODUCTION TO MARKETING MANAGEMENT  9

UNIT II  MARKETING ENVIRONMENT  9
UNIT III PRODUCT AND PRICING MANAGEMENT 9

UNIT IV PROMOTION AND DISTRIBUTION MANAGEMENT 9

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

TOTAL 45 : PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO1 Have the awareness of marketing management process
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:
OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I  INTRODUCTION TO HRM

UNIT II  HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III  RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection- Interview Types- Employee Engagement.

UNIT IV  TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V  CONTROLLING HUMAN RESOURCES

Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES
CMG342 FINANCING NEW BUSINESS VENTURES

Course Objectives
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE

UNIT II INTRODUCTION TO VENTURE FINANCING

UNIT III SOURCES OF DEBT FINANCING

UNIT IV SOURCES OF EQUITY FINANCING
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES

OUTCOMES:
Upon completion of this course, the students should be able to:
CO 1 Learn the basics of starting a new business venture.
CO 2 Understand the basics of venture financing.
CO 3 Understand the sources of debt financing.
CO 4 Understand the sources of equity financing.
CO 5 Acquaint with the methods of fund raising for new business ventures.
REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343  PRINCIPLES OF PUBLIC ADMINISTRATION  L T P C
3 0 0 3

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344 CONSTITUTION OF INDIA

UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi.
UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

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

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

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

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations
CMG346 ADMINISTRATIVE THEORIES L T P C 3 0 0 3

UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration 9

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

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design 9

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making 9

UNIT V
Administrative thinkers: Kautilya, Woodrow Wilson, C.I. Barnard, Peter Drucker 9

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

TOTAL: 45 PERIODS

CMG347 INDIAN ADMINISTRATIVE SYSTEM L T P C 3 0 0 3

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 9

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 9

UNIT III

UNIT IV
Coalition politics in India, Integrity and Vigilance in Indian Administration 9
UNIT V
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

UNIT I

UNIT II
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT III

UNIT IV
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT V
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

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

TOTAL: 45 PERIODS
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


UNIT V CORRELATION AND REGRESSION


TOTAL: 45 PERIODS

OUTCOMES:

➢ To facilitate objective solutions in business decision making.
➢ To understand and solve business problems.
➢ To apply statistical techniques to data sets, and correctly interpret the results.
➢ To develop skill-set that is in demand in both the research and business environments.
➢ To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

OBJECTIVES:
- To know how to derive meaning from huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION 9
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS 9
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES 9
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES 9
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI 9
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckeivich Stacia Misner, Business Intelligence, Microsoft, 2011
OBJECTIVE:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I      INTRODUCTION TO HR ANALYTICS  9
People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.

UNIT II   HR ANALYTICS I: RECRUITMENT  9
Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT III HR ANALYTICS - TRAINING AND DEVELOPMENT  9
Training & Development Metrics : Percentage of employees trained- Internally and externally trained -Training hours and cost per employee - ROI.

UNIT IV HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION  9
Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover-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  9
Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

OUTCOME:
- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:
OBJECTIVE:
➢ To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I  MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II  COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages-Linking Social Media Accounts-The Viral Impact of Social Media.

UNIT III  SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV  WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V  SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

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

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
OBJECTIVE:
➢ To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

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

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

UNIT III  INVENTORY MANAGEMENT  9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV  TRANSPORTATION NETWORK MODELS  9

UNIT V  MCDM MODELS  9
Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
➢ To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:
CMG354 FINANCIAL ANALYTICS

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

OUTCOME
➢ The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:
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

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


TOTAL: 45 PERIODS

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

CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005

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

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OBJECTIVES:
• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE 
CONCEPTS
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOME
• On completion of the course, the student is expected to be able to
CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem
REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

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

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1 – Low; 2 – Medium; 3 – High; ‘- ‘- No correlation

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  9

UNIT II  BIO POLYMERS  9
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-Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications
UNIT III BIO CERAMICS AND BIOCOMPOSITES
General properties- Bio ceramics - Silicate glass - Alumina (Al2O3) - Zirconia (ZrO2) - Carbon - Calcium phosphates (CaP) - Resorbable Ceramics - surface reactive ceramics - Biomedical Composites-Polymer Matrix Composite (PMC)- Ceramic Matrix Composite (CMC) - Metal Matrix Composite (MMC) - glass ceramics - Orthopedic implants - Tissue engineering scaffolds

UNIT IV METALS AS BIOMATERIALS
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT V NANOBIOMATERIALS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- Students gain knowledge on metals as biomaterials
- Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
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 polyacrylonitrile hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites)
composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL: 45 PERIODS

OUTCOMES
- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

CES335 GREEN TECHNOLOGY L T P C
3 0 0 3

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

UNIT I PRINCIPLES OF GREEN CHEMISTRY
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
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
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions
UNIT IV DESIGNING GREEN PROCESSES 9
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY 9
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

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

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS L T P C
3 0 0 3

OBJECTIVES:
• to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
• To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS 9

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS 9
UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING
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.

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 soil 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:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I  ENERGY SCENARIO  9
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  9
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III  SUSTAINABLE DEVELOPMENT  9

UNIT IV  RENEWABLE ENERGY TECHNOLOGY  9

UNIT V  ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit, Energy management (audit) approach-understanding energy costs, 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

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

TOTAL: 45 PERIODS

7. https://www.niti.gov.in/verticals/energy
REFERENCES: